Institution: Aston University

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

1. UNIT CONTEXT AND STRUCTURE, RESEARCH AND IMPACT STRATEGY

1.1 CONTEXT AND STRUCTURE

Research within Aston University's College of Health and Life Sciences (CHLS) is multidisciplinary and collaborative in nature and scope. CHLS was formed on 1st August 2020 (Institutional-Level Environment Statement [ILES] 2.1) by merging the activities of our former School of Life and Health Sciences and Aston Medical School (founded in 2015). Together, we address fundamental questions in the molecular and cellular biosciences, neural systems, human behaviour and the study of individuals in clinical, healthcare and societal settings. From blue-skies research through to translational studies with international societal impact, CHLS delivers on our **strategic aim to improve well-being across the lifespan**. Our work on rare inherited diseases (Impact Case Study [ICS] 7) and child feeding (ICS6) centres on the young and their carers, whilst in care-homes (ICS4) and medicines management (ICS5), we are focussed primarily on the well-being of older adults. Across the breadth of the lifespan, we address antimicrobial resistance (ICS2), deliver remote-platform eyecare solutions (ICS3) and contribute to the clinical development of new drugs for epilepsy (ICS8) and diabetes (ICS1).

1.1.1 Research Themes

All CHLS staff work squarely in the remit of allied health subjects in disciplines including biomedical sciences, pharmaceutical and clinical pharmacy, neuroscience, optometry and vision sciences, audiology, and psychology. Each member of CHLS staff joins one Research Theme (A-D; Figure 1) according to the specific nature of their research. Each Research Theme therefore contains staff from multiple Schools (Figure 1) who work together to deliver our shared strategic aim.

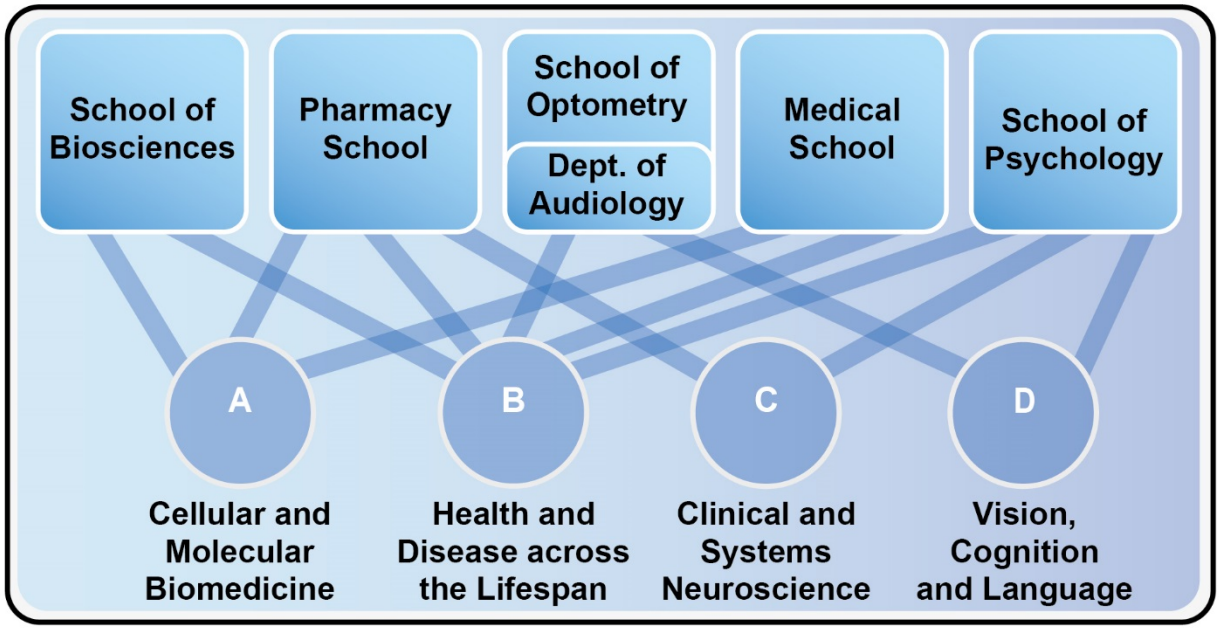

Figure 1: Research Themes (A-D) *encompass the work conducted in our five Schools of study. This structure naturally promotes multidisciplinarity, as indicated by the bars.*

In *Cellular and Molecular Biomedicine (Research Theme A)*, 39 staff work within:

- molecular biomedicine to understand the molecular mechanisms of life and develop novel protein-based technologies of relevance to industry and the clinic;
- cellular and molecular bioscience to improve the understanding of cell signalling and trafficking;
- mechanisms of disease and therapeutics to develop translational methodologies for evaluating efficacy of interventions through clinical collaboration.

In *Health and Disease across the Lifespan (Research Theme B)*, 38 staff work within:

- pharmaceutical development and clinical pharmacy to discover and synthesize new drugs, optimize their formulation and use, and drive improvements within healthcare, policy and education;
- optometry to better diagnose and manage ocular disease, through identification of early biomarkers and development of novel instrumentation;
- clinical practice and applied health psychology to promote scientific understanding of how to support physical and mental health and prevent or treat ill-health, throughout the lifespan.

In *Clinical and Systems Neuroscience (Research Theme C)*, 17 staff work within:

- clinical neurophysiology and experimental psychology to develop non-invasive diagnostic methods and effective pharmacological and surgical interventions for treating neuro-degenerative, neurological and psychiatric disorders, and to advance our understanding of developmental disorders such as dyslexia and autism;
- cellular neuropharmacology to understand neuronal activity at the cellular level and how neurons work as networks in health and disease.

In *Vision, Cognition and Language (Research Theme D)*, 24 staff work within

- clinical optometry to translate research to clinical applications and interventions to improve refractive and visual outcomes;
- experimental and educational psychology to advance our understanding of human perception, language and cognition in health and disease, and to apply this knowledge to improve clinical assessment, intervention and rehabilitation.

1.1.2 Centres of Research Excellence

To maximize the potential for interdisciplinarity, four Centres of Research Excellence were launched in 2017, each with **membership drawn from multiple Research Themes**. Their formation explicitly delivers on the 2018-2023 Aston Strategy to '*build on existing strengths and future opportunities by creating a research environment of outstanding vitality and financial sustainability that concentrates resources in areas of real current or clear future potential*'.

Aston Institute of Health and Neurodevelopment (AIHN) exploits advanced technology to explore brains, development and healthy behaviours. Research (funded by UKRI, GCRF, NIHR and the Wellcome Trust) is focused on cellular, behavioural and clinical neuroscience with cross-cutting areas of research strength in social cognition/autism, reading/dyslexia, epilepsy and eating/nutrition. A new strategic partnership with Birmingham Women's and Children's Hospital underpins research in the characterization of neurological disorders and atypical neurodevelopment. Initially launched as a CHLS Centre of Research Excellence, AIHN was formally adopted as one of four University Research Institutes in 2019 on the basis of its critical mass and excellent research (ILES 2.5).

Aston Membrane Proteins and Lipids (AMPL) investigates membrane protein-lipid interactions, particularly as drug targets for human disease. Its work is underpinned by over 30 industrial partners, from micro-SMEs to multinational corporations and is funded by UKRI, Wellcome Trust, IB Catalyst and the European Commission. Its central role in the EU-Horizon2020-COFUND MemTrain and BBSRC MIBTP2020 programmes means AMPL is training the next generation of membrane biotechnologists.

Aston Research Centre for Healthy Ageing (ARCHA) encompasses expertise from cellular neurophysiology to computational modelling, psychology and clinical science, capitalising on the critical mass of expertise in ageing and opportunities from our newly-founded Medical School. Its work with strategic partners (ARCHA's panel of older adults, Age UK, the ExtraCare Charitable Trust and the Third Age Trust) develops projects that better understand the fundamental needs of older adults, with a focus on delivering and testing novel interventions to improve the healthspan.

Ophthalmic Technologies (OT) pioneers life-changing breakthroughs in lens design, portable instrumentation to assess visual function and new treatments for dry eye disease and myopia. Its four-way partnerships with industry, academia, the NHS and private practice develop and run clinical trials for dry eye, presbyopia and for myopia control. OT's clinical-trial-supporting apps are already assisting industry to run more robust and sensitive clinical trials (with funding from NIHR, UKRI and industry) across the globe, leading to faster regulatory approval of future medical products.

1.1.3 Governance

Responsibility for CHLS research, impact and community engagement is devolved to three Associate Deans, who are members of the CHLS Senior Management Team and are accountable to the CHLS Executive Dean, Aston's Pro-Vice-Chancellor for Research and Aston's Executive Director of Business Engagement. These Associate Deans lead and drive our high-performance research and impact culture. Their monthly meetings with the Heads of Schools ensure a coherent approach to research, impact and engagement from within CHLS.

Roslyn Bill, Associate Dean for Research (ADR), Professor of Biotechnology and AMPL Director, chairs BBSRC Research Committee E and is a member of REF2021 Sub-Panel 8. She is responsible for setting CHLS research objectives and monitoring their delivery to achieve our strategic aim of improving well-being across the lifespan. She is supported by a team of Directors of Research, who are embedded in CHLS's Schools. This leadership team is gender-balanced (50% female, 50% male) and one is minority ethnic, reflecting the diversity of excellent researchers in CHLS. The Directors of Research are the first points of contact for all research within CHLS. The Directors of AIHN, AMPL, ARCHA and OT consult with them in devising their research strategies, providing coherence between Themes and Centres.

Anna Hine, Associate Dean for Knowledge Exchange and Impact (ADKEI) and Professor of Protein Engineering, chairs the BBSRC Follow-on-Fund and is a former BBSRC Commercial Innovator of the Year. She is responsible for embedding and supporting a culture of ongoing impact in CHLS.

James Brown, Associate Dean for Community Affairs and External Engagement (ADCAEE), Associate Professor of Biomedical Science and ARCHA Director, appears regularly on national television (including BBC1, BBC2, ITV1, Channel 4 and Channel 5). He is responsible for supporting CHLS staff to communicate effectively with the media, the public and the region.

The ADR and ADKEI co-chair CHLS Research and Enterprise Committee (REC). REC is responsible for the strategic and operational management and governance of all research- and impact-related activity within CHLS. It receives input from the Graduate School Management Committee and reports to University Research Committee. REC membership includes the Directors of Research, the Directors of AIHN, AMPL, ARCHA and OT, Heads of Schools, Aston's Pro-Vice Chancellor for Research Integrity (section 1.4), doctoral and early career researcher (ECR) representatives.

This governance structure ensures the collaborative, multi- and inter-disciplinary research and impact conducted within Research Themes A-D is in line with required ethical, legal and professional frameworks.

