Pain Centre Versus Arthritis
Annual Report 2023

Executive Committee: David Andrew Walsh and Victoria Chapman (Co-Directors), Duncan Hodkinson, Eamonn Ferguson, Federico-DajasBailador, Roger Knaggs, Weiya Zhang

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Contents

Mission

Pain Centre Versus Arthritis pursues international excellence in multidisciplinary, translational research, thereby enhancing understanding of pain and improving its treatment.

Introduction from the co-directors

Pain Centre Versus Arthritis is a collaborative community of outstanding, multidisciplinary researchers with strong national and international links. Each year we contribute to the worldwide advances in chronic pain research and become one step closer to fully understanding the mechanisms of pain. To achieve this, our scientists address pain from the standpoint of various disciplines - neuroscience, orthopaedic, rheumatology, psychology, genetics, molecular biology and evidence-based medicine. This year, we have further strengthened the collaborative links between our different multidisciplinary groups, working together towards our common goals fuelled by shared motivation – addressing the needs of people with chronic pain.

We embrace partnerships with external user groups, charities, industry and academic institutions, in both the UK and abroad. We welcome the collaborative research and exchange of expertise between our Centre and external institutions to ensure word-class research outputs.

This year's achievements are especially notable in fundamental science, treatment efficacy and real-world evidence research. We have opened doors to understanding how different biolipids contribute key switches that can not only cause, but also turn off pain. We introduced a unique perspective on the efficiency of nonpharmacological and pharmacological interventions, and reviewed pain assessment tools and self-management techniques. We progressed understanding of comorbidities and pain phenotypes, enabling personalised medicine.

We are growing a future generation of world class scientists in pain research by providing unparalleled training and educational opportunities to our PhD students and early career researchers through teaching, discussion, hands on research practice and multidisciplinary discussion.

The story so far

Pain Centre Versus Arthritis opened in 2010 and developed into a widely recognised and multidisciplinary research centre with strong national, international, charity and industry ties. The primary objective of the Centre remains to enhance understanding of chronic pain and turn possible new

therapeutic approaches into reality. Our over-riding ambition is to improve the quality of life for those living with pain.

The multidisciplinary and translational strategy of Pain Centre Versus Arthritis has continued to sustain a high volume of novel research outputs, with 499 peer-reviewed publications and scholarly articles to date, 43 during the past year.

We continue to build upon our cohorts and biorepositories. [Knee Pain and related health In the Community (KPIC)](#) collates longitudinal data including pandemic/lockdown measures from populations with or without chronic pain. Another cohort, the [Investigating Musculoskeletal Health and Wellbeing survey (IMH&W)](#), provides further important information about people with or at risk of developing arthritis or other musculoskeletal diseases, or frailty. Together, KPIC and IMH&W include information from more than 1,500 individuals, provided at several time points over several years. They help us understand what the key factors are that predict whether pain will go away, persist or get worse, including genes and chemicals in our bodies, medical conditions, things we do, treatments that we take, and external factors such as the recent covid-19 pandemic. They inform recruitment of participants to clinical research projects. Furthermore, our biorepositories, such as [Joint Tissue Repository](#), store blood, joint fluids and tissues that have been donated by people who have or do not have arthritis. We have been using these samples to identify and measure molecules (RNA, proteins, biolipids) that might cause knee pain, and to discover new medications that might relieve that pain.

We have extended our laboratory research to identify and develop models that mimic the mechanisms of human pain, in order to explore in more detail the molecular and electrophysiological mechanisms through which joints can become painful. These include complex models of disease, and cellular models for exploring how nerves grow and respond to their environment. We have used these models to explore novel medical approaches such as knocking down protein expression using siRNAs, and interfering with lipid metabolism in ways that can shift the balance from increasing to decreasing, or even switching off pain.

We have further developed ways of assessing pain, in both people and our models, in order to better understand pain's underlying mechanisms in the individual. Our Central Aspects of Pain in the knee (CAP-Knee) questionnaire measures symptoms that are associated with the increased sensitivity that occurs in people with chronic pain. We have further developed and validated CAP to measure this central aspect of pain in a

wide range of painful musculoskeletal conditions, including osteoarthritis, low back pain, fibromyalgia and rheumatoid arthritis, demonstrating that mechanisms and psychological aspects of pain driven by the Central Nervous System may be shared between a wide range of painful musculoskeletal conditions. We have refined methods of Quantitative Sensory Testing (QST) to measure pain sensitivity driven by the central nervous system in people with a similarly wide range of musculoskeletal diagnoses. Our QST protocols have been adopted as standards across the UK for assessing central sensitisation in musculoskeletal conditions, by the Advanced Pain Discovery Platform.

Our research on functional changes within the brain in people with painful osteoarthritis has led to our completion of a mechanistic clinical trial using Transcranial Magnetic Stimulation (TMS) aiming to reverse abnormalities in brain connectivity in order to reduce pain in people with osteoarthritis. The TMS intervention was well tolerated by patients, and data from the trial are now being analysed.

Collaborations

The Pain Centre maintains strong ties with the wider pain research community which includes charities, Industry partnerships and consortium-based UK platforms such as Advanced Pain Discovery Platform (APDP), for which the Centre's co-director, Prof Walsh, is Programme Director. By working together, much more can be achieved than by any single researcher, researcher, discipline or institution. Pain Centre Versus Arthritis pursues collaborations that help achieve its mission at an international level, securing contributions from collaborators to supplement the Centre's own expertise and resources, and sharing by sharing ideas and know how, data and biosamples, and providing training in specialist techniques.

Currently active UK collaborations include those with *academic institutions*; Keele and Loughborough Universities, and Universities of Bristol, Hertfordshire, Manchester Metropolitan, Oxford, Sheffield, London (King's and University Colleges, St George's Hospital) London, Warwick, Exeter, Aberdeen and the West of England.

Clinical service providers: West Suffolk Hospital, Nottingham University Hospitals, Sherwood Forest Hospitals, Llandough, North Bristol, St Bartholomew's (London), York, and Royal Devon and Exeter Hospitals NHS Trusts, Nottingham CityCare Partnership, University Hospitals of Derby and Burton NHS Foundation Trust, and

NIHR clinical research organisations: Nottingham, Birmingham and Bristol Biomedical Research Centres, Applied Research Collaboration-East Midlands, Leicester, UK.

