IMPERIAL

MedTechONE

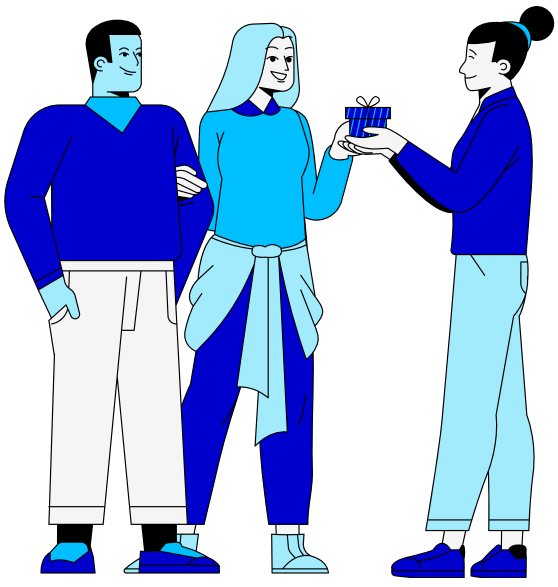
Institute of Infection

Clinicians, Engineers & Scientists

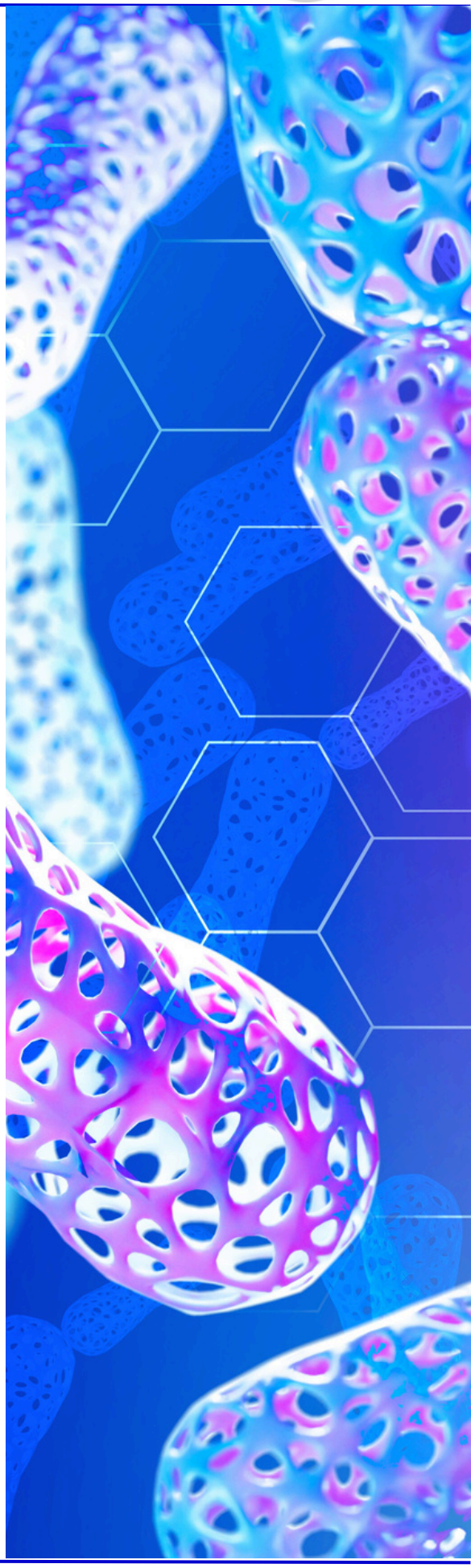
Clinical Challenges Workshop in Infection

Chaired by Professor Graham Cooke

Deputy Dean of the Faculty of Medicine



Clinicians, Engineers & Scientists Clinical Challenges Workshop in Infection



Event Details

Thursday 10th October
16:00 - 18:00

Imperial College London
58 Princes Gate
The Ballroom // The Boardroom
South Kensington

Overview

Chaired by Professor Graham Cooke, this event focuses on intervention, diagnosis, and treatment and will bring together infection researchers, clinicians, engineers, and experts in a range of disciplines to explore clinically relevant infection challenges and how Imperial's interdisciplinary expertise can be harnessed to solve them.

