Project outline

1. Project outline describing the scientific rationale of the project (max 4,000 characters incl. spaces and returns)

Air pollution is the world’s largest single environmental health risk, being responsible for an eighth of all global deaths per year (World Health Organisation, 2014). High levels of atmospheric particulate matter (PM) cause increased respiratory diseases such as chronic obstructive pulmonary disease (COPD) and asthma, and increased respiratory infection including pneumonia. PM impacts the host immune system and causes an oxidative stress in eukaryotic cells but the impact on bacterial cells has not been well studied.

Our groundbreaking studies showed that exposure to PM has a major impact on respiratory tract pathogens, *Streptococcus pneumoniae* and *Staphylococcus aureus* (Hussey et al., 2017). Biofilms are multi-component systems that are key for surface colonisation, and protecting bacteria from stresses such as antibiotics and the immune system. Our publication, which had worldwide impact, showed that PM induces changes in biofilm composition, structure, and function and altered the tolerance of biofilms to antibiotics (Hussey et al., 2017).

Additionally, PM alters bacterial colonisation in an *in vivo* murine model, causing *S. pneumoniae* to spread to the lower respiratory tract potentiating infection. Consequently, our data has major implications for human health as it is likely that PM will not only affect different pathogens but also the normal respiratory tract microbiota. Indeed our recent data has shown that PM has a differential impact on several respiratory pathogens, and alters bacterial regulatory responses. However we do not know how PM causes these differential responses.

Therefore the aim of this project is to investigate how PM differentially alters bacterial regulatory systems and interacts with cells.

Objectives are:

1. To investigate how PM affects bacterial signalling systems.

2. To determine how PM impacts signalling molecules and interacts with bacterial and eukaryotic cells.

3. To establish how the impact of PM differs between bacterial strains and species.
This project will enable us to understand the way that PM affects regulatory systems to produce the effects on behaviour that we have observed in model systems, and to understand why different strains and species react differently with PM.

References


4. How does the project comply with BBSRC’s requirement for multidisciplinarity and new ways of working (including use of advanced quantitative skills)? (5 lines)

This is a highly multi-disciplinary project involving microbiologists, geneticists, physicists, and atmospheric chemists, and involves new ways of working through the use of highly innovative imaging and transcriptomic analysis.

Techniques that will be undertaken during the project

Techniques involved in this project include molecular genetics and microbiology, transcriptomic analysis, bioinformatics, biochemistry, atmospheric chemistry, tissue culture and *ex vivo* infection models and highly innovative imaging such as cryo-electron microscopy.