

The Bloomsbury SET:

A Knowledge Exchange platform connecting capability to combat the threat from infectious disease and antimicrobial resistance (AMR)



THE BLOOMSBURY SET®

Science | Economics | Technology



Research
England



THE BLOOMSBURY SET IN NUMBERS



WHO WE ARE

The Bloomsbury SET (Science, Economics, Technology) innovation partnership brought together HEIs with a strong reputation in creating enduring impact from their research. This £6.9 million programme, awarded through Research England's Connecting Capability Fund, was led by The Royal Veterinary College, University of London.

The programme aimed to tackle the challenges of infectious disease, and the increasing resistance to antimicrobials that poses a major threat to human health. With particular attention to the rise of zoonotic diseases (diseases that jump from animals to humans), the focus was on improving our ability for early detection in animal populations and to assess the risks to human health. This requires low-cost, portable diagnostic tools, especially in low and middle-income countries. Likewise, disease control is hindered by a lack of suitable vaccines, and by data scarcity, leading to large uncertainties in mathematical models of pathogen spread and persistence, both in humans and livestock.

The Bloomsbury SET has adopted a multidisciplinary approach. Connecting expertise in comparative biological sciences, human and veterinary diagnostics, epidemiology, vaccine development, health economics including antimicrobial resistance (AMR), mathematical modelling of infectious disease, disease surveillance and public health. We integrated this with the knowledge and skills of social scientists in health economics, international development, governance, evidence-based policy-making, linguistics and agricultural economics.

PARTNERS IN THIS PROGRAMME:

THE ROYAL VETERINARY COLLEGE (RVC), with over 200 years of innovation and leadership in veterinary medicine and science, and with a commitment to improving human and animal health and welfare.

THE LONDON SCHOOL OF HYGIENE AND TROPICAL MEDICINE (LSHTM), a world leading centre for research and postgraduate education in public and global health.

THE LONDON SCHOOL OF ECONOMICS AND POLITICAL SCIENCES (LSE), one of the foremost social science universities in the world (2018-21 only).

SOAS UNIVERSITY OF LONDON, THE WORLD'S LEADING INSTITUTION FOR THE STUDY OF ASIA, Africa and the Middle East.

LIVERPOOL SCHOOL OF TROPICAL MEDICINE (LSTM), the first institution in the world dedicated to research and teaching in the field of tropical medicine (2021-22 only).

ALSO WORKING CLOSELY IN CONJUNCTION WITH:

THE LONDON INTERNATIONAL DEVELOPMENT CENTRE (LIDC), a consortium of seven University of London institutions shaping the future of international development.



CREATING A KNOWLEDGE EXCHANGE ECOSYSTEM ACROSS THE PARTNER COLLEGES

The Bloomsbury SET funding supported a knowledge exchange programme, designed to connect people, ideas, businesses, places and infrastructures, to accelerate the delivery of innovative scientific and technical solutions for global threats to human and animal health. By adopting a One Health approach, recognising that the health of people is closely connected to the health of animals and our shared environment, this also connected to shaping public health policies and practices.

CONNECTING CAPABILITIES by linking the knowledge exchange and research support teams from the partner Colleges to create a common vision and further opportunities for collaborative working.

CREATING NEW MODELS FOR KNOWLEDGE EXCHANGE whilst exploiting complementary expertise to understand people, business and cultures.

OPENING DOORS FOR INNOVATION by connecting academic staff with businesses, governments and a range of other partners, from not-for-profit humanitarian agencies to small and medium-sized enterprises.

PRINCIPAL AREAS OF ACTIVITY

TECHNOLOGIES AND TOOLS

From novel low-cost diagnostic methods and tools, to new vaccines, we are seeking to commercialise a range of technologies. Examples include:

- Vaccines for coccidian parasites in poultry, and *Streptococcus suis*
- Portable diagnostic tools for rapid identification of diseases of people and animals, such as malaria and tuberculosis



PUBLIC HEALTH INTERVENTIONS

Our One Health focus means addressing key issues related to public health and global healthcare challenges. We are working with UK and international partners to understand the main factors that determine societal acceptance of public health interventions, to aid chances of successful implementation.



ARTIFICIAL INTELLIGENCE AND BIG DATA

We are investigating whether analysis of big data can provide solutions for reducing antimicrobial use in livestock; and how building an automated genomics data curation and collection pipeline could help in predicting treatment and outcomes for neglected tropical diseases.



TACKLING ZOOONOTIC DISEASES

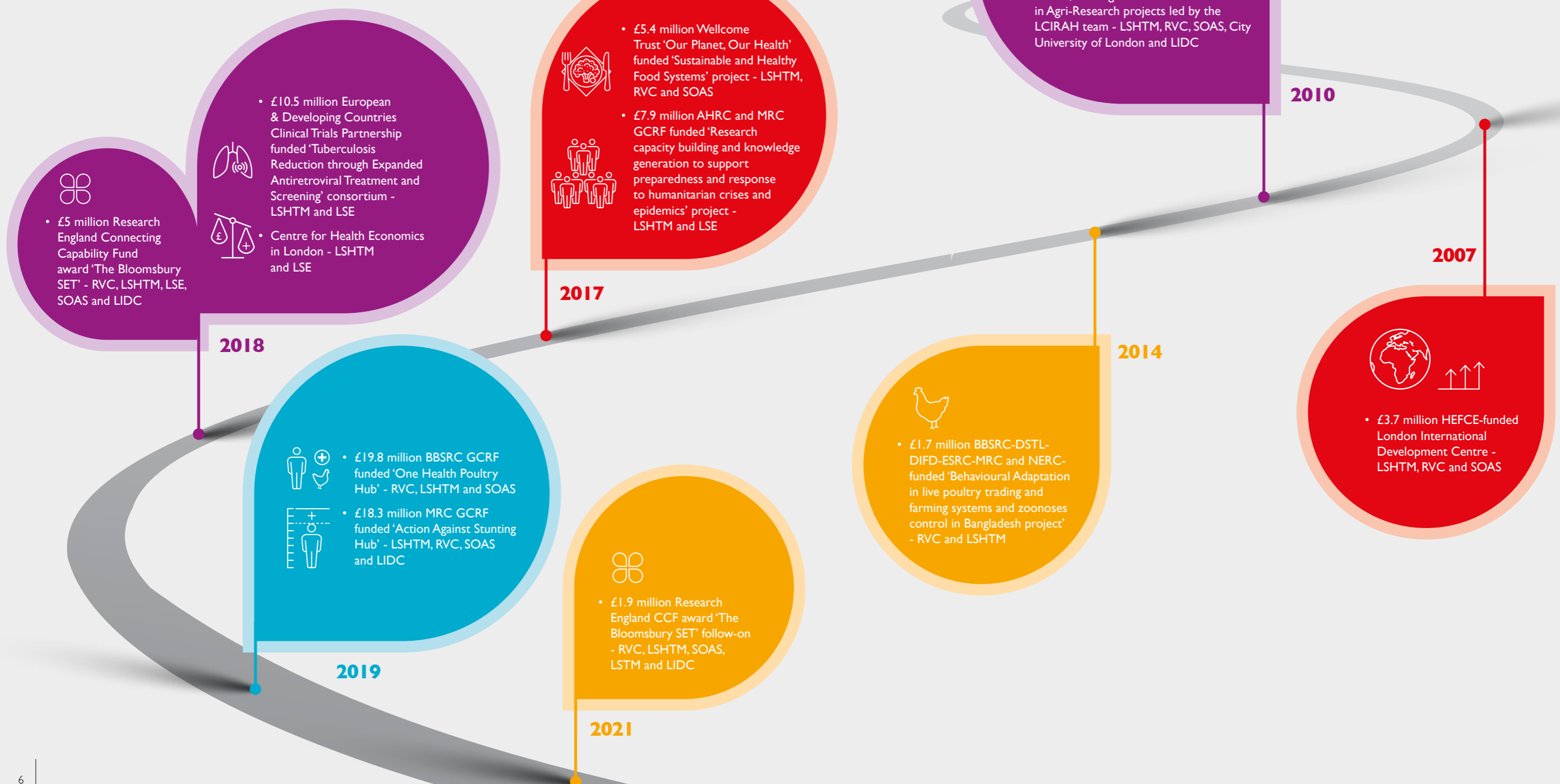
To combat infectious diseases of cattle, and support work in other livestock areas where there is zoonotic risk, we are looking at new tools and measures to facilitate both prevention and cure.





