

# Technology vs Infectious Diseases: An Imperial College / Royal Institution Summit

Tuesday 26<sup>th</sup> September 2017, 13.00-20.30

Royal Institution, 21 Albemarle Street, Mayfair, London, W1S 4BS

13.00-13.30	<b>REGISTRATION AND COFFEE</b>
13.30	<b>Welcome</b> <b>Professor Gail Cardew</b> , Director of Science and Education, Royal Institution
13.40	<b>Introduction</b> <b>Professor James Stirling</b> , Provost, Imperial College London
	<b>SESSION 1: GLOBAL INFECTION THREATS</b> <b>Chair: Professor Alison Holmes</b>
13.50	<b>Introduction to session</b> <b>Professor Alison Holmes</b> , Professor of Infectious Diseases, Imperial College London
14.00	<b>Innovative technology for the management and control of dengue</b> <b>Dr Jesus Rodriguez Manzano</b> , Research Fellow, Electrical and Electronic Engineering <b>Dr Sophie Yacoub</b> , Honorary Clinical Research Fellow, Imperial College London, and Clinician Scientist, Singapore-MIT alliance for research and technology  Dengue is the most important arboviral infection in the world, with an estimated 100 million symptomatic infections annually, of which 500,000 develop life threatening complications, including dengue shock syndrome. Improved diagnostics and better patient monitoring are urgently needed. In this talk, we will outline our group's collaborative work in developing innovative technologies for both, point-of-care diagnostics and also non-invasive wearable patient monitors – with the overall aim of improving dengue management at the individual and population level.
14.15	<b>From Global to Digital: Inter-disciplinary research for malaria eradication</b> <b>Dr Jake Baum</b> , Professor of Cell Biology and Infectious Diseases  Professor Baum leads an interdisciplinary group within the Department of Life Sciences at Imperial. His lab's research combines expertise in parasite cell biology, drug discovery and design and collaborative work with engineers and physicists applying state-of-the-art technologies to dissect how the malaria parasite works, how we might target its ability to cause disease and how to tackle the emerging problem of drug resistance to all frontline antimalarials. In this talk, he will discuss some of the interdisciplinary platforms being used by the group and also highlight the expanding network of researchers at Imperial College now unified under the umbrella of the newly-formed <i>Imperial College Network of Excellence in Malaria</i> , - one of the largest centres of excellence in malaria eradication science in the world, which Professor Baum co-convenes.

14.30	<p><b>Charting the global emergence of antimicrobial resistance in pathogenic fungi</b>  <b>Dr Darius Armstrong-James</b>, Clinical Senior Lecturer, Respiratory Fungal Diseases</p> <p>Pathogenic fungi are increasingly recognised as a major driver for infectious disease mortality globally, with HIV-related fungal disease causes almost the same annual mortality as malaria or tuberculosis (up to 500,000 deaths per annum) and <i>Candida</i> ranking as the fourth most common cause of bloodstream infections. Furthermore, pulmonary aspergillosis is a severe complication of chronic respiratory diseases affecting millions worldwide. Unfortunately, fungal antimicrobial drug resistance is rapidly becoming a global issue, with rates of resistance to orally-available drugs quickly rising for <i>Aspergillus fumigatus</i>, and recent multiple global outbreaks of multi-drug resistant <i>Candida auris</i>. We have shown that next-generation sequencing is a viable tool to characterise the spread of antifungal resistance in real-time, and have now developed robust protocols for fungal genome sequencing using the Minion nanopore portable DNA sequencer. The application of these technologies to characterise the emergence of drug-resistant <i>Aspergillus fumigatus</i> and <i>Candida auris</i> will be demonstrated.</p>
14.45	<p><b>Vaccines vs infection: old foes, emerging threats and changing populations</b>  <b>Professor Robin Shattock</b>, Head of Mucosal Infection and Immunity</p> <p>Vaccines and antibiotics have significantly contributed to improve the health and longevity of human beings. However infectious diseases are now emerging or re-emerging almost every year, while the rise in antimicrobial resistant organisms poses an important threat to public health. This trend is set to continue based on a number of factors, including the increased global population, widespread and indiscriminate use of antibiotics, aging, travel, urbanization, and climate change. However, significant advances in structural biology, reverse vaccinology and systems biology combined with the development of novel platform technologies offers new opportunities to develop next generation vaccines to deal with emerging threats and affordable systems for current and future mass vaccination campaigns.</p>
14.55	<p><b>Emerging Technologies for Vaccinology</b>  <b>Dr Emmanuel Hanon</b>, Global Head of GSK Vaccine Research and Development, GSK</p> <p>Over the last century, many biotechnologies have been discovered enabling the design, the development, and the production of vaccines. The present paper aims at reviewing the most recent advances in vaccine technology platforms. It will also consider their potential to address major remaining medical need, deliver new approaches such as disease modifying vaccines but also speed up availability of vaccines targeting emerging infectious threats.</p>
15.15	<p><b>Break</b></p>

