ADVANCING KNOWLEDGE TO TRANSFORM LIVES
For advancement of learning and ennoblement of life

The University of Liverpool has a proud history as a centre for research, knowledge and innovation that has changed the world. Founded in 1881, it was established by philanthropists for the advancement of learning and the ennoblement of life – an aim which still holds true today. As a member of the prestigious Russell Group of leading, research intensive universities, we are building on strong foundations and fantastic history with our vision of becoming a globally connected University at the forefront of knowledge leadership.

Our strategic approach puts a strong emphasis on impact and is built on high quality fundamental research, aiming to improve health, create wealth and ensure social justice. Our research is organised into eight institutional interdisciplinary priorities. Our three established themes, Advanced Materials, Personalised Health and Infectious Diseases are driving breakthroughs in developing new materials with large-scale applications in both industry and consumer products, enhancing the personalisation of health management, and progressing the global battle against infectious diseases. We are also investing in five other strong thematic areas including Heritage, Digital, Energy, Healthy Living/Ageing and Genomes to Life, so that we can grow the strength and breadth of research in these areas and accelerate the delivery of outputs.

Establishing reciprocal international partnerships is an integral component of our approach. Currently, over half of our research publications are co-authored with an international partner. In addition to nurturing and further developing these relationships, we are keen to foster a defined number of strategic partnerships where we can develop a cluster of research activity, supported through staff and student mobility. Our recently launched strategy for research collaboration with leading Chinese universities and institutions - focusing initially on the areas of energy, personalised medicine and heritage - is the first example of this approach.

The reputation and profile of the University of Liverpool is intimately connected to the city and our success is fundamentally linked to that of the Liverpool City Region. We recognise and actively nurture and develop this crucial relationship. From building a global network of colleagues and high quality partnerships that promote investment, to enabling social mobility and creating a knowledge base that would otherwise not exist, we play an intrinsic role in the economic and social fabric of the Liverpool City Region.

At the University of Liverpool, I have the privilege of working with dedicated academic and professional colleagues as well as our regional, national and international partners, to ensure that our world-class research changes lives for the better. Our research-led teaching programme across all disciplines is designed to provide the skills for the future leaders in their chosen fields and is delivered by colleagues who are at the cutting edge of their disciplines. We are creating an exciting research environment and developing future research leaders, enabling them to fulfil their potential and contribute towards our overarching aim of improving health, wealth and social justice.

Over the following pages, we present a snapshot of some recent research achievements, new initiatives and exciting projects. I very much encourage you to contact us, so that together we can explore ways to collaborate and extend the boundaries of discovery.

Professor Anthony Hollander
Pro-Vice-Chancellor for Research and Impact
Providing a small solution to a huge challenge – HIV nanomedicine

Globally, around 42.9 million people are living with HIV, while only 19.5 million people currently have access to the effective drugs used to suppress the virus and halt progression of the disease. Pioneering research led by the University of Liverpool is accelerating global efforts to make more effective and cheaper HIV therapies available to more patients through the use of nanotechnology, more specifically, using Solid Drug Nanoparticles (SDNs).

SDNs are tiny particles that enhance drug absorption. Their diameter, usually as small as 1/500th the width of a human hair, means less of a drug is needed to provide the same blood concentrations as a normal medicine. Using less medicine means lower cost of treatment per patient and better use of available drug supplies, making cutting-edge treatments available to more patients.

Given it is the poorest countries that need these new medicines the most, the University has chosen a not-for-profit development pathway to license these medicines for charitable use in low- and middle-income countries, through a partnership with the United Nations-backed public health organisation, Medicine Patent Pool. The partnership is also working with other leading charitable partners such as the Clinton Health Access Initiative.

Listen to our podcast to find out more about this project: www.blubrry.com/universityofliverpool_podcast/22528167/episode-3-nano-medicine-shrinks-the-cost-of-hiv-treatment

The cross-Faculty multi-disciplinary partnership accelerating this research encompasses members of award winning departments. The Department of Molecular and Clinical Pharmacology was honoured with a Queen’s Anniversary Prize in 2017 for its work in improving the safety and effectiveness of medicines. The Department of Chemistry was awarded with a Regius Professorship in 2016 as part of the Queen’s 90th birthday commemorations.

Bringing digital transformation to heritage

The concept of a ‘panopticon’, where all the inmates of an institution can be watched by a hidden observer, was first proposed by Jeremy Bentham in the 1790s as a means of rehabilitating criminals. Today, the ‘Digital Panopticon’, a flagship Arts and Humanities Research Council (AHRC) funded project led by the University of Liverpool, uses digitised historical data to bring a Big Data approach to this important issue for the first time.