BUILDING ON THE PAST, STRENGTHENING THE FUTURE

The Bloomsbury SET was designed to complement existing research and teaching partnerships between its members, as well as progressing a range of exciting new ventures and strengthening the partners' commitment to collaborative working in the area of human and animal health.



2004




- Bloomsbury Colleges' PhD training programme - LSHTM, RVC and SOAS

2010




- £3.5 million initial investment in the Leverhulme Trust-funded London Centre for Integrative Research on Agriculture & Health, which generated over £20 million in Agri-Research projects led by the LCIRAH team - LSHTM, RVC, SOAS, City University of London and LIDC

2007



- £3.7 million HEFCE-funded London International Development Centre - LSHTM, RVC and SOAS

2014



- £1.7 million BBSRC-DSTL-DIFD-ESRC-MRC and NERC-funded 'Behavioural Adaptation in live poultry trading and farming systems and zoonoses control in Bangladesh project' - RVC and LSHTM

2017




- £5.4 million Wellcome Trust 'Our Planet, Our Health' funded 'Sustainable and Healthy Food Systems' project - LSHTM, RVC and SOAS




- £7.9 million AHRC and MRC GCRF funded 'Research capacity building and knowledge generation to support preparedness and response to humanitarian crises and epidemics' project - LSHTM and LSE

2021




- £1.9 million Research England CCF award 'The Bloomsbury SET' follow-on - RVC, LSHTM, SOAS, LSTM and LIDC

2019




- £19.8 million BBSRC GCRF funded 'One Health Poultry Hub' - RVC, LSHTM and SOAS




- £18.3 million MRC GCRF funded 'Action Against Stunting Hub' - LSHTM, RVC, SOAS and LIDC


2018



- £5 million Research England Connecting Capability Fund award 'The Bloomsbury SET' - RVC, LSHTM, LSE, SOAS and LIDC



- £10.5 million European & Developing Countries Clinical Trials Partnership funded 'Tuberculosis Reduction through Expanded Antiretroviral Treatment and Screening' consortium - LSHTM and LSE



