MI NETWORKS

MIDLANDS FLOW CYTOMETRY GROUP

Delivered by

MIDLANDS INNOVATION

Aston University BIRMINGHAM UK

UNIVERSITY OF BIRMINGHAM

Cranfield University

Keele UNIVERSITY

University of Northampton

UNIVERSITY OF LEICESTER

Loughborough University

University of Nottingham UK | CHINA | MALAYSIA

UNIVERSITY OF WARWICK

CONTENTS

WORLD-LEADING RESEARCH EQUIPMENT AND FACILITIES ACROSS THE MIDLANDS

The Midlands Innovation Flow Cytometry Group supports essential research across the medical, life sciences, biotechnology, food science, and environmental sectors.

By sharing cutting-edge flow cytometry equipment and providing expert training, we enable experiments that would otherwise be out of reach – bringing substantial value to diverse research areas and fostering collaboration across Midlands Innovation institutions.

FRESH IDEAS

Network and collaborate with experts to gain new insights and drive research forward.

ENHANCE IMPACT

Broaden your research capabilities and increase research impact with diverse, advanced instrumentation.

EXPERT MANAGEMENT

Access state-of -the-art instruments in a structured manner, managed in a core facility for optimised access and management.

THROUGH COLLABORATION, WE ARE STRONGER

Midlands Innovation is a partnership of world-class universities in the Midlands collaborating to champion our people, place and partnerships.

We aim to develop the skills of our people whilst empowering and celebrating our diverse research and innovation community. We deliver world-class research that impacts people living in our communities.

Our partnership's research networks help promote research collaboration, share knowledge and deliver training and education. They secure funding for shared state-of-the-art equipment and new projects.

STATE-OF-THE-ART FLOW CYTOMETRY

The Midlands is at the forefront of flow cytometry, with state-of-the-art equipment and many advanced research groups addressing local and global challenges.

It is one of Midlands Innovation's longest-standing networks, promoting research collaboration, facilitating equipment sharing and delivering training and education.

> "Our vision is to bring together expertise in flow cytometry from across the Midlands and promote the facilities available.
>
> Our annual flow cytometry conference attracts **150+ researchers**, showcasing vital research undertaken with flow cytometry."

Professor Lucy Fairclough
MI Flow Cytometry Group Chair
University of Nottingham

OUR FLOW CYTOMETRY RESEARCH IMPACT

Our network supports vital research in the medical, life sciences, biotechnology, food science and environment sectors.

In the Midlands, we have used flow cytometry to:

- Phenotype immune memory in asymptomatic COVID-19
- Track microbial fingerprints to detect drinking water quality
- Investigate the health implications of temperature interventions
- Resolved cell cycle regulation at single-cell level
- Analyse plant ploidy and cell cycle to improve crop yield
- Identify lung pericytes and their role in fibrosis
- Fate-map regulatory markers of ILC plasticity
- Phenotype Type 2 immune cells in asthma and COPD
- Demonstrate RNA reprogramming to reduce toxic ataxin-1 aggregates in SCA1

> “The flow cytometry community in the Midlands has a strong track record of applying flow cytometry to a range of disciplines and securing funding for specialist equipment to enable vital research.”

Professor David Cousins
Head of School of Medical Sciences
University of Leicester

OUR FLOW CYTOMETRY RESEARCH IMPACT

Our network supports vital research in the medical, life sciences, biotechnology, food science and environment sectors.

> The strength of our network lies in its ability to translate complex cellular analysis into real-world impact — from medical diagnostics to food safety and environmental monitoring. Together, our shared expertise drives innovation that benefits both science and society.