1.2 DELIVERY OF RESEARCH AND IMPACT STRATEGY 2014-2020

Our collective focus on Research Themes A-D and the establishment of AIHN, AMPL, ARCHA and OT has seen a significant growth in the vitality of our research culture since REF2014. We have doubled our grant awards and doctoral completions, having made new appointments across all academic ranks, from 28 ECRs to the first and only **Regius Chair in Pharmacy** in the UK.

1.2.1 Review of REF2014 Research Plans

Our REF2014 plan defined **five strategic goals** that have provided the framework for our research and impact activities in this assessment period. We achieved each one as follows.

1. *Doubling the value of research awards.*
   - We increased our research awards from UKRI, EU, government, charities and industry to £47.4M (from £23.9M in the REF2014 period).
   - We are a top-ten UK recipient of EU-Horizon2020 Future Emerging Technology (FET-OPEN) grants (scheme success rates are <10%). We held one as partner (PRe-ART) and two as joint-lead with Aston's College of Engineering and Physical Sciences (NEU-ChiP and NEUROPA), evidencing the high-quality of our interdisciplinary research.

2. *Expansion of our research student cohort.*
   - We more than doubled our total doctoral awards to 206 (174 PhDs, 32 professional doctorates). We awarded 28 DOptom, 1 DOPhSc, 2 MD and 1 PharmD compared to 2 DOptom and 1 DOPhSc in REF2014.
   - We partnered in doctoral training programmes from the EU (MASSTRPLAN and MemTrain [as co-ordinator]) and, for the first time, BBSRC (MIBTP2020) and EPSRC (IifETIME), totalling an award value of £29.2M (£3.8M to Aston). Our inclusion in MIBTP2020 was commended by BBSRC for excellence in PGR student diversity. Aston's award of University of the Year 2020 was based on our '*commitment to sustainability and a focus on enabling students from a wide range of backgrounds to achieve their potential*'.

3. *Achieving closer engagement with service users to facilitate IP exploitation.*
   - We held a portfolio of 13 patent families and formed 4 companies with a value of £25M.
   - The award of 10 CASE studentships (9 BBSRC and 1 MRC), £2.1M in KTP awards (130% increase since REF2014) and £16.6M in industry-funded partnerships was possible through increased breadth and depth of engagement with our beneficiaries.

4. *Enhancing research infrastructure.*
   - In 2019, AIHN became CHLS's first, fully-accredited University Research Institute (ILES 2.5). Founding Director (Amanda Wood) was awarded an ERC Fellowship in developmental neuropsychology in 2016. AIHN builds on and expands the infrastructure of Aston Brain Centre and the Aston Laboratory for Immersive Virtual Environments that were established during the REF2014 assessment period.
   - We invested £11.4M in our equipment infrastructure including a new 3-Tesla MRI and a state-of-the-art cyclic ion mobility mass spectrometer.

5. *Increasing the depth of our international collaborative alliances.*
   - Our portfolio of EU-Horizon2020 and UKRI-GCRF awards (worth £9.8M and £1.3M, respectively) included international academic and industrial collaborators (section 4.1). Our work as part of a UK-Kenya team project has been shortlisted for a Newton Prize.
   - CHLS staff published with collaborators in 79 countries including the USA, Canada, Australia, New Zealand, China, Japan, Russia and Israel, as well as numerous European, Middle/Far Eastern, African and South American collaborators.

1.2.2 Achievement of Impact

Aston's beneficiary groups are students, business and the professions, and our region and society. All CHLS research, teaching and external engagement activities align to serve these groups. Led by the ADKEI, CHLS has embedded a culture of ongoing impact in this assessment period. Aston's 2020 award of *Times Higher Education Outstanding Entrepreneurial University* (ILES 2.4) highlighted the inclusion of entrepreneurialism in Aston Medical School. This exemplifies the authentic approach CHLS staff take to impact in all our activities. Impact is discussed as a standing item at CHLS all-staff meetings and achievements are shared and celebrated throughout our constituent Schools. Importantly, impact is explicitly recognized in Aston's promotions process.

Our workload model ring-fences colleagues' time to develop impact from their research. Impact activities are supported through individual coaching by the ADKEI, group workshops with external experts and access to dedicated funds (£50,000 via HEIF; ILES 4.13) to support pump-priming of research translation. Using these funds, we assisted development of impact case studies from an

initial pool of over 20, including Antimicrobial Resistance (ICS2), Medicines Management (ICS5) and the Child Feeding Guide (ICS6). Importantly, CHLS impact funds are not limited to REF2021, meaning that impacts not selected for this submission, along with several newly-identified impacts, are already being developed for public examples of CHLS outreach and/or future REF exercises.

1.3 DELIVERY OF OUR RESEARCH AND IMPACT STRATEGY OVER THE NEXT FIVE YEARS

We aim to:

1. Increase the value of competitive grant awards by 50% by continuing to drive-up the number of high-quality applications while proportionately increasing the number of awards with female lead applicants;
2. Strengthen our research environment by maintaining investment in our infrastructure and our PGR:staff ratio, whilst trebling the number of independent fellows;
3. Double the number of world-leading 4* outputs by further extending our international collaborations, enhancing the reach and influence of our research;
4. Achieve gender balance at all levels from ECR to Professor whilst increasing representation from minority ethnic groups. At 16% Black and Minority Ethnic (BAME), our staff cohort is in line with UK census data. To more fully represent our community and the students we educate, we aim to double the number of BAME staff over the next 5-10 years;
5. Maximize societal and other impacts by growing NHS and industrial collaborations. Through strategic partnerships (including Birmingham Women's and Children's, University Hospitals Birmingham NHS Foundation Trusts and Birmingham Community Healthcare Trust), we will double the number of awards from NIHR and other funders of translational and clinical science.

To deliver these objectives, we will build on our internationally-recognized excellence across Research Themes A-D. The critical mass within AIHN, AMPL, ARCHA and OT provides the required momentum, as demonstrated by recent progress (including current examples of success that have resulted from activity in the assessment period):

1. *Grants*: Since 2019, we have seen a substantial upward trajectory in grant awards across all Research Themes, notably in UKRI funding, which now accounts for 40% of our portfolio. Awards to female PIs are proportional (40% in 2019/20; female staff are 39% of our cohort). The quality of our research continues to be internationally recognized. Very recently, the importance of a highly-competitive EU-Horizon2020-FET grant of £3.06M was widely-reported in the media. On the BBC Radio 4 Today programme, Eric Hill described how AIHN colleagues are leading the interdisciplinary *Neu-ChiP* team of neuroscientists, physicists and computer scientists. Together they will harness neurons to supercharge computers' ability to learn;
2. *Culture*: We use our networks across Research Themes A-D to attract high-quality fellowship applicants and saw our first success in securing a Wellcome Trust Clinical Research Career Development Fellowship (Sukhvir Wright) into AIHN in 2019. We currently have fellowship proposals in submission at Epilepsy Research UK (AIHN), Leverhulme Trust (AMPL), and BBSRC Discovery (AMPL and AIHN) and UKRI-Future Leaders Fellowships (AIHN) programmes;
3. *Outputs*: Since 2016, we have seen a step-change in the publication of our highest-quality work in journals recognized for the rigour of their academic review. CHLS staff have published ground-breaking articles on the mechanisms of brain swelling (*Cell*, 2020, 181, 4, 784-799), mechanisms of pain (*Cell Reports*, 2019, 27, 3672–3683), psychosis and depression (*JAMA Psychiatry*, 2018, 75, 1156-1172) and drug resistant infections (*Nature Microbiology*, 2016, 1, 15006). In October 2019, *Nature Reviews Endocrinology* commissioned ARCHA colleagues to write an authoritative review on diabetes in older adults (led by Srikanth Bellary, the article is currently *in press*). Original research on the efficacy and safety of sotagliflozin in patients with diabetes and chronic kidney disease has just been published (Clifford Bailey, *N Engl J Med*, 2021, 384, 129-139);
4. *Diversity*: We are working to address the proportions of female and minority ethnic staff at senior ranks (section 2.3). In response to the fact that we enrol very few Black PGRs, we are preparing a bid to the Office for Students to improve their representation at PGR level;

5. *Impact*: In partnership with clinical colleagues (Universities of Birmingham, Glasgow and Washington USA), AMPL is developing new interventions (including a re-purposing clinical trial for trifluoperazine) for brain swelling and cognitive decline. Working with Age UK, the ExtraCare Charitable Trust and the Third Age Trust, ARCHA is developing randomized controlled trials on frailty and the development of digital bladder diaries. Working with Birmingham Women's and Children's Hospital, AIHN is developing a pipeline of paediatric health interventions in eating, mental health, medicines-use in pregnancy and pre-surgical imaging to improve neurosurgical outcomes. With funding from NIHR, UKRI and pharmaceutical, instrumentation and medical device companies, OT is running a portfolio of clinical trials of future medical products.

1.4 RESEARCH INTEGRITY AND OPEN INNOVATION

We have embedded research integrity (ILES 2.11-2.12) in our daily practices. Aston's first Associate Pro-Vice Chancellor for Research Integrity (James Wolffsohn, Professor of Optometry and Director of OT) was appointed in 2018, leads the Aston University Research Integrity Office and is a full-member of CHLS REC. Our regional leadership in research integrity is evidenced by the delivery of our '*Responsible Research and Innovation*' module (compulsory for all Aston PGRs, section 2.2.3) to the BBSRC MIBTP2020 PGR cohort.

We make our research accessible in line with the 2019 Aston Open Research Data and Open Access Policies (ILES 2.14-2.15). Since 2014, CHLS has supported £85,000 in Gold Open Access charges (above those supported by institutional funds from UKRI). We are also committed to open science. Charlotte Hartwright (Lecturer in Psychology, AIHN), is the national lead of the Open Research Working Groups for the UK Reproducibility Network (UKRN). Charlotte Pennington (Lecturer in Psychology, AIHN) is the local network lead for UKRN. Both promote reproducibility and open research through educational workshops and seminars, in addition to delivering open science journal clubs at Aston (ReproducibiliTEA.org).

2. PEOPLE

In our award of **Guardian University of the Year 2020** (ILES 1.2), "*the university shone out for its commitment to social mobility, diversity and sustainability*". Our REF2021 *Code of Practice* reflects this commitment (ILES 2.2).

Aston is an Institutional Silver Athena Swan Award holder, the School of Life and Health Sciences held a Bronze Award and CHLS is finalizing its Silver Award submission. Our unit has also held the EU's *HR Excellence in Research Award* since 2010. All staff within 7-years of their PhD graduation are members of Aston's ECR Network (ILES 3.13-3.14). CHLS ECRs feed-back collectively to CHLS REC (section 1.1.3); a standing item is presented by the CHLS representative (currently Anu Chembath). Aston's Action Plan for continued improvement against Concordat Key Principles is directed by ECR Facilitator, Jackie Blissett, co-Director of AIHN. This central involvement of senior CHLS staff and governance structures in the development of ECRs sets the framework for our approach to recruiting, nurturing and supporting our people at all career stages.