SESSION 2: CHALLENGES OF BACTERIAL INFECTIONS Chair: Dr Pantelis Georgiou	
15.45	<p><b>Introduction to session</b>  <b>Dr Pantelis Georgiou</b>, Reader, Department of Electrical and Electronic Engineering</p>
15.55	<p><b>Infectious Disease Diagnostics using Third Generation Sequencing on a Microchip</b>  <b>Mr David Davidson</b>, Chief Scientific Officer, DNA Electronics Ltd  <b>Professor Chris Toumazou</b>, Regius Professor, Imperial College London</p> <p>DNA sequencing-based tests that can rapidly provide accurate diagnostic information on infectious diseases will be a game-changer in terms of how clinicians treat infectious diseases, enabling treatment choice to be highly specific and tailored to the causative pathogens. This is about achieving better informed prescribing decisions, using genomic technologies. Semiconductor-based DNA sequencing was invented by Chris Toumazou and his group at Imperial College London (Department of EEE) and commercially exploited by DNAElectronics. The semiconductor whole genome sequencing technology is licensed to Thermo-Fisher and Ion Torrent and the invention showed how billions of standard microchip semiconductors found in mobile phones and computers could be used to sequence human genomes on a microchip a few millimetres area. This is known as second generation sequencing. A new semiconductor platform will be described in this talk which is more targeted known as third generation sequencing. DNAe's initial focus is on infectious disease diagnostics, where speed and DNA-specific information can make the difference between life and death. DNAe's first product, will be a diagnostic test for bloodstream infections for use in the management and prevention of sepsis.</p>
16.10	<p><b>Applying machine learning and biosensor technology to improve the precision of antibiotic management</b>  <b>Dr Danny O'Hare</b>, Reader in Sensor Research, Department of Bioengineering  <b>Dr Tim Rawson</b>, Clinical Research Fellow, Department of Medicine</p> <p>We currently prescribe antibiotic therapy in an almost one-size-fits all way. In hospital, up to 50% of all antibiotic prescriptions are inappropriate in some way. This puts patients at risk of poor treatment outcomes, side effects, and promotes the development of antibiotic resistance. With the support of Imperial Antimicrobial Research Collaborative 'ARC@Imperial', our multidisciplinary research group has developed an integrated continuous application that aims to improve the precision with which we provide antibiotic therapy. This utilises access to electronic health records, machine learning tools, and novel minimally invasive biosensor technology to optimise the selection and dosing of antibiotics as well as promote better communication with patients.</p>