- Centre for Health Economics in London - LSHTM and LSE

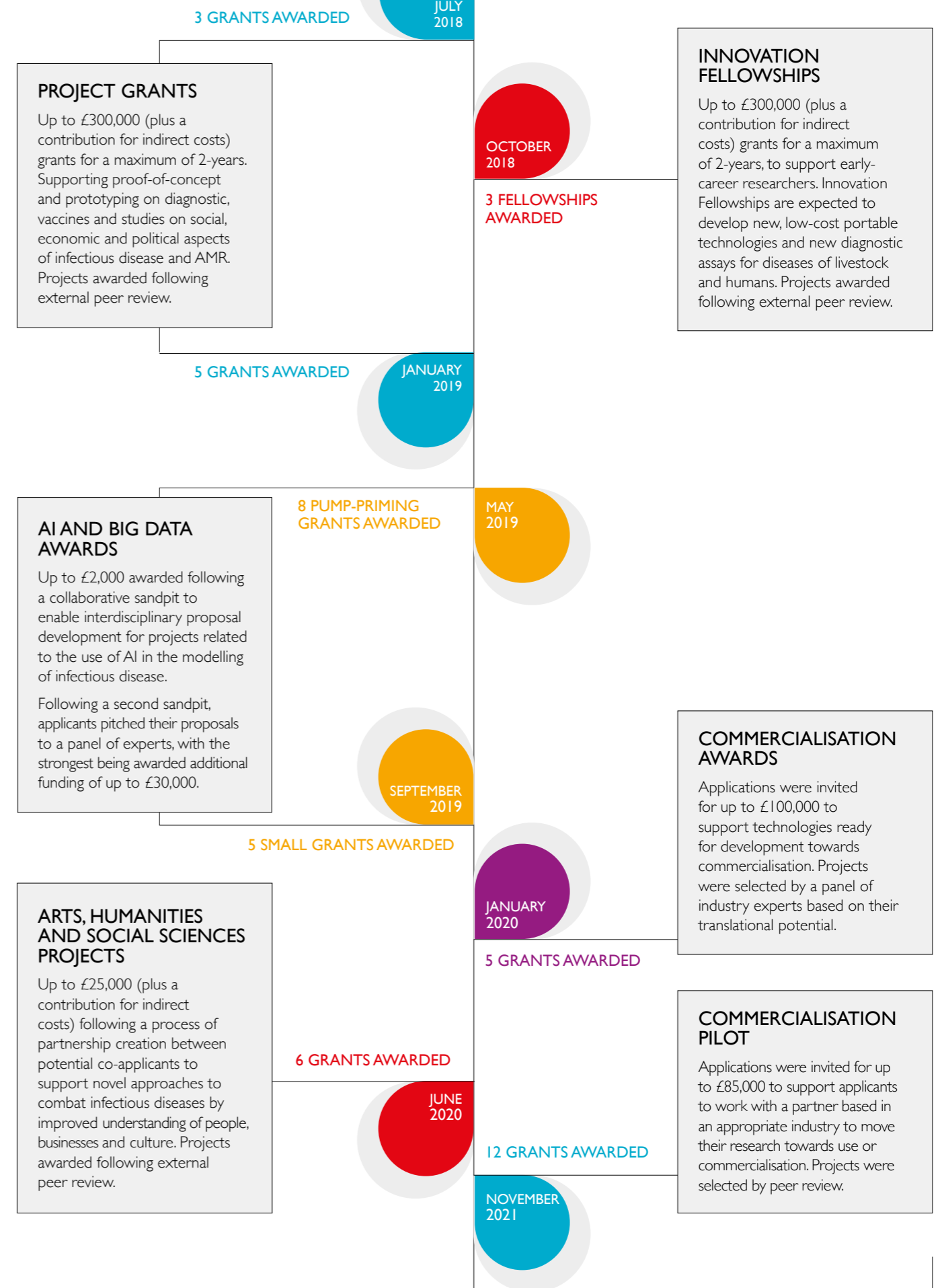


KNOWLEDGE EXCHANGE, COMMERCIALISATION AND WIDER IMPACT

Working collaboratively with academic and industry partners, policymakers, practitioners and governments, connections have enabled research and the translation of knowledge into wider benefits to society. The range of activities undertaken include developing new tools and products to support human and animal health, alongside improving services and policies for public health, and engaging with companies and partners in the ecosystem.

- Involving potential end-users of new knowledge in the design of translational research projects consolidates the relevance of the work to them and creating connections that will increase impact. Partners in projects providing co-design ensures that the research produces lasting benefits to end-users.
- Focusing on collaborative research to explore the potential of interdisciplinary approaches and building effective relationships between academia, research users and other relevant stakeholders.
- Facilitating the exchange of ideas through conferences, sandpits and other networking activities, thereby supporting our academics along the path to commercialisation.
- Committing to the Knowledge Exchange Concordat's eight principles by promoting knowledge exchange as a core part of university activities and supporting capacity building in this area.
- Reflecting on our work to improve our practice by continuous learning and sharing of best practice.

FUNDING CALLS AND AWARDS





AWARDS

PROJECT GRANTS

A multi-disciplinary approach to optimize, evaluate social uptake, and mathematically predict the impact of a novel point-of-contact diagnostic test for targeted treatment of zoonotic hybrid and livestock schistosomiasis in sub-Saharan Africa – Prof Joanne Webster (RVC), Dr James Rudge (LSHTM), Dr Martin Walker (RVC) and Dr Elsa Leger (RVC)

Development and testing of a *Streptococcus suis* candidate vaccine – Prof Brendan Wren (LSHTM), Prof Dirk Werling (RVC), Dr Jon Cuccui (LSHTM) and Henny Martineau (RVC)

Development of a poultry vaccine platform based on transgenic coccidia parasites and evaluation of immunoprotection against necrotic enteritis – Dr Virginia Marugan-Hernandez (RVC), Dr Francisco Olmo (LSHTM), Prof Damer Blake (RVC) and Prof Fiona Tomley (RVC)

Localised Evidence and Decision-making (LEAD) Project – Prof Tim Allen (LSE), Cristin Fergus (LSE), Dr Georgina Pearson (LSE) and Prof Melissa Parker (LSHTM)

Multi-disciplinary research for the strategic and translational development of late-stage tuberculosis vaccine candidates – Prof Richard White (LSHTM), Dr Rebecca Harris (LSHTM), Dr Miqdad Asaria (LSE) and Prof Janet Seeley (LSHTM)

Neglected malaria parasites: genomic discovery and translation – Dr Susana Campino (LSHTM), Prof Taane Clark (LSHTM) and Dr Martin Walker (RVC)

The potential role of wildlife in antimicrobial resistance and ecosystem contamination – Prof Ayona Silva-Fletcher (RVC), Dr J. Simon Rofe (SOAS), Dr Tierney Kinnison (RVC), Dr Niromi Jayasekera (University of Peradeniya, Sri Lanka), Prof Oswin Perera (University of Peradeniya, Sri Lanka), Dr Ruwani Kalupahana (University of Peradeniya, Sri Lanka), Dr Deepani Jayantha (Independent consultant), Dr Ganga Wijesinghe (University of Peradeniya, Sri Lanka), Dr Vijitha Perera (Department of Wildlife Conservation, Sri Lanka) and Dr Nihal Pushpakumara (Department of Wildlife Conservation, Sri Lanka)

Using system dynamics modelling for collaborative, evidence-based design of interventions to reduce tuberculosis transmission in South African health facilities – Prof Alison Grant (LSHTM), Dr Justin Parkhurst (LSE), Prof Anna Vassall (LSHTM), Dr Fiammetta Bozzani (LSHTM), Dr Aaron Karat (LSHTM), Dr Karina Kielmann (Queen Margaret University), Dr Karin Diaconu (Queen Margaret University) and Dr Hayley MacGregor (Institute of Development Studies, University of Sussex)

AI AND BIG DATA AWARDS

Big data analysis to identify innovative solutions for combating respiratory disease and reducing antimicrobial use in beef cattle – Prof Luca Guardabassi (RVC), Dr Richard Stabler (LSHTM), Dr Muna Anjum (APHA) and Prof Debby Bogaert (University of Edinburgh)

Building automated genomics data curation and collection pipeline – Dr Jody Phelan (LSHTM), Gary Napier (LSHTM), Dr Ruby Chang (RVC) and Dr Martin Walker (RVC)

Machine learning to combat AMR through the integrated analysis of VetCompass and laboratory data – Prof David Brodbelt (RVC), Noel Kennedy (RVC), Dr Dan O'Neill (RVC), Dr Collette Taylor (RVC), Prof David Church (RVC), Dr Sam Clifford (LSHTM) and Prof Yonghong Peng (University of Sunderland)

Phenotype Image Data and Digital Learning Innovation (PhIDDLI) – Dr Michael Delves (LSHTM), Dr Rajat Dhawan (LSE), Dr Maurizio Gioli (SOAS) and Dr Edgar Whitley (LSE)

Predicting treatment outcomes for neglected tropical diseases – Dr Martin Walker (RVC), Dr Jody Phelan (LSHTM) and Dr Julie Halder (RVC/IDDO)

INNOVATION FELLOWSHIPS

Bacteriophage technology: rapid point-of-care detection and antibiotic resistance profiling of tuberculosis infections – Dr Ben Swift (RVC)