2.1 STAFFING STRATEGY AND STAFF DEVELOPMENT

2.1.1 Recruitment

Our recruitment strategy focuses on building critical mass in Research Themes A-D through AIHN, AMPL, ARCHA and OT, facilitated by ongoing dialogue between the Associate Deans and the Heads of School, who meet monthly. Our unit uses a standard model of permanent appointment with a 3-year probation period. The only staff on fixed-term contracts in this submission are four Independent Research Fellows (funded by AXA Research Fund, Leverhulme, Wellcome Trust and intramural funding from Aston Medical School).

We have increased our staff cohort since REF2014 (Table 1) through promotion and recruitment at all levels from Professor (132% increase) to Lecturer/Independent Research Fellow (313% increase). Four REF2014 Fellows (2 male, 1 BAME male, 1 female) were promoted to academic positions, while one (male, BAME) took up a position at University College London.

Table 1: *CHLS staff are presented by academic rank, gender and ethnicity within Research Themes A-D. F, female; M, male; numbers in parentheses identify as BAME; figures in italic are from REF2014, which was a selective return, compared with our 100% REF2021 return.*

Research Theme	Professor		Reader		Senior Lecturer		Lecturer		Independent Research Fellow		Total	
	F	M	F	M	F	M	F	M	F	M	F	M
A	3	10(2)	0	2	1	8 (2)	7 (3)	7 (1)	0	1	11(3)	28(5)
B	2	4 (1)	3	4(1)	1	4	12	7 (4)	1	0	19	19(6)
C	1	7	0	0	0	0	3	5 (1)	1(1)	0	5 (1)	12(1)
D	0	6 (1)	4	3(1)	2	3	4 (1)	1	1	0	11(1)	13(2)
Total REF2021	6	27(4)	7	9(2)	4	15(2)	26(4)	20(6)	3(1)	1	46(5)	72(14)
Total REF2014	*5*	*20(1)*	*3*	*4(1)*	*5*	*8(1)*	*5*	*6(1)*	*1*	*4(2)*	*19*	*42(6)*

To attract proposals from a diverse pool of applicants, we use inclusive language and images in all advertisements and job descriptions. We advertise on platforms including disabilityjobs.co.uk, bamejobs.co.uk and lgbtjobs.co.uk and avoid single-gender recruitment panels (all members undergo compulsory EDI training). Whilst postdoctoral researchers are not returned under REF2021 rules, we recruit them in line with the processes used for other staff. By joining our ECR Network, they are supported to develop their personal networks and build their CVs. We also take steps to recognize their contribution to research proposals through their inclusion as researcher-co-investigators; examples on BBSRC responsive mode awards in the current assessment period were Michelle Clare and Ivana Milic.

2.1.2 Staff Development

Our supportive environment is founded on **mentoring**, **appraisal**, **training** and **probation**.

- We model research **mentorship** on BBSRC Research Committee E's support of its fellows, extending CHLS mentorship to all staff. Research mentors provide structured support on funding, networking and publication strategies.
- **Appraisals** are conducted through Aston's *My Development Conversation* (MDC; ILES 3.8). They reflect on research performance and future goals (against CHLS research KPIs, which are based on application rather than award to promote activity) in addition to teaching performance, career development and promotion, and **training** needs (such as AdvanceHE recognition and acquisition of specific technical and transferable skills [ILES 3.10]). MDC is an ongoing process led by Heads of Schools with input from the relevant Director of Research, ensuring the implementation of our joined-up research and impact strategy.
- We champion flexible and/or remote working at all levels and make no distinction between part-time and full-time staff in terms of career progression. For example, our ADKEI has worked part-time since 2003 and was promoted to Professor in the current assessment period. In total, 21 colleagues from ECR to Professor (9 female, 1 BAME female, 9 male, 2 BAME male) worked part-time due to caring responsibilities and/or other personal circumstances.
- Our CHLS-wide workload planning tool, introduced in 2018, ensures appropriate teaching loads regardless of seniority.

New appointees are provided with objective progression criteria for their 3-year **probation** period, where they must at least meet CHLS research KPIs.

- CHLS and Aston's *New Starters* events outline expectations of all new staff and the infrastructure available to support them (ILES 3.8-3.12, 4.4-4.5).
- Teaching and administrative workloads are reduced in the first three years to allow time to establish a programme of research and impact.
- ECRs are prioritized for the award of a first PhD studentship.
- ECRs join Aston's ECR Network.

Our unit has a strong focus on supporting all colleagues to develop a sustainable portfolio of income, outputs and impact appropriate to their career-stage.

- Our robust **peer review** process supports the crafting of competitive grant proposals and is built on the expertise of CHLS staff who sit on decision-making panels of major funders (section 4.5.1). This has resulted in a substantial increase in UKRI and charity funding. Our first Wellcome Trust Clinical Research Career Development Fellowship to clinician-scientist, Sukvhir Wright, was awarded within AIHN (clinical colleagues are further noted in section 4.2.2).
- All colleagues can participate in our annual, **residential grant-writing retreat** at which they receive tailored proposal support from a panel of senior colleagues. Recent success resulting from the retreat includes UKRI responsive mode grant BB/T001488/1.
- The ADR and Directors of Research oversee an annual **pump-priming budget** of £47,500 to seed-fund pilot data generation, conference attendance or other research support. Support for conference attendance led to the award of £660,000 by Dutch charity, Longfonds, including work on inflammatory lung disease within ARCHA.
- An annual budget of £21,500 for **Gold Open Access** supports all publications that are at least internationally-excellent in terms of originality, significance and rigour, but which are not eligible for support from Aston's UKRI fund.
- **Seminars** are organized by CHLS, the Schools, AIHN, AMPL, ARCHA and OT for staff and PGR students to present data, receive internal peer feedback and facilitate collaboration. Our AMPL seminar series (MemSem) is sponsored by the Biochemical Society.
- Staff at all stages of their careers may apply for **sabbatical leave or secondments** for research and impact (ILES 3.11). CHLS KTP associates also have placements within our unit, facilitating exchanges with business, industry and third sector bodies.

2.1.3 Research and Impact Culture

In the current assessment period, we have strengthened a culture in which our staff are supported and mentored to build a portfolio of research funding, outputs and impact. Our **research KPIs** establish an expectation of the **annual submission** of high-quality grant proposals (with the aim of submitting bids to a value of £900k over three years), competitive studentship applications (at least one) and original research articles (at least one). Staff are given the support, time and training to do so. Monthly updates record staff progress against these KPIs and we celebrate successes (awards, PGR completions and publications), including at an annual event hosted by Aston's Vice-Chancellor.

In this assessment period, all ECRs in post for 12-months or more submitted at least one grant proposal as PI and 61% secured at least one PI award, with ECRs on average securing two awards in this assessment period. This evidences the effectiveness of our supportive approach in the context of a highly-competitive funding environment.

In terms of promotions (Table 2), our most senior ranked Professors (Bands 2 and 3) were all promoted on the Research track (2 female, 3 male). We promoted 11 female and 7 male staff to senior ranks (Professor Band 1 and Reader) across all tracks, with research being the most common promotional route. Since 2018, our promotions criteria have explicitly rewarded **impact** as well as excellent research. Candidates applying on the Learning and Teaching or External Engagement tracks are all required to show ability and effectiveness in both research and impact.

Integral to **CHLS succession planning** is the pipeline from our team of Directors of Research. These roles allow colleagues to obtain deep knowledge of our research and impact work in preparation for senior leadership positions within CHLS and the University. The current ADR is a former Director of Research. Two of our current Heads of School (Optometry and Biosciences) were previously Directors of Research and both were promoted to Professor on the research track in the current assessment period.

Table 2: *CHLS promotions to the indicated rank by gender, ethnicity and track. F, female; M, male; numbers in parentheses identify as BAME.*

Applicant gender, ethnicity and promotional track	Professor (Band 3)	Professor (Band 2)	Professor (Band 1)	Reader	Senior Lecturer
Gender (BAME)	0F 1M	2F 2M	7F 2M	4F 5M(1)	3F 6M
Track					
Research	0 1	2 2	6 1	3 3(1)	1 1
Learning and Teaching	0 0	0 0	1 1	1 1	2 5
External Engagement	0 0	0 0	0 0	0 1	0 0

2.2 RESEARCH STUDENTS

Table 3 shows that from 1st August 2013 to 31st July 2020, we graduated 206 PGRs (52% female, 48% male, 44% BAME).

Table 3: *CHLS PGR graduates are presented by gender and ethnicity within Research Themes A-D. F, female; M, male; numbers in parentheses identify as BAME.*

Research Theme	PhD		Professional Doctorate		Total
	Female	Male	Female	Male	
A	30(16)	33(21)	1	0	64(37)
B	29(17)	30(15)	0	1(0)	60(32)
C	14(5)	7(0)	0	1(0)	22(5)
D	23(8)	8(2)	11(1)	18(5)	60(16)
Total	96(46)	78(38)	12(1)	20(5)	206(90)

2.2.1 PGR Funding

CHLS supports 31% of students with fully-funded PhD studentships (Home/EU); 7% receive CHLS scholarships (£7,000 towards international fees, £4,000 towards bench fees/consumables per year); 25% are funded through partnerships with charitable/commercial sponsors or non-UK HEIs (co-tutelles); 9% are charity-funded; 12% are self-funded (distance-learning/professional doctorates); 8% are EU-funded; 4% are UKRI-funded; and 4% are funded by overseas government scholarships.

In 2014, we secured EU-Horizon2020-ITN funding as co-ordinator for the MASSTRPLAN project supporting 14 PGRs, 3 of which were CHLS PhD students. The 2018 EU-Horizon2020-COFUND MemTrain project provides 12 CHLS PhD studentships over two cohorts. In 2019, CHLS joined lifETIME, an EPSRC Centre of Doctoral Training led by the University of Glasgow, with 6 PhD studentships at Aston over the 3-year programme and opening up the research environment to visiting PGRs. In 2020, CHLS joined the BBSRC Doctoral Training Programme (DTP), MIBTP2020 led by the University of Warwick, representing Aston's first membership of a BBSRC DTP and providing 30 PhD studentships over the 5-year programme and access to BBSRC's iCASE competition, which moved into DTPs in 2015. The PGR community has been further enriched during this assessment period by international co-tutelle arrangements with the Complutense University of Madrid, Macquarie University in Sydney, Reykjavik University, Sapienza University of Rome and the University of Valencia.