David Onion
Flow Cytometry Facility Manager
University of Nottingham

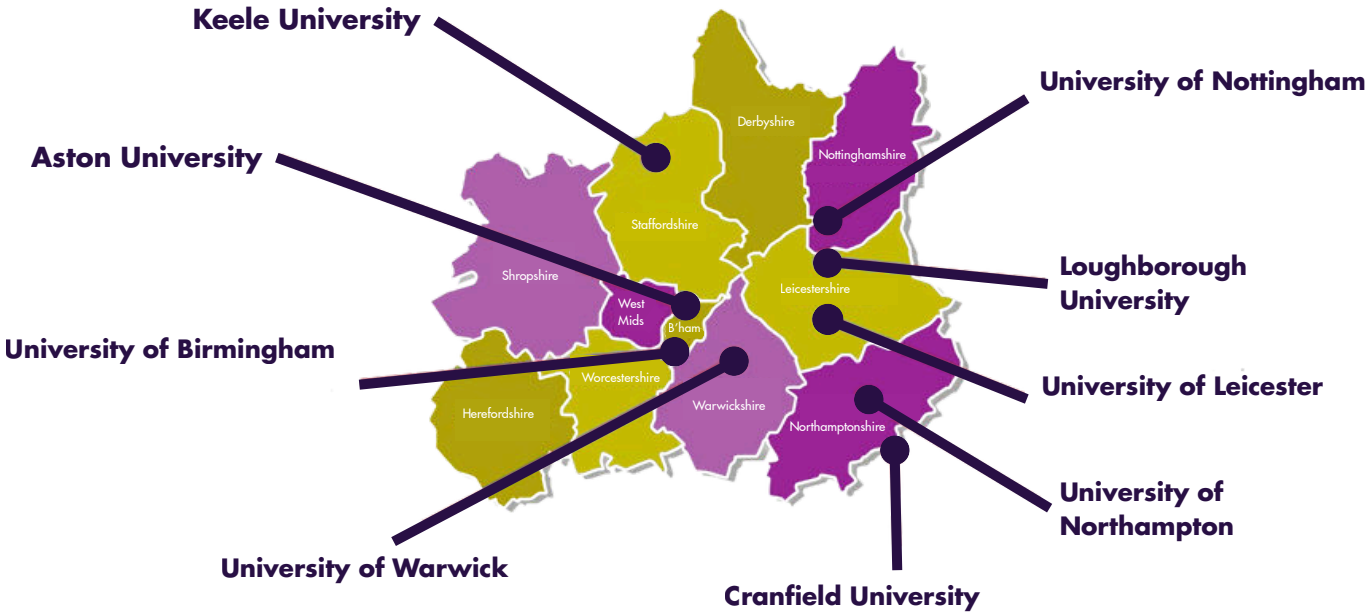
£1.7M
FUNDING SECURED

UK-FIRST
SONY SPECTRAL ANALYSER

400+
RESEARCHERS TRAINED

150+
ATTENDING ANNUAL CONFERENCE

FLOW CYTOMETRY FACILITIES ACROSS THE MIDLANDS



Midlands Innovation Flow Cytometry Equipment Summary

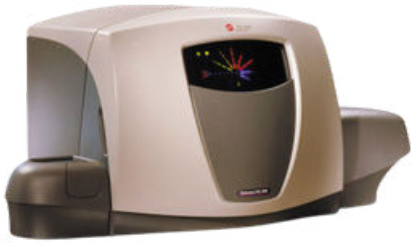
Instrument	Available at	Contact
BD Accuri C6	Aston	j.johnson1@aston.ac.uk
	Cranfield	francis.hassard@cranfield.ac.uk
	Leicester	dc282@leicester.ac.uk
	Loughborough	n.c.bishop@lboro.ac.uk
BD FACSCanto II	Leicester	dc282@leicester.ac.uk
BD LSR Fortessa	Birmingham	flowcytometry@contacts.bham.ac.uk
	Warwick	s.bennett.1@warwick.ac.uk
BD FACSAria Fusion (Cell Sorter)	Birmingham	flowcytometry@contacts.bham.ac.uk
	Leicester	dc282@leicester.ac.uk
	Warwick	s.bennett.1@warwick.ac.uk
Beckman Coulter Astrios EQ (Cell Sorter)	Nottingham	david.onion@nottingham.ac.uk
Beckman Coulter CytoFLEX	Birmingham	flowcytometry@contacts.bham.ac.uk
	Keele	a.richardson1@keele.ac.uk
	Leicester	fdc282@leicester.ac.uk
	Loughborough	n.c.bishop@lboro.ac.uk
	Northampton	lee.machado@northampton.ac.uk
	Nottingham	david.onion@nottingham.ac.uk
Beckman Coulter FC500	Aston	j.johnson1@aston.ac.uk
Biorad S3e (Cell Sorter)	Cranfield	francis.hassard@cranfield.ac.uk
Cytek Aurora (Spectral Analyser)	Warwick	s.bennett.1@warwick.ac.uk
Helios CyTOF Mass Cytometer	Birmingham	flowcytometry@contacts.bham.ac.uk
Cytek Amnis ImageStream X Mk II (Imaging Flow Cytometer)	Nottingham	david.onion@nottingham.ac.uk
	Warwick	s.bennett.1@warwick.ac.uk
Sony FP7000 (Spectral Cell Sorter)	Nottingham	david.onion@nottingham.ac.uk
Sony ID7000 (Spectral Cytometer)	Birmingham	flowcytometry@contacts.bham.ac.uk
	Nottingham	david.onion@nottingham.ac.uk
	Warwick	s.bennett.1@warwick.ac.uk
Sony MA900 (Cell Sorter)	Warwick	s.bennet.1@warwick.ac.uk

ASTON UNIVERSITY

The flow cytometry facilities at Aston University support research in cell biology, regenerative medicine, and therapeutic innovation.

Aston's researchers use flow cytometry to investigate a wide range of applications, including the phenotyping of stem cells, the study of cellular responses under inflammatory conditions, and the characterisation of complex cell populations to better understand disease mechanisms and inform translational research.

3x BD Accuri C6



Beckman Coulter FC500

Contact:

Jill Johnson
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UNIVERSITY OF BIRMINGHAM

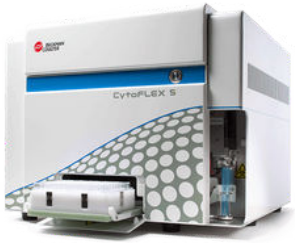
The Flow Cytometry Platform at the University of Birmingham supports cellular analysis and cell sorting for research across immunology, cancer, infection, regenerative medicine and life sciences.

We provide end-to-end support throughout the experimental workflow, from study design and panel optimisation to acquisition, helping researchers generate robust and reproducible results. Based in the Institute of Biomedical Research and complemented by additional sites across campus, the service is accessible to both University users and external academic, clinical, and industry collaborators.

The facility houses a modern portfolio of flow, spectral, cell sorting and mass cytometry systems for high-parameter analysis and precise cell isolation. Expert-assisted data analysis is available for all flow cytometry experiments and a range of training courses, available live or on demand, for both internal and external users at all experience levels.