Development of a suspension bead assay targeting the zoonotic malaria parasite – Dr Kevin Tetteh (LSHTM)

Mining RNA unmapped reads: developing a fast diagnostic tool for infectious disease in cattle – Dr Laura Buggiotti (RVC) in collaboration with Dr Neil Paton (RVC), Dr Alecks Schaefer (Michigan State University), Dr Jason Hinds and Dr Adam Witney (BUGS Bioscience Ltd)

COMMERCIALISATION AWARDS

An antimalarial drug targeting Plasmodium phosphodiesterases to cure patients and block transmission; a new tool to combat drug resistance – Dr David Baker (LSHTM), Dr Mark Gardner (Salvensis), Dr Alan Brown (Salvensis), Dr James Duffy (Medicine for Malaria Venture)

Antimicrobial eye drops with extended duration of effect and efficacy – Prof Liam Good (RVC / Tecrea Ltd), Dr Winnie Ntowbohene (RVC), Chiara Febrarro (Tecrea Ltd), David Cook (Tecrea Ltd) and John Ridden (Tecrea Ltd)

Development of an inactivated oral yeast vaccine against poultry Eimeria – Prof Damer Blake (RVC), Prof Fiona Tomley (RVC), Prof Dirk Werling (RVC), Dr Francesca Soutter (RVC), Dr Matthew Nolan (Cambridge University) and Dr Tatiana Küster (Universität Bern)

Malaria Detection Dogs – Prof James Logan (LSHTM), Prof Steve Lindsay (Durham University) and Claire Guest (Medical Detection Dogs)

Optimising sugar attachment site in vaccine – Dr Jon Cuccui (LSHTM) and Prof Brendan Wren (LSHTM)

ARTS, HUMANITIES AND SOCIAL SCIENCE PROJECTS

Assessing Social Acceptability and Economic Impact of Centralised Antibiotic Usage Data Collection for GB Cattle Farms – Dr Mehroosh Tak (RVC), Dr Naomi Bull (LSHTM), Dr Lucy Brunton (RVC), Dr Jackie Cardwell (RVC) and Dr Pablo Alarcon-Lopez (RVC)

Contextualising antimicrobial resistance perspectives in Sri Lanka and European Union – Dr Risa Morimoto (SOAS), Prof Ayona Silva-Fletcher (RVC), Dr J. Simon Rofe (SOAS), Prof Martin Bauer (LSE) and Prof Mohan Munasinghe (Munasinghe Institute for Development, Sri Lanka)

Enhancing Political Economy Research Skills to Tackle Infectious Disease and AMR Challenges – Dr Mehroosh Tak (RVC), Dr Sara Stevano (SOAS), Prof Tony Barnett (RVC), Dr Barbara Haesler (RVC) and Prof Ayona Silva-Fletcher (RVC)

Knowledge exchange through a Bedouin lens: a photovoice exploration of camel owner perceptions of zoonotic disease risk – Dr Jackie Cardwell (RVC), Dr Mehroosh Tak (RVC), Peter Holloway (RVC), Kerry Ann Brown (LSHTM) and Prof Abdel Hakim AlHusban (Abdel Hakim AlHusban, Jordan)

Tackling antimicrobial resistance in rivers: A design-based policy approach – Dr Naomi Bull (LSHTM), Dr Alberto Asquer (SOAS), Dr Lucy Brunton (RVC), Dr Mehroosh Tak (RVC) and Prof Claire Hefferman (LSHTM)

Visual Arts for Localised Evidence and Decision-making – Dr Polly Savage (SOAS), Cristin Fergus (LSE), Kara Blackmore (LSE), Dr Benjamin Dix (SOAS/ PositiveNegatives), Prof Tim Allen (LSE) and Prof Mellisa Parker (LSHTM)



COMMERCIALISATION PILOT PROJECTS

Preclinical and clinical testing of a repurposed drug for use as an early oral therapeutic for tropical snakebite: a model to leverage western markets for LMIC access – *Prof Nicholas Casewell (LSTM)*

An anti-Wolbachia azaquinazoline small molecule as a preventative drug candidate for veterinary heartworm disease – *Dr Joseph Turner (LSTM)*

Advancing inhibitors targeting Cathepsin D as a new drug treatment for schistosomiasis – *Dr Nicholas Furnham (LSHTM)*

The GeneDrive Crimean Congo Haemorrhagic Fever assay; from prototype to design freeze – *Dr Thomas Edwards (LSTM)*

Developing a novel serosurveillance kit in partnership with Luminex, A DiaSorin to support global malaria elimination efforts using the xMAP® Technology platform – *Dr Kevin Tetteh (LSHTM)*

Validation of specific immune responses against an Eimeria (protozoa) prototype expressing a Clostridium perfringens antigen and comparison to the same antigen obtained by standardised prokaryote and eukaryote protein expression system – *Dr Virginia Marugan-Hernandez (RVC)*

Determine the therapeutic potential of sialylated Fc for influenza therapy – *Prof Richard Pleass (LSTM)*

Development and validation of improved automated spray cabinet to enable commercial application of spray deposits – *Dr Rosemary Susan Lees (LSTM)*

Drug Discovery against MDR TB: Development of preclinical data Pack, IP protection and patenting strategy – *Prof Giancarlo Biagini (LSTM)*

Development and commercialisation of a novel Livestock Schistosomiasis-Point of Care-Circulating Cathodic Antigen lateral flow test (LS-POC-CCA) – *Prof Joanne Webster (RVC)*

Probabilistic diagnostic algorithm for early serological detection of Johne's disease in dairy cattle – *Prof Javier Guitian (RVC)*

Commercialisation of the LSTM Barrier bed net – *Dr David Weetman (LSTM)*

CONNECTING PEOPLE AND PROJECTS

A varied series of events were used to highlight examples of our translational research capabilities and connect our researchers with industry. These events explored new opportunities for collaborative funding, helping to avoid gaps that could interrupt progress in the research.

PAST EVENTS HAVE PROVIDED WIDER CONTEXT ON:

- The Knowledge Transfer Network's (KTN) support for translational work in AMR and infectious disease covering both animal and human health.
- Other research initiatives related to London International Development Centre that are exploring interdisciplinary solutions to address the complexity of infectious diseases and AMR. From these experiences, we've learned that building consensus on what the problem is and sharing a common language is an effective way to overcome barriers for working across disciplines.
- Ways in which a global partnership between public, private, philanthropic, and civil society organisations (like the Coalition for Epidemic Preparedness Innovations) can work to accelerate the development of vaccines against emerging infectious diseases and enable equitable access to these vaccines during pandemics.
- Exploring the challenges and opportunities for Knowledge Exchange in infectious disease.