Anyone can now search the free-to-use website created by the project for information on over 90,000 people sentenced to transportation to Australia or imprisonment in the UK. Users can investigate individual life-histories, see how punishment affected prisoners and their families, and gain insights into how crime and criminal life has evolved since the 18th century.

The website has already been used by thousands of genealogists and family-historians as well as criminologists, policy-makers, lawyers and historians, students and researchers. Research findings have stimulated discussion about the effectiveness of imprisonment and probation, and the impact of prison on health outcomes, in the UK, Australia, and the US.

Find out more about this project: www.liverpool.ac.uk/sociology-social-policy-and-criminology/research/research-projects/digital-panopticon

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This new interdisciplinary network tackles one of the most significant global challenges facing humanity today and will explore how approaches from the arts and humanities can shift anti-slavery efforts towards a more community-engaged, human rights focus that delivers real development impacts.

Professor Alex Balch, Co-Director of the Centre for the Study of International Slavery (CSIS)

The battle against modern slavery

The transatlantic slave trade was the greatest forced migration in history with a lasting impact on Africa, South America, the US, Caribbean and Western Europe. There is now a pressing need to tell the stories related to this trade and to highlight their legacies and relevance to contemporary issues that affect us all. Sadly, slavery is not just confined to history – one measure estimated that in 2016 over 40 million people around the world were victims of modern forms of enslavement, including human trafficking, forced labour and forced marriage.

Liverpool was a major slaving port in the past, but has long since been a centre of research on slavery through the Centre for the Study of International Slavery (CSIS), a partnership between the University of Liverpool and National Museums Liverpool. Through this facility, Liverpool’s ‘dark heritage’ is today facilitating world-leading research into the abolition of modern slavery.

The University recently secured £2 million of funding for a four-year project to help combat slavery in Sub-Saharan Africa. The CSIS joins three of the main UK centres on research into slavery with leading anti-slavery Non-Governmental Organisations (NGOs) and a range of partners across West and Central Africa in Ghana, Sierra Leone and the Democratic Republic of Congo.

Find out more about our work on modern slavery:
www.liverpool.ac.uk/csis

“One of the best ways of mitigating AMR and preventing infections is to design and engineer a new generation of surfaces and materials that prevent the formation of biofilms, eradicating the problem at source. Our Open Innovation Hub for Antimicrobial Surfaces is designing novel antimicrobial materials capable of inhibiting bacterial, viral, and fungal attachment and proliferation.”

Professor Rasmita Raval, Director of The Open Innovation Hub for Antimicrobial Surfaces

ADDRESSING HEALTH AND SOCIAL JUSTICE CHALLENGES

www.liverpool.ac.uk/research
Driving understanding of global political realities

The University of Liverpool’s Institute of Irish Studies was established in 1988, shortly after the 1985 Anglo-Irish Agreement, to foster contact between Britain and Ireland. It is unique in terms of outreach and scholarship, and continues to stimulate greater understanding between the islands with the aim of better post-conflict resolution.

In 2017 Prime Minister Theresa May secured a confidence and supply deal with the Northern Irish Democratic Unionist Party (DUP). Based upon extensive research with the DUP and their Economic and Social Research Council (ESRC) funded studies of recent Northern Ireland elections, our experts were able to demonstrate authoritatively the extent and limits of DUP pragmatism and show the implications of a parliamentary deal with the Conservatives, not just for Brexit but also for economic policy. This highlights the exciting dialogue our researchers, much sought-after for their expertise, engage in to facilitate in-depth understanding of rapidly-shifting global political realities.

The Institute of Irish Studies’ excellence in teaching, research and outreach beyond academia was recognised by the Irish government in 2007 through the creation of an endowed chair in Irish Studies. Our extensive collaborative networks and strong commitment to public engagement provide the essential evidence-base for policy-making that safeguards democracy and human rights and ultimately social justice.

Find out more about our Institute of Irish Studies:
www.liverpool.ac.uk/irish-studies

A world where every patient receives the right drugs at the optimum dose

The burden of adverse drug reactions on the NHS is high, accounting for considerable morbidity and mortality, and a projected annual cost estimated to be greater than £1 billion. The University of Liverpool’s Medical Research Council (MRC) Centre for Drug Safety Science is dedicated to understanding the mechanisms of these adverse drug reactions in order to improve the benefit-risk ratio of medicines.

