CHIEF SCIENTIST OFFICE

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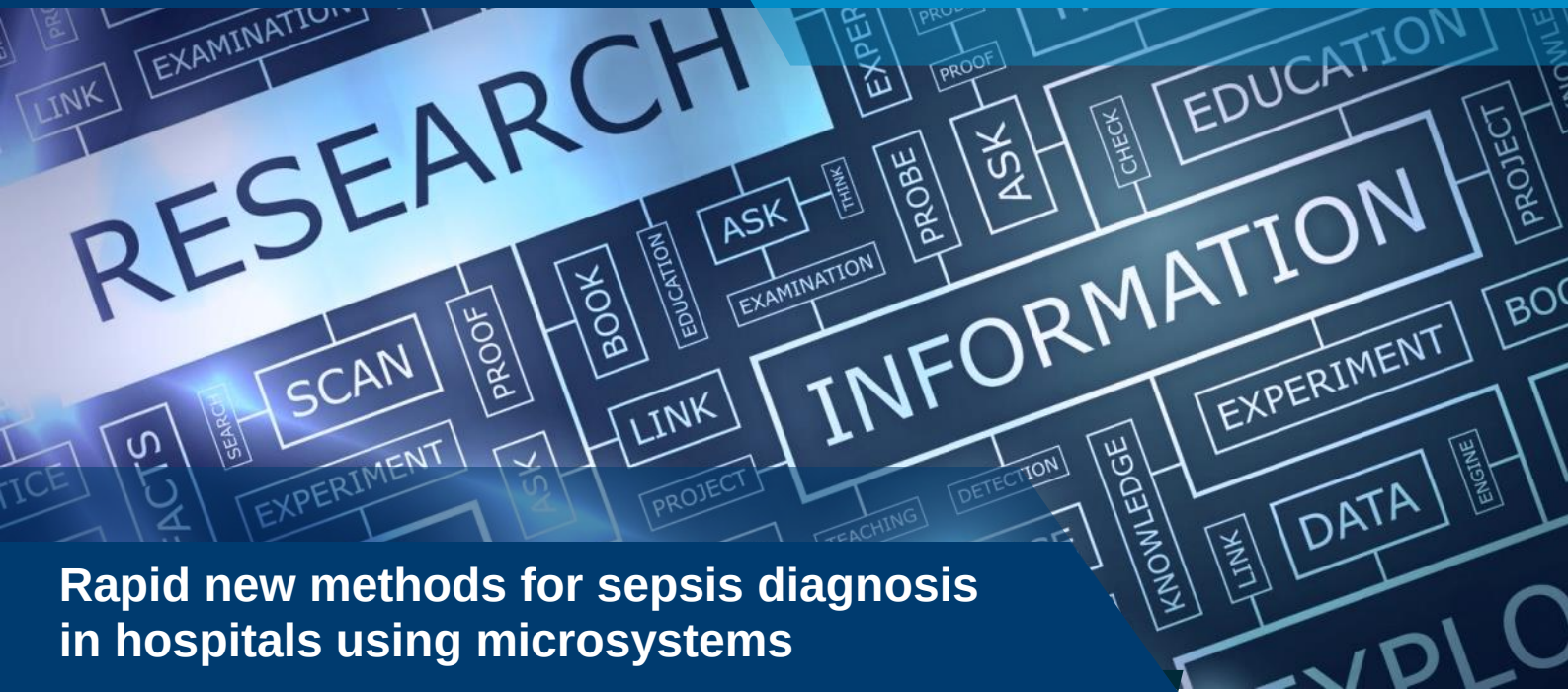
RESEARCH PROJECT BRIEFING



Rapid new methods for sepsis diagnosis in hospitals using microsystems

AIMS

The main aim of this project is to investigate new approaches to detect more quickly the presence of harmful, typically hard to find, pathogens in the bloodstream to make sepsis diagnostics faster and save lives.

KEY FINDINGS

- Equipment already available in hospitals can be combined with new blood processing strategies to make pathogen detection faster
- Immune receptors present in the body act as a sepsis warning sign in the presence of pathogens, and these receptors can be engineered to help identify pathogens quickly
- These immune receptors also interact differently with each other in the presence of pathogens, which can be used for diagnostic purposes

WHAT DID THE STUDY INVOLVE?