Our *international collaborations* currently include:

Europe	
Belgium	• Centre for Environment & Health • Research Foundation-Flanders (FWO) • University of Leuven • Vrije Universiteit Brussel
Denmark	• Aalborg University
France	• Hôpital Ambroise Paré • University Hospital Clermont-Ferrand • Descartes University
Germany	• Max Planck Institute of Psychiatry
Norway	• SINTEF, Trondheim
Spain	• Universidad Rey Juan Carlson
Sweden	• Lund University • University of Gothenburg
Switzerland	• University Hospital Lausanne • Zurzach Care Group
The Netherlands	• Erasmus MC • Leiden University
Rest of the World	
Brazil	• São Paulo State University
Japan	• Niigata University
Malaysia	• University of Malaya, Kuala Lumpur
Saudi Arabia	• King Abdul Aziz University
United States of America	• PRIDE Research Foundation • Cornell University • University of California • University of Texas • Harvard University
Uruguay	• IIBCE Institute, Montevideo
China	• South China University
Taiwan	• Chang Gung Memorial Hospital
Australia	• The University of Sydney • Monash University

Training, Capacity Building and Educational Activities:

Pain Centre Meetings

Our Pain Centre meetings serve as a primary source of training opportunities for students and the early career researchers.

Internal Scientific Meetings allow students to improve their knowledge and skills, become more comfortable in public speaking and presenting, and be

more confident in addressing the questions from the audience. These meetings also have an important networking component where presenters may receive additional feedback, suggestions, and inspiration for their work. We welcome all sorts of presentations at various progress stages with our members presenting a chapter from their thesis, a completed research project, a publication, or simply a research plan. Such structure is especially beneficial to PhD students who may choose to present their research design in the first year of their studies and then present an update of their research in the following years.

Some of the other meetings are *External* and *Themed scientific meetings* where we invite external speakers, from outside the Pain Centre and beyond the University of Nottingham. These meetings deliver training opportunities and grow collaborations between the Pain Centre and other research groups.

A full list of Pain Centre meetings can be found here.

Pain Centre Versus Arthritis makes major contributions to national and international meetings and conferences. In 2022 we organised the 4th Versus Arthritis Pain Research in the UK conference at King's College, London. The conference successfully brought together researchers from diverse pain-related disciplines within the excellent facilities of the Great Hall, Kings College, London. The meeting was the culmination of extensive efforts from our secretariat, Organising Committee, Versus Arthritis, Pain Centre Versus Arthritis at the University of Nottingham and, most of all, everyone who participated in the conference. We identified the most influential directions in pain research and encouraged the exchange of views, ideas, and inspiration to promote further advancement in these areas.

During the period of this report, Pain Centre members have provided workshops to international conferences including Osteoarthritis Research International (OARSI), Berlin (contribution of bone marrow lesions to Osteoarthritis pain) and Denver (pain assessment in preclinical models), European League Against Rheumatism (EULAR), Copenhagen (pain in spondyloarthropathies), the International Association for the Study of Pain (IASP), Toronto, Canada (pain phenotyping in low back pain), Open Rheumatology, Barcelona (pain in rheumatoid arthritis), European Congress on Clinical Trials in Pain (outcome measurement in osteoarthritis trials), and the British Neuroscience Association (virtual meeting, new treatments for pain).

Teaching Activities
Pain Centre Versus Arthritis is committed to building capacity for pain research, and ensuring that understanding chronic pain is a key element of professional training for clinicians, from undergraduate studies through

continuing professional development. Our members contribute to education through hands on delivery of teaching within Nottingham, and contribution to teaching/training programmes and materials at national and international levels. University of Nottingham courses run by Pain Centre members include undergraduate and postgraduate course in neuroscience (Gareth Hathway), Pain Management (Roger Knaggs), Spinal Disorders (Stefan Kluzek), Physiotherapy and Sport Rehabilitation (Michelle Hall and Paul Hendrick), Pain Rehabilitation (Stefan Kluzek), Communicating Science (Stefan Kluzek and Tobias Bast), quantitative evidence synthesis (Weiya Zhang), and Health Psychology (Kavita Vedhara) degree programmes. The Centre makes additional teaching contributions to preclinical and clinical medical, physiotherapy, pharmacology and neuroscience curricula, Masters course in Pharmacy, Psychology, Sports and Exercise Medicine, and PhD student training. Contributions to professional development include leading roles in a course for non-medical prescribing (Roger Knaggs). Supervision of undergraduate and postgraduate research students supports a developing enthusiasm to advance understanding of the mechanisms and management of chronic pain. Centre members have also contributed to text books and web-based materials supporting international education on pain. The Centre's active Public and Patient Involvement and Engagement programme also delivers training on the nature and value of PPI/E to undergraduate medical students (Jo Stocks) and postgraduate researchers. Pain inequalities remain a key area in our postgraduate teaching on cross-cultural health care, ethnic diversity, inequality and health (Eamonn Ferguson).

Chitra Joseph is a co-founder of the "Parents in Science and Society" who provide support, mentorship and personalised guidance to staff and students with parental responsibilities.

Destination cases

Pain Centre Versus Arthritis is dedicated to delivering the best possible training to our PhD students to enable them to build the career they want. Below are some of the individual destination cases from the Pain Centre students.

Peter Gowler has previously completed his PhD project within the Pain Centre under the supervision of Victoria Chapman and David Walsh. His research focused on the role of the neurotrophins in mediating chronic joint pain in preclinical models of osteoarthritis. Peter then remained in Victoria's lab as a research fellow and investigated the therapeutic potential of Omega-3 and -6 metabolites for treating chronic joint pain. At present, Peter is working as a Research Liaison Manager at Versus Arthritis.

Subhashisa Swain commenced his PhD in 2018 supervised by Weiya Zhang, Carol Coupland and Michael Doherty to investigate the

epidemiology of osteoarthritis and it's comorbidities. Subhashisa continued as a Research Fellow at Pain Centre Versus Arthritis before taking up the NIHR research fellowship for primary care research at the University of Oxford, fully utilizing his skills in quantitative research. Subhashisa is leading a European consortium for research osteoarthritis and comorbidity and NIHR funded 'Dementia Fellow'. Subhashisa also acts as an external supervisors for two PhDs within the Pain Centre Versus Arthritis.