WE CREATE OPPORTUNITIES FOR ACADEMIC PARTICIPANTS TO SHARE THEIR EXPERIENCES AND VIEWS ON ISSUES RELATED TO:

- Acceptability and applicability of their technology, and the need to improve understanding of the commercialisation process, including how to protect inventions, engage appropriate stakeholders and evaluate potential markets.
- Limitations of public health interventions and the importance of adopting a whole-systems (One Health) approach to understand linkages and to drive change.

EAST AFRICA CASE STUDY

To inform aspects of our global work, we mapped the emerging knowledge ecosystem in infectious disease surveillance and control in animals and humans, aimed at combating antimicrobial resistance in East Africa (Kenya, Tanzania and Uganda). We have extensive and long-term working partnerships in this region, which is also a potential market for UK-made products and therapeutics. In addition, this study identifies further opportunities for strengthening UK collaboration with countries in East Africa.

CREATING OPPORTUNITIES TO MAKE A DIFFERENCE

Aimed to harness creative thinking and innovative ways to approach a problem, our sandpit events brought together academics and industry professionals from different disciplines. Fostering new connections and collaboration, these intensive discussions connected capability across our partners to uncover innovative solutions.



HARNESSING THE POWER OF BIG DATA

Data are one of the most important resources in our world today. The use of AI techniques has the potential to discover patterns from a large data-set, to generate new knowledge and narrative, identifying hitherto unseen connections, and supporting the decision-making process when tackling infectious disease.

WHILE SOME DATA-SETS ARE EASILY ACCESSIBLE, THEY MAY NOT BE SUFFICIENTLY WELL UTILISED.

We are developing a data-linkage machine learning methodology for the knowledge hub 'VetCompass', a lead primary care practice programme that collates de-identified electronic patient record data from 1,800 primary-care veterinary practices in the UK for epidemiological research. We are also working with the Infectious Diseases Data Observatory using cutting edge statistical approaches to analyse individual participant data on responses to treatment for neglected tropical diseases, connecting expertise between the LSHTM and RVC.

BIG DATA CAN BENEFIT FROM AUTOMATION, USING COMPUTERS TO PERFORM ANALYTICAL TASKS WITH LITTLE OR NO HUMAN INTERVENTION.

By using next-generation sequencing technologies, the DNA of micro-organisms can be accurately characterised, with potential to provide drug-resistance predictions. We are building an automated genomic data curation and collection pipeline of next-generation sequencing data for Mycobacterium tuberculosis. The pipeline uses machine-learning methods to cluster organisms according to their genetic makeup to understand the pathogen's evolution and resistant populations, supporting treatment options.

Drugs that block mosquito-borne transmission of malaria from person to person are effective in halting the spread of malaria. These drugs can induce extreme changes in the shape of Plasmodium parasite cells that can be analysed to identify how the drugs work. We are evaluating commercial off-the-shelf solutions for automated cell isolation and identification of drug-treated parasites from microscope images. The automation will accelerate analysis of a high volume of images and could inform the mode of action of these drugs.

Find out more at: www.bloomsburyset.org.uk/awards/data-studies/





BRINGING ALTERNATIVE PERSPECTIVES TO GLOBAL HUMAN AND ANIMAL HEALTH

Using approaches from the arts, humanities and social science to better understand the historical, cultural and socioeconomic diversity that connects people, animals and ecosystems can be vital for tackling the complex challenges of infectious disease and antimicrobial resistance. Interdisciplinary teams from the programme's partner Colleges have been awarded grants to focus a social science lens on these issues through knowledge exchange projects that utilise innovative visual art, design and storytelling methods.

VISUAL ARTS FOR LOCALISED EVIDENCE AND DECISION-MAKING (LEAD)

Researchers from SOAS and LSE, in collaboration with Positive Negatives, are collaborating with African artists to visualise the LEAD project's research findings to enable greater knowledge exchange and impact between local stakeholders. Reflecting the project's mixed methodologies, the artists are using a variety of different media such as animation, posters, murals and short films to visually document different perspectives on the prevention of schistosomiasis and helminth infection for local audiences in Uganda and Malawi.

Working with oral history testimonials and other collected data, artists are also producing comics to narrate local issues such as water use and the experiences of village health workers for use amongst community populations with varying levels of literacy. Visual and interactive materials are proven to be effective in attitudinal and behavioural change especially around topics such as infectious disease.

UNDERSTANDING PEOPLE, BUSINESS AND CULTURE IN COMBATting INFECTIOUS DISEASE AND AMR

This project invites Bedouin camel owners in Jordan to become active co-researchers by collecting data from their own perspective. Using photovoice, a participatory photography approach, camel owners can demonstrate their community knowledge and practices. Their photographs are subsequently used as the basis for collaborative discussions to increase understanding of their perspectives and to share conflicting or unexpected ideas.

Added knowledge exchange comes from the insights into people's ordinary daily habits, routines, practices and perceptions of camels, highlighted by what the Bedouin camel owners choose to capture in their photos. It is through better understanding of these small daily details, which are easily missed in interviews and conversations, that development of infectious disease risk mitigation strategies or interventions will be better informed and thus have a higher chance of uptake and success.

Find out more about past projects:
www.bloomsburysset.org.uk/awards/



CASE STUDY

DEVELOPING VACCINE CANDIDATES WHILST REDUCING ANIMAL TESTING

Vaccines have a major role in protecting animals and humans by stimulating an appropriate immune response against the infecting organism. Therefore, they are an important option for the control and eradication of infectious diseases. Despite their effectiveness, vaccines have not been developed for most human and animal infections and developing a vaccine can be a complex process.

Healthy animals equate to better human health and prosperity. The two are intertwined. Within the global livestock industry, there is a movement to reduce the use of antibiotics. Antibiotic resistant bacteria are on the rise and there is a significant concern that farming may be contributing to this. As antibiotic use drops however, alternative methods to keep animals healthy are required. One such solution is vaccines. Glycoconjugate vaccines are among the safest and most successful vaccines licensed for use in humans in the last

30 years. We are developing and testing *Streptococcus suis* (*S. suis*) candidate vaccines using a cheap method of manufacture that uses a bacterial cell itself as the factory. This ubiquitous bacterium causes significant disease and mortality in pigs, and it is also capable of infecting humans who are exposed to contaminated pigs or pig meat.

Recently, evidence was published that a vaccine consisting of capsule from *S. suis* attached to a carrier protein, can protect pigs from infection. However, the current method of manufacture, known as chemical conjugation, is too expensive to be developed for the mass market. We will gain significant knowledge about the immune response to these vaccines by combining the vaccine assembly expertise at the LSHTM with the molecular immunology expertise at the RVC. Through the collaboration of these two teams we are hoping to make a significant contribution to the reduction of disease burden caused by *S. suis*, as well as developing screening systems allowing for the reduction of animals used to test vaccine candidates. Our joint technical approach has the potential to be used more generally to reduce the burden of other human and animal infections.