2.2.2 PGR Recruitment

All doctoral research projects are reviewed for quality by the ADR. Recruitment and selection are administered by Aston Graduate School, who provide administrative support from admission to award (ILES 3.15-3.16). Applicants are short-listed and interviewed by the supervisory team at a panel chaired by their Director of Research. Selection panels update their unconscious bias training regularly and we strive for diversity on our selection panels. This inclusive approach has produced our diverse PGR cohort (Table 4).

Table 4: *Current CHLS PGR students (including those outside the UK, in an extension year and/or on an approved leave of absence) are presented by gender and ethnicity within Research Themes A-D. F, female; M, male; numbers in parentheses identify as BAME. Italicized numbers in parentheses are international (non-Home/EU) students. FT, full-time; PT, part-time.*

Research Theme	PhD				Professional Doctorate				Total
	Female		Male		Female		Male		
	FT	PT	FT	PT	FT	PT	FT	PT	
A	36(7;*6*)	5(1)	24(12;*6*)	1	0	0	1(1)	0	67(21;*12*)
B	25(10;*6*)	10(5)	9(5;*1*)	4(1)	0	2(1)	0	2(1)	52(23;*7*)
C	8(3;*1*)	1	9(1)	1	0	0	0	0	19(4;*1*)
D	4(1;*1*)	4	5(2)	2	0	4(1)	0	4(*1*)	23(4;*2*)
Total	73(21;*14*)	20(6)	47(20;*7*)	8(1)	0	6(2)	1(1)	6(1;*1*)	161(52;*22*)

On the census date, our PGR community of 148 PhD students and 13 research-active professional doctorates were 61% female, 39% male, 32% BAME. There were 139 Home/EU and 22 overseas students from Cameroon, China, Egypt, Ghana, Hong Kong, Iran, Iraq, Israel, Jordan, Kuwait, Libya, Malaysia, Mexico, Nigeria, Saudi Arabia, Singapore, Tanzania, and Vietnam. A quarter of PGRs were part-time, demonstrating our commitment to supporting students with differing personal circumstances.

2.2.3 PGR Monitoring, Support and Future Careers

On **enrolment**, students are assigned to a Research Theme, where they join academic staff, postdoctoral colleagues and fellow students in a mutually-supportive network of expertise and skills. Supervisory teams may span more than one Research Theme promoting further multi- and inter-disciplinary working. Within the first month of enrolment, PGRs meet formally with their supervisory team to complete a *Training Needs Analysis* (mapped against Vitae's *Researcher Development Framework* and reviewed annually) and a *Learning Agreement*, which provides a framework for supervisors and PGRs to discuss and record their responsibilities to each other.

Completion of at least 90 hours of **skills training** is required across the four domains in the *Researcher Development Framework*. This is delivered, in part, by a Professional Development Advisor through the *Responsible Research and Innovation* module, together with the *CHLS Postgraduate Professional Development* module in year 1. A 3-hour workshop on public engagement prepares PGRs for our annual CHLS PGR Day where each student presents a poster or gives a talk about their research. CHLS students are additionally expected to present their work at a minimum of one major international/national conference. Where students are completely self-funded, CHLS provides financial support of up to £1,500 towards the cost in line with Graduate School regulations. Where travel is challenging for PGRs with caring responsibilities or other personal circumstances or those suffering ill-health or disabilities, we work with them to find solutions (including virtual conferences).

CHLS uses the apprenticeship model of PGR supervision. Typical meeting patterns are at least one 1:1 weekly meeting of 30-60 minutes in addition to regular e-mail and in-person interactions. PGR **monitoring** involves submission of:

- 3-monthly reports summarizing the outcomes of weekly supervisory meetings;
- an end-of-year-1 report that is examined by *viva*, allowing progression to doctoral student status;
- an end-of-year-2 draft manuscript/chapter/presentation that is assessed by the relevant Director of Research;
- a completed thesis within 36-months of enrolment (or up to 48-months with permission of the ADR).

In the current assessment period, our **PGR completion rate within 48-months was 95%**.

To promote **student well-being**, PGRs join our mentoring programme in their 1st year to take advantage of fellow students' experiences. In their 2nd/3rd years they become mentors to new

PGRs. In 2019/20, 94% of CHLS new starters joined the Programme. In the majority of cases, PGR needs can therefore be accommodated through discussion with their peers and supervisory team. For example, we have recently supported NHS-based PharmD students by increasing the time they can take as leaves-of-absence from their studies during the pandemic. We have also established a COVID-19 hardship fund to support PGR students in need. In circumstances where PGRs need an independent source of academic guidance or pastoral support, they can speak in confidence with the Postgraduate Research Tutor (Tim Meese).

To encourage a diversity of **student voices**, PGRs are encouraged to join Aston's PG Research Society (ILES 3.18). The CHLS PGR representative is a member of CHLS REC (as well as Aston Graduate School Committee and University Research Committee; currently Athanasios Kesidis), where they report on behalf of the PGR body. Each year, CHLS specifically seeks feedback from its PGRs. The Director of Research Degree Programmes and the Postgraduate Tutor hold an open meeting for PGRs with discussion and interactive voting framed around themes defined by the Postgraduate Research Experience Survey. The discussion is recorded and actions are proposed for consideration at CHLS REC.

Aston Graduate School provides webinars, online resources and tailored information relating to PGR **career prospects**. Aston's *Careers+Placements* team provides dedicated support for PGRs, who can book a one-to-one appointment with a Careers Consultant. Access to the *Aston Futures* careers database allows them to register for events, workshops and activities organized by the central Careers team. The latest *Graduate Outcomes* survey available for the current assessment period showed that 100% CHLS PGR graduates seeking employment found graduate-level positions: 33% took up postdoctoral research positions, 20% secured academic positions and the remaining 47% went into professional-level work in industry.

2.3 EQUALITY AND DIVERSITY STRATEGY

As evidenced throughout the narrative of this submission, CHLS integrates equality, diversity and inclusivity considerations into all research practices. This includes support for grant proposal submission, access to internal funds, mentorship, promotions and recruitment to leadership roles irrespective of personal circumstances, gender, ethnicity, disability or other protected characteristics. We have explicitly implemented mentoring opportunities for BAME students (through collaboration with the BBSTEMM Alliance), established a new BAME staff network and launched an LGBT Inclusion Charter, Menopause Policy and a reasonable Adjustments Passport to support staff with disabilities. We are currently rolling out a reciprocal BAME mentoring scheme for junior and senior research staff. We actively highlight successes and achievements of a diversity of students, staff and alumni in our staff magazine, weekly newsletter, internal campaigns and social media feeds.

The regular update of unconscious bias training is compulsory for all Aston staff. CHLS REC has additionally adopted the *Seven Principles of Public Life* into its method of working. We have progress to make in gender balance across our unit at Professorial and Senior Lecturer levels (18% female and 21% female, respectively; Table 1). Our pipeline of Lecturers (57% female) and Readers (44% female) is more gender-balanced and 75% of our Independent Research Fellows are female. With regard to other protected characteristics, our only complete dataset is on ethnicity. At 19, our BAME cohort at the REF2021 census date was three times that of our REF2014 BAME cohort of six. In 2014, all six were male, and in 2021, a quarter are female. 12% of CHLS Professors are BAME (all male), as are 13% of Readers (all male), 11% of Senior Lecturers (all male), 22% of Lecturers (40% female; 60% male) and 25% of Research Fellows (female). Again, there is progress to be made at senior ranks in terms of female diversity. The Lecturer data suggest we have interventions in place to redress this balance: while the 'leaky pipeline' is a well-known phenomenon in academic careers, our data (Tables 1 and 2) show that we promote colleagues as frequently as we make new appointments. This lends confidence that gender and diversity balance is achievable within the next 5-10 years (Objective 4, section 1.3).

Our process for selecting REF outputs and impact case studies was overseen by Aston's REF Management Group to ensure transparency and alignment with Aston's Code of Practice (ILES

2.2). Comparing our selective REF2014 return with the current 100% return, the number of female staff has more than doubled, while the proportion of female staff has increase from 31% to 39% (Table 1). Outputs by female staff increased by 77% (Table 5). The number of BAME staff more than tripled (Table 1) and their outputs increased by 67% (Table 5). For our eight impact case studies (ICS1-8), nine authors were female (2 BAME) and 14 were male (compared to 8 female and 15 male [1 BAME] in REF2014).

Our inclusive method of working is evidenced by our final Equality Impact Assessment (conducted January 2021), which shows alignment between FTE and attributions across protected characteristics. Looking forward, we will further encourage minority ethnic colleagues in authorship of future REF impact case studies.

Table 5: *CHLS outputs are presented by gender and ethnicity within Research Themes A-D. F, female; M, male; numbers in parentheses are staff who identify as BAME. Total figures in italic text are data from REF2014, when no category B staff were returned.*

Research Theme	REF2021 outputs Category A staff		REF2021 outputs Category B staff		*Total REF2014 outputs*	
	Female	Male	Female	Male	*Female*	*Male*
A	32(5)	57(9)	0(0)	4(0)	*11(0)*	*47(12)*
B	45(0)	40(12)	2(0)	0(0)	*27(0)*	*24(5)*
C	9(3)	29(3)	-		*10(0)*	*45(4)*
D	22(1)	28(2)	-		*14(0)*	*37(0)*
Total	108(9)	154(26)	2(0)	4(0)	*62(0)*	*153(21)*

3. INCOME, INFRASTRUCTURE AND FACILITIES

3.1 RESEARCH FUNDING AND STRATEGIES FOR ITS GENERATION

In the current assessment period, we secured competitive research funding from a diverse range of sources. Our major funders included:

- **UKRI** (BBSRC [responsive mode, ALERT, iCASE], EPSRC responsive mode, ESRC responsive mode, MRC [responsive mode, iCASE and DPFS], UKRI-GCRF), £11.3M (24% of our total awards, with an increase to 40% in 2019/20);
- **UK Government** (NIHR, Food Standards Agency), £2.4M (5%);
- **EU** (Horizon2020 Programme [ERC, FET-OPEN, ITN, Health Work Programme and COFUND], ERA CoBioTech Programme), £9.9M (21%);
- **Charities and Learned Societies** (Academy of Medical Sciences, Alzheimer's Research UK, Autistica, Baily Thomas Charitable Fund, British Academy, Cerebra, Dunhill Medical Trust, Epilepsy Research UK, Humane Research Trust, Kidney Research UK, Leverhulme Trust, NC3Rs, Nuffield Foundation, Royal Society, Rubenstein-Taybi Support group, Wellcome Trust), £6.2M (13%);
- **Industry-led** (Innovate UK [KTP, Smart Grants and ICURe] and companies ranging from high-tech SMEs to major, multinational organizations), £16.6M (35%);
- **Other** (private donations from individuals/foundations), £1M (2%).