Kehinde Akin-Akinyose joined Pain Centre Versus Arthritis back in 2015 to pursue her PhD on "A clinical assessment tool to improve the use of pain-relieving treatments in knee osteoarthritis" supervised by David Walsh, Eamonn Ferguson and Dan McWilliams. Kehinde has progressed to become Lecturer in Population Health at Hull York Medical School.

Nuria Casanova Vallve completed a doctoral degree in 2019 in Pain Centre Versus Arthritis investigating skeletal muscle dysregulation in rheumatoid arthritis and was supervised by Victoria Chapman and Paul Greenhaff. Nuria has held postdoctoral research roles at Scripps Research Institute and University of California San Diego after graduating from the University of Nottingham, and she is now a Senior Scientist at Insmed Incorporated – a biopharmaceutical company based in San Diego, USA.

Public and Patient Involvement and Engagement (PPI/E)

Pain Centre Versus Arthritis continues to build on the effective partnership between the PPI members and the researchers through its Patient and Public Advisory Group (PPAG). This partnership is of extreme importance to us as we want the PPI insight to be in the heart of everything we do. Our research aims to improve the quality of life for people with pain and we involve the people with lived conditions so that together we can advance our research. We facilitate the partnership between the public who are enthusiastic about making a difference in the world of pain research and investigators who want their studies to reflect the views and needs of people living with pain.

For the past year, we have been looking into ways of expanding our PPI activities and collaborating with a greater infrastructure to achieve this. We have been working closely with Nottingham University Hospitals NHS Trust (NUH) to build an effective partnership between our two systems and further enhance the experience for our PPAG members. We are also in close alliance with the University of Nottingham PPI/E Operations Group, together working to further develop the internal structures of PPI/E operations within the School of Medicine.

Thanks to our strong ties with other PPI/E providers, we have reviewed our own processes and strategies to make sure we deliver a high standard PPI practice, making it easier and more efficient for the researchers to access and benefit from PPI, and for PPAG members to gain from their PPI/E activities. We have developed mechanisms to enable us to meet NIHR standards on payments for PPI/E activities. We continue to develop our communication with the PPI members, and have launched a regular Newsletter which celebrates the research progress of our members supported by the PPAG contributors and advertises PPI/E related events.

Expansion of the PPAG to include different perspectives on the diverse aspects of pain is also very important to us. We are inviting more people to join the PPAG from Pain Centre cohorts, for example, people with pain due to rheumatoid arthritis.

Our engagement activities include presentations to local patient and public groups (e.g. Dementia, Frail Older People and Palliative Care PPI group, Wendy Chaplin). The Centre has prepared written materials about pain and pain research for the general public, including lay summaries posted on our website here, and articles in lay press, including editorialship of an edition of Pain Matters, Edinburgh (Walsh and Colvin, 2022).

Research Themes

Pain Centre research spans 5 major themes: (1) Biomarkers and Novel Therapeutic Targets, (2) Nociplasticity, (3) Neurocognitive and Psychological Function. (4) Treatment Efficacy and Real-World Evidence, and (5) Phenotyping and Personalised Medicine.

Below we summarise some of the advances that were made by the Pain Centre members in each theme, illustrating the diverse range of expert techniques and resources that were employed this year.

Biomarkers and Novel Therapeutic Targets

Pain Centre Versus Arthritis is proud of its pioneering discoveries in biological targets research. It remains our ambition to shed light on previously unexplored pathways which give rise to painful conditions.

This year, our researchers have helped to elucidate sources of chronic postoperative pain after total knee arthroplasty (TKA) (Kurien et al., 2022). TKA is the treatment of choice for patients with end-stage osteoarthritis (OA), but all too often pain persists postoperatively. The factors that underlie chronic postoperative pain have remained unclear, and so treatment options for such pain are limited. Researchers in Pain Centre Versus Arthritis evaluated patients with and without pain following the TKA

procedure, using magnetic resonance imaging (MRI) of the knee with the implanted prosthesis, qualitative sensory testing (QST) to establish patients' pain sensory profile and clinical assessment of pain and catastrophizing thoughts. They found that postoperative pain was associated with synovitis, synovial effusion, sensitisation of the central pain mechanisms and, to a lesser extent, pain catastrophizing thoughts.

Other Pain Centre researchers also addressed the issue of synovial inflammation, which is a known contributor to chronic OA pain but whose potential role in transitions from early to late stages of OA pain is unclear (Gowler et al., 2022). Using a slow-progressing murine model of OA, we found that joint inflammation and plasma oxylipin mediators of inflammation and pro-resolution molecules are likely to influence the transition to chronic pain in OA. Our findings point to the importance of changing the balance between pro- and anti-inflammatory pathways in the progression of pain from early to later stages of OA. The study employed a diverse range of expert techniques: behavioural testing, such as weight-bearing asymmetry and hind-paw withdrawal thresholds, joint histology and liquid chromatography with tandem mass spectrometry.

Nociplasticity

Pain after COVID-19 infection is recognised as a new global healthcare issue. Post-infection pain can present as different phenotypes: nociceptive, neuropathic, nociplastic or mixed type. There are different treatment options available for each phenotype, and identifying the correct phenotype of post-COVID pain is essential for maximising treatment efficacy. Pain Centre members entered an international collaboration of research groups to investigate pain phenotyping as part of a precision pain medicine approach using the 2021 International Association for the Study of Pain (IASP) clinical criteria (Fernández-de-las-Peñas et al., 2022). Pain phenotypic classification using the 2021 IASP system can improve multimodal treatment of post-COVID pain.

Neurocognitive and Psychological Function

Cognitive and psychological factors have a considerable impact on the transition from acute to chronic pain and on treatment efficacy. We have made a significant breakthrough in understanding the links between knee osteoarthritis and cognitive impairment (Gonçalves et al., 2023). Hippocampal function, which is critical to cognitive function, has been found through neuroimaging studies to be impaired in human chronic pain conditions. In human studies, there are often multiple confounding factors, such as comorbidities and pain medication, that make it difficult to interpret results. We have used rodent OA models to study the impact of pain on cognitive function, without the influence of these other factors. Using a mono-iodoacetate (MIA) model, we found that OA-induced pain did not undermine memory function and behavioural flexibility by damaging the

hippocampus, in contrast to findings in other chronic pain conditions. Following the induction of the rodent MIA model, we performed the following behavioural testing: the water maze DMT task, which is highly sensitive to hippocampal dysfunction, the Novel Object Recognition (NOR) memory test, and the operant test of behavioural flexibility.