BD FACSAria™ Fusion Cell Sorters

BD LSR Fortessa X-20



Beckman Coulter CytoFLEX S

Helios™ Mass Cytometer

Sony ID7000 Spectral Cytometer

Contact:

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https://www.birmingham.ac.uk/about/college-of-medicine-and-health/facilities/flow-cytometry

CRANFIELD UNIVERSITY

Cranfield's flow cytometry facility enables the testing of microbiological water quality, addressing one of the greatest challenges for water providers.

Flow cytometry is uniquely suited for this application due to its speed and potential for automation, enabling total and live bacterial cell counts in around 20 minutes, compared to traditional microbiological water quality assessment methods which are labour-intensive and take days to return results.

Cranfield researchers use flow cytometry to assess microbiological water quality, characterise bacteria, eukaryotes and viruses from complex environmental samples, and characterise biofilm.

4x BD Accuri C6

Biorad S3e™ Cell Sorter

Contact:

Francis Hassard
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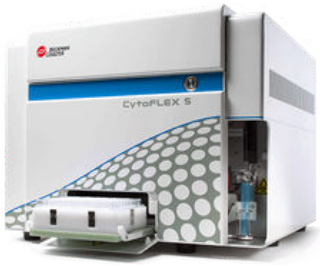
KEELE UNIVERSITY

Keele's flow cytometry capability supports a wide spectrum of cutting edge biomedical research, with particular strengths in stem cell biology, cancer research, and respiratory, cardiovascular, and inflammatory disease studies.

Our primary research instrument is the Beckman Coulter CytoFLEX, located at the Guy Hilton Research Centre, which provides high quality surface marker and cell cycle analysis. Equipped with 488 nm and 638 nm lasers and FITC, PE, PC5.5, and APC filters, it offers flexible, sensitive detection for a broad range of assays.

We also host a BD FACS Canto II at an additional site, expanding our analytical capacity and supporting diverse research needs across the university. Together, these systems enable robust, high resolution cell analysis that underpins Keele's vibrant and interdisciplinary research environment.



Beckman Coulter CytoFLEX S

Contact:

Alan Richardson
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UNIVERSITY OF LEICESTER

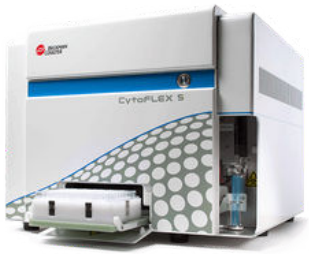
Located within Core Biotechnology Services, the Flow Cytometry Facility at the University of Leicester is equipped with three cell analysers and a cell sorter, open for use for all researchers with appropriate training. They also hold a site licence for Flowjo Software, a leading platform for flow cytometry analysis.

The facility enables research applications including immunophenotyping, single cell sorting for cloning or genomics analysis, and cell cycle and cell death assays. It supports major clinical studies, particularly in respiratory disease and immunotherapy development.

BD Accuri C6 Plus

BD FACSAria™

BD FACSCanto II



Beckman Coulter CytoFLEX S

Contact:

David Cousins
dc282@leicester.ac.uk

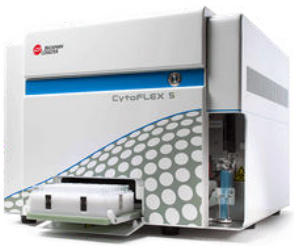
https://le.ac.uk/cbs/facilities/flow-cytometry

UNIVERSITY OF LOUGHBOROUGH

Located in the School of Sport, Exercise and Health Sciences, the flow cytometry facilities at Loughborough University support studies in exercise physiology, cell biology and clinical research across respiratory, cardiometabolic and inflammatory arthritic diseases.

Researchers use the flow cytometry to support research the role of lifestyle (e.g. diet, exercise, sleep) on immunity and inflammation in the general population and those with long-term conditions, allowing us to better understand disease mechanisms allowing translation to the design of effective interventions.

BD Accuri C6 Plus



Beckman Coulter CytoFLEX S

Contact:

Lettie Bishop
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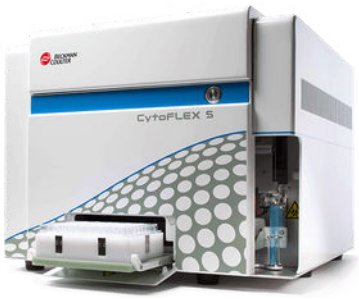
UNIVERSITY OF NORTHAMPTON

The Northampton Advanced Imaging Facility (NAIF) is the University of Northampton's core facility for advanced imaging and flow cytometry. A wide range of equipment, training and services are available for both internal users and external users from other academic institutions and industry.

The Facility's flow cytometry platform is equipped with three active lasers and nine channels for fluorescent detection across 13 repositionable bandpass filters. Training packages and access to cell culture facilities and expert FlowJo analysis software are available.

This equipment is part funded by Research Innovation Funding to establish the Northampton Advanced imaging facility (NAIF).



