



ceidr.

**CENTRE OF
EXCELLENCE IN
INFECTIOUS
DISEASES
RESEARCH**

ACCELERATING SOLUTIONS FOR
EXISTING AND EMERGING INFECTIONS



UNIVERSITY OF
LIVERPOOL



LSTM
LIVERPOOL SCHOOL
OF TROPICAL MEDICINE

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In partnership with our NHS, industrial, venture capital and product development partners, we provide fast and seamless access to world-class facilities, know-how, and funding for organisations looking to develop products for the diagnosis, prevention or treatment of infectious diseases.”

Professor Bob Burgoyne –
Executive Pro-Vice-Chancellor for
Health and Life Sciences at
University of Liverpool.

THE CHALLENGE

INFECTIOUS DISEASES CAUSE A HIGH BURDEN OF MORBIDITY AND MORTALITY ALL OVER THE WORLD, PLACING A SUBSTANTIAL STRAIN ON LIMITED HEALTH BUDGETS, HEALTH SYSTEMS AND ECONOMIES.

As well as an urgent need to develop antimicrobials to tackle emerging resistance in ‘superbugs’, we also need improved diagnostics to initiate appropriate therapy; vaccines and immunotherapy for prevention and treatment; enhanced infection control; improved control of vector-borne diseases; and evidence-based policies that underpin health services.

OUR SOLUTION

To tackle this global challenge, we have developed the **Centre of Excellence in Infectious Diseases Research (CEIDR)**.

Translating expertise from across two world-leading institutions – the University of Liverpool and the Liverpool School of Tropical Medicine (LSTM) – **CEIDR has been created to develop innovative healthcare and medical technologies to improve healthcare at global and local levels.**

THE LIVERPOOL ADVANTAGE

WE HAVE THE LARGEST CONCENTRATION OF TRANSLATIONALLY-FOCUSED PUBLIC SECTOR R&D EXPERTISE IN INFECTIOUS DISEASES IN THE UK AND ARE IDEALLY POSITIONED TO ADDRESS CURRENT AND FUTURE HEALTH PRIORITIES IN INFECTION.

We have an extensive track record of establishing Public-Private Partnerships and working with major public bodies in the area of infection including:

- World Health Organization
- TDR – the Special Programme for Research and Training in Tropical Diseases
- USAID
- Department for International Development
- The Medicines for Malaria Venture
- The Bill & Melinda Gates Foundation.

We have access to patient populations (and pathways for drug and diagnostic evaluation and implementation) in the UK and also in Africa, Asia and South America.

We have strong existing relationships with pharmaceutical and healthcare companies and our people are used to working in joint academic/commercial/health service teams.



WE CAN HELP YOU MOVE DISCOVERY RESEARCH INTO AN EFFECTIVE INNOVATION PIPELINE

Our combined facilities offer access to:

- Multi-disciplinary expertise in adjacent buildings on our Liverpool campus
- New Containment Level 3 facilities that regularly handle Hazard Group 3 human pathogens
- *In vitro* and *in vivo* models of infection
- Adjacent space in our bespoke ‘incubator building’ (which will open in summer 2017)
- Expertise and specialist facilities in our Malawi Research Programme
- Access to patient populations in both the North West of England through Liverpool Health Partners and in low-income country settings across the world.

When requested we can help manage portfolios of projects which address the whole product lifecycle, from basic research through to policy change.

This end-to-end approach positions us at the interface between academia, health services and the private sector, we can help to bring the most promising interventions to market more quickly and ensure that our research is more directly relevant to patient needs in diverse settings.



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I warmly welcome this partnership between the University of Liverpool and Liverpool School of Tropical Medicine which assembles considerable synergistic talent and experience in the identification and clinical development of new products to tackle infection in the UK and globally.”

John F Stageman OBE, Chairman Medical
 Research Council Technology, Chairman BioNow /
 CELs Ltd, Chairman Biomedical Catalyst for MRC / InnovateUK

“

Vestergaard has enjoyed successful collaborations with the school and is excited by this initiative that will speed development of critically needed solutions to combat infectious diseases. We are looking forward to continuing this highly effective public-private partnership to bring a new dynamic to product development and deployment.”

Helen Pates Jamet
 Head of Entomology, Vestergaard

SECTOR-LEADING FACILITIES

CEIDR brings together a range of highly specialised facilities that accommodate the full lifecycle of discovery, development and deployment – all contained within less than a square mile of the city. These facilities are adjacent to the newly built £335 million Royal Liverpool University Hospital, which will open in 2017 and contains Merseyside's Tropical and Infectious Disease Unit.

