WELCOME TO HEALTH SCIENCES RESEARCH

By Professor Peter Hogg (Associate Dean for Research) and Dr Steve Preece (Research Centre Director)

Based in the School of Health and Society, our research spans a wide range of areas, from foot and knee biomechanics and assistive device design, through to clinical rehabilitation, public health, psychology and diagnostic imaging.

The strength of the research centre has been recognised recently by the Engineering and Physical Sciences Research Council (EPSRC) who have provided funding for a Centre for Doctoral training. This centre will address important global health challenges in the prosthetic, orthotic and wider healthcare technology sector. In addition to EPSRC funding, our research is supported by the National Institute for Health Research (NIHR) and the Medical Research Council (MRC), along with numerous medical charities. We also work closely with many partners in the commercial sector and also with NHS providers and sports organisations.

The difference we are making in our research areas is reflected in the 2014 REF impact case studies, two thirds of which were recognised as being of internationally excellent or world leading quality.

We are a true community, holding regular research seminars throughout the year to share knowledge and expertise, and our newsletters, blogs and tweets keep our community updated with the latest research news across our Centre. We provide excellent support for new researchers with our Early Career Researcher Group, continue to support Mid-Career Researchers and have a thriving postgraduate research community.
The EPSRC Centre for Doctoral Training (CDT) in prosthetics and orthotics combines expertise from the University of Salford, Imperial College London, the University of Strathclyde and the University of Southampton with more than 25 global industry partners and national facilities. We have assembled a world-leading set of research organisations to address important global health challenges in the prosthetic, orthotic and wider healthcare technology sector.

Our aim is to create a new generation of highly skilled researchers who can deliver the technology and service innovations needed to meet the needs and aspirations of prosthetic and orthotic users.

All students will commence their studies at the University of Salford and after six months they will complete their four-year PhD programme at one of either the University of Salford, Imperial College London, University of Strathclyde or the University of Southampton. Students will be immersed in authentic real-world academic, industry and clinical experiences, working directly with users and industry from the outset.

The CDT will offer:

- Ambitious interdisciplinary PhD projects that blend high quality training with practical experiences that enhance employability.
- Training in research skills relevant to prosthetics, orthotics and the wider healthcare technology industry.
- Integrated training in engineering, physical, medical and health sciences, as well as business, entrepreneurial and other professional skills.
- Opportunities to work on research projects directly with industry and users and understand the journey from user needs to product or service implementation.

Find out more:
www.salford.ac.uk/research/doctoral-training-inprosthetics-and-orthotic/home
CDT@Salford.ac.uk

@HSRC_Research
Leads: Professors Laurence Kenney (L.P.J.Kenney@salford.ac.uk), Malcolm Granat (M.H.Granat@salford.ac.uk), Alison Hammond (A.Hammond@salford.ac.uk) and David Howard (D.Howard@salford.ac.uk)

Our group focuses on three areas of research: Quantification of free-living physical behaviour(s); clinical rehabilitation; and technologies for assisting human movement. Members of the group are based in the School of Health and Society and the School of Computing, Science and Engineering and group members’ backgrounds reflect this interdisciplinary approach, spanning engineering, physiotherapy, occupational therapy, public health, prosthetics and orthotics, and psychology. Our current research is supported by external grants worth around £8 million from NIHR, EPSRC and charities, making it one of the strongest groups in the University. Professor Granat is the Principal Investigator for the flagship, EPSRC-funded Centre for Doctoral.

Members of the group have been instrumental in setting up the new International Society for the Measurement of Physical Behaviour and the associated journal; the Arthritis Research UK/ Medical Research Council Centre for Musculoskeletal Health & Work and EULAR Study Group for Work & Arthritis. Group members have also chaired the XV International Symposium on 3D Analysis of Human Movement, the Trent International Prosthetics Symposium and the 2019 meeting of the International Society of Posture and Gait Research.

Quantification of free-living physical behaviour(s)
We study the applications of objective measurement and quantification of free-living physical behaviour(s) and its related constructs using body-worn devices. We are developing event-based analysis techniques and outcome measures for the quantification of free-living physical behaviours. Collaborations with clinicians and health practitioners allow this research to be applied across varied populations where the benefits of physical activity to health are of key importance. Outcomes measures, based on physical activity patterns, are being developed to quantify the effectiveness of interventions in a wide range of clinical groups and these techniques are also being used to enhance our understanding of how physical behaviours are affected by environmental and social factors.