Our work has shown that adverse reactions to a number of medicines, including the HIV/AIDS drug abacavir, are linked to variations in the Human Leukocyte Antigen (HLA) genes on chromosome. Individuals with certain variants of the gene are at higher risk of ‘hypersensitivity’ – serious adverse drug reactions which can be fatal. This research has led to a change in drug labelling and, in some cases, the introduction of gene testing to see whether someone carries the risky gene variant, before the drug is prescribed to them.

Professor Sir Munir Pirmohamed, David Weatherall Chair of Medicine and NHS Chair of Pharmacogenetics, comments: “Applying this personalised medicine approach in practice has led to a huge decline in adverse reactions from drugs such as abacavir, down from 7% to less than 1%. Since the beginning of this century, at least 30 serious adverse reactions have been linked with the HLA genes. We have worked with MC Diagnostics, a small company, to develop a gene panel to test for HLA genes, which will be available to the NHS in the near future. Our aim is to individualise drug prescription to a patient based on key characteristics such as genetic factors, so that the patient receives the right drug at the optimum dose for them, a key component of precision medicine.”

Find out more about our interdisciplinary research on Personalised Health:
www.liverpool.ac.uk/research/our-research/personalised-health
A global impact in infectious diseases

With over a century of established research in infectious diseases, the University of Liverpool is a recognised leader in the field of global health. The depth and breadth of our clinical expertise, together with our capabilities in translational science and facilities for undertaking preclinical work and clinical trials, ensures we are in a prime position to respond when new global threats emerge.

By understanding how pathogens cause disease, through to pioneering new diagnostics, treatments and vaccines, our Institute of Infection and Global Health works to advance knowledge of the most important global health challenges.

Dedicated to improving the health and wellbeing of humans and animals, the Institute is an international centre of excellence which seamlessly brings together doctors, veterinarians and scientists to collaborate on major pathogens such as Zika virus, Ebola virus and many others.

Understanding the emerging global disease Zika

One important factor in tackling the recent outbreak was to understand both how Zika spread from Africa to South America, and its crossover from animals to humans. Research conducted by the Institute used climate data modelling to identify that temperature conditions related to the 2015 El Niño climate phenomenon (a climate cycle in the Pacific Ocean with a global impact on weather patterns) were ideal for mosquito-borne Zika transmission.

Further collaboration with the Liverpool School of Tropical Medicine resulted in the first facility in the UK where mosquitoes can be infected with dangerous human viruses. With funding from the National Institute of Health Research (NIHR) Health Protection Research Unit (HPRU) in Emerging and Zoonotic Infections, experiments with Zika virus and mosquitoes are currently underway. We have a long track record of working on such pathogens with high levels of safety and biosecurity, and this resource will allow our researchers to identify which mosquito species most effectively spread the virus and therefore need to be controlled in order to prevent further spread.

Maximising the global impact of rotavirus vaccine

For children living in the poorest countries, vaccine protection against rotavirus is around half of that seen in wealthier countries such as the UK. Vaccine uptake is lower among the most deprived communities across both low-income and high-income settings. Building upon a world-leading rotavirus research programme spanning over 20 years, the Institute is currently undertaking a range of studies to maximise the impact of rotavirus vaccines among the most vulnerable populations in the world. These range from surveillance and modelling to assess the current and predicted future impact of rotavirus vaccination in Malawi and in Liverpool, clinical cohort studies into why immune responses to rotavirus vaccine differ between infants in Liverpool, Vellore (India) and Blantyre (Malawi), through to clinical trials of a new neonatal rotavirus vaccine in Malawi.

As leaders of the European Rotavirus Surveillance Network, we are monitoring the distribution of rotavirus strains in the community, including the detection of emerging strains. Locally, through qualitative research in deprived communities in Liverpool, we are attempting to improve our understanding of the barriers and enablers to rotavirus vaccine uptake.

Find out more about our interdisciplinary research on Infectious Diseases:

www.liverpool.ac.uk/research/our-research/infectious-diseases

We are at the forefront of the ‘one health’ agenda. Our strong interdisciplinary approach brings together medical and veterinary science with a focus on emerging infectious diseases and zoonoses (diseases that spread from animals to humans).

Our interdisciplinary research will inform future rotavirus vaccine strategies, aiming to give every child the best protection against rotavirus, regardless of location.
Pioneering the discovery of advanced materials

With our expertise in materials chemistry and computer-aided materials design we are pioneering the discovery of advanced materials. Using techniques underpinned by computer simulations and robotics, our work has applications in clean energy, sustainable living, manufacturing, healthcare, and consumer products. Our world-leading expertise, unique facilities and innovative attitude to interdisciplinary research will allow future research leaders to nurture their talent in this field.