Beckman Coulter CytoFLEX B4-R3-V2

Contact:

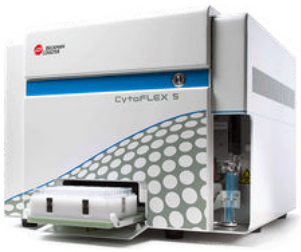
Lee Machado
lee.machado@northampton.ac.uk

UNIVERSITY OF NOTTINGHAM

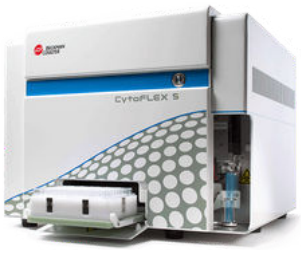
The University of Nottingham Flow Cytometry Facility provides a comprehensive flow cytometry and cell sorting service to research groups across the University, Midlands Innovation partners, and (by agreement) external organisations. The facility offers access to full-spectrum, conventional and imaging flow cytometers, supported by a complete range of training and user support to enable high-quality experimental design and data acquisition.

The facility underpins research across immunology, infection, cancer, and cell biology. Its combination of high-end instrumentation and expert support allows researchers to perform deep cellular phenotyping, high-speed sorting, and advanced imaging applications.

Beckman Coulter Astrios EQ Cell Sorter



Beckman Coulter CytoFLEX Flow Cytometer



Beckman Coulter CytoFLEX S Flow Cytometer

ImageStream X MKII Imaging Flow Cytometer

SONY ID7000C Full-Spectrum Flow Cytometer

SONY FP7000 Spectral Cell Sorter

Contact:

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david.onion@nottingham.ac.uk

https://www.nottingham.ac.uk/life-sciences/facilities/flow-cytometry-facility/index.aspx

UNIVERSITY OF WARWICK

University of Warwick's Flow Cytometry Bio-Analytical Shared Resource Laboratory (Flow BioSRL) is a CL2 lab capable of conventional, spectral and imaging flow cytometry analysis, as well as cell sorting.

Warwick flow cytometry experts have experience analysing a full range of samples, from bacteria to yeast and mammalian to plant cells, providing technical expertise for flow cytometry experiments, data analysis and cell sort services to both internal and external users.

Warwick Medical School host a SONY ID7000 and a Cytek Aurora CS Cell Sorter (Clinical Sciences Research Laboratory, University Hospitals Coventry and Warwickshire), both available to internal and external users.

BD FACSAria™

BD LSRFortessa

Cytek Aurora Spectral Analyser

ImageStream X MKII Imaging Flow Cytometer

SONY ID7000C Full-Spectrum Flow Cytometer

SONY MA900 cell sorter

Contact:

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https://warwick.ac.uk/fac/sci/lifesci/tic/flow/

CASE STUDIES

Aston University

Investigating pericyte phenotype and function under chronic inflammatory conditions

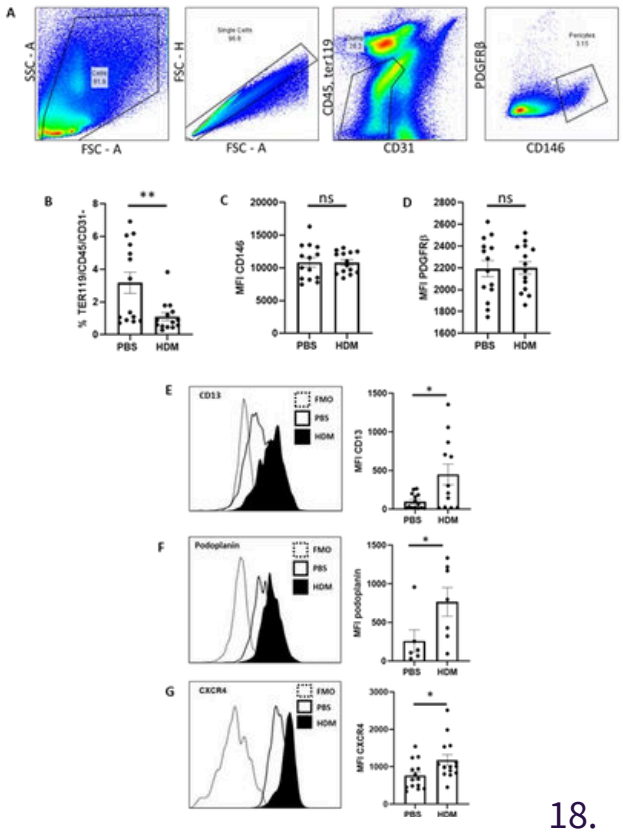
Scar formation is a vital mechanism of tissue repair following injury. However, healthy tissue repair can develop into pathological fibrosis, which ultimately leads to tissue destruction and organ failure. Fibrosis is associated with chronic inflammation, oxidative stress, and ageing.

However, there are currently no treatment options for organ fibrosis, and these diseases impose a significant burden on public health care systems and have detrimental impacts on patient quality of life. Importantly, little is known about the factors that initiate fibrosis.

Previous work in the research group of Dr Jill Johnson has identified pericytes, a type of tissue-resident mesenchymal stem cell, as the primary driver of fibrosis. Pericytes provide support to capillaries throughout the body and are particularly vital to maintaining healthy tissue structure. Importantly, pericytes are strongly associated with tissue fibrosis in the lung, liver, and kidney.

Recent studies have shown that pericytes contribute to fibrosis by uncoupling from local blood vessels, followed by migration to the site of inflammation via the CXCL12/CXCR4 axis and differentiation into scar-forming myofibroblasts (Figure 1).