Clinical rehabilitation
We aim to improve outcomes and quality of life for people with long-term physical conditions by working across the research spectrum: developing measurement tools; identifying the mechanisms underlying impairments; developing evidence-based interventions; and evaluating effectiveness of interventions and their impact on patients and clinical services.

A feature of our research is its’ impact on clinical services, patients’ lives and policy nationally and regionally through our close links and involvement with national policy makers, patient groups and charities, clinical services, professional bodies’ research groups to build capacity and capability.

Technologies for assisting human movement
We focus on three types of assistive technologies - Prosthetics and orthotics, functional electrical stimulation systems and walking aids. Our approach to the design and development is to first gain an in-depth understanding of the limitations of current devices. We build on this understanding to produce novel designs, often in collaboration with leading companies, including Chas A Blatchford (prosthetics and orthotics) and Odstock Medical (functional electrical stimulation). We have been involved in work leading to the regulatory approvals of a number of medical devices, including ShefStim and StimUStep. We have also published the first research showing the potential of miniature hydraulics for advanced energy storage and return in lower-limb prosthetics. We are also developing new evaluation techniques, often based on wearable sensors and, where relevant, in collaboration with psychologists. We use advanced mechanics-based modelling to inform some of this work. For example, our group was one of the first to publish on an approach to gait prediction based on inverse-dynamics combined with optimisation. Our most recent work has introduced a novel mechanics-based approach to evaluating the stability of walking aid users.
The knee, ankle and foot research group’s focus is to create real world solutions for injuries and diseases affecting the feet and knees of people across a wide variety of settings. The programme has three areas of research: Understanding foot and knee assistive technologies, the impact of injury and disease on biomechanical and clinical outcomes and clinical and public/patient orientated research. These strands coalesce with other research programmes within the EPSRC Centre for Doctoral Training (CDT) where Professor Nester is the Academic Director. The research programme has a strong multi-disciplinary team covering wide range of healthcare domains, including engineering, rehabilitation, technology, sport, and lived experience contexts. This ensures that high quality mechanistic and applied research is delivered alongside meaningful real-world impact for people with foot and knee problems.

**Understanding foot and knee assistive technologies**

This research focuses on footwear and orthoses design and evaluation, including how these interact with individuals at a mechanistic (dose exposure of insoles, mechanical alignment from valgus knee braces) and patient factor and efficacy levels (pain changes and comfort rating). Development of new and innovative insoles and have been a highlight of this work, particularly related to diabetes, workplace foot health and children’s feet. We work with some of the best known companies in the footwear industry. Other technology research has included clinical trials of assistive devices such as negative pressure therapy to accelerate foot and leg wound healing, and 3D printed orthoses, and there is an increasing interest in the use of technology for daily monitoring of foot and knee health.

**Impact of musculoskeletal injury and disease on biomechanical and clinical outcomes**

Musculoskeletal injury is a very significant global health burden and arthritis, diabetes and sporting injuries are areas we focus on. Our research seeks to reduce injury risk, with specific focus on patellofemoral pain, anterior cruciate ligament injuries and lateral ankle sprains in sport. Post-traumatic osteoarthritis and physical therapy interventions for joint disease are very well-established research foci. This includes the developments of orthoses, implementing physiotherapy programmes and a new biofeedback application for individuals suffering from knee osteoarthritis. There are also long standing interests in work place posture and musculoskeletal health. This research requires that we understand how the foot and knee tissues affected by injury. We have research investigating the properties of foot skin, muscles, ligaments and foot and knee shape, movements and the forces that are associated with joint injury. We do this in young children as they learn to walk, all the way through to older adults adjusting to a loss of mobility (e.g. due to stroke).

**Clinical and public-orientated research**

How an individual perceives their health, injury and recovery from surgery or other therapeutic intervention is critical. Understanding the perceptions of patients allows us to anchor our scientific research in the experiences of real people and patients. This includes young people and children, adults of working age, athletes, and older people in care home settings. Research includes understanding how people think and perceive their feet and loss of foot health, including the beliefs and behaviours of parents towards their children’s feet and footwear habits. Patient satisfaction from total knee replacement and how physical behaviour changes due to effective physical therapy affects daily lives are also key topics.

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OUR RESEARCH GROUPS

Equity, Health and Wellbeing

Lead: Professor Penny Cook (P.A.Cook@salford.ac.uk)

We carry out research into important aspects of health and wellbeing affecting people today, with particular focus on inequalities in health and issues in the workplace and the working age population. We specialise in applying and evaluating evidence-based health practice, and the design, development and evaluation of contemporary health interventions. Our research looks at specific health issues, such as chronic illness, behaviour change, physical activity and alcohol misuse, within settings such as workplaces, schools or communities, and uses a range of intervention and evaluation methods. We are an interdisciplinary group with biopsychosocial expertise, including public health scientists, physiotherapists, exercise and health scientists, psychologists and sociologists.