16.25	<p><b>Serious games: a new ‘tablet’ against drug-resistant infections?</b>  <b>Dr Enrique Castro Sánchez</b>, Academic Research Nurse, Department of Medicine  <b>Mr Jamie Firth</b>, Games Developer, <a href="http://www.monkey99.co.uk">www.monkey99.co.uk</a></p> <p>Drug-resistant infections are a global public health threat. Antibiotic prescribing improvement interventions often fail to gain and maintain the engagement of prescribers. Serious electronic games can be used to overcome such challenge and benefit from ubiquity of mobile devices and increased computing power. In collaboration with games industry experts we developed in 2015 the first antimicrobial prescribing game worldwide, ‘On call: antibiotics’. The software uses the psychological techniques in place in games to optimise prescriber behaviours in hospitals, and has the potential to enhance existing antimicrobial education and behaviour initiatives. It can also be easily adapted to reflect practice in low- and middle-income countries, as well as emphasise the participation of different professionals involved in decisions about antibiotics.</p>
16.40	<p><b>Using Rapid Evaporative Ionisation Mass Spectrometry (REIMS) to Improve Early Detection of Antimicrobial Resistance and to Reduce AMR in Agriculture</b>  <b>Dr Frankie Bolt</b>, Research Associate in Microbial Metabonomics  <b>Dr Simon Cameron</b>, Research Associate in Microbial Populations and Metabonomics</p> <p>Mass spectrometry (MS) has revolutionised the workflow of clinical microbiology laboratories. Rapid evaporative ionisation MS (REIMS) allows analysis of a microorganism directly from an agar plate and we have shown that it is capable of the rapid identification of clinically important microorganisms. Due to the analytical sensitivity of REIMS, it can be used for the early detection of antimicrobial resistance in the diagnostic laboratory and also to detect the cause of livestock infection in agriculture; thereby reducing the unnecessary use of broad-spectrum antibiotics.</p>
16.55	<b>Q&amp;A for Sessions 1 and 2</b>
17.15	<p><b>Closing remarks</b>  <b>Professor Nick Jennings</b>, Vice-Provost (Research), Imperial College London</p>
17.25	<p><b>Close of the afternoon event</b>  <b>Professor Gail Cardew</b>, Director of Science and Education, Royal Institution</p>
17.30	<b>TECHNOLOGY SHOWCASE</b> and refreshments
18.45	<b>Audience to take their seats for evening event</b>
	<b>EVENING EVENT</b>
19.00	<p><b>Introduction</b>  <b>Sir Richard Sykes</b>, Chairman, The Royal Institution</p>
19.10	<p><b>KEYNOTE: Global Infectious Diseases: Priorities for action</b>  <b>Professor David Heymann CBE</b>, Head, Centre on Global Health Security at Chatham House</p>
20.00	<b>Facilitated discussion</b>
20.30	<b>Close of the evening event</b>

## **Biographies (in programme order)**



### **Professor Gail Cardew, Director of Science and Education, The Royal Institution**

Gail Cardew is the Royal Institution Professor of Science, Culture and Society, and Director of Science and Education. She leads the institution's charitable public engagement activities and champions its mission to encourage people to think more deeply about the wonders and applications of science. Gail is an internationally recognised expert in public engagement and a committed advocate for the UK's excellence in this field.



### **Professor James Stirling, Provost, Imperial College London**

James Stirling became the first Provost of Imperial College London in August 2013. Under the College's President and Provost leadership model, Professor Stirling has responsibility for delivering and enhancing Imperial's core academic mission - the pursuit of excellence in education, research, and translation. In recognition of his contribution to particle physics research he was elected to the Fellowship of the Royal Society in May 1999.



### **Professor Alison Holmes, Professor of Infectious Diseases, Imperial College London**

Alison Holmes is a Professor of Infectious Diseases at Imperial College London and the Director of Infection Prevention and Control and Associate Medical Director for Imperial College Healthcare NHS Trust. She is also the Director of the NIHR Health Protection Research Unit (HPRU) in Healthcare Associated Infection and Antimicrobial Resistance and the lead for the multidisciplinary Antimicrobial Research Collaborative 'ARC@Imperial'.



### **Dr Jesus Rodriguez Manzano, Research Fellow, Imperial College London**

Jesus Rodriguez Manzano is a Research Fellow at the Centre for Bio-inspired Technology, Imperial College London. His core expertise is situated within the interface of biology and engineering, including: development of low-cost sample preparation methods, innovative molecular tools for detection, quantification and typing of microbial pathogens, microfluidics, isothermal nucleic acid amplification chemistries and digital single-molecule assays.