Dr Johnson's group has used flow cytometry to identify lung pericytes (CD45-/Ter119-/CD31-/CD146+/PDGFRb+) and shown that these cells upregulate markers of cell migration (CD13, podoplanin, CXCR4) in response to chronic airway inflammation driven by house dust mite (HDM) exposure.



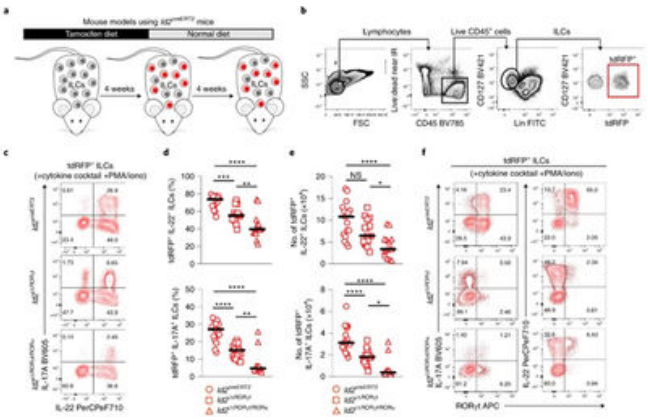
University of Birmingham

Investigating the transcriptional networks regulating innate lymphoid cell fate and function

Identification of the Innate Lymphoid Cell (ILC) family over 10 years ago revealed a new axis in supporting tissue homeostasis and coordinating the response to local infection or damage. Several types of ILC have now been described; however, many of these populations do not appear to be terminally differentiated and, rather, they appear able to extensively remodel their effector functions. How this cellular 'plasticity' is regulated post-development remains poorly understood, but remains a key question given the ability of these cells to coordinate the actions of many immune populations and that altered ILC frequencies correlates with several inflammatory conditions.

Using mouse models to inducibly delete different transcription factors, alone and in multiple combinations, we sought to unpick how different networks combine to control ILC plasticity. Crucially, we additionally 'fate-mapped' those cells in which Cre Recombinase mediated gene deletion was induced to accurately track the fate of these cells in vivo. Complex flow cytometry monitoring surface phenotype, cytokine and transcription factor expression, in combination with fate-mapping (revealed by tdRFP expression) was fundamental to these studies.

Reference: Fiancette, R., Finlay, C.M., Willis, C. et al. Reciprocal transcription factor networks govern tissue-resident ILC3 subset function and identity. Nat Immunol 22, 1245–1255 (2021). https://doi.org/10.1038/s41590-021-01024-x



Cranfield University

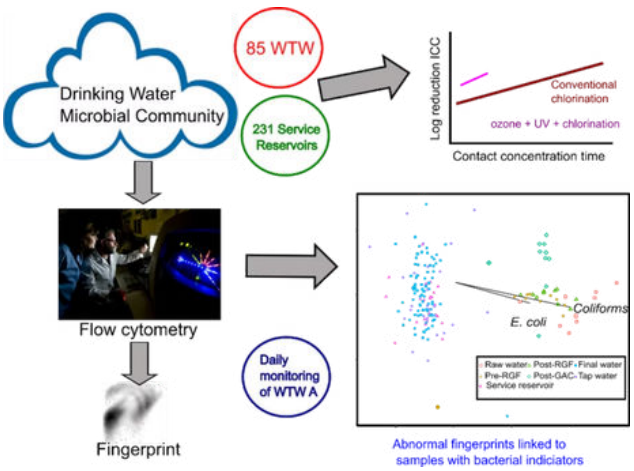
Flow cytometry fingerprints to investigate bacterial water quality events in drinking water

Deviations in the quality of final treated drinking water from Water Treatment Works (WTW) can result in problems such as regulatory fines, reputational damage, taste and odour complaints and, significantly, potential for increased public health risk. Traditional drinking water flow cytometry (FCM) parameters that measure intact and total cell populations (viability), the nucleic acid content of bacteria and the microbial fingerprint better reflect the inherent heterogeneity within drinking water bacterial communities compared to culture-based approaches. Here, daily inter-stage monitoring and flow cytometry data was undertaken at WTW and weekly analysis of hydraulically linked service reservoirs was undertaken over a 12-month period. Extra information provided by the flow cytometry fingerprint (e.g. fluorescence intensity distribution of cells) was assessed.

BD Accuri C6 flow cytometer (Becton Dickinson U.K. Ltd., U.K.) which was equipped with a 488 nm solid state laser. Green fluorescence was collected in the FL1 channel at 533 nm (FL1) and red fluorescence in the FL3 channel at 670 nm (FL3) after staining with SYBR GI and Propidium Iodide. The fingerprint analysis was performed using CHIC on FlowJo, ImageJ, and R software. A non-parametric analysis of similarities (ANOSIM) was performed using 9999 permutations (free) to test for significant difference between the interstage microbial fingerprints at WTW A and the fingerprints from different SR outlets.

Changes to the distribution of bacteria within the microbial fingerprint (diversity quantified via Bray-Curtis dissimilarity index) provided a leading indicator for detecting events, such as poor microbial water quality and compliance exceedance.

Funding – Engineering and Physical Research Council and Southeast Water.