Psychosocial factors influence treatment effectiveness for OA knee pain. Treatment effectiveness may be reduced if there are discrepancies between the patient's perspective and the treatment focus. Our team has examined what perspectives patients hold regarding the mechanism underlying how their pain changes (or doesn't change) over time (Walsh et al., 2023). Participants from the Knee Pain and Related Health in the Community (KPIC) cohort were recruited and interviewed about their understanding of their pain. Patients shared a primarily biomechanical understanding of their pain progression but displayed little recognition of psychosocial factors that can influence pain. Interventions that help patient perspectives to converge with current evidence-based practice, recognising the biopsychosocial nature of pain, have huge potential to improve outcomes from treatment. This research used qualitative methodologies with interviews from stratified participants recruited from our well-phenotyped KPIC cohort.

Treatment Efficacy and Real-World evidence

Each year the Pain Centre increases understanding of different treatments aimed at reducing the negative impact of chronic pain. The effects of pain management therapies in real-world practice often differ from the outcomes in clinical trials. Our researchers apply findings from experimental medicine studies/clinical trials, systematic reviews, and well-controlled real word observational studies to fill the gaps and assess both benefits and harms of a treatment.

Self-management is a key approach for dealing with chronic low back pain (CLBP). Self-management involves biological, psychological, and social home-based interventions aimed at reducing CLBP and its impact on the individual. However, self-management approaches often only have small to moderate effects. This might be explained if different self-management strategies work better for different individuals, instead of a `one size fits all' approach. We sought to identify a specific group of patients with CLBP who benefit from self-management intervention, and use the findings from this sub-group to improve overall treatment strategies (Banejee et al., 2022). A multi-centre longitudinal cohort study employed questionnaires to measure self-management constructs and biopsychosocial factors (disability, depression, physical activity, etc.). Many of these factors predicted self-management constructs. Our study highlights the importance of uncovering biopsychosocial predictors to inform when self-management approaches are most likely to be successful.

Opioid safety has long been a concern in clinical practice, especially in chronic non-malignant pain management. Low- and middle-income countries have a high prevalence of chronic pain but a lack of access to strong opioids, and, conversely, some countries might inappropriately use opioids where their benefits might not outweigh the risks. We explored motivators in opioid use behaviour and the factors which underlie unsafe use of opioids, and illegal distribution of medical opioids. We presented possible strategies to overcome these difficulties (Iqbal et al., 2022). This research used exploratory qualitative methods, such as interviews, focus groups, and non-participant observational case studies. Our research can be used as a benchmark for improving the current legislation to ensure safe and efficient opioid use.

Patients with painful knee osteoarthritis commonly also experience other long-term health conditions, such as cardiovascular or metabolic disorders. These conditions might follow the diagnosis of osteoarthritis, but might also represent side effects of analgesic use. We used data from the Knee Pain and related health In the Community (KPIC) cohort (Swain et al., 2022) to show that people with knee pain have a high risk of developing two or more persistent health conditions. Furthermore, we discovered that NSAIDs and opioid use is linked to the subsequent development of more chronic health conditions.

Phenotyping and Personalised medicine

A personalised medicine approach is at the heart of Pain Centre research. Our research helps direct patients away from the treatment strategies that for them do not work and encourages healthcare providers to customise therapies based on the patient's unique genetic makeup and disease phenotype.

Osteoarthritis has been revealed as a complex disorder which can be influenced by various genetic and environmental factors. The co-existence of other health conditions in people with osteoarthritis defines a distinct phenotypic subgroup with particular therapeutic challenges. Osteoarthritis might increase the risk of developing other chronic conditions, such as cardiovascular, neurologic, endocrine or psychological conditions. In collaboration with our partners in Sweden, Weiya Zhang measured the risk of developing other chronic conditions in patients after knee or hip OA diagnosis (Dell'Isola et al, 2022). This was a large cohort study involving around half a million Swedish residents. The study showed that osteoarthritis is a significant risk factor for comorbidities. Will managing osteoarthritis better reduce the probability of developing other chronic diagnoses such as depression, cardiovascular conditions, diabetes, and back pain, and should interventions that reduce the risk of those conditions be targeted at people with osteoarthritis?

Knee pain is often caused by injuries or osteoarthritis, and is measured using questionnaires. Often patients and clinicians rely on this information to decide on the best course of treatment, but how much does pain need to be reduced to conclude that a treatment is effective? Patient Acceptable Symptom State (PASS) is the threshold score on a pain questionnaire below which people would be willing to put with that level of pain for the rest of their life. PASS values are specific to the questionnaire used. This makes it challenging to compare the results between treatments. Georgopoulos et al., 2023 showed by systematic review with meta-analysis, combined with individual patient data analysis, different pain questionnaires can be standardised to reveal similar PASS thresholds for groups of people with knee pain. However, PASS values are affected by patient and treatment characteristics and need to be applied only with great caution to individuals with knee pain. Personalised medicine requires an understanding of an individual's pain, and how it responds to treatment, and averages derived from a group of individuals may conceal important inter-individual heterogeneity.

Organisational Structure

Co-directors

Name	School and Faculty	Position	Area of Expertise
Prof Victoria Chapman, Pain Centre Executive Committee Member	School of Life Science; Faculty of Medicine and Health Sciences	Co-Director of Pain Centre Versus Arthritis; Professor of Neuropharmacology	In vivo studies, pharmacological intervention, pain biomarkers, CNS function, forward and back translation.
Prof David Andrew Walsh, Pain Centre Executive Committee Member	School of Medicine; Faculty of Medicine and Health Sciences	Co-Director of Pain Centre Versus Arthritis; Professor of Rheumatology and Consultant Rheumatologist at Sherwood Forest Hospitals NHS Foundation Trust.	Pain phenotyping in arthritis, mechanistic pain modelling and assessment across preclinical and clinical studies, pharmacological and non-pharmacological therapeutic intervention, biorepositories.