CEIDR has been boosted by £200 million investment across the three adjoining campuses of:

- The £33 million **Liverpool Bio Innovation Hub** – a collaborative venture which brings together current biobanks and tissue collections
- The £28 million **Centre for Tropical & Infectious Diseases** – a leading specialist research centre for microbial diseases
- The £7 million **Wolfson Building** – designed to support T1 and T2 translation activities in infection
- A £68 million **Materials Innovation Factory** at the University of Liverpool in partnership with Unilever which will drive the discovery of novel materials, including applications in nanomedicine, drug delivery and 'omics' biotechnology
- A £24 million **Liverpool Life Sciences Accelerator Building** with space for SMEs due to open in 2017 which will provide access to fully staffed Category 3 antimicrobial, parasitology and insectary provision to facilitate rapid biological screening of candidate molecules
- The **Ronald Ross Building**, a £40 million state-of-the-art facility, which houses the University of Liverpool's Institute of Infection and Global Health, and has *in vivo* and *in vitro* containment level III laboratories.

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CEIDR is helping our partners to move products to market faster, enabling us to make a major contribution to human health outcomes worldwide. This is a really exciting step-change; by capitalising on our expertise and research, companies can simplify R&D processes, reduce time and cost, and produce the necessary data required for regulatory approval.”

Professor Janet Hemingway FRS,
Director, Liverpool School of Tropical Medicine

“

My three years leading AstraZeneca's input to a collaboration with LSTM and University of Liverpool on the AWOL project has given me first-hand experience of the organisations' ability to collaboratively devise and advance drug discovery programmes. The translation of pre-clinical findings to the clinic and individual patients is a key weakness in our ability to discover and develop novel therapies, and the creation of CEIDR is a timely and well-positioned investment. I look forward to hearing of its future successes.”

Peter Webborn,
Director of PJHW Consulting Ltd



WHAT WE CAN OFFER

Target validation

CEIDR has access and handling facilities for all major human and animal pathogens, including vector-borne pathogens such as malaria, dengue and Zika.

Through a range of leading technology platforms, including those housed within the Medical Research Council Centre for Genomic Research, the Centre for Preclinical Imaging, and Centre for Proteomics, we can facilitate validation and manipulation of biological targets and validation of biomarkers to support preclinical and clinical product development programmes.

High throughput screening

High throughput industry standard robotic screening systems, linked to state-of-the-art imaging systems, are available within category II and III containment facilities for screening compounds against organisms such as multi-drug resistant TB.

We currently hold a chemical diversity library of more than 500,000 diverse compounds for screening against potential biological targets or for use in whole cell phenotypic screens.

Medicinal chemistry

Extensive facilities and expertise in medicinal chemistry allow us to assess the potential of transforming these into lead compounds against specified target product profiles.

We are able to assess potency, toxicity, *in vitro* and *in vivo* stability, simplicity of synthesis for scalability, pharmacokinetic and solubility.

Pharmacokinetic (PK) / pharmacodynamic (PD) analyses

Liverpool has world-leading programmes in antimicrobial PK/PD, encompassing extensive expertise in exploratory and regulatory PK/PD study design, modelling and simulations needed to support discovery efforts suitable for FDA and EMA scrutiny.

This expertise is enhanced through GCP-accredited analytical facilities with more than 10 LCMS workstations. The group has capability in micro-dosing PK studies, pre-clinical *in vitro* and *in vivo* PK/PD evaluation in disease relevant models (including hollow fibre infection models that are increasingly mandated by regulatory bodies and innovative cell-culture models). The group also has capability in formal human clinical PK/PD trials in multiple patient populations including, neonates, children, and the critically ill.

There is a critical mass of investigators with experience in PK/PD analysis of new anti-infective therapeutics, novel combinations and resistance modulators. Liverpool has a track record and expertise in working with industry and developing data packages for regulatory submission.

Drug safety

Liverpool houses the MRC-supported Centre for Drug Safety Science (CDSS), a Centre of Excellence, which has developed an integrated chemical, biochemical, molecular, cellular and genetic approach to analyse the fundamental and complex mechanisms of clinically important adverse drug reactions (ADRs) in clinical samples, *in vitro* models and *in vivo* models.