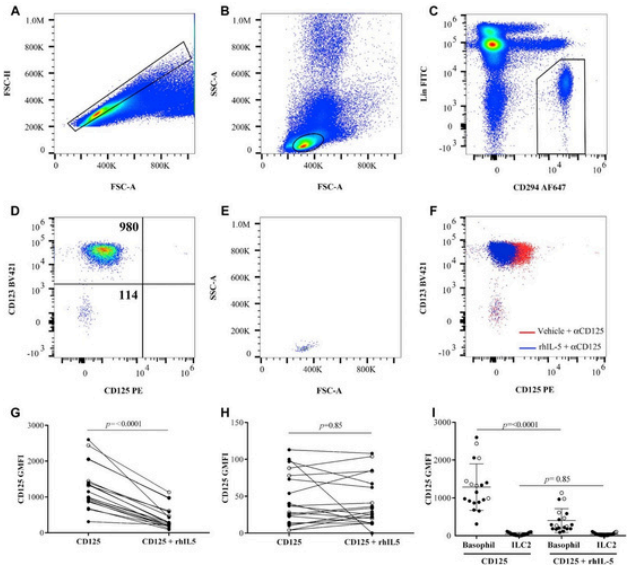
University of Leicester

Investigating Type 2 cell subsets during clinical trials of novel biologics to treat Asthma and COPD

Both asthma and COPD involve inflammatory responses in the lung that impact disease severity and progression. Many patients have a disease phenotype that involves eosinophils and Type 2 immunity. Many novel biologic drugs targeting molecules in the Type 2 immunity pathway are either licenced or in development to treat these diseases. Understanding the mechanism of action of these drugs during clinical development is critical to inform future therapeutic approaches.

Using multicolour acoustic focussing flow cytometry we have developed a panel of antibodies to allow us to deep phenotype and enumerate several Type 2 immune response cells from 100 ml of whole blood. Cells that can be assessed include eosinophils, basophils, conventional and pathogenic Th2 cells and Type 2 innate lymphoid cells. Proof of concept was developed using samples from patients being treated with Mepolizumab (1). This approach is being used to examine immune responses in several clinical studies using novel biologics to target Type 2 immunity.

Funding – Leicester Drug Discovery and Diagnostics (LD3) with financial contributions from MRC grant MC_PC_15045 and supported by the NIHR Leicester Biomedical Research Centre



Loughborough University

Investigating how heat and exercise interventions shape inflammatory, immune, and metabolic responses in humans

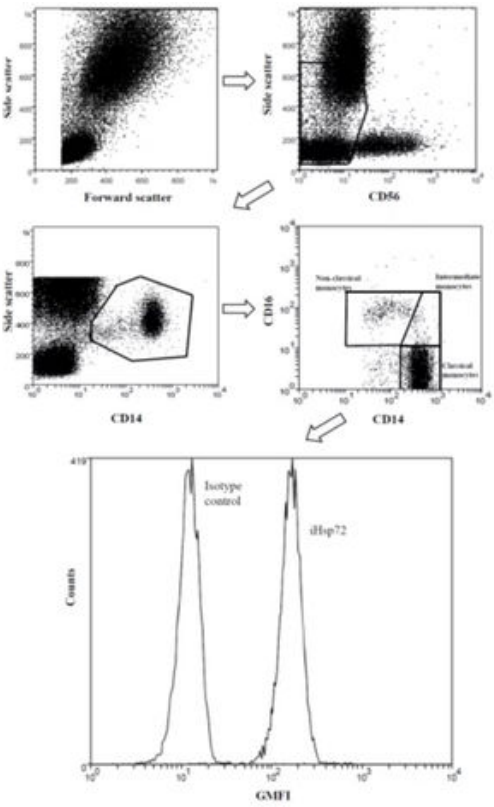
- To investigate the health implications of temperature interventions (e.g., hot water immersion, sauna, or exercise in the heat) in humans
- To investigate the impact of exercising muscle mass on inflammatory responses and glycaemic control in humans
- To investigate health benefits of exercise in chronic kidney patients

Tissues analysed: Whole blood and peripheral blood mononuclear cells (PBMCs)

Main markers of interest:

- Monocyte subset distribution, leukocyte distribution
- Intracellular heat shock protein 72
- Toll like receptors
- Microparticles

Selection of CD14 positive cells after exclusion of CD56 positive natural killer cells. Monocyte subsets are then defined based on CD16 and CD14 expression, and intracellular heat shock protein 72 (iHsp72) then determined for each of the subsets



University of Northampton

Aim: To evaluate the therapeutic potential of RNA trans-splicing for the treatment of spinocerebellar ataxias (SCAs)

Spinocerebellar ataxia type 1 (SCA1) is caused by an expanded polyglutamine (polyQ) tract in the protein ataxin-1 encoded by the ATXN1 gene. At the cellular level, SCA1 is characterised by the presence of ataxin-1 aggregates in the nucleus. The exact pathogenic mechanism is not understood, but phosphorylation of ataxin-1 at S776 is critical for the stabilisation and subsequent neurotoxicity of polyQ-expanded ataxin-1.

Transgenic mice expressing polyQ-expanded S776A ataxin-1 in Purkinje cells do not manifest ataxia and the pathology is less prominent than in animals expressing poly-Q expanded ataxin-1 with unmodified S776. Moreover, pharmacologic inhibition of S776 phosphorylation in SCA1 cell and animal models leads to a decrease in ataxin-1 protein levels. Our hypothesis is that a SCA-causing protein can be converted into a non-toxic form by RNA reprogramming. RNA trans-splicing is one such technology that creates a hybrid mRNA through a trans-splicing reaction between an endogenous target pre-mRNA and an exogenously delivered pre-trans-splicing molecule (PTM).