Executive Committee

Name	School and Faculty	Position	Area of Expertise
Prof Eamonn Ferguson	School of Psychology; Faulty of Science	Professor of Health Psychology	Health psychology, cohort studies, statistical modelling, psychosocial impact
Dr Federico Dajas-Bailador	School of Life Sciences Faculty of Medicine and Health Sciences	Assistant Professor	Physiology Pharmacology and Neuroscience, regulation of axonal protein expression by selective degradation
Dr Roger Knaggs	School of Pharmacy; Faculty of Science	Associate Professor in Clinical Pharmacy	The appropriate use of analgesic medicines, and associated clinical outcomes and healthcare utilisation
Prof Weiya Zhang Committee Member	School of Medicine; Faculty of Medicine & Health Sciences	Professor of Epidemiology	Epidemiology, evidence-based medicine, osteoarthritis, Gout research
Dr Duncan Hodkinson	School of Medicine; Division of Mental Health and Clinical Neuroscience	Senior Research Fellow	Imaging; pain & neuroscience

Senior Investigators

Name	School and Faculty	Position	Area of Expertise
Prof Abhishek Abhishek	School of Medicine; Faculty of Medicine and Health Sciences	Professor of Rheumatology Honorary Consultant Rheumatologist, Nottingham University Hospitals NHS Foundation Trust	Autoimmune Rheumatic Disease Epidemiology, Gout, CPPD, OA clinical research, Clinical Trials - CTIMPs, Pragmatic trials, Ultrasound imaging
Prof Ana Valdes	School of Medicine	Professor of Molecular and	Genetic epidemiology and musculoskeletal genetics

	Faculty of Medicine and Health Sciences	Genetic Epidemiology	
Dr Andrew Bennett	School of Life Science; Faculty of Medicine and Health Sciences	Associate Professor and Director of the FRAME Alternatives Laboratory	Molecular Biology /Biochemistry, models of inflammation in disease states, neuroinflammation and metabolic dysfunction
Prof Avril Drummond	School of Heath Sciences; Faculty of Medicine and Health Sciences	Professor of Healthcare Research	Healthcare research and occupational therapy, stroke rehabilitation and rehabilitation research
Prof Benjamin Ollivere	School of Medicine; Faculty of Medicine and Health Sciences	Professor of Orthopaedic Trauma, Head of Division Rheumatology, Orthopaedics and Dermatology	Non-union, bone infection, trauma and major injury along with treatment of complex fractures and the complications of these treatments; interest in limb reconstruction
Prof Brigitte Scammell	School of Medicine; Faculty of Medicine and Health Sciences	Dean and Head of School of Medicine	Orthopaedic surgery, biology of fracture healing, osteoarthritis and biomaterials
Dr Cornelia De Moor	School of Pharmacy; Faculty of Science	Associate Professor in RNA Biology	Post-transcriptional mechanisms of gene expression in arthritis
Dr Dong-Hyun Kim	School of Pharmacy; Faculty of Science	Associate Professor	Analytical Bioscience
Prof Dorothee Auer	School of Medicine; Faculty of Medicine and Health Sciences	Professor of Neuroimaging	Clinical neurosciences using advanced MRI techniques
Dr Galina Pavlovskaya	School of Medicine; Faculty of Medicine and Health Sciences	Associate Professor, Translational Imaging	Translational and Molecular Imaging
Dr Hareth Gathway	School of Life Sciences	Associate Professor, Director of	Science of pain and nociception, pain

		Neuroscience Degrees	processing and chronic pain states
Prof Holly Blake	School of Health Sciences; Faculty of Medicine and Health Sciences	Associate Professor of Behavioural Science	Health psychology, behaviour change, self-management, psychological / behavioural / digital interventions.
Dr Joanne Stocks	School of Medicine; Faculty of Medicine and Health Sciences	Assistant Professor in Sport And Exercise Medicine	Healthy aging, focusing on the role of nutrition in frailty, osteoarthritis and pain
Dr Isabella Maiellaro	Faculty of Medicine & Health Sciences	Ann Mclaren Fellow	GPCR-mediated synaptic plasticity
Prof Joe Kai	School of Medicine; Faculty of Medicine and Health Sciences	Clinical Professor and Head of Primary Care	Expertise in clinical and applied health research, teaching and service development
Prof John Gladman	School of Medicine	Emeritus Professor of Medicine of Older People	Expertise in pain and frailty/dementia
Prof Kavita Vedhara	School of Medicine; Faculty of Medicine and Health Sciences	Professor of Health Psychology	Psychological stress, psychoneuroimmunology, patient expectations, placebo effect, psychological interventions, foetal programming hypothesis, psychological/behavioural interventions
Prof Lucy Donaldson	School of Life Sciences; Faculty of Medicine and Health Sciences	Professor of Sensory Physiology	Neurophysiology of acute and chronic pain, particularly in arthritis
Prof Marilyn James	School of Medicine; Faculty of Medicine and Health Sciences	Professor of Health Economics	Applied economic and clinical evaluation
Prof Meritxell Canals Buj	School of Life Sciences;	Professor of Cellular Pharmacology	Interactions between G Protein-Coupled Receptors and

			intracellular proteins, and their consequences for receptor signalling and trafficking
Dr Michael Stocks	School of Pharmacy; Faculty of Science	Professor of Medicinal Chemistry and Drug Discovery. Associate Professor, Centre for Biomolecular Sciences	Drug Discovery, Design, Medicinal and Synthetic Chemistry
Dr Michelle Hall	School of Health Sciences; Faculty of Medicine and Health Sciences	Assistant Professor Physiotherapy and osteoarthritis	Musculoskeletal rehabilitation and rheumatology
Prof Paul Greenhaff	School of Life Sciences; Faculty of Medicine and Health Sciences	Professor of Muscle Metabolism	Physiology, Pharmacology and Neuroscience
Dr Paul Hendrick	School of Health Sciences; Faculty of Medicine and Health Sciences	Lecturer in Physiotherapy and Rehabilitation Sciences	Low back pain research, Pain Research, Clinical outcomes research
Dr Pavel Gershkovich	School of Pharmacy; Faculty of Science	Associate Professor of Biopharmaceutics	Biopharmaceutics, Pharmacokinetics, Pharmacodynamics, Bioanalytical Techniques, Oral Drug Delivery, Effects of Disease States on Pharmacokinetics and Pharmacodynamics
Prof Penny Gowland	School of Medicine; Faculty of Medicine and Health Sciences	Professor of Physics	Developing quantitative MRI for biomedical applications
Dr Richard Pearson	School of Psychology; Faculty of Medicine and Health Sciences	Assistant Professor, Orthopaedics and Trauma Group	Quantified changes in bone associated with several disease pathologies