Pigs are one of the most important sources of protein worldwide.

In the UK alone, it is estimated that there are over 10,000 pig farms.

In Vietnam, *S. suis* is the most common cause of adult meningitis.



Prof Brendan Wren and Dr Jon Cuccui (LSHTM) in collaboration with Prof Dirk Werling and Dr Henny Martineau (RVC)

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CASE STUDY

IMPROVING DIAGNOSTIC TESTS

The development of new rapid, affordable, sensitive and specific point-of-care platforms for detection of infectious diseases is vital for the surveillance and diagnosis in endemic areas of many major diseases, such as schistosomiasis.

We have demonstrated how zoonotic hybrid schistosomes are having a substantial impact on the epidemiology, evolution and clinical outcomes of human disease, with further challenges and constraints for effective control. Furthermore, we have documented highly important animal welfare, productivity, and financial impacts of animal schistosomiasis, which further jeopardize livelihoods, food security and nutrition amongst neglected communities.

There is a need to easily and inexpensively diagnose animal schistosomiasis, and to effectively treat only infected individuals and/or herds. An ideal method could be through a targeted test-and-treat (TnT) or T3: Test, Treat, Track design for livestock schistosomiasis in SSA, which anchors the key recent WHO policy recommendations on diagnostic testing, treatment and surveillance in general.

We assessed the sensitivity and specificity of a currently available point-of-care circulating cathodic antigen test

(POC-CCA), designed for *Schistosoma mansoni* detection in humans, and the detection of intestinal livestock schistosomiasis caused by *Schistosoma bovis* and *Schistosoma curassoni* amongst West African livestock. We then evaluated the potential effectiveness of a theoretical TnT strategy to control bovine schistosomiasis using the currently available POC-CCA test. We showed that implementing TnT at herd-level from 2022 to 2030 could be highly effective in suppressing infection in cattle and even, in lower prevalence settings, reaching nominal 'elimination' targets.

Both these studies highlight the importance of enhancing the specificity of POC-CCA for use in livestock to avoid unnecessary treatments (and thereby also reduce costs and lower the risk of drug resistance emerging) and we are working with a new pharma partnership to modify the current human-specific POC-CCA for application as a novel livestock-specific tool – a LS-POC-CA assay.

Schistosomiasis is a neglected tropical disease of profound medical importance.

Over 240 million people are infected with 90% amongst the poorest of sub-Saharan Africa.

Although generally ignored, schistosomiasis is also a disease of substantial veterinary importance, causing widespread morbidity and mortality.



Prof Joanne Webster, Dr Martin Walker and Dr Elsa Leger (RVC) and Dr James Rudge (LSHTM)

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Photography: Elsa Legar

CASE STUDY

TARGETING EVIDENCE FOR IMPROVED PUBLIC HEALTH

Understanding the efficacy and implementation of large-scale pharmaceutical-based global health interventions, such as “Mass Drug Administration” for schistosomiasis and soil-transmitted helminths, is especially important in the context of antimicrobial resistance, with the mass distribution of tablets within child and maternal health for malaria, HIV, and other neglected tropical diseases potentially encouraging the emergence of resistant microbes, among other health concerns.

In recent years, there has been a focus on the utilisation of evidence-based decision-making in global health. While an emphasis on the localisation of this approach is often part of the rhetoric, its realisation has been challenging in practice. The processes of decision-making at different localities is inherently diverse and the evidence needs of local practitioners are not well understood. Further, the most prominent methods used to synthesise knowledge about global health interventions only permit the inclusion of a very narrow, specific type of information and produce results that are not generalisable for needs of local decisionmakers.

The Localised Evidence And Decision-making (LEAD) project addresses these issues in relation to the transmission and control of schistosomiasis and soil-transmitted helminths in Kenya, Malawi, Tanzania, and Uganda with a synergistic approach to evidence development between local public health practitioners and researchers at LSE and LSHTM. Using a complex systems approach, the LEAD Project aims to identify and respond to the evidence needs of local health practitioners by integrating a series of participatory modelling workshops with locally-relevant evidence development, while taking advantage of recent advances in technological and computational capabilities.

The WHO says:

“ Estimates show that at least 290.8 million people required preventive treatment for schistosomiasis in 2018, out of which more than 97.2 million people were reported to have been treated. ”



Prof Tim Allen, Cristin Fergus, Georgina Pearson, Liz Storer and Kate Dawson (LSE) and Prof Melissa Parker (LSHTM)

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CASE STUDY

EYES ON THE GROUND - ANTIMICROBIAL RESISTANCE SPREADING THROUGH WILDLIFE IN SRI LANKA

Antimicrobial resistance (AMR) is one of the biggest threats to global health today. The excessive and inappropriate use of antibiotics is causing some infections to become difficult to treat. AMR is particularly acute in those countries where antibiotics are widely available without prescription.

Antibiotics are used to treat bacterial infections in humans and animals. When exposed to low levels of antibiotics for prolonged periods, bacteria evolve to become resistant to that drug. The new resistant bacteria may then pass resistance genes to other bacteria, which also develop AMR. These bacteria are found in farm effluent or untreated human sewage which then contaminate groundwater and the wider ecosystem.

We are taking a ‘citizen science’ approach to our research in Sri Lanka. Using our Nature Citizen app, developed specifically for the project, volunteers are helping with wildlife identification and data collection. By engaging with ordinary people in this way, we are also educating local communities about the problem and its potential solutions.

We are investigating three areas in Sri Lanka, taking photos and faecal samples to establish the occurrence of resistant bacteria in selected mammals and wildlife. One study area has a high density of poultry farms and one, aquaculture sites. The third is a remote location without large-scale commercial farms or human habitations.

Our objective is to establish and compare the prevalence of AMR in these areas and to see if wildlife species aid transmission of resistance genes. We hope our research will provide data that shows AMR spreads through environmental contamination to innocent bystanders and thus enable the community and policy-makers to better address the threat of AMR.

The resistance rates of organisms to antibiotics in Sri Lanka are much higher than other countries.

Sri Lanka spends 12.7% of its health budget on antimicrobials.

Sri Lanka has reported 90% penicillin resistance in some strains of pathogenic bacteria.