### **Dr Sophie Yacoub, Honorary Clinical Research Fellow, Imperial College London**

Sophie Yacoub, is an Honorary Clinical Research Fellow, Imperial College London and a Consultant Physician in Infectious Diseases and General Medicine. She is currently based in Singapore, with appointments at Singapore-MIT alliance for research and technology (SMART) and at DUKE-NUS as an Adjunct Assistant Professor. She is also an Honorary Consultant Infectious Diseases & Internal Medicine at London North West Healthcare NHS Trust. Her research interests are the pathophysiology of severe dengue infections and clinical trials of novel therapeutics.



### **Professor Jake Baum, Professor of Cell Biology and Infectious Diseases, Imperial College London**

Jake Baum leads an interdisciplinary group within the Department of Life Sciences at Imperial. His lab's research combines expertise in parasite cell biology, drug discovery and design and collaborative work with engineers and physicists applying state-of-the-art technologies to dissect how the malaria parasite works, how we might target its ability to cause disease and how to tackle the emerging problem of drug resistance to all frontline antimalarials.



**Dr Darius Armstrong-James, Clinical Senior Lecturer, Respiratory Fungal Diseases, Imperial College London**

Darius Armstrong-James is a Clinical Senior Lecturer in respiratory fungal diseases at the National Heart and Lung Institute, Imperial College London and honorary consultant physician in infectious diseases and medical mycology to the Royal Brompton and Harefield NHS Trust. His research is primarily on innate immunity to *Aspergillus fumigatus* with a particular focus on macrophage cell biology and signal transduction. In addition, he is also involved in clinical translation relevant to medical mycology.



**Professor Robin Shattock, Head of Mucosal Infection and Immunity, Imperial College London**

Robin Shattock is the Head of Mucosal Infection and Immunity within the Department of Medicine at Imperial College London. Robin's research focuses on the mechanisms of mucosal infection and the development of novel preventative strategies appropriate to a developing world setting. This has led to the establishment of international collaborations aimed at preclinical identification, development and selection of HIV microbicide and vaccine candidates prior to formal clinical efficacy trials.



**Dr Emmanuel Hanon, Global Head of Vaccine Research and Development, GSK**

Emmanuel Hanon is the Global Head of GSK Vaccine Research and Development. He leads GSK global R&D organisation, covering discovery, early and late development, regulatory and medical affairs activities. He joined GSK Vaccines in 2001, taking on roles of increasing responsibility in Immunology and Human Cell mediated immunity before leading the viral vaccines programme in R&D.



**Dr Pantelis Georgiou, Reader in Biomedical Electronics, Imperial College London**

Pantelis Georgiou currently holds the position of Reader at Imperial College London within the Department of Electrical and Electronic Engineering. He is the head of the Bio-inspired Metabolic Technology Laboratory in the Centre for Bio-Inspired Technology; a multi-disciplinary group that invents, develops, and demonstrates advanced micro-devices to meet global challenges in biomedical science and healthcare.



**Mr David Davidson, Chief Scientific Officer, DNA Electronics Ltd.**

David Davidson is the Chief Scientific Officer at DNA Electronics, which is developing a rapid, point of need DNA analysis platform to detect infectious disease using core technologies first developed at Imperial College by Professor Chris Toumazou. David has more than 20 years of experience working across the life sciences industry, ranging from PPL Therapeutics, the transgenic technology company most noted for Dolly the sheep, through to an Alere company developing consumer diagnostics products, as well as extensive experience working in drug discovery.



**Professor Chris Toumazou, Regius Professor, Imperial College London**

Chris is London's first Regius Professor of Engineering and Founder of Imperial College's Institute of Biomedical Engineering. He is also chairman of DNA Electronics. A multi-award winning inventor and serial entrepreneur, his invention of semiconductor DNA sequencing revolutionised genetic testing. In recognition, he received the prestigious 2014 European Inventor Award. Chris' newest venture is start-up company dnaNUDGE which is developing the first saliva-based, user-operated genetic 'self-test' to personalise consumers' shopping experience. Chris is also a Founder of medtech companies DNA Electronics Ltd (DNAe) and Toumaz Holdings Ltd. Chris is a Trustee at the Royal Institution.