The study involved a collaboration between the Universities of Strathclyde, Glasgow and the Glasgow Royal Infirmary to integrate new engineering approaches for the detection of pathogens in hospitals. This was enabled by:

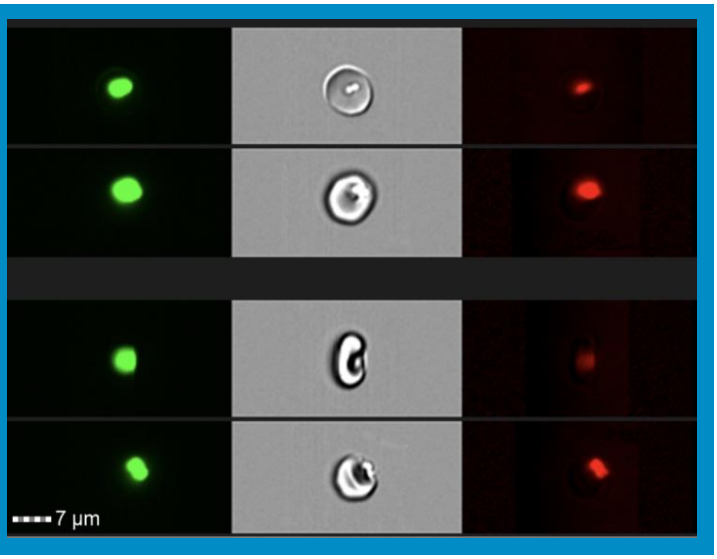
- the characterisation of equipment already used in hospitals for pathogen detection and better understanding of their potential for faster detection
- the development of new processes to enrich pathogens rapidly using bespoke chemical treatment, fluidic manipulation and immunological understanding
- a collaboration with Sepsis Research FEAT Charity to engage school children with the topic of sepsis and better understand its signs

WHAT WERE THE RESULTS AND WHAT DO THEY MEAN?

The main results of this study can be summarised as follows:

- current equipment in hospitals can be adapted for faster pathogen detection but still require stringent pathogen isolation from blood to work with existing algorithms
- chemical treatments can be used to remove blood cells and enrich pathogens, but these tend to have a strong impact on pathogen's wellbeing that can impede their detection using existing hospital workflows
- fluidic approaches to filter blood cells can be used as an alternative to rapidly concentrate pathogens, and we have demonstrated potential for high-throughput red blood cell depletion (red blood cells are the main blood components)
- receptors from the immune system (namely pattern recognition receptors) can be engineered for use "outside the body" to rapidly detect pathogens; as opposed to standard approaches that require a knowledge on pathogen identity, these receptors can recognise molecular patterns that are shared between pathogens and can consequently trap a wide range of harmful bugs

Examples of bacteria-red blood cell interaction (middle row), captured using high-speed imaging equipment (imaging flow cytometer), where green fluorescent bacteria (left row) could also be detected using red fluorescent immune receptors (right row). These red receptors are capable of quickly detecting a wide range of pathogens that can be harmful to our health.



WHAT IMPACT COULD THE FINDINGS HAVE?

To the best of our knowledge, this study demonstrates for the first time how a certain family of immune receptors engage with harmful pathogens outside the body and how this interaction can be used for diagnostic purposes. Existing workflows in hospitals could, in the longer term, be adapted to include the use of these receptors to indicate more rapidly than currently possible the presence of bloodstream infections and potential sepsis. Rapid antimicrobial treatment is key in helping patients recover from sepsis and this study paves the way for a new diagnostic approach.

HOW WILL THE OUTCOMES BE DISSEMINATED?

This work has already been presented at various international events (e.g. CYTO conference in Canada, 2023) and will soon lead to an open-access publication to share the proposed approach with the research community. The current goal is to translate the main findings of this work into intensive care units, with further funding currently being sought. Findings have also been disseminated in schools in Scotland, with the delivery by the team of an activity pack, available on the Scottish Government website.

CONCLUSION

This study, at the interface of engineering, chemistry and clinical sciences, aimed to bring a new interdisciplinary lens to the problem of pathogen detection in hospitals. The preliminary data obtained, thanks to this funding, demonstrate the potential of immune receptors to be engineered for a role in rapid pathogen detection. Future work will include additional characterisation of these receptors in a wide range of blood samples to further demonstrate their translational potential.

RESEARCH TEAM & CONTACT

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Additional Information

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