Dr Rob Lane	School of Life Sciences; Faculty of Medicine and Health Sciences	Associate Professor of Molecular Pharmacology	G protein-coupled receptors with a particular emphasis on novel approaches towards the development of improved therapeutics for CNS disorders
Prof Roshan das Nair	School of Medicine; Faculty of Medicine & Health Sciences	Professor of Clinical Psychology and Neuropsychology	Multiple sclerosis, Acquired brain injury, Pain research
Dr Stefan Kzulek	School of Medicine; Faculty of Medicine & Health Sciences	Clinical Associate Professor	Sports and Exercise Medicine
Dr Tobias Bast	School of Psychology; Faculty of Science	Associate Professor	Brain mechanisms of cognition and behaviour, neuroscience and biological psychology
Dr Stephen Ryder	Faculty of Medicine & Health Sciences	Consultant Physician	Hepatology and Gastroenterology
Dr Richard James	Faculty of Science	Assistant Professor	Addictive behaviours
Dr Louise Wilson	Faculty of Science	Assistant Professor	Pharmacy Practice
Dr Anna Piccinini	Faculty of Science	Assistant Professor	Inflammation Biology
Dr Kate White	Faculty of Medicine & Health Sciences	Deputy Head of School, Clinical Director of SVMS, Head of Division of Veterinary Clinical Sciences	Veterinary Medicine and Science
Dr Kim Chisholm	Faculty of Medicine & Health Sciences	Ann Mclaren Fellow	In vivo microscopy
Dr Victoria James	Faculty of Medicine & Health Sciences	Associate Professor	Cancer Biology and Gene Expression

Research Fellows and Early Career Researchers

Name	School and Faculty	Position

Dr Fuller, Amy	Faculty of Medicine & Health Sciences	Research Fellow
Dr Georgopoulos, Vasileios	Faculty of Medicine & Health Sciences	Research Fellow
Dr Goncalves, Sara	Faculty of Medicine & Health Sciences	Research Fellow
Dr McWilliams, Daniel	Faculty of Medicine & Health Sciences	Research Fellow
Dr Nakerero, Georgina	Faculty of Medicine & Health Sciences	Research Fellow
Dr Smith, Stephanie	Faculty of Medicine & Health Sciences	Research Fellow
Dr Chitra Joseph	Faculty of Medicine & Health Sciences	Research Fellow
Dr Stephen Woodhams	Faculty of Medicine & Health Sciences	Research Fellow
Dr Li Li	Faculty of Medicine & Health Sciences	Research Fellow
Dr John Harris	Faculty of Science	Lecturer in Neurophysiology
Dr Jyoti Agrawal	Faculty of Medicine & Health Sciences	Research Fellow
Dr Onosi Ifesemen		Research Fellow
Dr Jemima Collins	Faculty of Medicine & Health Sciences	Research Fellow
Dr Giulia Ogliari	NUH	Research Fellow
Dr Wendy Chaplin	Faculty of Medicine & Health Sciences	Research Associate
Dr Daniel Scott	Faculty of Medicine & Health Sciences	MND Association Junior Non-Clinical Fellow
Dr Chitra Joseph	Faculty of Medicine & Health Sciences	Research Fellow
Dr James Turnbull	Faculty of Medicine & Health Sciences	Research Fellow
Dr Tameille Valentine	Faculty of Medicine & Health Sciences	Research Fellow
Dr Hannah Jackson	Faculty of Medicine & Health Sciences	Research Fellow

Research Support

Name	School and Faculty	Position
Rose Farrands-Bentley	Faculty of Medicine & Health Sciences	Administrative co-ordinator
Eoin Gormley	Faculty of Medicine & Health Sciences	Musculoskeletal Research Administrator

Vlada Yarosh	Faculty of Medicine & Health Sciences	Administrative co-ordinator
Doris Chu	Faculty of Medicine & Health Sciences	Administrative co-ordinator
Dr Anthony Kelly	Faculty of Medicine & Health Sciences	Research Nurse
Thomas Lott	Faculty of Medicine & Health Sciences	Musculoskeletal Data Administrator
Sean McLoughlin	Faculty of Medicine & Health Sciences	Musculoskeletal Research Administrator
Dr Bonnie Millar	Faculty of Medicine & Health Sciences	Musculoskeletal Project Manager
Fozia Naushah	NUH	Research Nurse, Faculty of Medicine & Health Sciences
Paul Millns	Faculty of Medicine & Health Sciences	Laboratory Technician
Dr Seyed Shahtaheri	Faculty of Medicine & Health Sciences	Laboratory Technician
Jennifer Taylor	Clinical Sciences	Research Administrator
Marie Ward	Faculty of Medicine & Health Sciences	Research Nurse
Kirsty Widdowson	NUH	Patient and Public Involvement and Engagement Facilitator
Deborah Wilson	Sherwood Forest	Research Nurse
Dr Laura Wyatt	Faculty of Medicine & Health Sciences	Clinical Trial Manager
Dr Benjamin Smith	Faculty of Medicine & Health Sciences	Clinical research physiotherapist

