Plan Overview

A Data Management Plan created using DMPonline

Title: CV-19: µ-ECTs: Micro-engineered convertible tissues for both AMR and COVID pandemic challenges

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Funder: Engineering and Physical Sciences Research Council (EPSRC)

Template: EPSRC Data Management Plan

Project abstract:

Antimicrobial resistance (AMR) is a major global health threat that has worsened due to COVID-19. As bacteria continue to evolve and become resistant to current antibiotics, AMR will keep posing serious risks to public health. Additionally, new COVID-19 strains might emerge in the future. To tackle these ongoing challenges, coordinated efforts are urgently needed to create new antimicrobials and develop proper guidelines for their use. This research aims to design micro-engineered convertible tissues (µ-ECTs) with controllable complexities to test antimicrobials and guidelines for treating AMR and COVID-19.

Traditional bacterial models are often used to study AMR and test antibiotics. However, these models cannot replicate the complex interactions between pathogenic microbes and infected tissues. Animal models and human volunteers are more accurate but have significant ethical concerns and high costs. While 2D cell cultures are reproducible, cheap, and easy to use, they do not reflect what actually happens in living organisms. Tissue models created through tissue engineering (TE) have clear advantages over microbial and 2D cell models. Their 3D structures better mimic the complex physiological environments and host-pathogen interactions. These 3D tissue models are also crucial for COVID-19 research and antiviral testing. Despite their benefits, 3D tissue models are not widely used for AMR and COVID-19 research because they are mainly produced using a top-down TE strategy. This approach has several drawbacks, including:

1. Limited in vivo-like complexity.
2. Difficulty in adapting to high-throughput screening (HTS) compared to 2D cell models.

To address these issues, we recently developed a 3D cell culturing and imaging system (3D-CCIS). This system uses thin scaffolds in a miniaturized culture setup, allowing real-time microscopic analysis and further offline assessments. However, due to its top-down TE strategy and lack of complex in vivo-like structures, this 3D-CCIS is suitable for studying cell-scaffold interactions but not for more complex AMR and COVID-19 research.

In this proposed research, an additive developmental engineering (DE) strategy is used to create innovative µ-ECTs with controllable physiological complexities for AMR and COVID-19 research and HTS of antimicrobials. Multiple modular tissues (MTs) will be prepared by

culturing different cells on corresponding modular scaffolds (MSs). Convertible mini-chambers will be fabricated in tissue culture plates to assemble these MTs into 3D μ-ECTs with varying physiological structures.

The key benefits of the proposed 3D μ-ECTs include:

1. **Tailorable tissue complexity:** By using epithelial, mesenchymal, endothelial, and nerve cells, MTs are produced and used to assemble simple or composite μ-ECTs with varying structures.
2. **High-throughput screening suitability:** Miniaturizing the entire culture system will enable rapid, non-destructive analysis of 3D μ-ECTs using established technologies for 2D cell cultures, such as high-throughput confocal microscopy. Before or after microbial infections, the 3D μ-tissues can be assessed offline using immunofluorescent and histological analysis, or further processed for other assays.

This research will evaluate 3D μ-ECTs for AMR and COVID-19 studies, including screening antimicrobial drugs and exploring alternative phage therapies. By developing these advanced tissue models, we aim to improve our understanding and management of AMR and potential future COVID-19 outbreaks.

ID: 156023

Start date: 01-02-2025

End date: 31-08-2026

Last modified: 17-07-2024

Grant number / URL: https://www.ukri.org/opportunity/epsrc-standard-research-grant-nov-2023-responsive-mode/

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Data Collection

What data will you collect or create?

Materials fabrication and characterization data, cell and tissue culture data, Data about screening of anti-microbial drugs, anti-viral drugs and phage therapies.

How will the data be collected or created?

Analysis of the materials, cultured cells, cultured tissues, screened anti-microbial, anti-viral drugs, and phage therapy using, Phase contrast microscopy, fluorescent microscopy, TEM, SEM, PCR, plaque assay.

Documentation and Metadata

What documentation and metadata will accompany the data?

appropriately structured metadata and published papers

Ethics and Legal Compliance

How will you manage any ethical issues?

N/A

How will you manage copyright and Intellectual Property Rights (IPR) issues?

appropriate confidentiality agreements and publication plans

Storage and Backup

How will the data be stored and backed up during the research?

Reasonable steps should be taken to ensure that publicly-funded data is not held in any jurisdiction where the available legal safeguards provide lower levels of protection than are available in the UK

How will you manage access and security?

The appropriate security controls created at Loughborough University and Nottingham University will be followed.

Selection and Preservation

Which data are of long-term value and should be retained, shared, and/or preserved?

The data of screening anti-microbial, anti-viral drugs and phage therapies.

What is the long-term preservation plan for the dataset?

Paper publications

Data Sharing

How will you share the data?

The data will be made freely and openly available with as few restrictions as possible in a timely and responsible manner.

Are any restrictions on data sharing required?

N/A

Responsibilities and Resources

Who will be responsible for data management?

The PI of the project

What resources will you require to deliver your plan?

N/A