Prof Ayona Silva-Fletcher and Dr Tierney Kinnison (RVC), and Dr J. Simon Rofe (SOAS) in collaboration with colleagues in Sri Lanka

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Photography: Kushini Kalupahana



OUR GLOBAL REACH

UK

- Examining options for farmers to diagnose infectious cattle disease faster and investigating pneumonia in calves
- Assessing social acceptability and economic impact of centralised antibiotic usage data collection in cattle farms
- Developing data-linkage machine learning methodology to add individual patient data and improve accuracy of predictions
- Building an automated genomic data curation and collection pipeline of next-generation sequencing data and evaluating solutions for automated images analysis.

ASIA

SRI LANKA

- Utilising Citizen Science methods to understand AMR in poultry farms and aquaculture to understand antibiotic use
- Surveying local community understanding of AMR for comparison with similar European results

MALAYSIA

- Developing a diagnostic tool to accurately monitor the transmission of the *P. knowlesi* malaria parasite

VIETNAM

- Creating vaccines to reduce the disease burden of adult meningitis as well as deaths in pigs caused by *S. Suis*

AFRICA, ASIA AND THE MIDDLE EAST

SOUTH AFRICA, INDIA & CHINA

- Combining social science, mathematical modelling, epidemiology and health economics to estimate the expected future impact of TB vaccines

AFRICA & ASIA

- Developing a new drug to target enzymes that are highly potent inhibitors of malaria parasites in Africa and Asia
- Developing an assay to improve testing for Crimean Congo Haemorrhagic Fever (CCHF)
- Developing an oral therapeutic for tropical snakebite

GLOBALLY

- Developing a novel platform diagnostic technology with the potential to revolutionise the detection of tuberculosis in humans and animals
- Creating more effective and potent vaccines using new method of making glycoconjugate vaccines inside safe laboratory bacteria
- Developing a flexible and novel vaccine platform for chickens to support increasing global demand for food
- Using nanotechnology to develop antimicrobial eye drops with extended duration of efficacy
- Developing an online training module on political economy approaches to infectious disease and AMR research for researchers
- Developing a novel serosurveillance kit to support global malaria elimination efforts

SOUTH AMERICA

- Using whole genome sequencing technologies of global malaria samples sourced worldwide to gain a deeper insight into parasite biology to develop new diagnostics

THE MIDDLE EAST

JORDAN

- Utilising photovoice to explore Bedouin camel-owner views and practices relevant to zoonotic disease control

AFRICA

SENEGAL

- Evaluating current diagnostics for livestock and zoonotic schistosomiasis

KENYA, MALAWI, TANZANIA & UGANDA

- Exploring locally relevant evidence in public health decision-making to localise evidence for decision-making
- Creating visual materials to enhance local knowledge exchange

KENYA

- Training local stakeholders in design thinking and envisioning future scenarios for tackling antibiotic resistance in rivers

SOUTH AFRICA

- Investigating evidence-informed decision-making for TB transmission in health facilities

THE GAMBIA

- Conducting a pilot field study of malaria detecting dogs for scaling-up the intervention across border posts

EAST AFRICA

- Conducting a study into regional knowledge exchange practices

DCR

- Conducting a pilot field study of insecticide treated barrier bed nets for use in malaria endemic settings

CASE STUDY

SNAKEBITE INTERVENTIONS IN LMICS

Snakebite is a life-threatening neglected tropical disease that causes more than 130,000 deaths annually. Current treatment is restricted to intravenous antivenom, which has to be delivered in a clinical environment, resulting in delays and poor patient outcomes.

Previous work demonstrated that the orally available, licensed, heavy metal poisoning drug Dimaval® showed preclinical efficacy against African/Asian snake venoms rich in metalloproteinase toxins, and that early oral delivery followed by later antivenom administration conferred increases in efficacy in mouse models over antivenom alone. Thus, Dimaval® had potential as a valuable early therapeutic intervention, via oral delivery in a community setting soon after a bite, against certain snakebites.

First, we propose to perform pharmacokinetic analyses to define drug levels collected from healthy volunteer patient cohorts receiving escalating oral doses to define optimal human dosing regimens. This will enable the transition of Dimaval® for snakebite from TRL4 laboratory-scale

validation, through TRL5 via small scale safety testing, ready for entry into a Phase II clinical trial (i.e. larger-scale testing in relevant environment, TRL6), thus overcoming a major clinical and regulatory milestone. Simultaneously, we will conduct in vitro and in vivo preclinical research, backfilling the TRL4 space, to investigate the efficacy of Dimaval® against other snake venoms. This enabling strategy will allow the commercial partner leverage of additional markets, where a tangible return on investment exists, to facilitate clinical and regulatory progression while simultaneously prioritising an LMIC access plan.

WHO estimates 5.4 million people are bitten each year with up to 2.7 million envenomings.

As well as the more than 130,000 people who die each year because of snake bites, around three times as many amputations and other permanent disabilities are also caused by snakebites annually.



Photography: R. Wilson

Prof Nicholas Casewell (LSTM)

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CASE STUDY



NEW TREATMENTS FOR SCHISTOSOMIASIS

The WHO 2021–2030 road map for neglected tropical diseases targets Schistosomiasis for elimination as a public health problem in all endemic countries and highlights that an integrated approach in which therapeutic intervention will play an important part.

There are three main Schistosoma species that can infect humans with three stages - schistosomula, juvenile and adults - in its complex life cycle present in humans. Infection leads to acute and chronic disease, with current treatment relying on a single 45-year-old drug – praziquantel, which has significant limitations as a therapeutic. With signs of resistance emerging and a vaccine still a distant prospect, discovery of novel anti Schistosoma drugs is of ultimate importance.

This project built on an international interdisciplinary partnership founded under a MRC Newton Award (short-listed for the Newton Prize 2018) bringing together a unique skill set focused on Schistosomiasis drug discovery. This had developed an innovative pipeline for schistosomiasis drug discovery, combining new techniques for target identification, the latest developments in structure-guided drug discovery,

advanced high content imaging and new methods in computational chemistry using machine learning/AI techniques.

The team used a combination of computational and experimental techniques to screen a large library of commercially available compounds, and to identify those that inhibit the activity of a protein (smCD1) shown to be crucial for the parasite's survival. This protein was cloned, expressed and purified as a recombinant protein from Schistosoma mansoni, one the main species that infect humans. By X-ray crystallography the atomic three-dimensional structure was determined for the first time, and we saw promising compounds from the initial screen we co-crystallized with smCD1. We aimed to develop these promising new compounds, improving their efficacy and demonstrating their effectiveness at killing the parasite.

Schistosomiasis is one of the most prevalent global helminth infections leading to acute and chronic disease, affecting 200 million people and threatening over 800 million in 54 endemic countries.