We have established that SMaRT can successfully edit both mouse and human ATXN1 transcripts to substitute S776 for alanine.

Here, we have used our new 3 laser, 9 parameter Beckman Coulter CytoFLEX instrument to demonstrate that PTM S776A significantly reduces the intensity of YFP-ataxin-1 aggregates in an inducible human cell model of SCA1.

This equipment is part funded by Research Innovation Funding to establish the Northampton Advanced imaging facility (NAIF).

University of Nottingham

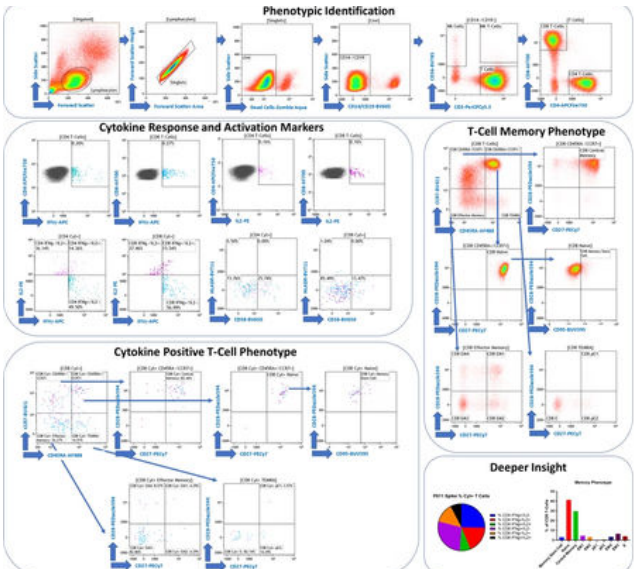
Investigating cell-mediated immunity following asymptomatic infection with SARS-CoV2

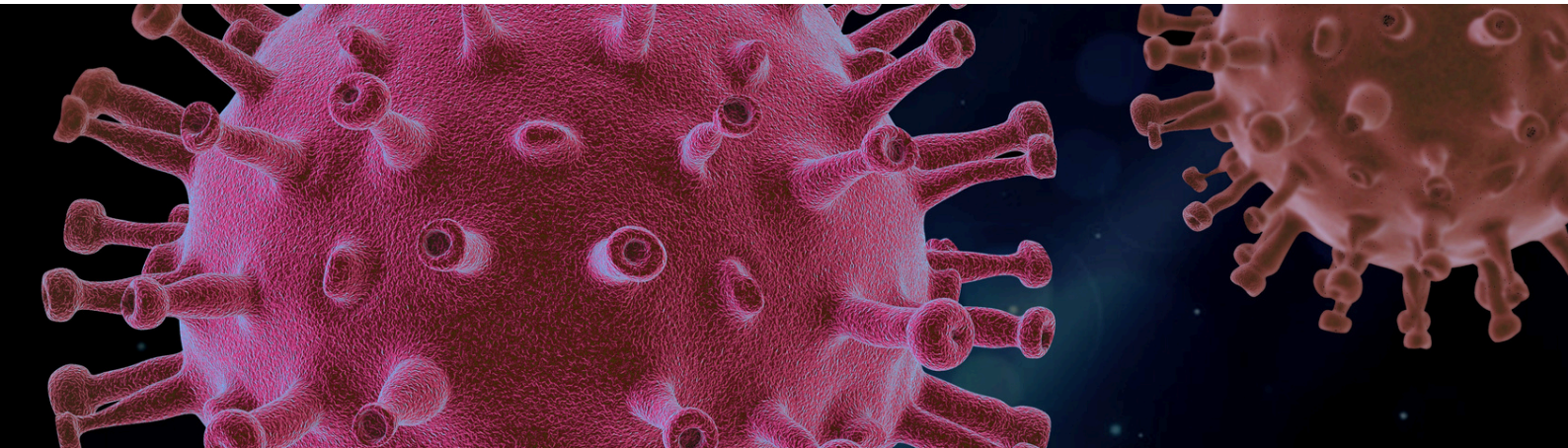
An important challenge during the COVID-19 pandemic has been to understand asymptomatic disease as this may be a key source of transmission. Asymptomatic disease is by definition hard to screen for so there is currently a lack of clarity about this aspect of the COVID-19 spectrum. It is clear that adaptive immunity is strongly activated during asymptomatic infection but some features of the T cell and antibody response may differ from those in symptomatic disease.

Using spectral flow cytometry, we have developed a panel of 22 antibodies to enable us to deep phenotype the cellular responses following either asymptomatic or symptomatic infection.

Specifically, we have examined cytokine expression to Spike, Membrane and Nucleocapsid SARS-CoV2 (using overlapping peptide pools) and identified memory phenotypes related to clinical outcome.

Funding – National Core Studies : Immunity theme: “Asymptomatic Covid-19 In Education (ACE) Immunity Study”, L Fairclough, M Wills and A Godkin.





