# The War on Bacteria – Are We Nearing the End?

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*Antibiotic resistance is currently one of the biggest issues of modern medicine. An increasing number of resistant bacteria pose a serious threat against human health. To be able to deal with this problem, it is important to understand the mechanisms behind resistance in bacteria. Streptomycin is an old and well-used antibiotic that has been important in many areas, including tuberculosis treatment and pesticide treatment of fruit orchards. In my project, I have investigated the genetics behind the rise and dispersal of streptomycin resistance.*

## Streptomycin resistance

Streptomycin is an antibiotic classified as an aminoglycoside. This class of antibiotics kills bacteria by negatively affecting its protein synthesis. The protein synthesis is an important process since it creates all the proteins that builds the bacterial body and makes the bacteria function normally. However, bacteria can quite easily get resistant to streptomycin. This is because they are very adaptable organisms. Their relatively short generation time along with a high tendency to mutate gives them an advantage, since a population can quickly adapt to changing conditions. Resistance to one or several antibiotics is an advantageous property that can quickly arise and spread among bacteria.

**Did you know?**
Antibiotics has been around for quite some time. They were first discovered in the 1920s by Alexander Fleming.

Streptomycin was the first ever antibiotic to be successfully used against tuberculosis.

### Genes are important

Streptomycin works in a very specific manner to effectively kill bacteria. This means that the bacteria can become resistant if the specific targets are somehow changed. The genes that control these specific targets can randomly get a mutation, which disrupts the specificity of the antibiotic. However, mutations can only occur spontaneously, meaning that bacteria cannot control if resistance arises or not. If a lucky bacterium gets a mutation, this mutation can spread like wildfire throughout a population.

### Heritage and horizontal gene transfer

If a bacterium becomes resistant against streptomycin through a mutation, its progeny will definitely inherit the mutation. Bacteria reproduces without any sexual interaction, meaning that the progeny is a genetic copy of its parent. However, this is not the only way to spread the resistance. A process known as horizontal gene transfer can occur between two mature bacteria both within and between species. Horizontal gene transfer is divided into three different types of mechanisms; conjugation, transduction and transformation. Conjugation is the union of two bacteria through a pore, where DNA can be transferred between them. The second mechanism, transduction, is the transfer of DNA between bacteria through viruses called bacteriophages. Viruses that infect bacteria can accidentally pick up some bacterial genes in the infection process. These can then be transferred to another bacterium. The last mechanism, transformation, is the uptake of free DNA from the environment. DNA is frequently found in many bacterial environments and some bacteria possesses the ability the take up this DNA.

**Why do we need to learn this?**
Learning more of the mechanisms behind resistance is highly important to be able to overcome the problems resistant bacteria causes in our healthcare. Extensive research is much needed if we ever want to control harmful bacteria and minimize the diseases caused by them. Thanks to advances in medicine and technology a solution is hopefully just around the corner.

## More information

Nordin S. 2017. Uppkomst och spridning av streptomycinresistens hos bakterier. Independent Project in Biology, Uppsala University.