Lighting up the Lung
Multispectral Imaging of Lung Disease in Intensive Care
Helen E. Parker and the Proteus team

£11.1 billion
Lung disease is the UK’s 4th most costly disease area. \[1\]

Lower respiratory infections
Upper respiratory infections
Trachea, bronchus and lung cancers
Chronic obstructive pulmonary disease (COPD)
Asthma
Other respiratory problems

Patients in intensive care are susceptible to developing lung infection. Because diagnosing these infections is slow and ineffective, doctors are often forced to prescribe broad-spectrum antibiotics which could lead to antimicrobial resistance.

There are few public health issues of greater importance than antimicrobial resistance (AMR). \[2\]

Imaging lung disease in intensive care could help doctors diagnose quickly and treat effectively.

1 Context
Lung disease is the UK’s 4th most costly disease area.

2 Lung Imaging

a) We use novel fibre optics to reach the deepest parts of the lung where infection may take hold. The fibre has an imaging component as well as capillary channels. By spraying the area with molecules called Smartprobes, down the capillary channels, we can visualize disease.

b) Smartprobes can be squirted down the fibre into the lung. These are molecules that fluoresce only when in the presence of bacteria (or other disease of interest). This means that the Smartprobe is off when there is no bacteria and on when there is bacteria.

c) Collagen and elastin, which are proteins that give your lungs elasticity, actually fluoresce green. This makes it difficult to see bacteria that have been labelled with Smartprobes.

3 Multispectral Lung Imaging

Spectra of healthy lung tissue (top) and Smartprobe-labelled bacteria (bottom) show how similar they are in colour. Both are broad and have a strong peak in the green section. However, there are slight differences between them that can be used to separate them in images.

Ratiometric imaging adds enhanced contrast using the unique spectral characteristics of the imaging targets. This enables us to better understand the images produced both in autofluorescence and molecular imaging contexts. For example, we can identify green bacteria even on a background of green lung tissue.

Images are now presented with a new colour scale, where the values on the bar distinguish the origin of the fluorescence – healthy lung tissue or labelled bacteria.

References

[2] UK Five Year Antimicrobial Resistance Strategy 2013 to 2018

Acknowledgements
We would like to thank Engineering and Physical Sciences Research Council EPSRC United Kingdom Interdisciplinary Research Collaboration grant EP/K03197X/1 for funding this work.