The Centre has a matrix approach for:

- The collection and biobanking of clinical material
- The construction of experimental methods with appropriate statistical and informatic modelling
- The application of state-of-the-art qualitative and quantitative bioanalytical methodologies to define the chemical, biological and genetic basis of clinically-relevant ADRs, which allows evaluation of both well established and newly emerging safety issues.

Paediatric formulations

New drugs are usually developed and tested for adults, but often the burden of infectious disease is disproportionately on infants and children. With a specialist group dedicated to paediatric formulations, and a partnership with Alder Hey Children’s Hospital Trust, we are able to work with industrial partners looking to develop products aimed at this cohort.

Surfaces and materials

Antimicrobial surfaces have the potential to be a formidable weapon in the fight against infection and especially antimicrobial resistance (AMR) by directly combatting infections and preventing their transfer. The University of Liverpool’s multimillion pound Open Innovation Hub for Antimicrobial Surfaces possesses highly interdisciplinary expertise and state-of-the-art techniques to design and fabricate advanced surfaces that will create a step-change in antimicrobial technologies.

The Hub exploits leading research from chemistry, physics, microbiology, materials science and engineering to create smart, responsive and biomimetic strategies that deliver innovation in infection control, while also reducing the threat of AMR. The Antimicrobial Hub has an excellent track record in translating research via collaborations with large multinational partners in the healthcare, coatings, medical devices and chemicals sectors, including Smith & Nephew, De Puy Synthes, Boots, Croda and Akzo Nobel.

Diagnostics development

Collaborating with a variety of SMEs and large diagnostic companies to perform diagnostic development for infectious disease, our projects range from detection of AMR targets to the development of multiplex panel field tests for emerging infectious diseases. We focus on the development of tests that can be used in community settings where diagnostic results can initiate prompt and appropriate therapy.

Diagnostic evaluation platform

We can perform alpha and beta testing for diagnostics in our category II and III laboratories, plus field testing of diagnostics internationally from community settings to reference laboratory situations. Our Clinical Diagnostic Parasitology Laboratory is a fully accredited unit which acts as a reference centre for the NHS and has access to a large range of samples for diagnostics validation. In addition, international field testing facilities are available for diagnostics aimed for use at point-of-care in less developed countries.

Diagnostic implementation

LSTM has an international reputation for the implementation of diagnostics for TB, HIV, malaria and Neglected Tropical Diseases (NTDs). We work with a variety of stakeholders to initiate diagnostics interventions based on evidence and policy. LSTM houses the Cochrane Collaboration for Infectious Disease bringing together evidence on clinical trials, including diagnostics, to inform policy.



“From my experiences with other Product Development Partnerships in the control of vector-borne diseases, for example IVCC, I am convinced that an entity launched by LSTM and the University of Liverpool will open a new chapter in the fight against infectious diseases. Such a collaboration is of highest interest for commercial partners in combining and extending expertise and facilities for mutual collaboration.”

Dr. Gerhard Hesse,
Senior Expert / Vector-Borne Disease Management
& Co-chair Roll Back Malaria Vector Control Working Group

Clinical trials and patient access

The highly respected international work of Liverpool’s institutions and our long-established overseas research partnerships provide unrivalled access to patient populations around the globe and enable us to undertake high-quality research in the most relevant groups.

Our MHRA-accredited Clinical Research Unit (CRU) within the Royal Liverpool University Hospital facilitates first-in-human and first-in-patient studies and has been pivotal in supporting the development of human challenge models, while our CRU at Alder Hey Children’s Hospital enables experimental medicine studies in children.

There are two adult clinical trial units (Liverpool Clinical Trials Unit and the Clinical Trials Research Centre) along with the MRC North West Hub for Trials Methodology Research.

LSTM also hosts a dedicated tropical clinical trials unit and a dedicated clinical trials facility at the Malawi-Liverpool-Wellcome Trust programme in Blantyre, Malawi, which undertakes both early and late phase studies to good clinical practice (GCP) standards.

Collectively, these facilities and expertise have enabled Liverpool to be one of the premier centres for early phase clinical studies of new medicines, vaccines and diagnostics.

Liverpool Health Partners

Access to patients and study populations in the NHS is facilitated by Liverpool Health Partners, an Academic Health Science Centre for the North West Coast Academic Health Science Network.