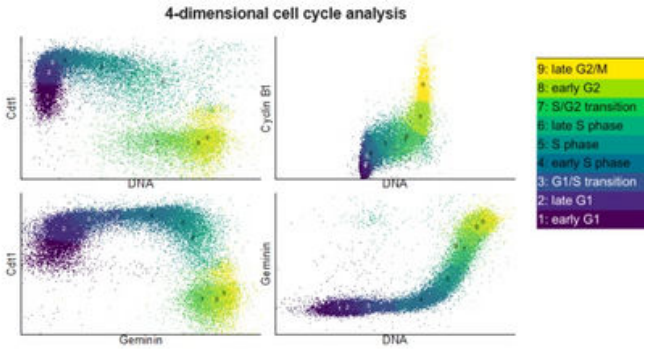
University of Warwick

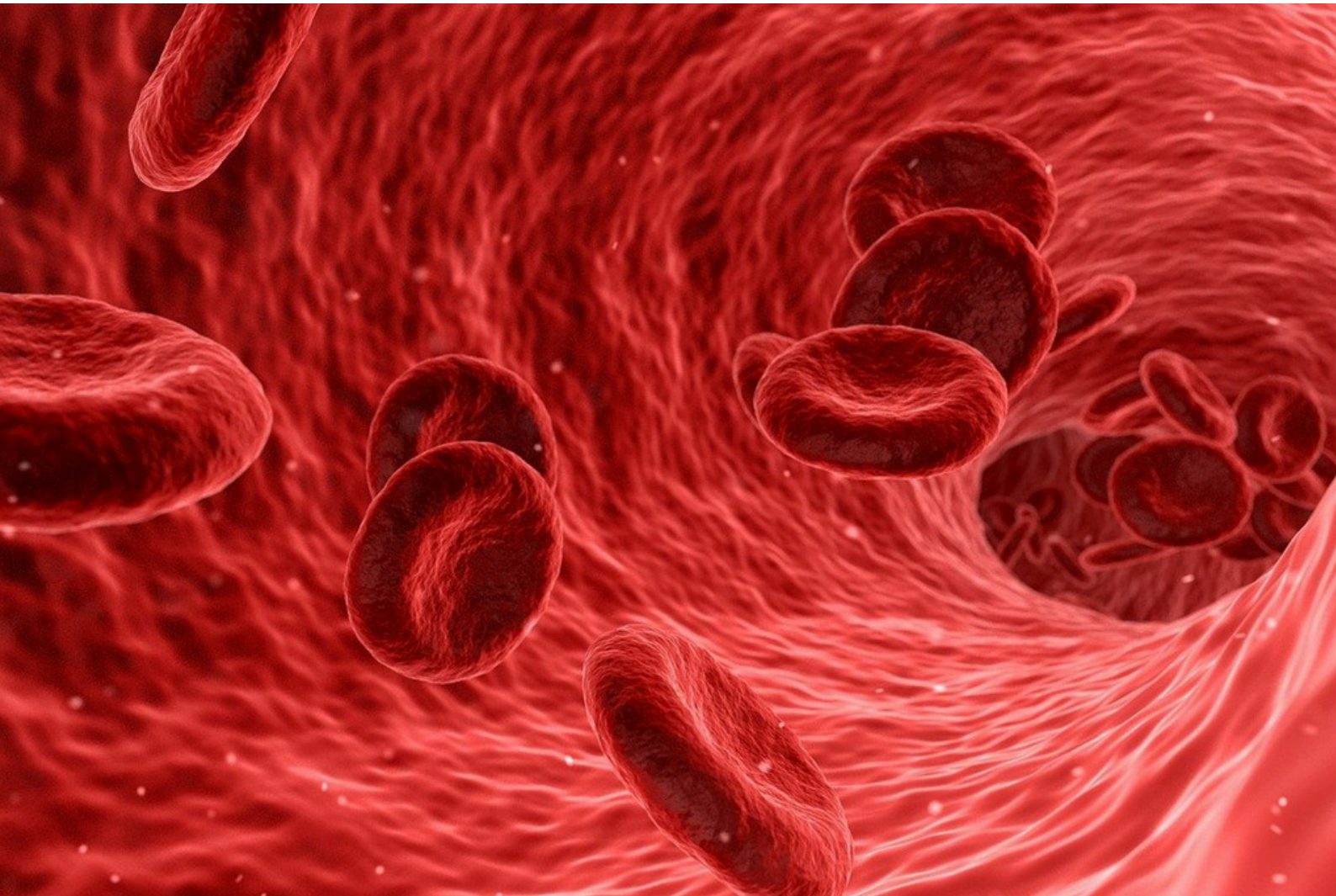
High resolution cell cycle mapping based on flow cytometry

Regulation of the mammalian cell cycle and how it interacts with growth, cell size, transcription, translation, and metabolism is not clear; some mechanisms and factors have been identified, but details are murky. In particular, how variation on the single cell level and the noise this introduces into the system are handled, remains obscure.

Using flow cytometers at the Warwick School of Life Sciences allows us to resolve the cell cycle at high precision and single cell level (Fig. 1). We can combine this with measurement of transcription rates and other growth-related processes via different fluorescent channels to understand better the interplay of growth, cell cycle, and single cell variation. FACS sorting further allows us to isolate cells in specific cell cycle phases and subject them to transcriptomics and similar experimental techniques.

Funding – Warwick Integrative Synthetic Biology Centre (WISB), BBSRC/EPSRC (BB/M017982/1).





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