Personalised Medicine - You're unique, so your medicine should be too: Precision Antimicrobial Prescribing in the ICU using Machine Learning

Edward Barker, PhD Student in Digitial Health & Care, Department of E&EE
Supervisors: Andrew Dowsey, Ranjeet Bhamber, Chris McWilliams (University of Bristol), Chris Bourdeaux (Bristol Royal Infirmary)

Summary: This project takes information from electronic health records, labs, and bedside health monitors, then using a type of machine learning called individualised treatment effect inference produces an antimicrobial prescription, to increase chances of survival and minimise unnecessary antibiotic use

Motivation of project

Sepsis is a widespread infection of the bloodstream, and can be a life-threatening medical emergency. Most importantly, sepsis can cause someone's condition to deteriorate in a matter of hours, and so early identification of the infection, and then appropriate treatment, is crucial in terms of increasing a patient's survival.

Currently, it can take a day or more to determine what organism a patient is infected with, and so often "broad-spectrum" antibiotics are used. These are antibiotics that target many organisms, including healthy bacteria in your gut and elsewhere.

Why is this so important?

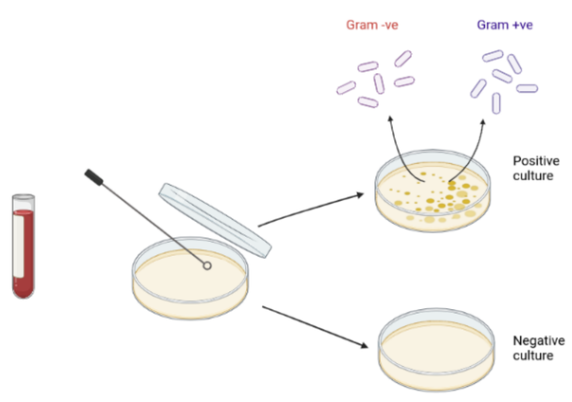
This current approach has two problems:
1. We use a lot of our broad-spectrum antibiotics. We need to use these sparingly as there are few new ones in development, and organisms are becoming resistant to the existing ones.
2. More targeted yet delayed antibiotics increase survival of the patient. The choice of the antibiotic, and the patient's response, very much depend on the characteristics of the patient.

Correlation vs Causation

We need to take causality into account to look at the relative risks and benefits of different antibiotics. Most machine learning models currently look at association. We can say that when the weaher is hot, people go to the beach and they eat ice cream.

The trouble is, we can find "spurious" or wrong correlations. We could find that shark attacks are correlated with ice cream sales. Really this is just that hot weather is associated both with ice cream sales, and also with people swimming at the beach, and so there is a "back-door" path.

Using causality directly in a problem such as antibiotics for sepsis means we can adjust the fact that the choice of treatment is dependent on the characteristics of the patient, as well as finding links between the patient's characteristics, the infection, and the best antibiotic. We can then predict how they would respond to different treatments, and prescribe a targeted antibiotic that gives them the best chance of survival



Blood (and other kinds of) samples are taken from a patient and investigated to see what organisms are responsible for an infection.

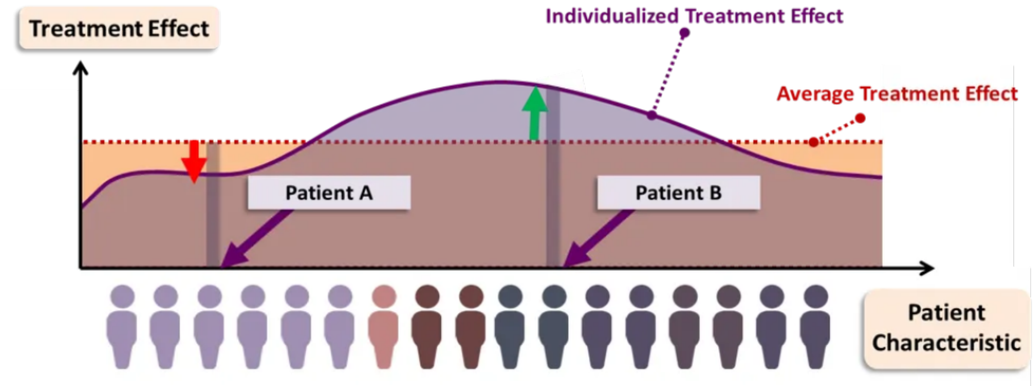
This takes a long time, often 24 hours.

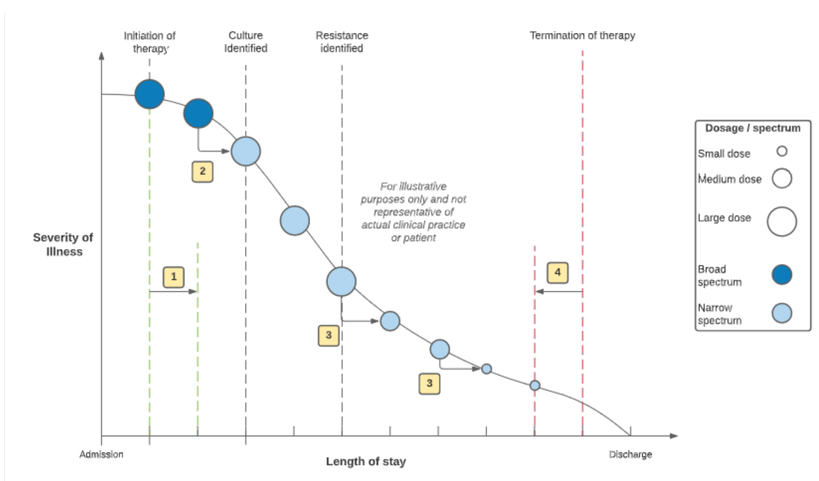
The majority of samples don't turn up a result.

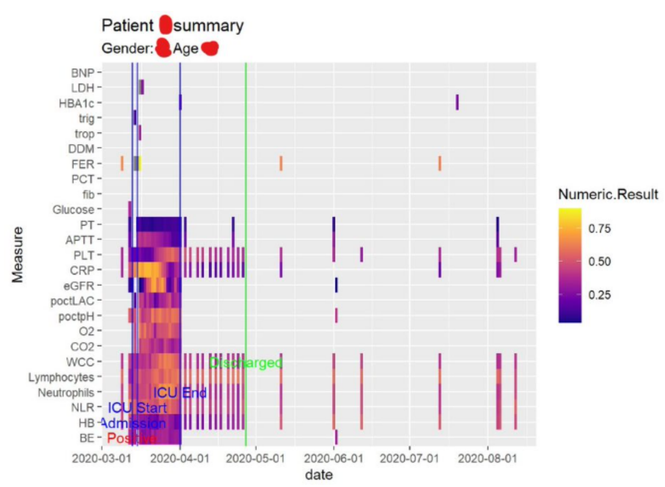
We need an additional way to choose antibiotics that is faster, and more consistent.

What works best for all patients, on average, doesn't necessarily work best for an individual.

Often randomised control trials will use a wide variety of individuals,to make sure that they aren't skewing their sample. However, they may find that a new treatment for exammple may boost attention span by an **average of 50%**. But this could be an **increase** of 80% for 75% of the population, and a **reduction** of attention span of 40% for 25% of the population.







What Next?

This project has been working with data from a publicly available Intensive Care Unit dataset; MIMIC. The next step is to trial these techniques with the "Systemwide Dataset"; integrated care records from the Bristol area.

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Bristol Data & AI Showcase

Working together to do good with data