Students

Name	Project Title	Start Date	Supervisors
Ahmed Thanoon	Prevalence and associated risk factors of foot/ankle osteoarthritis and neurodegenerative conditions in ex-professional footballers compared to general population	October 2021	Professor Weiya Zhang (Principal Supervisor) Professor Michael Doherty (co-supervisor) Dr Shima Espahbod (co-supervisor)
Aya Abd Elkhabir	Personalised approaches to the	October 2021	Prof. David Walsh(Principal

	management of chronic musculoskeletal pain in people with Rheumatoid Arthritis		Supervisor), and Dr Daniel McWilliams
Ayah Ismail	Optimising Contextual Factors in the Practitioner-Patient Encounter in the Management of Osteoarthritis	October 2018	Prof Weiya Zhang
Charles Besidonne	Alternative splicing targets in arthritis	October 2021	Prof Lucy Donaldson, Dr Kim Chisholm, Prof David Bates, Dr Andrew Benest
Lauren Brown	Investigating opioid tolerance at the cellular level and its relationship with its behavioural manifestations	October 2021	Prof Meritxell Canals Buj
Monirah Shuaib	Knee pain and multimorbidity in retired male professional football players and general population control men	February 2021	Prof. Weiya Zhang, Prof. Michael Doherty, Dr Michelle Hall and Dr Subhashisa Swain
Neave Smith	Early life exposure to opioids and pain in later life	May 2023	Gareth Hathway, Victoria Chapman
Nouf Al-Otaibi	Epidemiology of Chronic shoulder pain and associated risk factors in the United Kingdom: a population-based study of UK primary care data using clinical	April 2021	Michelle Hall, Weiya Zhang, Subhashisa Swain, Michael Doherty

	practice research datalink (CPRD)		
Ojasvi Mehta	Role of the gut microbiome and serum metabolome in knee pain in patients with Osteoarthritis	October 2019	Dr Ana Valdes
Prajakta Bhoir	Age related changes in serotonergic pathways and pain processing	September 2022	Gareth Hathway, Victoria Chapman
Rebecca Pope	The effect of inflammatory signalling on DRG sensory neuronal excitability	September 2021	Dr Federico Dajas-Bailador, Gareth Hathway
Reham Baamer	Postoperative pain assessment and opioid utilisation following colectomy	October 2019	Dr Roger Knaggs, Li Shean Toh, Dileep Lobo
Roheena Sohail	Arthritis damage and pain: VEGF involvement	October 2018	Prof Lucy Donaldson
Sophie McCann	Investigating the ability of medulloblastoma derived extracellular vesicles to modify the development of mouse primary cortical neurones	September 2022	Gareth Hathway, Federico Dajas-Bailador
Yasmine Zedan	Understanding pain mechanisms in knee osteoarthritis	October 2018	Dorothee Auer, Professor Brigitte Scammell, Mr Tom Kurien
Angela Higgins	Co-Design of Assistive Robotic Systems for Monitoring and Management of Chronic Pain	October 2012	Holly Blake, Michelle Hall

Fahad Alotibi	Virtual Reality for Chronic Low Back Pain: A Mixed Methods Feasibility Study in the Kingdom of Saudi Arabia	October 2021	Paul Hendrick
Maria Alshammari	Chronic Pain Management for Children and Adolescents in Saudi Arabia	April 2023	Paul Hendrick
Walid Mohamed	Arabic translation, cultural adaptation, and psychometric validation of a measure of patient's outcome expectations in the musculoskeletal population	April 2022	Paul Hendrick

Active Funding and Awards

Pain Centre Versus Arthritis benefits from a broad foundation of funding sources, with current active grants totalling approximately £43 million.

Senior Investigator(s)	Awarded By	Details	Period
Ana Valdes, Stefan Kluzek, Benjamin Smith	UK Research and Innovation	Molecular signatures of endocannabinoid induced pain relief in humans: lifestyle interventions, systemic and localised changes.	2022-2025
Kim Chisholm	BBSRC	A brighter future cutting-edge multiphoton imaging at Nottingham	2023-2024
Victoria Chapman, Ana Valdes, Dong-Hyun Kim, Federico Dajas-Bailador, Dong-Hyun Kim. Peter Gowler	UK Research and Innovation	MICA: Exploiting specialised pro-resolution molecule mediated analgesia to identify novel targets for the treatment of chronic pain	2022-2025

Victoria Chapman, Gareth Hathway, Steve Woodhams	Medical Research Council	Mechanistic studies of opioid-induced exacerbation of chronic pain responses	2022-2025
Victoria Chapman	Versus Arthritis	Harnessing the potential of 17-HDHA a novel biomarker of OA pain status	2019-2024
Victoria Chapman and Dong-Hyun Kim	University of Nottingham	Nano-electrospray ionisation source for nano-liquid chromatography system to establish new methods for the detection of low abundance endogenous opioid peptides in biological samples	2023-2024
Victoria Chapman	Versus Arthritis	Lymphotactin in arthritis pain	2020-2024
Ana Valdes and Weiya Zhang	UK Research and Innovation	Advanced Pain Platform ALLEVIATE Data Hub for Pain	2021-2024
Ana Valdes	Versus Arthritis	Synovial fluid to define endotypes by unbiased proteomics in OA	2010-2024
Benjamin Ollivere	National Institute for Health Research	Erector Spinae Plane blocks for the Early Analgesia of Rib fractures in trauma: a feasibility randomised controlled trial with embedded qualitative assessment (ESPEAR trial).	2021-2024
Benjamin Ollivere	Smith and Nephew	smart TSF Software analysis	2021-2023
Benjamin Ollivere	AO Foundation	Muscle Phenotyping in frail older patients having hip surgery following fracture	2021-2023
Benjamine Ollivere	National Institute for Health Research (NIHR) Evaluation Trials and Studies	The ORiF (Operative Rib Fixation) Procedure mEchanisms of Rib fixAtion (OPERA) STUDY	2021-2023