Event Schedule

Registration
15:45 - Upon entry

Welcome address - Prof Graham Cooke
16:00 - The Ballroom

Introduction to MedTechONE - Prof Dan Elson
16:09 - The Ballroom

Introduction to the Institute of Infection - Prof Charles Bangham
16:12 - The Ballroom

Clinicians Pitch Session - Chaired by Prof Graham Cooke
16:15 - The Ballroom

Developing antigen arrays for diagnostics in lung transplantation - **Prof Darius Armstrong-James**

AI for predicting immune responses for vaccinology - **Prof Faith Osier**

Adapting AI-driven epitope prediction methods for bacterial vaccine development: Investigating immunodominant epitopes in non-typhoidal Salmonella - **Dr Anna Rydlova**

Challenges in gut microbiome sampling and manipulation for clinical benefit - **Prof Julian Marchesi, Dr Benjamin Mullish**

Detecting Human T-cell Leukaemia virus: A chance to break the cycle of transmission - **Dr Aileen Rowan**

Reception & Networking
17:20 onwards - The Boardroom

CHAIR

Professor Graham Cooke

Deputy Dean of the Faculty of Medicine

Vice-Dean for Research, Faculty of Medicine

Professor Cooke is a NIHR Senior Investigator based within the Department of Infectious Disease. He is the Vice-Dean for research in the Faculty of Medicine and leads the Infection and Antimicrobial Resistance Theme of the Biomedical Research Centre.

He leads a multidisciplinary programme of research in hepatitis and has longstanding collaborations with engineering groups, best exemplified by the development of the COVIDnudge diagnostic in response to COVID-19.

INTRODUCTION

Professor Dan Elson

Professor of Surgical Imaging, Faculty of Medicine

Daniel Elson is a Professor of Surgical Imaging and Biophotonics in the Hamlyn Centre for Robotic Surgery, Institute of Global Health Innovation and Department of Surgery and Cancer at St. Mary's Hospital. Research interests are based around the development and application of photonics technology to medical imaging, including multispectral imaging, near infrared fluorescence, structured lighting, light sources in endoscopy and diffuse and fluorescence spectroscopy.

Professor Charles Bangham

Co-Director, Institute of Infection

Professor Charles Bangham is co-Director of the Institute of Infection. His research has focused on the human T-cell leukaemia virus, HTLV-1. His group discovered the virological synapse - the mechanism by which viruses including HTLV-1, HIV and murine leukaemia virus are transmitted from cell-to-cell. Charles is a Fellow of the Royal Society and Fellow of the Academy of Medical Sciences.

THE CLINICAL CHALLENGES

Professor Darius Armstrong-James

Professor of Infectious Diseases and Medical Mycology

Developing antigen arrays for diagnostics in lung transplantation

We are interested in developing antigen arrays to distinguish different types of infection from graft rejection in organ transplantation

Solution scope: Diagnosis is challenging and having high-resolution antigen arrays to distinguish differing infection vs graft responses would be invaluable, perhaps also more broadly in infection diagnostics.

Professor Faith Osier

Co-Director Institute of Infection
Chair Immunology & Vaccinology, Dept. of Life Sciences

AI for predicting immune responses for vaccinology

We are interested in using AI to help distinguish people who are protected versus susceptible, or who might develop severe versus mild/asymptomatic disease following infection. We are also interested in understanding which vaccine platform is most suited to our candidate protein antigens for vaccine design.

Solution scope: Using AI to predict these outcomes following infection or vaccination could save time, money and effort...and, ultimately lives.

THE CLINICAL CHALLENGES

Dr Anna Rydlova

Department of Infectious Disease

Adapting AI-driven epitope prediction methods for bacterial vaccine development: Investigating immunodominant epitopes in non-typhoidal Salmonella:

Despite having extensive immune sequencing data available as well as comprehensive knowledge of proteomes of many bacteria of interest, integrating these to pinpoint the most effective antigens for bacterial vaccine development remains computationally impractical (not impossible!).

Solution scope:

Many novel AI-powered computational techniques are currently being investigated for viral antigens/TCRs. However, there is a pressing need for novel empirical-based and/or AI-informed computational constraints to enable predictions of bacterial immunodominant epitopes and make it computationally feasible.

1) MHC-peptide binding predictions (bacterial peptides likely to bind to MHC?).

2) MHC-peptide – T cell receptor recognition

Reverse epitope discovery based on bulk & single cell TCR sequencing, and Deep Learning methods (such as transfer learning, ESM, Alphafold, and others) that utilize protein language models (PLMs) and transformer architectures to provide predictive models and features for understanding peptide-MHC interactions, with additional deep learning techniques (such as transformers or advanced activation functions) that can further enhance the accuracy of MHC-peptide binding predictions.

THE CLINICAL CHALLENGES

Professor Julian Marchesi

Professor of Digestive Health

Dr Benjamin Mullish

IIPRF Research Fellow

Challenges in gut microbiome sampling and manipulation for clinical benefit

Faecal / intestinal microbiome transplant (FMT/ IMT) holds promise as a treatment for a variety of gut-related infections. However, preparation of “capsulised FMT” is laborious, currently involving prolonged lyophilisation, and attempted capsulisation of static powder - we would like a higher throughput system that would allow more refined manufacture of this therapeutic.