**Dr Danny O'Hare, Reader in Sensor Research, Imperial College London**

Danny O'Hare is a Reader in Sensor Research with expertise in analytical chemistry, biochemistry and electrochemistry. O'Hare is a Chartered Chemist and member of the Royal Society of Chemistry, the Electrochemical Society and British Society for Matrix Biology. He is also a Member of the Advisory Board for Analytical Abstracts (Royal Society of Chemistry).



**Dr Tim Rawson, Clinical Research Fellow, Imperial College London**

Tim Rawson is a Clinical Research Fellow at the NIHR Health Protection Research Unit in HCAI and AMR and is currently leading a project exploring the utility of Enhanced, Personalised, and Integrated Care for Infection Management at the Point-of-Care (EPIC IMPOC). This aims to explore the utility of integrating machine learning techniques, rapid diagnostics, and mechanisms for drug dose optimisation into clinical decision support systems to improve infection management in the hospital setting.



**Dr Enrique Castro Sánchez, Academic Research Nurse, Imperial College London**

Enrique Castro Sánchez, Academic Research Nurse, is currently combining an Early Career Research Fellowship exploring increased participation of nurses in antimicrobial stewardship decision-making and a position as Lead Research Nurse at the NIHR Health Protection Research Unit in HCAI and AMR where he works in the theme "Innovations in behaviour change, technology and patient safety to improve infection prevention and antimicrobial use".



**Mr Jamie Firth, Games Developer, [www.monkey99.co.uk](http://www.monkey99.co.uk)**

Jamie Firth has worked in the games industry in various roles for 12 years, mostly in publishing. Recently working as an end-to-end Product Manager, he takes many roles in producing, designing, analysing and refining F2P monetisation and retention. He believes the future is a sharing economy: people largely trading skills for skills, instead of money, wherever possible.



**Dr Frankie Bolt, Research Associate in Microbial Metabonomics, Imperial College London**

Frankie Bolt is a Research Associate in Microbial Metabonomics at Imperial College London with a particular interest in microbial diagnostics. Frankie worked closely with many public health agencies and was awarded a Microbiology Society grant which allowed her to spend four months at the Centers for Disease Control.



**Dr Simon Cameron, Research Associate in Microbial Populations and Metabonomics, Imperial College London**

Simon Cameron joined Prof Zoltan Takat's research group in 2015 in the Division of Computational and Systems Medicine as a Research Associate in Microbial Populations and Metabonomics. His most recent research has focussed on the use of metabolome and microbiota profiling techniques to identify novel clinical biomarkers for lung cancer. He has also worked on the sputum microbiota found in patients with chronic obstructive pulmonary disease, and the response of the human microbiome and metabolome to extreme physiological and environmental stress.



**Professor Nick Jennings, Vice-Provost (Research), Imperial College London**

Nick Jennings CB, FREng is Vice-Provost (Research) at Imperial College. He is responsible for promoting, supporting and facilitating the College's research performance and for leading on the delivery of the Research Strategy. Nick also holds a chair in Artificial Intelligence in the Departments of Computing and Electrical and Electronic Engineering. He is an internationally-recognized authority in the areas of artificial intelligence, autonomous systems, cybersecurity and agent-based computing. His research covers both the science and the engineering of intelligent systems. He has undertaken fundamental research on automated bargaining, mechanism design, trust and reputation, coalition formation, human-agent collectives and crowd sourcing.



**Sir Richard Sykes, Chairman, The Royal Institution**

Sir Richard is Chairman of The Royal Institution of Great Britain and of Imperial College Healthcare NHS Trust and was Rector of Imperial College London from 2001-2008. He has over 30 years' experience within the biotechnology and pharmaceutical industries, serving as Chief Executive and Chairman of GlaxoWellcome from 1995 -2000 and then as Chairman of GlaxoSmithKline until 2002. Sir Richard was knighted in 1994 and elected a Fellow of the Royal Society in 1997.