Diagnostic Imaging

Leads: Dr Andrew England (A.England@salford.ac.uk) and Dr Lucy Walton (L.A.Walton@salford.ac.uk)

Our diagnostic imaging research makes a real difference in the detection and diagnosis of diseases, to improve outlooks for patients. Our first area of focus is improving image quality and lesion detection in digital radiography and CT scans, whilst at the same time minimizing patients’ exposure to x-radiation. Secondly, we aim to improve breast cancer screening and diagnosis using full-field digital mammography. We collaborate with a wide range of clients, patients, industrial partners and healthcare staff around the world to develop and validate innovative methods and improve existing practices. Our research has won a number of awards, such as “best papers” in various conferences and “best journal paper”.

Psychology

Lead: Dr Sharon Coen (S.Coen@salford.ac.uk)

Research in Psychology at Salford is aimed at contributing to the understanding and addressing of the challenges our society faces in the 21st Century using cutting edge psychological science.

As such our research advances our theoretical and applied understanding of topics such as the value of educational apps in enabling children learning to talk, the links between visual search and the effective use of prosthetic limbs, creative interventions for depression, VR technology, artificial intelligence, and modern transport.
Shared Mixed Reality Therapy (SMaRT)

Lead: Professor David Roberts (D.J.Roberts@salford.ac.uk)

We are interested in how sharing the experience of health simulations can help management of emotions. Towards this, we use Mixed Reality (AR/VR) technologies to share simulations with real and virtual others within a variety of emotive health contexts. The goal is to support feelings of togetherness and support underpinned by simulation focussed non-verbal communication. This can be applied to understanding, diagnosis, therapy and training.

For example, we have helped the NHS to use a form of mixed reality where the therapist and surroundings stay visible until late in therapy. This is being used to treat victims of the Manchester Arena bomb. We have pioneered the use of neuroimaging within shared health simulations, for example, being the first to show neural leaning within VR (in this case shared MR) exposure therapy. One of our virtual humans annoys people about BREXIT, while monitoring of the brain indicates ability to an supress antisocial response. The critical mass of current work is in MR exposure therapy for vulnerable clients; both understanding and treatment. However, we are also investigating the use of immersive neuroimaging for diagnosis and virtual humans for training. This team cross cuts others within the school and wider University. For example, working with: Psychology on psychological evidence of efficacy; Prosthetics & Orthotics on prosthetic acceptance; Mental Health on psychotherapy and dementia; ThinkLab on development of simulated virtual humans; Computer Science on MR displays, and Health Simulation on training.

Sport and Exercise Science

Lead: Dr Paul Comfort (P.Comfort@salford.ac.uk)

Our Sport and Exercise Science research covers a variety of sub-disciplines, including biomechanics, performance analysis, physiology, nutrition and psychology. We focus on two primary areas: optimisation of performance and the prevention and rehabilitation of sports injuries.

Performance enhancement focuses on finding the most effective variations and types of exercise to help athletes attain their best possible performance, and identifying key performance characteristics of different sporting tasks and how to improve them.

Prevention and Rehabilitation of Injuries focuses on identifying the causes of common musculoskeletal injuries and screening to identify factors which may increase the athletes risk of injury. We study various interventions to reduce these risks, along with identifying the best methods of rehabilitation post-injury.

Physical Activity and Health

Lead: Dr Steve Pearson (S.Pearson@salford.ac.uk)

Our aim is to improve or maintain quality of life at all stages of people’s lives. The research we carry out covers a broad spectrum of activity, with the goal of improving or maintaining health through a combination of physical activity and nutritional interventions in both health and disease.

Currently, we are involved in research to examine the responses of muscle and tendon tissues to various exercise interventions. We are also developing ways of examining the signals within the blood shown in response to exercise by people with conditions such as diabetes and obesity, and comparing these to a ‘healthy’ model. We look at the physiological and psychological effects of changes in diet on glycaemic responses, and are developing an understanding of activities and health in the workplace, such as posture and exercise. We are also investigating physical activity and optimisation of cardiorespiratory health, and the clinical and qualitative outcomes of knee surgery.