	Coordinating Centre		
David Walsh	UK Research and Innovation /Versus Arthritis	Advanced Pain Discovery Platform (APDP) – Programme Director	2023-2025
David Walsh	Versus Arthritis	Improving pain outcomes in rheumatoid arthritis; detecting the contribution of central pain mechanisms.	2020-2023
David Walsh	National Institute for Health Research	Biomedical Research Centre (musculoskeletal theme NIHR/NOCRI Musculoskeletal-Translational Research Collaboration for MSK, Trauma, Surgery and Recovery theme)	2022-2027
David Walsh	GlaxoSmithKline Research and Development Ltd	Analysis of paired synovium and DRG samples from OA donors	2023-2025
David Walsh	Orion Corporation	Evaluation studies of the expression of pain targets on osteoarthritis tissues and the association of target expression with osteoarthritis pain.	2022-2024
David Walsh	Versus Arthritis	Assessing central nervous system contributions to accelerate musculoskeletal pain diagnosis and treatment (CNS-MSK Pain	2023-2026
Holly Blake, David Walsh, Daniel McWilliams,	Nuffield Foundation/Versus Arthritis Oliver Bird fund	The PAW Trial: A feasibility and acceptability trial of the Pain At Work toolkit	2023-2025
Victoria Chapman, Dong-Hyun Kim	Versus Arthritis	Harnessing the potential of 17-HDHA a	2019-2023

		novel biomarker of OA pain status	
Dorothee Auer	Wellcome Trust	Midlands Mental Health & Neurosciences PhD Programme for Healthcare Professionals	2022-2029
Dorothee Auer	Engineering and Physical Sciences Research Council	Realising the potential of open MRI for dynamic studies of human anatomy and function	2021-2024
Joanne Stocks	Research England	Investigating Microbiome Diversity in the UK Population - Public Engagement	2023-2023
Kim I Chisholm	University of Nottingham	Illuminating the spinal cord to understand chronic pain: In vivo imaging of somatosensory responses of spinal networks	2022-2025
Kim I Chisholm	Royal Society	Shedding light on chronic cold pain: The role of spinal cord networks in cold hypersensitivity	2022-2023
Robert Lane	Biotechnology and Biological Sciences Research Council	New tools for acute spatiotemporal control of GPCR signalling in vivo	2020-2023
Roshan das Nair	National Institute for Health Research (NIHR) Programme Grants for Applied Research	Multicentre Research Programme to Enhance Return to Work after Trauma (ROWTATE)	2019-2024
Stefan Kluzek	Versus Arthritis	Biomarkers and Joint Pain in Military Osteoarthritis Study (Bio-Mil-OA)	2020-2023
Michelle Hall, Paul Hedrick	NRC Research Fund	Developing a core outcome set for complex fractures	2023-2024

Gareth Hathway, Federico Dajas-Bailador, Beth Coyle, Anna Grabowska, Vicky James	Medical Research Foundation	Extracellular vesicles as conduits for the transfer of biologically active compounds which mediate cancer chemotherapy based pain in early life	2023-2026
Victoria Chapman (PI)	Versus Arthritis	Human Validation For Novel Targets Associated With OA Pain	2019-2024

Our commitment to collaboration is reflected by a portfolio of current collaborative grants totalling approximately £4.8 million.

Senior Investigator(s) and Institution	Awarded By	Details	Period
Simon Jones, University of Birmingham (PI), Victoria Chapman, University of Nottingham (Co-I).	UK Research and Innovation	APDP: Synovial fibroblast pain pathotypes: A roadmap to understanding and targeting the complexity of patient-reported joint pain in osteoarthritis	2022-2025
Mohammad Al-Amri, Cardiff University (PI), David Walsh, University of Nottingham (Co-I)	Versus Arthritis	A randomised feasibility study to evaluate home-based personalised virtual reality physiotherapy rehabilitation compared to usual care in the treatment of pain for people with knee osteoarthritis	2022-2025
Christian Mallen, Keele University (PI); Roger Knaggs (Co-I)	National Institute for Health Research (NIHR)	Improving outcomes for patients with opioid-treated persistent non-cancer pain: a proactive clinical pharmacist-led primary care intervention (PROMPPT intervention).ACRONYM: Pharmacist-led intervention to Reduce inappropriate use of Opioid Medicines and optimise Persistent Pain Therapy (PROMPPT)	2019-2024

Andrew Price, University of Oxford (PI); Stefab Kluzer (Co-I); Anna Valdes (Co-I).	National Institute for Health Research (NIHR)	Genicular Artery Embolisation for the symptomatic treatment of knee osteoarthritis refractory to conservative management (GEKO)	2023-2026
Rachel Gooberman-Hill, University of Bristol (PI), David Walsh (PI)	National Institute for Health Research (NIHR) Programme Development Grant (PDG), NIHR202618	Support and treatment after joint replacement (STAR): translation into practice and long-term follow up	2021-2023

Publications 2022 – 2023

Abhishek A, Fuller A, Nakafero G, Zhang W, Dumbleton J, Hawkey C, Coupland C, Terkeltaub R, Doherty M. Feasibility of conducting a randomized, placebo-controlled study assessing whether omega-3 fatty acids prevent gout flares when starting urate-lowering treatment. Rheumatol Adv Pract. 2022;6(3):rkac086.

Aso, K, Walsh, DA, Wada, H, Izumi, M, Tomitori, H, Fujii, K, Ikeuchi, M. Time course and localization of nerve growth factor expression and sensory nerve growth during progression of knee osteoarthritis in rats. Osteoarthritis Cart. 2022, 30, 1344-55. https://doi.org/10.1016/j.joca.2022.07.003

Baamer RM, Iqbal A, Lobo DN, Knaggs RD, Levy NA, Toh LS. Utility of unidimensional and functional pain assessment tools in adult postoperative patients: a systematic review. Br J Anaesth. 2022 May;128(5):874-888. doi: 10.1016/j.bja.2021.11.032. Epub 2022 Jan 5. PMID: 34996588; PMCID: PMC9074792.

Banerjee A., Hendrick P., Blake H., Predictors of self-management in patients with chronic low back pain: a longitudinal study. BMC Musculoskeletal Disorders. 2022;23(1):1-9. 10.1186/s12891-022-05933-2

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Dell'Isola A, Turkiewicz A, Zhang W, Kiadaliri A, Bierma-Zeinstra S, Runhaar J, Prieto-Alhambra D, Englund M. Does osteoarthritis modify the association between NSAID use and risk of comorbidities and adverse events? Osteoarthr Cartil Open. 2022;4(2):100253. doi: 10.1016/j.ocarto.2022.100253

Dell'Isola A, Turkiewicz A, Zhang W, Bierma-Zeinstra S, Runhaar J, Prieto-Alhambra D, Swain S, Kiadaliri A, Englund M. The association between preexisting conditions and osteoarthritis development in peripheral joints: A population based nested case-control study. Osteoarthr Cartil Open. 2022 May 2;4(2):100265. doi: 10.1016/j.ocarto.2022.100265. PMID: 36475291; PMCID: PMC9718144.

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