Solution scope: Expertise in preparation of the product, static removal, encapsulation of biological materials, payload delivery to the right part of the gut, and potentially also sampling of GI content (especially small bowel) in the process.

THE CLINICAL CHALLENGES

Dr Aileen Rowan

Lecturer in Molecular Virology

Detecting Human T-cell Leukaemia virus: A chance to break the cycle of transmission

The World Health Organisation has identified that HTLV-1 has been neglected in the past, and has identified an urgent public health need for improved diagnostic tests for HTLV-1. Serological tests are widely available but are prone to false positives, so a nucleic-acid-based test that detects viral DNA in blood is preferable. An ideal test would be cost-effective and suitable for use in the field, as this virus affects people living in remote areas where sample collection is challenging.

Solution scope: We are seeking a partner who is interested in developing any of the following:

- point of care tests e.g. LAMP that can work directly from blood with minimal processing
- sample collection solutions e.g. membranes for dried blood spots, virus inactivation
- low cost diagnostic tests in general

Through our collaboration with the National Centre for Human Retrovirology, we can collect blood samples and evaluate the performance of any potential novel diagnostic pathway.

THE TECHNOLOGY SOLUTIONS

THE INNOVATION	KEYWORDS
A hybrid AI-digital twins technology to solve clinical problems whose (patho)physiology is well described by mathematical equations.	Physics-Informed Neural Networks (PINNs), AI-Personalised Digital Twins
A project aiming to develop robust manufacturable antimicrobial surfaces enabled by superhard plasmon-enhanced photocatalytic materials.	Array of nano-spikes made out of photocatalytic plasmonic materials
(Undisclosed)	Microbiome therapeutics
MARPLE is a rapid diagnostic that uses mRNA biomarkers to accurately differentiate between bacterial and viral infections, enabling more precise treatment decisions and reducing unnecessary antibiotic use. It is designed to be simple, cost-effective, and suitable for use in both high-resource and low-resource healthcare settings.	Point-of-care testing, host response signatures
Developing sensors and technologies to be used to detect and monitor disease including infectious diseases.	Sensor technology

THE TECHNOLOGY SOLUTIONS

THE INNOVATION	KEYWORDS
Platform technologies that can address challenges in vaccine formulation, targeted nanomedicine, cell and gene therapy.	Thermostable RNA formulations; targeted drug, protein and gene delivery; cell engineering and preservation
Glycan microarray technology and its application in diverse glycan recognition studies, including those involving immune lectins, antibodies, viruses, and whole bacterial cells.	Glycan microarray
AI, machine learning, mathematical modelling	AI, Machine Learning
Optical sensors	Biosensors
Mathematical/ theoretical/computational techniques including ordinary differential equations, machine learning (e.g. random forest, elastic net, gradient boost), multivariable regression and agent based modelling.	Mechanistic ODE, ML/AI, regression, ABM
(Undisclosed)	Wearable technologies

THE TECHNOLOGY SOLUTIONS

THE INNOVATION	KEYWORDS
Leveraging nano/microtechnology and light-matter interactions (especially based on plasmonics) for molecular sensing and micromanipulation of active colloids (e.g. bacterial suspension) for diagnostic (e.g. POC/MIS sensing) and therapeutic (e.g. drug delivery) applications.	Nanotechnology, plasmonics, microrobotics, surface-enhanced Raman spectroscopy (SERS) sensor, bacteria-based microrobot
A nanomaterials based sensing platform, which could enhance the assay sensitivity, and lower detection limits.	Optical biosensors, based on metal enhanced fluorescence technology (IP filed)

About MedTechONE

Overcoming challenges within MedTech innovation and supporting the clinical translation journey.

MedTechONE is comprise of three streams:

Accelerator

Dedicated to creating progress pathways for medtech innovators, the MedTechONE Accelerator's focus includes networking events, funding calls, and supporting innovations and spinout companies at Imperial through their translation journey.

Foundation

The Foundation stream has a heavier focus on Early Career Researchers, and knowledge collation and dissemination. A large part of the Foundation's current work is creating a knowledge-base for ECRs and academics that includes key resources on all stages of innovation development.

Collaborative

The Collaborative stream works with local and national networks of clinical specialties. This can include coordinating national evaluations of our technologies in wider clinical trials, as well as accepting incoming devices into our medical technologies programme for support at all stages of translation, from first-in-human to early adoption.

About The Institute of Infection

We drive interdisciplinary infection research that brings together the outstanding skills and perspectives of Imperial scientists from across the Faculties of Medicine, Natural Sciences, Engineering and Business School.

By bridging the gaps between faculties and disciplines, we accelerate, enhance, and ensure the global impact of Imperial's world-leading infection research community in finding solutions to infections and the diseases they cause.