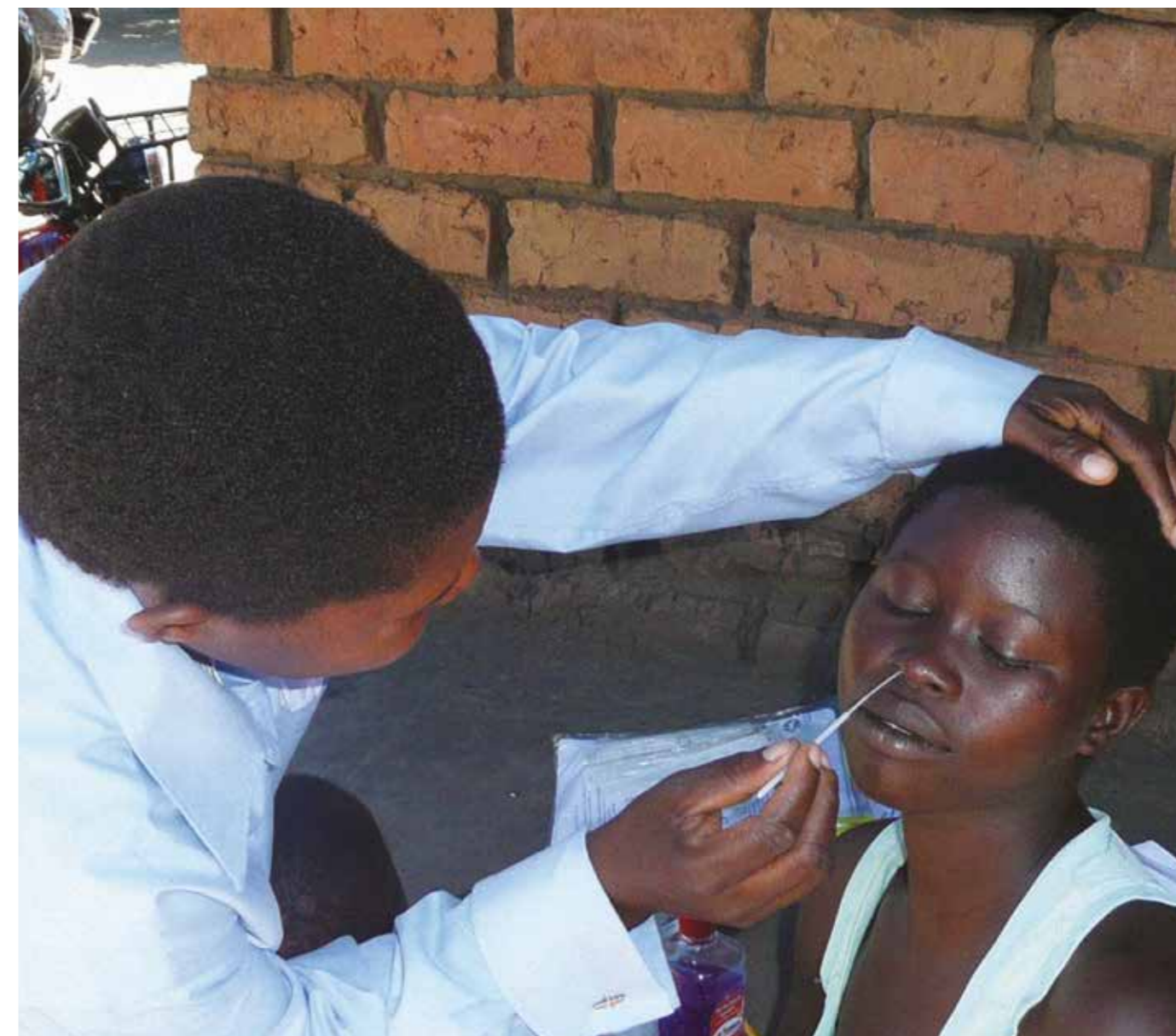
CEIDR offers collaborative opportunities between eight hospital trusts, the Liverpool NHS commissioning group, and Liverpool academic institutions. It provides the necessary support and access to skills to streamline and drive translational research within the NHS facilities, complementing the North West Coast NIHR clinical research network.

The Malawi-Liverpool-Wellcome Trust Research Programme (MLW)

Situated in Malawi’s largest city (Blantyre) in the grounds of the major Queen Elizabeth Central Hospital, MLW is based on a two-decade partnership with the local academic establishment. State-of-the-art laboratories are adjacent to hospital facilities and well-linked to a range of field sites that enable large-scale intervention studies.