Recently we have been applying our knowledge of physiological systems to help determine and validate methods of non-invasively monitoring the fire fighters operating in high temperature environments. This work is driven by requirements for safe working practice and involves both commercial and industrial partners.
Occupational Therapy

Lead: Jo-anne Webb (J.Webb@salford.ac.uk)

Occupational therapy facilitates health, identity and well-being through the therapeutic use of meaningful and purposeful activities to enable individuals of all ages to achieve their full potential in their everyday lives and communities.

Our research topics are diverse, but all have direct links with an individual’s occupational engagement and include innovations in moving and handling training, interface pressure mapping and promotion of 24-hour postural management to minimise pressure ulcer risk. We encourage service user engagement in occupational therapy and have published works around the exploration of fathers’ roles who have an adult with a learning disability, vocational rehabilitation and welfare-to-work provision.

The development of The Home Modification Process Protocol to assist practitioners when prescribing adaptations within the home is a product of the Directorate’s research whilst The Salford Integrated Social Prescribing Hub, is developing a model for understanding social prescribing through occupational science, and a tool which will benefit OTs and a range of practitioners.

Find out more

www.salford.ac.uk/research/health-sciences/research-groups/occupational-therapy

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A number of routes are available to study with us, including full-time or part-time PhDs, PhD by published works PhD by Distance Learning, MPhil and MSc. There are over 90 Post Graduate Research (PGR) students studying in our Research Centre, supported by researchers and academics who are world leading in their areas of expertise. Their varied experience ranges from laboratory-based investigations and clinical trials, to epidemiology and public health research, exploring people’s experiences of health and health care. Our PGR students also have access to a wide range of training opportunities, as well as excellent facilities. The research training is tailored to particular needs and there will be opportunities to develop skills such as in academic teaching, which aims to enhance employment opportunities.

Here are just a few examples of the breadth of the doctoral research currently being undertaken by our PGR students:

**PhD, MPhil and MSc by Dr Yeliz Prior, Director of Postgraduate Studies (Y.Prior@salford.ac.uk – 0161 295 0211)**

Lara’s PhD

Lara Al-Khlaifat is a trained physiotherapist from Jordan and chose Salford because of its leading reputation in foot, knee and ankle biomechanics and its state-of-the-art facilities. Her PhD focuses on the development and testing of an exercise programme for patients who suffer with knee osteoarthritis. Using her clinical training, she delivered this intervention to 20 patients and subsequently assessed its impact on both pain levels and muscle/movement patterns. Her work has been published in the Journal “Knee” and was one of the first studies showing that muscle coordination patterns can be changed with effective physiotherapy. She is now a university lecturer in Jordan.

Alix’s PhD

Alix Chadwell is a Medical Engineer who is working with users of upper limb myoelectric prostheses; these devices can be opened and closed using muscle signals (or EMG). Her research aims to establish why some users find these high tech hands difficult to control. To do this, she has developed an innovative way to assess the capability of the user in controlling the muscle signals, and the ability of the electrodes to pick up these signals. Furthermore, she is assessing various clinical measures of functionality, and is collecting novel data reflecting the everyday use of the device outside the clinic. Her work will inform designers, clinicians and researchers who can then concentrate their efforts appropriately.

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Lewis’ PhD

Lewis Atkinson’s background is in Sports Biomechanics. He is investigating how “4D” foot scanning technology can be incorporated to improve the existing design of foot orthoses which aim to improve function and mobility of people with various foot problems. Foot orthoses are normally designed based on a single foot shape captured when the foot is still. Innovative “4D” foot scanning technology enables foot shape to be captured when the person is walking, providing a description of how foot shape changes over a period of time. Ultimately, it is hypothesised that the information gained from multiple rather than single foot shapes will result in better “4D orthotics”.

Nazemin’s PhD

Nazemin Gilaniogullari is a physiotherapist from Cyprus. Her PhD focuses on the development and testing of a daily activity questionnaire for Stroke Survivors and the online platform www.strokesurvivorshub.com. The online platform will help Stroke Survivors and their healthcare professionals to access the self-reported outcome measures easily and use this platform as a self-management tool in future. Ultimately, the development of the online platform and the self-reported outcome measure for Stroke Survivors may help to provide patient-centred care and improve treatment outcomes.

Jo’s PhD

Jo Bragg’s PhD is focusing on adolescent alcohol misuse and is developing a universal school-based intervention that can be embedded into the curriculum. The aim of the intervention is to reduce alcohol consumption by influencing the attitudes of young adolescents as they make the transition into secondary education by using techniques to influence intrinsic motivation. It will also incorporate role play as a means of developing awareness of and attitudes towards alcohol. The intervention will be tested using a randomised controlled trial. It is hoped that young adolescents will adopt healthier attitudes towards drinking alcohol which will influence their future behaviour.