3.1.1 Strategies for Income Generation

We use **facilitation**, **support** and **staff management** to achieve our awards targets. **Facilitation** occurs through management of staff workloads; 40% of working hours are ring-fenced for research/impact activities. Research KPIs (section 2.1.3) establish an expectation of the annual submission of high-quality grant proposals and the conversion of grant income into high-quality, impactful outcomes. Research mentors (section 2.1.2), the Associate Deans and the Directors of Research, AIHN, AMPL, ARCHA and OT provide structured support and feedback to all staff in the publication and dissemination of CHLS research and impact using our collective experience of serving on Editorial Boards, in commercialization and in the media.

The effectiveness of structures to **support** these activities was enhanced in this assessment period through the integration of central support staff into CHLS. **Embedded as Business**

Partners and working alongside the Directors of Research, they organize events and workshops to inform colleagues about upcoming funding calls and support the development of new partnerships. Support is tailored to meet the individual needs of researchers based on their career stage and track record. To support academic-led funding (UKRI, UK Government and Charities), embedded Research and Knowledge Exchange (RKE; ILES 1.3) Strategic Funding Manager, Jen Whale, circulates regular funding initiatives, works closely with PIs to cost applications, arranges peer-review and agrees milestones for meeting deadlines. EU-specialist, Paul Knobbs, similarly supports proposal submission to EU Programmes. Industry-led-funding is supported by Martin May (KTPs), Luke Southan (commercialization) and Angela Jeffery (regional initiatives). Smooth transition from award to project commencement is facilitated by CHLS's Finance and HR Business Partners to enable employment of research staff and timely delivery of audit/progress reports.

Staff **management** is multi-faceted. RKE co-ordinates applications and awards data, liaising with the ADR and the Directors of Research, AIHN, AMPL, ARCHA and OT to ensure current portfolio and pipeline knowledge in their respective areas. This allows the Associate Deans to monitor CHLS Research KPIs and to liaise with Heads of Schools for annual MDC appraisals. Subsequent impact is managed by the ADKEI, working with Luke Southan and the ADCAEE.

3.1.2 Links Between Research Funding, High-Quality Research and Impact

During the current assessment period, we demonstrated effective conversion of our grant awards into high-quality research outputs and impacts. Links to Centres of Research Excellence and funding sources are indicated in parentheses, by Research Theme, below.

Research Theme A built on our REF2014 strengths in biomedicine together with a continued translational focus on molecular targets for therapeutics. In total, staff won **£26.9M in awards** (from BBSRC, EPSRC, MRC, UK Government, EU, charities and industry), including £1.8M from MRC-DPFS, £1M from EU-Horizon2020-FET-OPEN and £2M from Isterian Biotech Inc. Selected **research** and **impact** highlights include:

- Roslyn Bill (AMPL) led investigators from the USA, Canada, Sweden, Denmark and the UK to define a pharmacological intervention for brain and spinal cord swelling following traumatic injury. Their novel approach targets water channel trafficking. This study was reported in *Cell* and will form the basis of a repurposing Phase I/II clinical trial (BBSRC and Aston University fellowship funding);
- Xuming Zhang (AIHN) uncovered new molecular mechanisms by which two pain-sensing ion channels are governed in sensory neurons. This study was published in *Cell Reports* and is the basis of developing novel analgesics for inflammatory pain (MRC and CHLS intramural funding);
- James Brown co-created ICS4 (BBSRC and EU) and Anthony Hilton co-created ICS2 (EPSRC and charity, including Wellcome Trust).

Research Theme B built on our REF2014 theme, *Chronic and Communicable Conditions*, by capitalizing on the impact of our lifelong health research. In total, staff won **£8.9M in awards** (from BBSRC, MRC, UK Government, EU, charities and industry), including £173k from NIHR and £1M from EU. Selected **research** and **impact** highlights include:

- Afzal Mohammed (ARCHA) patent-protected particle engineering technology to improve drug coating and delivery (EP22896142011-03-02, PCT/EP2018/068816). Aston Particle Technologies is now developing dry powder inhalers for asthma, taste-masking of bitter drugs and delivery of poorly-soluble drugs (Innovate UK);
- James Wolffsohn (OT) developed new techniques and apps to assess visual function and diagnose dry eye disease. The work was published in *British Journal of Ophthalmology*, *Contact Lens and Anterior Eye* and *Lab on a Chip*, underpinning commercialization through Wolffsohn Research Ltd. It will inform global clinical trials (EPSRC, Alcon and Reckitt Benckiser);
- Clifford Bailey created ICS1 (Aston University), Claire Farrow created ICS6 (UKRI-GCRF, MRC, HEIF and charity), Ian Maidment created ICS5 (NIHR and charity), Jane Waite created ICS7 (Charity and NHS), James Wolffsohn created ICS3 (EPSRC, Innovate UK and industry) and Tony Worthington co-created ICS2 (EPSRC, Innovate UK and charity).

Research Theme C continued close engagement between patient-focused studies and cellular neurosciences. Staff won **£5.1M in awards** (from BBSRC, MRC, EU, charities and industry) including £1.9M from ERC and £1M from Wellcome Trust. Selected **research** and **impact** highlights include:

- Stuart Greenhill (AIHN) published data in *eLife* showing that chemokine receptor, CCR5, has a central role in learning and memory and its activation leads to cognitive deficits. Patent application GB2102247.0 has been filed to underpin initiation of a repurposing clinical trial (MRC);
- Amanda Wood (AIHN) published in *Epilepsia* a benchmark for estimating the risk of developing autism-spectrum disorder following exposure to anti-epilepsy medication during pregnancy. This work will be used to inform more effective clinical management of patients (Australian Research Council, with support from Sanofi-Synthelabo, UCB Pharma, Janssen Cilag, Novartis, Pfizer and Glaxo SmithKline);
- Gavin Woodhall and Stuart Greenhill co-created ICS8 (NC3Rs and industry).

Research Theme D continued to explore how we perceive and interact with our environment to inform interventions for patient benefit. Staff won **£6.4M in awards** (from EPSRC, ESRC, UK Government, EU, charities and industry), including £863k from ESRC-GCRF and £1.3M from NIHR. Selected **research** and **impact** highlights include:

- Nicola Logan (OT) demonstrated that a novel contact lens design slows myopia progression in children. As part of a multi-centre, randomized clinical trial, the work was published in *Optometry and Vision Sciences* and led to FDA-approval of MiSight lenses (CooperVision);
- Andrew Schofield (ARCHA) published in *Experimental Brain Research* that older adults have reduced sensitivity to visual texture. Their impaired judgment of surface shape leads to reduced toe-clearance when climbing stairs (EPSRC);
- Laura Shapiro (AIHN) published in *Cognition* that phonological awareness has a key role in learning to read. Her work has already led to changes in teaching policy in Scotland and the outcomes are currently in development for a future REF impact case study (ESRC, CHLS fellowship funding and charity, including Leverhulme Trust).

3.2 ORGANIZATIONAL INFRASTRUCTURE SUPPORTING RESEARCH AND IMPACT

Our organizational infrastructure focuses on embedded staff to support research (section 3.1.1), central RKE staff to support impact (Larry Atwood and James Crawford) and strategic investment to build critical mass (co-funding PhD programmes and fellowships) and improve our research infrastructure (with a focus on our equipment base). Consistent with Aston's focus on supporting areas of excellence through the formation of University Research Institutes (URIs; ILES 2.5), our goal in creating AIHN, AMPL, ARCHA and OT has been to further increase CHLS awards successes and generate high-quality outputs. **Significant investment** to achieve this goal included the examples below.

- £5.5M to establish AIHN as a URI:
  - £2.7M for a new 3-Tesla MRI and associated estates work;
  - £1.5M in advanced MEG technology and supporting infrastructure;
  - £0.5M in staff costs (Research Strategy and Operations Manager; Research and Development Officer);
  - £0.7M to develop our nutrition laboratories;
  - £0.1M in pump-priming, training and development, travel to develop partnerships, and outreach.
- £4.8M in new equipment within AIHN, AMPL, ARCHA and OT. Projects ranged from strategic matched-funding of external grants (BBSRC 18ALERT and responsive mode) to direct investment in CHLS equipment.
- £4M committed over the next 3 years to match-fund AIHN applications to Trusts and Foundations for pre-clinical MRI and advanced MEG technology.
- £1.9M matched-funding to secure CHLS involvement in large collaborative PhD programmes:
  - EPSRC lifETIME (£219,000);

  - BBSRC MIBTP2020 (£1,058,500);
  - EU-Horizon2020-COFUND MemTrain programme, as co-ordinator (£647,432.69).
- £1.1M in maintaining our existing research infrastructure.
- Access to a £300k institutional-level impact support fund.
- £90k in CHLS-funded support for impact activities (short-term research assistants, travel to beneficiaries, teaching buy-out, writing support).
- £55k per year on an on-going basis to support a postdoctoral researcher (in 36-month fixed-term contracts), awarded in open competition to support an ECR in building their research team. Current PI, Laura Shapiro, is developing a future REF impact case study on family phonological awareness; postdoctoral researcher, Rachael Hulme, has managed the co-development of a phonics course for parents.

CHLS benefitted from major **benefits-in-kind** through strong, strategic partnerships:

- £1.3M donation of 150 g pure cannabidiol from GW Pharma to AIHN for chronic dosing of epileptic rodents during assessment of the anticonvulsant effect of the drug for mechanism-of-action studies (ICS8);
- £155k in reagents, staff time (1-2 hours of support per month), equipment loan, consumables, technology access and hosted placements for AMPL PGR students by their company sponsors;
- £52k income-in-kind for access to the European Synchrotron Radiation Facility within ARCHA;
- £0.5M in equipment use and donations within OT, leading to the FDA-approval of MiSight contact lenses in 2019.