Liverpool Insect Testing Establishment (LITE)

The LITE facility undertakes commercial testing of potential new vector control products in a customised good laboratory practice (GLP) facility operated to industry standards. It already operates as the industry standard testing facility for the Innovative Vector Control Consortium (IVCC) and a range of commercial companies. Testing can be undertaken on a contract basis or companies can have access for staff to use the facilities as needed.



FUNDING THE FUTURE OF INNOVATIVE HEALTHCARE

OUR PORTFOLIO OF EXTERNAL RESEARCH GRANTS IS WORTH IN EXCESS OF £100 MILLION PER ANNUM (FROM FUNDERS INCLUDING INDUSTRY, MRC, THE WELLCOME TRUST, USAID, DFID, BMGF, NIHR, AND THE EUROPEAN UNION) AND COVERS ANTIMICROBIALS, DIAGNOSTICS, DRUGS, VACCINES AND VECTOR CONTROL PRODUCTS AT ALL STAGES OF THE PIPELINE – FROM EARLY STAGE DISCOVERY TO LARGE SCALE OPERATIONAL IMPLEMENTATION AND EVALUATION.

Drugs / Antimicrobials

A range of programmes with different industrial partners is in place at different points of the product development pathway, including bacterial (gram positive and gram negative) and fungal pathogens, malaria, TB and the NTDs, filariasis and onchocerciasis.

Our Research Centre for Drugs and Diagnostics works with industry, academia and other NGOs to discover, develop and deliver novel therapies and diagnostics against a range of pathogens. The Centre offers flexible models of collaboration from open access to commercial service provision.

Diagnostics

Our diagnostics portfolio extends from discovery to implementation of new point of care diagnostics. Currently we are progressing diagnostics in the areas of malaria, TB, HIV, NTDs, Sepsis, and *C. difficile*.

Vaccines

Our vaccine activities cover all aspects of the development lifecycle – from discovery to registration – with a focus on Pneumococcus, rotavirus, Salmonella, Zika and onchocerciasis. Our newly established Centre for Global Vaccine Research works with national and international partners bringing together scientists working on human and animal vaccines.

Vector control products

Vector control products range from new diagnostics for the detection and quantification of insecticide residues, to new formulations of insecticides or new insecticidal entities.

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Unilever in the UK has a track record of more than 100 years of invention and innovation, and since we started we have worked with both the University of Liverpool and the Liverpool School of Tropical Medicine. The recent creation of CEIDR by these partners is an exciting opportunity for ourselves and others to access a comprehensive world-class capability and a suite of state-of-the-art facilities in infectious disease research.”

Dr Matt Reed,
Open Innovation Director, Unilever R&D Port Sunlight

To see our research in action, visit:
www.ceidr.org.uk

EDUCATING THE NEXT GENERATION OF INFECTION SPECIALISTS

CEIDR IS CREATING A NEW WORKFORCE OF INFECTION RESEARCHERS WORKING AT THE INTERFACE BETWEEN ACADEMIC, INDUSTRIAL AND CLINICAL RESEARCH.

Our researchers work in an environment that links basic and applied research, clinical impact and commercial development, building capacity in an area where there is a significant skills gap within the life sciences sector.

We also offer a programme of short-term placements (1-3 months) in industry and other key organisations as well as opportunities and honorary academic positions for industrial personnel secondments.



CEIDR IS PROUD TO BE PART OF KNOWLEDGE QUARTER LIVERPOOL

Knowledge Quarter Liverpool (KQ Liverpool) is a 450-acre urban innovation district and is home to some of the world's most influential players in science, health, technology, education, music and the creative and performing arts.

KQ Liverpool is supported by Liverpool School of Tropical Medicine, University of Liverpool, Liverpool John Moores University, The Royal Liverpool and Broadgreen University Hospitals NHS Trust, Liverpool City Council, Liverpool Vision and the Visit Hope Street Community Interest Company and helps to bring together the city's key partners to collaborate in a unique and creative environment.

With over £1 billion of new developments currently underway – and a further £1 billion in the pipeline – it plans to increase the city's employment figures, improve graduate retention and attraction rates and establish Liverpool at the forefront of the Northern Powerhouse.

If you'd like to know more about the the KQ Liverpool vision visit: www.kqliverpool.co.uk.



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FURTHER INFORMATION

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