

The genetic makeup of antibiotic resistant *Shigella* spreading around England and abroad

Most bacteria, also known as germs, are harmless. However, some bacteria can make you sick. One kind of bacteria that can make you sick is called *Shigella*. They can cause a sickness in your guts called shigellosis. This can make you: feel hot, feel sick, have tummy cramps, and have blood in your poo. *Shigella* can spread by getting even a tiny bit of poo in your mouth. This means that *Shigella* can spread when having sex. *Shigella* can also spread by eating and drinking food and water that have poo in them. There are four kinds of *Shigella*. Our biggest piece of work so far looked at the genetic makeup and spread of a kind of *Shigella* called *Shigella sonnei* (*S. sonnei*). This *S. sonnei* has become a bigger problem, as it has spread around England and other parts of the world.

Antibiotics are medicines used to kill bacteria. We saw that many antibiotics do not work against this *S. sonnei* – the *S. sonnei* have become antibiotic resistant. The *S. sonnei* are resistant to so many antibiotics that they are called extensively drug resistant (XDR). This XDR *S. sonnei* is resistant to ciprofloxacin, ceftriaxone, and azithromycin - three out of the four antibiotics recommended by the World Health Organisation (WHO) for treating shigellosis. This is a problem because some people with shigellosis need antibiotics, or they will get seriously ill and may die.

Like us, bacteria have DNA. DNA is like a recipe book that our body uses to build our muscles and organs. Bacteria can use DNA as a recipe to build tools that stop antibiotics from working. We worked together with scientists from France, Belgium, Australia, and the USA. We saw that all of the XDR *S. sonnei* were building enzyme proteins called beta-lactamases (tiny scissors) which cut antibiotics up to stop them from working.

Genes are short sections of DNA that hold the code to make proteins. The *bla*_{CTX-M-27} gene - which codes for the beta-lactamase enzymes - is found on the p893816 plasmid in *S. sonnei*. A plasmid is a piece of DNA, shaped like a ring. Plasmids can be made thin by twisting them up like a rubber-band. This DNA is copied and pushed through a tube from one bacterium to another.

Looking at the genetic makeup of these *S. sonnei* means we now know that these XDR *S. sonnei* have spread around many countries quite quickly. By monitoring the genetic makeup of this XDR *S. sonnei*, we can help predict future outbreaks of XDR *S. sonnei*, and help make recommendations to prevent the *S. sonnei* from becoming resistant to all recommended antibiotics.