3.3 OPERATIONAL INFRASTRUCTURE SUPPORTING RESEARCH AND IMPACT

CHLS's facilities support research and impact in Research Themes A-D. Our laboratories benefit from a range of molecular, cellular, electrophysiological, behavioural and clinical instrumentation supported by specialist software and data storage. Examples of cross-cutting CHLS facilities include:

- *AIHN Facilities:* AIHN houses specialist research facilities including the world-class Aston Neuroimaging Facility (MRI Laboratory, Wellcome Trust Laboratory for MEG Studies, EEG Laboratory and TMS Laboratory), eating and behaviour laboratories and neuropsychology laboratories. AIHN also provides MRI and MEG services through Aston University Imaging and educational assessments through the Aston University Neurodevelopment and Assessment Unit. Research and clinical services in AIHN are supported by a team of 10 clinical, administrative and technical staff;
- *ALIVE*: Associated with AIHN, ALIVE includes motion capture, virtual reality and EEG recording equipment, supporting research into visual perception, social cognition, and social vision;
- *Animal Facility*: Supporting work on human disease (pre-eclampsia, epilepsy, Alzheimer's, Parkinson's, asthma), neuroplasticity and glia-neuronal function, 4 full-time staff breed and maintain 500 rats and 3-5,000 mice per year. The Home Office Inspectorate rates CHLS low risk, with a first-class culture of care. AIHN's RISE rodent epilepsy model (ICS8) is recognized by the Home Office as nationally-leading in animal welfare. It complements studies in human tissue and whole brain studies within AIHN;
- *ARCHA Advanced Imaging Facility*: Our wide-field fluorescence microscope and laser-scanning confocal system with a resonant scanner and multiphoton laser add-on are managed by our dedicated imaging manager. The facility supports sample screening, deep tissue imaging and *in vivo* studies;
- *Mass Spectrometry and Lipidomics Laboratory*: Incorporating AMPL's state-of-the-art cyclic ion mobility mass spectrometer (funded by BBSRC 18ALERT), the facility is open to the UK scientific community, with priority for Midlands Mass Spectrometry member institutions (part of Midlands Innovation);
- *Vision Sciences Facility*: Together with a state-of-the-art, on-campus day-case surgical hospital, Vision Sciences and its professional public eye-clinic houses a wide-range of specialized instruments (including OT's advanced non-invasive technologies), supported

by 5 technical staff. Examples include vision testing apps and optical coherence tomography lens metrology developed by OT, along with collaborating manufacturers' instrumentation that OT helped to refine/evaluate.

3.4 EQUALITY AND DIVERSITY

The benefits of our inclusive approach to encouraging and supporting staff are reflected by the fact that our BAME staff (26% female, 74% male), who are 16% of our total staff cohort, win 19% of our grant awards. In REF2014, 10% of our staff were BAME and they won 5% of our awards. Further support will be provided to increase the proportion of awards to female and female BAME staff as principal applicant (PI). Female staff (39% of staff) win 28% of awards as PI, while male staff (61% of staff) win 72% (compared to 26% and 74%, respectively, in REF2014; Table 6). Explicitly focusing our support structures towards the more specific needs of CHLS staff will inform our research strategy for the next 5-years (section 1.3). We already take seriously our responsibilities to colleagues who have personal circumstances that may affect their ability to meet proposal deadlines (e.g. caring/parental responsibilities, illness, disabilities). The former circumstance often disproportionately affects female staff and we will continue to build flexibility into our processes to ensure support for all carers without compromising proposal quality. We work with all colleagues from an early stage to co-create a proposal preparation work-plan containing milestones. This ensures that workloads can be managed appropriately and that plans can be revised in the event that personal circumstances change. Our sign-off milestone also has in-built flexibility to accommodate personal circumstances. The ADR briefs the Executive Dean on the CHLS proposal pipeline at formal monthly meetings and is in contact with him on a continuous basis should a more immediate response be required.

Table 6: *CHLS grant awards are presented by PI gender and ethnicity within Research Themes A-D. F, female; M, male; numbers in parentheses identify as BAME. Total figures in italic text in the final row are data from REF2014.*

Research Theme	Awards to female staff (£)	Awards to male staff (£)	Totals (£)
A	4,969,978.87 (338,242.00)	21,928,199.07 (5,976,063.12)	26,898,177.94 (6,314,305.12)
B	3,339,025.54 (0)	5,606,786.35 (1,734,899.50)	8,945,811.89 (1,734,899.50)
C	2,218,255.35 (0)	2,903,203.12 (0)	5,121,458.47 (0)
D	2,648,475.49 (10,000.00)	3,794,320.46 (776,566.98)	6,442,795.95 (786,566.98)
Total REF2021	13,175,735.25 (348,242.00)	34,232,509.00 (8,487,529.60)	47,408,244 .25 (8,835,771.60)
Total REF2014	*6,138,486.17 (3,600.00)*	*17,805,544.34 (1,291,454.43)*	*23,944,030.51 (1,295,054.43)*

3.5 CROSS-HEI USE OF RESEARCH INFRASTRUCTURE

Aston has an excellent network of regional, national and international connections and is involved in collaborative activities across the Midlands that facilitate shared use of research infrastructure (ILES 4.3). The most important of these is **Midlands Innovation**, which is a collaboration between eight leading Universities across the Midlands (Aston, Birmingham, Cranfield, Keele, Leicester, Loughborough, Nottingham and Warwick) that drives cutting-edge research, innovation and skills development to grow the high-tech, high-skilled economy of the Midlands and the UK (ILES 1.5). Together, we share experimental resources, computing power and research networks, with CHLS playing a substantial role in several initiatives.

- *Midlands Innovation's Innovation and Knowledge Exchange* (a £5M Connecting Capabilities Funded project; MICRA) to develop a shared gateway to IP and to use critical mass to attract investors and funds. It supported an evaluation of isothermal dry particle coating technology and its potential for commercialization through Aston Particle Technologies.

- *Midlands Innovation's Technicians Forum* (a £3M Research England Development grant; TALENT). CHLS Head of Technical Services, Jiteen Ahmed serves on both the TALENT Policy Commission and its Strategy Committee, which aims to promote the importance of technical skills, roles and careers throughout UK Higher Education.
- *Midlands Innovation Health* facilitates collaborative bids and supported successful CHLS bids for doctoral training programmes (BBSRC-funded MIBTP2020 and EPSRC-funded lifETIME) and mass spectrometry equipment (18ALERT) supported by the Midlands Mass Spectrometry Group co-founded by Corinne Spickett.
- As part of an *Energy Research Accelerator* award, £1.6M was awarded to Aston for equipment to support activities in AMPL.

4. COLLABORATION AND CONTRIBUTION TO THE RESEARCH BASE, ECONOMY AND SOCIETY

4.1 RESEARCH COLLABORATION

In CHLS, collaboration is key to delivering our research and impact strategy (section 1). CHLS staff have published with collaborators in 79 countries (Figure 2) demonstrating the effectiveness of their partnerships.

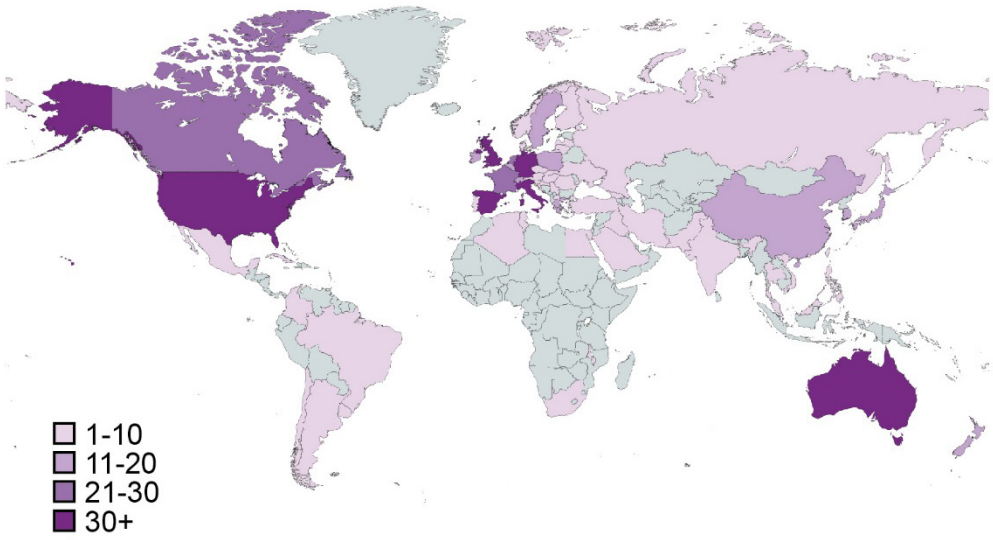

Figure 2: Heat map of national and international collaborations *leading to published outputs in this assessment period.*

Examples of funded projects leading to these outputs are as follows.

Research Theme A:

- BBSRC funded the MIBTP2020 DTP with Birmingham, Harper Adams, Leicester and Warwick Universities;
- EPSRC and the Science Foundation Ireland funded the lifETIME CDT with CÚRAM, Glasgow and Birmingham Universities;
- BBSRC-GCRF funded a collaborative grant with the Universities of Danang and Mumbai to create high-value chemicals from agricultural waste in India and Vietnam;
- The EU supported the:
    - Horizon2020-ITN MASSTRPLAN PhD training programme with Aveiro, Leipzig, Ghent, Milan and CSIC-CIB Universities, ThermoFisher, Mologic and two hospitals;
    - ERACoBioTech project, *MEmbrane Modulation for BiopRocess enhancement* with Groningen, Julich, IATA-CSIC Valencia and York Universities, Lallemand, Pakmaya, Remembrane and nova-Institute GmbH;

- Horizon2020-FET-OPEN MESO-Brain project with Barcelona University, Laserzentrum Hannover, Fundacio Institut de Ciencies Fotoniques and Axol Bioscience Ltd;
- Horizon2020-FET-OPEN PRe-ART project to create antibody replacements with the Universities of Bayreuth and Zurich;

- Isterian Biotech (USA) funded a transgluaminase-2 inhibitor drug development project to treat chronic lung disease; Sorin CRM SAS funded the CRT Improved Clinical Response UK Trial (CRICKET) to treat cardiac failure.

Research Theme B:

- Health Education England funded CHLS researchers and the Royal College of Emergency Medicine to study clinical educators in emergency departments across 52 hospitals. The education needs of emergency department staff are now being evaluated in light of the current pandemic;
- The EU supported:
  - the EU-IMI pan-European SPRINTT project (a collaboration of 25 academic and industrial partners) to enable efficient European-level public health intervention against frailty;
  - a European Innovation Partnership of 44 partners on frailty management optimization;
  - the Horizon2020-ITN European Dry Eye Network, EDEN with Optegra, Innz Medical, Laboratorios Thea, Bausch and Lomb, and the Universities of Madrid, Valencia and Wroclaw.
- KTP partnerships with Sarissa enabled the production of a stroke detection point-of-care device and with Rayner the development of a focusing eye implant.

Research Theme C:

- The Wellcome Trust funded work on animal models of childhood autoimmune epilepsies with immunologists (Charité Hospital, Berlin and Dusseldorf University) and computational neuroscientists (King's College, London);
- The Moulton Foundation supported a clinical trial studying the effects of zolpidem in Parkinson's disease in collaboration with software developers and clinical trials specialists at Birmingham University;
- Birmingham Children's Hospital Research Foundation and GW Pharma funded PhD studentships to develop a collaboration between neurosurgeons and AIHN *in vitro* electrophysiologists to investigate mechanisms in children with medically-intractable epilepsies;
- GW Pharma supported multiple mechanism-of action-studies of cannabidiol in AIHN's rodent epilepsy model, leading to collaboration with molecular neuroscientists at New York University Medical School (USA).