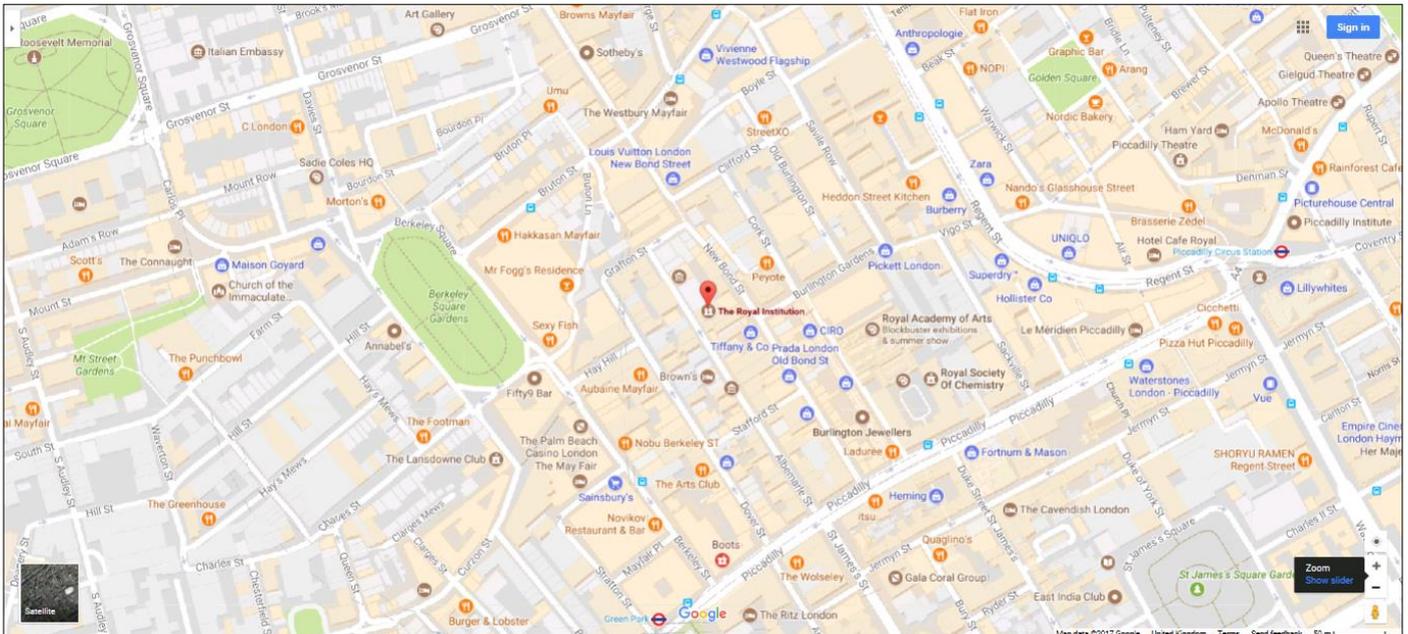


**Professor David Heymann CBE, Head, Centre on Global Health Security, Chatham House**

David Heymann is currently Head of the Centre on Global Health Security at Chatham House, London and was Chairman of Public Health England from 2012-2016. Previously he was the World Health Organization's assistant director-general for Health Security and Environment, and representative of the director-general for polio eradication. He is an elected fellow of the Institute of Medicine of the National Academies (US) and the Academy of Medical Sciences (UK). In 2009 he was appointed an Honorary Commander of the Most Excellent Order of the British Empire (CBE) for service to global public health.

## Venue

The Royal Institution of Great Britain, 21 Albemarle Street, London, W1S 4BS



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The closest tube station to the Royal Institution is Green Park on the Jubilee, Victoria and Piccadilly lines. The Royal Institution is a five minute walk from the station. Also within a ten minute walking distance is Piccadilly Circus tube station, on the Piccadilly and Bakerloo lines, or Oxford Circus tube station on the Victoria, Central and Bakerloo lines.

### **By bus**

There are numerous bus stops along Piccadilly which runs along the entrance to Albemarle Street. Bus numbers: 9, 14, 19, 22 and 38

### **By bicycle**

There is parking for bicycles located around the corner from the Ri, on Bond Street.

### **By car**

Travelling to the Ri by car is inadvisable as there is only limited and expensive parking available nearby. Please note that the Ri is located within the Congestion Charging zone.