Photography: Peddalanka Ramesh Babu/Shutterstock

Dr. Nicholas Furnham (LSHTM)

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CASE STUDY

ORAL VACCINE USE FOR POULTRY DISEASE

Poultry is the world's primary source of animal protein with chickens providing the largest quantity (meat and eggs) consumed by humans. Chicken products are generally affordable, provide high-quality protein and face few religious and cultural barriers. Necrotic enteritis (NE) is a global disease of poultry, which causes damage to the intestines, diarrhea and death in chickens.

In a previous project funded by the Bloomsbury SET Project Grant, a prototype vaccine against *Clostridium perfringens* which can be delivered orally to chickens using a poultry parasite was developed. This prototype had proven to successfully express the selected antigens, and this new proposal aims to generate important information on the chicken's immune response, safety and efficacy when administered as an oral vaccine.

This proposal will compare these important parameters (immune response and vaccine safety and efficacy) with other expression systems and other methods of delivery including injection.

Oral vaccination with the prototype vaccine is expected to generate a better response than an injected vaccine, as it targets the gut, which is where the bacteria causing NE would naturally infect the chicken, improving local immune responses and simplifying the vaccine administration to chicken flocks comprised of large numbers of animals.

Partners in the project included MSD Animal Health, the largest producer of poultry vaccines worldwide, who will evaluate efficacy of the vaccine in a well-established animal model for *C. perfringens*. Data from the different trials, once collated, is likely to lead to further applications for commercialization of this potential new vaccine solution for poultry farmers, which could be extended to other poultry diseases.

NE is a growing concern to the poultry industry. Estimations of the cost from loss of flocks caused by this disease tripled from US\$2billion in 2000 to US\$6billion in 2015.



Photography: Samir Behlic/Shutterstock

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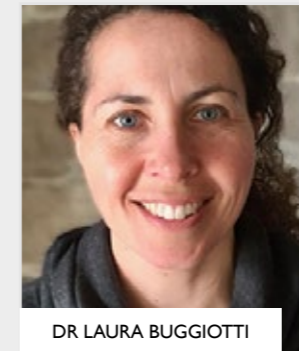


OUR INNOVATION FELLOWS

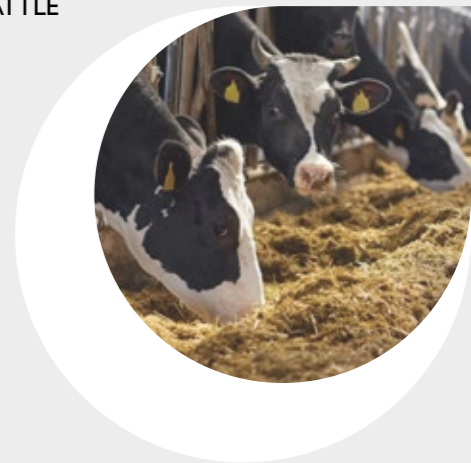
TOMORROW'S ENTREPRENEURS

The Bloomsbury SET funded two-year Fellowships for three early career researchers to develop new diagnostic tools for infectious diseases of humans and animals. The Fellows have been provided with training and mentorship to develop their skills and join the cohort of academics within the broader Bloomsbury SET portfolio.

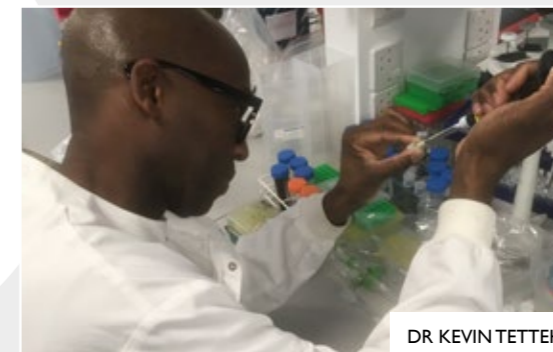
MINING RNA UNMAPPED READS: DEVELOPING A FAST DIAGNOSTIC TOOL FOR INFECTIOUS DISEASE IN CATTLE



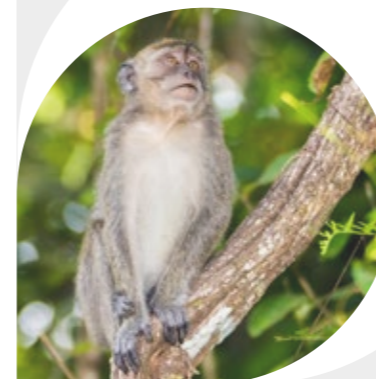
DR LAURA BUGGIOTTI



DEVELOPMENT OF A SUSPENSION BEAD ASSAY TARGETING THE ZOONOTIC MALARIA PARASITE



DR KEVIN TETTEH



THE ENEMY OF OUR ENEMY IS OUR FRIEND: BACTERIOPHAGE TECHNOLOGY FOR THE RAPID POINT-OF-CARE DETECTION OF TUBERCULOSIS



DR BEN SWIFT





REFLECTIONS ON THE BLOOMSBURY SET

Since the start of The Bloomsbury SET programme in April 2018, we have nurtured new partnerships, fostered new knowledge exchange, and facilitated the generation of new ideas. We have achieved wide ranging impacts from developing highly skilled, well-connected people and a portfolio of technologies moving to higher levels of technology readiness, to partnerships with industry and engagement with policymakers on public health interventions for infectious diseases.


The intellectual property portfolio arising from our translational research projects provides many opportunities for collaboration and/or further investment to accelerate the commercialisation of research. We have established connections with industry partners interested in helping find routes to market for the solutions being developed by researchers at the partner Colleges.

In addition to more than £5 million in grants translational research, The Bloomsbury SET has further supported academics through mentorship schemes, standalone masterclasses, and a training programme to further their understanding of knowledge exchange and commercialisation.

The Bloomsbury SET has organised a number of events, including our virtual conferences held in 2021, which brought together UK and global partners to explore the concepts and challenges of responding to emerging and infectious diseases, and antimicrobial resistance.

The programme has established and developed strong collaborative relationships between academics and knowledge exchange professionals across the partner Colleges.

Find out more online: www.bloomsburyset.org.uk

 [@bloomsburyset1](https://twitter.com/bloomsburyset1)



THE BLOOMSBURY SET

A Knowledge Exchange platform bringing together partner Colleges, together with the London International Development Centre, to accelerate the delivery of innovative scientific and technical solutions to help safeguard human and animal health.

CONNECTING CAPABILITY FUND

Research England's Connecting Capability Fund (CCF) supports university collaboration in research commercialisation through allocation of £100 million for competitive projects and formula funds. It aims to share good practice and capacity internally across the higher education sector; forge external technological, industrial and regional partnerships, and deliver the Government's industrial strategy priorities.

Partners 2018-2022



Supported by the Connecting Capability Fund





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