Research Theme D:

- ESRC-GCRF supported a collaboration between academics (from CHLS, University of Zambia and Kisii University in Kenya) and experts from rural African communities to develop sustainable strategies for enhancing children's academic outcomes in rural Africa;
- NIHR supported the 3-arm randomized, double-masked, placebo-controlled, phase-3 CHAMP trial to examine the effect of atropine sulphate on slowing myopia progression;
- Carl Zeiss Vision funded the DriveSafe double-masked, cross-over, comparative study of spectacle lenses optimized for driving;
- CooperVision supported a 3-year randomized masked, placebo-controlled study to examine the effect of novel contact lenses to slow myopia progression in children, followed by 4-year follow-up study.

4.1.1 Networks and Partnerships

Local networks include:

- the pan-Birmingham Clinical Diabetes Network of care providers in primary, community and secondary care (including public health) and Birmingham City Council (Srikanth Bellary);
- Midlands Universities Children's Eating Research (MUnChiES) group with over 150 years of combined experience working with children and families in healthcare settings (Jackie Blissett and Claire Farrow);
- as a member of Midlands Innovation, CHLS provides data to the EPSRC-funded national database of equipment.

National and international networks include:

- The pan-European research network *INTERDEM* for early detection and psycho-social interventions in dementia (Ian Maidment);
- The EU COST Action *EpiLipidNET* comprising 200 members working on lipidomics (Corinne Spickett, Working Group Leader);
- *The Guide to Pharmacology* (a joint venture between the International Union of Basic and Clinical Pharmacology [IUPHAR] and the British Pharmacological Society), in which Roslyn Bill was appointed as an Aquaporin sub-committee member;
- Consensus evidence-based reports from the *Tear Film and Ocular Surface Society* (James Wolffsohn), *International Myopia Institute* (Nicola Logan, James Wolffsohn) and *British Contact Lens Association* (Debarun Dutta, Shezad Naroo, James Wolffsohn) that informed the guidance for clinical practice and research direction in dry eye disease, the myopia epidemic and contact lenses;
- Two BBSRC Networks in Industrial Biotechnology and Bioenergy to boost interaction between the academic research base and industry, promoting the translation of research into benefits for the UK. Ivan Wall served on the BioProNET: Bioprocessing Network and Alan Goddard on the CBMNet: Crossing Biological Membranes management boards;
- *NICE guidelines for tinnitus care*, NHS England commissioning framework for hearing loss with Helen Pryce as consultant;
- *The UK Network of Open Research Working Groups* (UK-ORWG) with Charlotte Hartwright as joint lead, overseeing and supporting the development of new groups and developing an ORWG at Aston, whereby staff and graduate students are invited to attend *ad hoc* talks and skills sessions, as well as receiving updates on relevant events and activities.

4.2 DEVELOPING IMPACT WITH KEY RESEARCH USERS 2014-2020

Our research and impact strategy is beneficiary-focused (ILES 1.1) and as such we seek to co-develop impact with our audiences. These collaborations enrich our research environment through the development of new partnerships and the identification of research questions that we address together.

4.2.1 Advisory Roles Leading to Changes in Policy

CHLS staff shape and support the delivery of public services through contribution to international policy. For example, ICS2 (Antibiotics in Healthcare and Public Settings) contributed to the removal of Triclosan from antiseptic products across the EU and USA, while ICS5 (Polypharmacy in Older Adults) led to changes in national and international prescribing guidelines.

In addition to these impact case studies, our work has enabled our beneficiaries to develop and evaluate their strategic goals, directly impacting changes in their service provision. For example:

- James Brown (ARCHA Director) developed a new model of diabetes disease burden which is being implemented by the actuarial firm, Towers Watson. His work has shaped their **actuarial risk planning** over the next decade;
- Claire Farrow was an expert advisor for Cancer Research UK on their published guidance, which advocates for restrictions on high fat, salt or sugar products being advertised on **family viewing shows** before 9pm;

- Chris Langley co-wrote the PEARs report, commissioned by the Pharmaceutical Society of Ireland. Following a **change to the law** in 2015 to enable his recommendations to be fully implemented, students now undertake an integrated pharmacy programme, experiencing patient-facing situations and real-life pharmacy practice at several stages before attaining their qualification;
- Michael Larkin worked with West Midlands Police to facilitate the co-design of five action plans for their *Domestic Abuse Operational Group*. As a result of his work, a survivors' group provides advice on processes and plans to this group. Larkin was a member of the *Vulnerable Victim's Review* conducted by the Crime Commissioner, which made recommendations about working with **survivors of domestic abuse**;
- Laura Shapiro's research shaped *The Emerging Literacy Workstream* of eight local authorities across the north of Scotland. Her work emphasized the importance of phonological awareness skills in literacy teaching and is one of the key workstreams within The **Northern Alliance Regional Improvement Plan**, 2018.

We also work closely with **Government** to contribute to **priority-setting** in our areas of expertise:

- Amanda Wood (AIHN Director) contributed to the Cumberledge Review for the UK Government. The *First Do No Harm* report for the Independent Medicines and Medical Devices Safety Review made recommendations around apologies, redress, specialist care, data collection and the role of the MHRA;
- Gavin Woodhall contributed expertise to the UK Government Animals in Science Committee in his role as neuroscience expert member, 2013-2017;
- Laura Shapiro presented *Learning Skills in Children* to the House of Lords in 2014;
- CHLS researchers spoke at four Industry-Parliament Trust events attended by policy makers, MPs and industrial stakeholders on the Government's *Life Sciences Strategy* (Roslyn Bill, 2018), *Intergenerational Fairness* and *Adult Social Care* (James Brown, 2020) and *Innovation* (Anna Hine, 2020).

4.2.2 Work with Clinical Audiences

Cliff Bailey designed and led the clinical trials described in ICS1 (Dapagliflozin), which is an alternative treatment for type 2 diabetes and the most-prescribed drug in its class. Gavin Woodhall developed the RISE rodent model of epilepsy, which led to regulatory approval of the anti-convulsive drug, Epidiolex (ICS8).

In the current assessment period, eight clinician-scientist staff were clinically-active in local NHS Trusts:

- Birmingham Women's and Children's NHS Foundation Trust (Stefano Seri, Consultant Clinical Neurophysiologist; Sunil Shah, Consultant Ophthalmologist; Sukhvir Wright, Consultant Paediatric Neurologist);
- Birmingham and Solihull Mental Health NHS Foundation Trust (George Tadros, Consultant Psychiatrist);
- University Hospitals Birmingham NHS Foundation Trust (Srikanth Bellary, Honorary Consultant in Diabetes and Endocrinology; Francisco Leyva-Leon, Consultant Cardiologist);
- University Hospitals Coventry and Warwickshire NHS Trust (Ioannis Kyrou, Consultant Endocrinologist);
- South Warwickshire NHS Foundation Trust (Gary Misson, Consultant Ophthalmic Surgeon).

Having strong links through our staff base has meant that we not only work directly with our own patients, but also facilitate further partnerships between CHLS and clinical audiences and beneficiaries. For example:

- Patients with early-onset pre-eclampsia were recruited onto the world's first randomized, masked, placebo-controlled trial using pravastatin at Birmingham Women's and Children's NHS Foundation Trust (Asif Ahmed);

- We supported an aphasia rehabilitation programme in Moor Green Outpatient Brain Injury Unit providing direct benefit to patients (Cristina Romani);
- Late-stage Parkinson's Disease patients were recruited into the first sponsored clinical trial on the repositioning of zolpidem for motor and cognitive deficits at University Hospitals Birmingham NHS Foundation Trust (Ian Stanford);
- Patients with moderate to severe dry eye were recruited onto the world's first randomized, masked, placebo-controlled trial of an amniotic membrane within CHLS (James Wolffsohn).

4.3 WIDER CONTRIBUTIONS TO THE ECONOMY AND SOCIETY

Impact is embedded throughout activities across CHLS and remains central to our institutional goal to '*shape the businesses and the communities of tomorrow'*. ICS4 (Promoting Healthy Ageing in the Public Domain), ICS6 (The Child-Feeding Guide) and ICS7 (Support for Rare Neurogenetic Conditions) are prime examples of our **contribution to society**.

We have made major **contributions to the economy**. For example, resulting from the clinical trials described in ICS1, AstraZeneca made royalty payments of $0.6 billion to Bristol Myers Squibb for dapagliflozin. As a result of the *Clostridium difficile* germination solution developed at Aston (ICS2), Insight Health estimates an increase in revenue by 20%. More locally, four companies (Aston Particle Technologies, Aston Vision Sciences, Eyoto Ltd (ICS3) and Mirzyme) are Aston spinouts or start-ups and are currently valued at £25M.

CHLS held a portfolio of 13 patent families during the assessment period (lead inventor is shown). Eight of these patent families have been either licenced or assigned to the identified industrial partner:

- *Coating Apparatus and Method* (Afzal Mohammed) – Licenced to Aston Particle Technologies;
- *Oligonucleotide Library Encoding Randomized Peptides* (Anna Hine) – Licenced to Isogenica Ltd;
- *Ophthalmic Device* (Karl Obszanski, PGR graduate) – Licenced to Aston Vision Sciences;
- *Compound for treating* Clostridium difficile (Dan Rathbone with Aston's College of Engineering and Physical Science) – Assigned to Insight Health;
- *Diagnostic Assay and Treatment for Preeclampsia* (Asif Ahmed) – Assigned to MirZyme;
- *Preeclampsia (miRNA Treatments)* (Asif Ahmed) – Assigned to MirZyme;
- *Questionnaire for Clinical Vision Assessment* (James Wolffsohn) – Assigned to Mapi Research Trust;
- *Glycoproteins Having Lipid Mobilizing Properties* (Michael Tisdale) – Assigned to Halsa Pharmaceuticals Inc;
- *Digital Biomicroscope* (James Wolffsohn);
- *TG2 Inhibitors* (Martin Griffin);
- *Antibiotics* (Jonathan Cox with University of Bradford);
- *Mesoporous Polymeric Particulate Material* (Ali Al-Khattawi);
- *Nanoparticles for Cancer Imaging and Therapy* (Boris Kysela).

In terms of immediate future activity, four further patent families resulting from research in the current assessment period are being prepared for filing in 2021.

4.4 ENGAGEMENT WITH DIVERSE COMMUNITIES

Engagement is central to CHLS's research and impact strategy. We are committed to not only sharing our research with the public, but going further by engaging in an active dialogue with them to improve it, for example in our *Patient and Public Involvement* groups within ARCHA and OT. We also work on effective and engaging ways to disseminate our findings using a diverse range of approaches.