Two key academic research groups, led by Professors Andy Cooper FRS and Matt Rosseinsky FRS, are creating innovative new materials with a range of uses; from porous molecular organic solids and liquids which can capture harmful pollutants to new materials for the harvesting, storage and conversion of low-carbon energy.

The Cooper Group’s research on porous organic cages was recently displayed at the Royal Society Summer Science Exhibition 2017 – one of the most cutting-edge science and technology shows in the UK. Professor Cooper himself was listed in the Thomson Reuters’ 2017 list of World’s Top 100 Materials Scientists.

The Rosseinsky Group is also recognised for its research excellence, fusing the development of new synthetic methods, the identification of key functional materials such as room temperature multiferroics for low-energy information storage, and new methodology that allows materials to be synthesised guided by computer calculations. Professor Rosseinsky was recently awarded one of the Royal Society’s most prestigious awards, the Davy Medal (previously won by R. Bunsen and D. Mendeleev amongst others) in recognition of his advances in the design and discovery of functional materials, integrating the development of new experimental and computational techniques.

Find out more about our interdisciplinary research on Advanced Materials:
www.liverpool.ac.uk/research/our-research/advanced-materials

Our award-winning research expertise is backed by award-winning facilities. The Materials Innovation Factory (MIF) recently won Development of the Year at the NW Business Inside Liverpool City Region Property Awards, where the judges also noted the role the MIF will have in supporting the Liverpool economy.

The Materials Innovation Factory (MIF)
The MIF, our £68 million facility co-funded by the University of Liverpool, Unilever and Higher Education Funding Council for England (HEFCE) as part of the UK Research Partnership Investment Fund, houses one of the highest concentrations of automated equipment for materials chemistry in the world.

Close partnership between materials scientists and computer scientists is key to accelerating the discovery of new materials. The MIF and the new Leverhulme Research Centre for Functional Materials Design are facilitating important cross-disciplinary collaborations, enabling the co-location of researchers with distinct expertise sets.

Bringing together such expertise, alongside specialised space, equipment and flexible business models is helping create innovation communities, and a new approach to materials science research.

We aim to open up transformative solutions to a range of societal challenges and accelerate research in the fields of Organic Materials, Inorganic Materials, Nanomedicine, Energy, Genomic Sequencing, and High Throughput Formulation.
Transforming the future of energy

The University of Liverpool is committed to addressing global energy challenges. Our Stephenson Institute for Renewable Energy is pioneering research in energy conversion and storage. Its laboratories include specialised facilities in battery chemistry, heat storage and microencapsulation, and solar materials innovation. We work in partnership with SMEs and multinational organisations such as Unilever and Johnson Matthey.

Our expertise and leadership in the energy field are an important part of this multicentre team, which is developing highly-skilled students who will be capable of transforming state-of-the-art research and development across the sustainable energy and photovoltaic sectors.

By facilitating access to talent, expertise and facilities, we can help businesses to transform ideas into innovative technologies. Our recent collaboration with global glass manufacturer NSG Group, for example, has paved the way to better and cheaper transparent conductors. This important discovery could lead to coatings with improved transparency and up to five times higher conductivity, reducing cost and enhancing performance in a myriad of applications from touch screens, LEDs, photovoltaic cells and energy efficient windows.

Find out more about our interdisciplinary research on Energy: www.liverpool.ac.uk/research/our-research/energy

A supportive research environment

The University of Liverpool leads 14 Doctoral Training Centres spanning the breadth of disciplines in the three faculties of Health and Life Sciences, Science and Engineering, and Humanities and Social Sciences.

Alongside these, the Liverpool Doctoral College is home to more than 2,000 PhD students and all doctoral training and development at the University.

An active and engaging research community, the College organises regular events and offers plenty of opportunities for collaboration and support.

Our approach is to develop a programme of personalised training tailored to need, circumstance and aspiration, helping our students develop the skills required for fulfilling and successful careers, as well as orient themselves within our research community.

The College also delivers a comprehensive placement scheme, with time enabled outside of academia and a bursary scheme helping bring together employers and active postgraduate researchers.

Leadership development in research is a key priority. Our newly established Academy brings a step-change in the level, range and quality of development opportunities available to staff at the University whether early career, experienced academics, managers or leaders.

The University is also training the next generation of researchers as part of the Engineering and Physical Sciences Research Council (EPSRC) Centre for Doctoral Training in New and Sustainable Photovoltaics.
For advancement of learning and ennoblement of life

81% of our research is ranked world-leading & internationally excellent (REF 2014)

£144m research project funding allocated in 2015/16

2,000+ active interdisciplinary research staff across three faculties

14 doctoral training centres led by the university

9 Nobel laureates associated with the university

www.liverpool.ac.uk/research