Kholoud’s PhD

Kholoud Alzyoud is a radiographer in the Medical Imaging Department at Hashemite University, Jordan. Kholoud’s research aims to establish an evidence base of erect pelvis X-ray use in the early diagnosis of hip pathologies, addressing a lack of standardisation in positioning and image quality. This research has the potential to influence practice, resulting in better image quality for diagnostic purposes and should also benefit patients as the risk of overexposure to radiation is eliminated.
IT IS HOPED THAT THIS STUDY WILL HELP PHYSICAL THERAPISTS, COACHES, AND TRAINERS TO EFFECTIVELY DEVELOP AND CONSTRUCT COMPREHENSIVE REHABILITATION PROGRAMS

Anna’s PhD

Anna Clark is a qualified physiotherapist specialising in paediatrics. Before starting her PhD she worked in the NHS for 10 years treating children with a wide range of musculoskeletal conditions. The aims of her PhD are to explore if there is an association between reported MSK pain and/or discomfort of children aged 7-17 and their personal electronic device (PED) usage. The research will involve an online questionnaire which will explore the understanding of PED usage in children (7-17 years olds) and any prevalence of musculoskeletal pain or discomfort in these children. From this a case control study will be conducted to explore the prevalence of biomechanical/physiological/ergonomic risk factors for MSD in children using PEDs and how they are linked to PEDs usage.

Sue’s PhD

Sue is a PhD researcher and podiatrist. Her PhD is focused around exploring attitudes and beliefs toward feet and foot health. The global health burden is increasingly defined not by what is killing people but by what is making them sick. Chronic diseases such as diabetes and heart pathology often have a direct and significant impact on foot health. Therefore, understanding perceptions and beliefs toward feet is fundamental to the generation of healthcare strategies and practices that raise awareness and engage people in foot health self-care. Digital tools are a central part of the research process as a data collection, recruitment and research dissemination tool. Narrative stories have been shown to increase empathy amongst practitioners, provide support and information and encourage proactive health behaviours. Digital platforms will therefore be used to disseminate the narrative interviews collated during the research as a public health resource under the ‘Why Feet Matter’ umbrella.

We are proud that the research within our centre has a real, positive impact on the health of people living with a range of conditions, and also on the health providers with whom we collaborate.

Our research informs health policy, furthers the understanding of physical and mental health, improves the effectiveness of disease detection and diagnosis, and is helping to develop new technologies for rehabilitation. With more than £5M of direct investment from industry and partnerships, our research has been independently assessed and its impact was rated as considerable, with the impact on foot health having elements of outstanding reach and significance.

Self-management for people with arthritis

One in five British adults are currently living with arthritis, and the self-management of this condition is a key approach used by occupational therapists (OTs) to support them. Professor Alison Hammond and Dr Yeliz Prior have improved the tools available to health professionals to enable them to deliver more effective self-management education to patients, in turn helping them to improve their quality of life.

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Alison was a member of the NICE Guideline Development Group: The management of rheumatoid arthritis (RA) in adults, offering best practice evidence on the care of adults with RA. Her recommendations included allowing people with RA access to specialist Rheumatology OT for assessment, provision of comprehensive OT and periodic review if they have problems with everyday activities and/or hand function.

Alison has trained over 200 OTs, who are now better equipped to help patients manage their pain and fatigue, improve their psychological resilience, and remain in work. Yeliz is a member of the European League Against Rheumatism (EULAR) Scientific Committee and the British Society of Rheumatology Health Professionals Council, and also works in the NHS as an Advanced Practitioner in Rheumatology, where she leads the knowledge translation from research directly to practice and train health professionals in rheumatology. Yeliz also leads the www.mskhub.com: an online self-management platform for people with msk conditions and research data repository for the University of Salford.

**Foot health devices**

Professor Chris Nester and his colleagues have transferred their research findings in the foot health devices sector into products and services in commercial and clinical settings, supporting a £100 billion global healthcare equipment and supplies industry, and improving quality of life on a daily basis for those with foot and lower limb health problems.

Chris and his team have established highly valued partnerships with some of the leading companies in the foot health sector, with continuous industry funding totalling £5M since 2008.

They launched the salfordinsole brand in 2008, and since then more than 100,000 pairs of salfordinsole orthoses have been sold to the NHS and private sectors and via overseas distributors.

Chris and his colleagues have pioneered the connection of research to commercial foot health products and services, bringing credible and science led innovation in foot health devices to commercial partners and the market, contributing significant economic benefit internationally.

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