- ***Animations***. We developed animations to educate and inform the public about membrane proteins as therapeutic targets; to highlight enzymatic solutions to generating high-value

products in India and Vietnam (Roslyn Bill; BBSRC and BBSRC-GCRF funded); and to develop awareness of antimicrobial resistance (ICS2).

- ***Apps***. The *Early Ears app* (Amanda Hall) supports parents and health professionals in screening and testing the hearing of children. *The Blink Test app* (James Wolffsohn) supports GPs, pharmacists and the general public in diagnosing dry eye disease;
- ***Citizen Science***. Jackie Blissett has supported a citizen science project with Parenting Science Gang (supported by the Wellcome Trust) to help parents design and run their own study to explore how sensory processing impacts on fussy eating. The SuperYeast project (Alan Goddard) uses samples of yeast sent in by the public to test for alcohol and sugar tolerance. Results are posted online, allowing the public to learn about biotechnology.
- ***Games.*** Alan Goddard developed the *Microstrike* board game for school-aged children to teach them how microbes thrive. Claire Farrow was funded by the British Psychological Society to develop *Vegetable Maths Masters* for children, which uses images of vegetables in mathematical problems to support healthy eating (ICS6).
- ***Media.*** National media immediately reaches millions of diverse listening and viewing public:
    - Srikanth Bellary contributed to BBC's *Panorama: Diabetes - the hidden killer* in 2016;
    - Jackie Blissett was a guest on Radio 4's *Woman's Hour* and the *Curious Cases of Rutherford and Fry* in 2017 on the psychology of eating;
    - James Brown has had numerous appearances on BBC1, BBC2, ITV1, Channel 4 and Channel 5, including '*Trust Me I'm a Doctor*' 2016-2018, Channel 4's '*Old People's Home for 4 Year Olds*' (ICS4), '*The Truth About*' Series and BBC News;
    - Claire Farrow was interviewed by Radio 4's *Woman's Hour* on supporting children who are fussy eaters in 2020 (ICS6);
    - Klaus Kessler was interviewed by BBC Breakfast about life-or-death decision making by the Police in 2019;
    - Ian Maidment was interviewed by BBC News and the *British Medical Journal* about the withdrawal of Priadel® and the potential impact on patients;
    - CHLS authors have attracted over 3-million reads in *The Conversation*.
- ***Music***. The MeMBrane project (led by Alan Goddard) produced a music video written and performed by Megson and animated by ScribbleStache to promote biology, biomedicine and biotechnology. The video aims to explain the benefits they bring to society and encourages an interest in biochemistry as a career.
- ***Outreach***. Our staff regularly take part in events such as *Pint of Science*. In 2020, we produced a mini-series of *Pintcasts* (on topics including tuberculosis [Cox], the psychology of living with allergies [Knibb] and stem cell technology [Hill]). Each year we are involved in events including at the Think Tank Science Museum, *Brain Awareness Week* and *Big Bang UK* (including exhibits such as technology to support health [2018] and STEM superheroes [2019]). We presented '*Not a Dry Eye in the House*' at the Royal Society's Summer Exhibition (2018, 2020) and *#singlecellscience* in 2015.

4.5 SUSTAINABILITY, INTERDISCIPLINARITY & RESPONSIVENESS OF OUR RESEARCH

4.5.1 Sustainability and Responsiveness

In 2016 we were awarded the only **Regius Chair of Pharmacy** in the UK, in which it was recognized that '*the innovative research at Aston University is an exemplar and means that our country can remain agile and a front-runner in the global market for generations to come*'.

Further contribution to the sustainability of our disciplines is exemplified by the fact that in the current assessment period**, two of the five BBSRC Research Committee Chairs were CHLS staff.** A third CHLS staff member chairs the **BBSRC Follow-on-Fund panel**. CHLS academics therefore continue to be well-placed to influence and respond to the national and international research landscape.

- Roslyn Bill (ADR) is the current Chair of BBSRC Research Committee E (2019 to date) and is a Full Panel Member of REF2021 Sub-Panel 8. She was Chair of UKRI Future Leaders Fellowships Interview Panel C in 2019, Deputy Chair of UKRI Future Leaders Fellowships

Sift Panel C in 2018 and has been a Member of the Future Leaders Fellowships Panel College since 2018;
- Andrew Devitt is the current chair of BBSRC Committee A (2015 to date), co-chaired the BBSRC sLoLa Committee in 2019 and is a member of the Dunhill Medical Trust Grant Committee;
- Martin Griffin was a Full Panel Member of RAE2008 Sub-Panel 3 and REF2014 Sub-Panel 12;
- Klaus Kessler was a member of ESRC Grant Assessment Panel A, 2015-2019;
- Anna Hine (ADKEI) is Chair of the BBSRC Follow-on-Fund Committee (having been a Panel Member 2015-2019) and was a Panel Member of BBSRC Impact Acceleration Account (2017), BBSRC Excellence with Impact Panel (2015-2016) and EPSRC International Centre-Centre Panel (2019);
- Afzal Mohammed is a Full Panel Member of REF2021 Sub-Panel 3.

Our staff lend their expertise to national and international **advisory boards**, including:
- Jackie Blissett on the NIHR Clinical Research Network West Midlands, whose strategic priorities serve the economically and ethnically diverse population of our region;
- Doina Gherghel on the World Glaucoma Association's Panel on Ocular Blood Flow;
- Boris Kysela on the Advisory Committee for Proton Therapy, Ministry of Health, Slovak Republic;
- Cristina Romani as part of the European Commission's revision of Clinical Guidelines for the Treatment of Phenylketonuria.

CHLS researchers, from ECR to Chair, continue to serve on the **editorial boards** of prestigious journals. Examples include:
- *Acta Ophthalmologica* (Rebekka Heitmar, Associate Editor);
- *Antibiotics* (Jonathan Cox, Topic Editor; Alan Goddard, Editorial Board);
- *Appetite* (Jackie Blissett, Consultant Editor for Child Development);
- *BBA Biomembranes* (Roslyn Bill, Editorial Board);
- *BMC Endocrine Disorders* (Srikanth Bellary, Associate Editor);
- *BMJ Open Ophthalmology* (James Wolffsohn, Associate Editor);
- *Brain Topography* (Stefano Seri, Associate Editor);
- *Contact Lens and Anterior Eye* (Shezad Naroo, Editor-in-Chief);
- *Free Radical Research* (Corinne Spickett, Associate Editor);
- *Membranes* (Roslyn Bill, Alan Goddard, Alice Rothnie, Editorial Board)
- *Ophthalmic and Physiological Optics* (Nicola Logan, Editorial Board)
- *Optometry and Vision Science* (James Wolffsohn, Editorial Board);
- *PLOS ONE* (James Wolffsohn, Academic Editor; Gavin Woodhall, Section Editor).

CHLS staff have been recognized for their individual achievements as evidenced by diverse **fellowships and prizes** including:
- Srikanth Bellary won the 2019 Diabetes UK Primary Care Award for the SOLID model;
- Roslyn Bill was awarded the Federation of European Biochemical Societies 2019 National Lecturer Medal;
- Irundika Dias was awarded the 2018 Catherine Pasquier Award from the International Society for Free Radical Research and a 2014 Kidney Research UK Fellowship;
- Samantha Gregory received a 2018 Leverhulme Trust Early Career Fellowship;
- Megan Jarman received a 2019 AXA Research Fund Future Research Leaders fellowship;
- Nicola Logan was awarded the 2018 College of Optometrists' Neil Charman Medal;
- Sukhvir Wright received a 2019 Wellcome Trust Clinical Research Career Development Fellowship and a 2016 Epilepsy Research UK Emerging Leader Fellowship within AIHN.

We are regularly invited to **deliver keynote addresses** and **organize/chair symposia** at prestigious conferences in our fields. Examples include:
- Jackie Blissett delivered the keynote address to *UK Society for Behavioural Medicine*, 2018;

- Andrew Devitt co-organized the 2017 *Royal Society Meeting on Extracellular Vesicles and the Tumour Microenvironment*, London;
- Martin Griffin gave the 2018 plenary lecture at the Gordon Conference on Transglutaminases, Switzerland;
- Nicola Logan organized the 2017 *International Myopia Conference* at Aston University and was an invited speaker at the 2019 meeting, Japan;
- Stefano Seri was invited speaker and session chair at the 2016 *European Epilepsy Congress*, Prague;
- Corinne Spickett delivered a plenary address at the 2016 *EuroFed Lipid Congress*;
- Ivan Wall was conference co-chair at the 2019 *ECI Advancing Manufacture of Cell and Gene Therapies VI*, San Diego.

4.5.2 Interdisciplinarity

As a consequence of our structure, CHLS staff work across discipline boundaries as a routine. CHLS subject areas such as neuroscience and pharmacy are also interdisciplinary by nature. For the purposes of this submission, we only categorize research as being interdisciplinary if the discipline combinations go beyond the norm for the subject area, as exemplified here.

In **Research Theme A**, in a collaboration between AIHN and Aston's College of Engineering and Physical Sciences (EPS), Rheinallt Parri was awarded £1.8M (as part of the MESOBrain and NEUROPA FETs). Using photonics, physics, neuroscience and stem cell biology the team developed three-dimensional human neuronal networks. As a consequence, they have just been awarded the Neu-ChiP-FET project to use human brain stem cells on microchips to push the boundaries of artificial intelligence.

In **Research Theme B**, collaborating with engineers and mathematicians in EPS, Afzal Mohammed (ARCHA) developed novel particle engineering technology (EP22896142011-03-02) with £0.5M funding from Innovate UK. Jackie Blissett and Megan Jarman (AIHN) are collaborating with colleagues in EPS on an AXA research award applying agent-based modelling to examine individual psychological, familial, and social influences on eating behaviours in young children. This project synergizes genetic, psychological, behavioural and environmental data into a predictive model to identify and simulate future intervention targets.

In **Research Theme C**, Sukhvir Wright (AIHN) worked with engineers at Brandeis University, USA, to build wireless EEG devices that record epileptic activity in freely-moving animal models of immune-mediated epilepsy. Her collaboration with mathematicians and computer modellers at King's College London and the University of Pennsylvania, USA, allowed the combination of *in vivo* data with novel *in silico* computational models using dynamic causal modelling and computational analyses of electrophysiological recordings.

In **Research Theme D**, Laura Shapiro (AIHN) collaborated with educational psychologists (Research Consultants, Optima) to bring together educational practice with Shapiro's psychological expertise in longitudinal analysis of language and literacy development. Her work highlighted the need for children to have good phonological awareness when learning to read and has influenced educational policy and practice.

Looking to the future, CHLS will build on existing partnerships and forge new links at a local, national and international level. By continuing to invest in the research infrastructure, staff and doctoral students within Research Themes A-D, CHLS will produce excellent, impactful and sustainable research for the benefit of society throughout the lifespan.