

Antibiotic resistance

INTRODUCTION TO ANTIBIOTICS

Antibiotics (antimicrobial drugs) are mainly used to destroy bacteria that cause infections and illnesses in both humans and animals however, they can only be used for certain bacterial infections and are not effective for viral infections for example, sore throats (although they can be caused by bacteria) and colds. Other uses of antibiotics include acne medication and cleaning agents. Using antibiotics at any time can have side effects and will contribute to the development of antibiotic resistance in which bacteria develop the ability to overcome antibiotics and therefore, reduce the drug's effectiveness at treating bacterial infections.

SCIENCE BEHIND ANTIBIOTICS AND HOW BACTERIA BECOME RESISTANT

Penicillin is the most famous antibiotic since it was the first one to be accidentally discovered by Alexander Fleming in 1928. The first successful treatment with Penicillin was in 1942, and during World War II in 1945, Penicillin was mass-produced and used to fight bacterial infections among soldiers. However, there are people who react adversely to Penicillin which makes them allergic to it. Due to the constant use of Penicillin and other new antibiotics developed after this, antibiotic resistance has increased.

Most antibiotics, including penicillin, destroy bacteria by preventing it from synthesising a molecule called peptidoglycan in the cell wall which provides strength for the cell to survive. However, there are other ways to destroy or stop bacteria from multiplying, another antibiotic may inhibit important molecules called tRNA from binding to ribosomes (where protein synthesis occurs) in the bacterial cell so that proteins are not produced - without proteins, bacteria is dysfunctional in reproducing asexually.

Overuse and misuse of antibiotics has played a part in an increase in resistant bacteria. When an individual has been overprescribed antibiotics, the bacteria in their body has been exposed to it frequently and can become resistant in multiple ways for instance, random genetic mutations. If random mutation has occurred in which a bacterium is not affected by antibiotics anymore, the bacterium which possesses this genetic material is able to transfer their genetic information to other bacteria increasing the number of resistant bacteria. Natural selection will take place

¹ <https://www.nhs.uk/news/medical-practice/inappropriate-antibiotic-prescribing-by-online-pharmacies-reckless/>

and these resistant bacteria can then rapidly reproduce creating a whole population of antibiotic-resistant bacteria or 'superbugs'.

There were (and may still be) online pharmacies whom were illegally selling antibiotics to their consumers in 2017. The UK public misusing antibiotics by using it for viral infections or acne can unknowingly spread antibiotic resistance in the same way as overusing them.¹ An international team of researchers found a 65% rise in worldwide consumption of the drugs from 2000 to 2015.²



ANTIBIOTICS AS FOOD FOR BACTERIA

There was an article in New Scientist about Bacteria using antibiotics as a source of food – ten years ago, Gautam Dantas, a professor from Washington University in St Louis and his colleagues discovered that some bacteria can eat antibiotics. As part of their experiment, they found that bacteria growing in soil were feeding on penicillin (an antibiotic) which led to exponential growth. After, they did some more work to find out how bacteria did this. Firstly, the bacteria use an enzyme to resist the antibiotic and then use a couple of other different enzymes to break down penicillin before many more enzymes enable the bacteria to use the carbon in penicillin as a food source.³

As of May 2018, there are no diseases caused by bacteria that are known to thrive on antibiotics in this way which gives us an advantage to develop new antibiotics that cannot be broken down in this way.

COLLAPSING SUPPLY

Recently on The Guardian, there was an article about the antibiotic resistance crisis worsening due to the collapse in supply. Limited access to specific antibiotics has led to less appropriate ones being used and using lower doses to treat bacterial infections which can in fact spread antibiotic resistance. The article suggests that worldwide supply shortages are due to low profits meaning low production

² <https://www.theguardian.com/science/2018/mar/26/calls-to-rein-in-antibiotic-use-after-study-shows-65-increase-worldwide>

³ <https://www.newscientist.com/article/2167660-how-some-resistant-bacteria-can-even-eat-antibiotics-as-food/>

of antibiotics and that it is expensive and risky to develop new antibiotics since they are rarely used in fear of the development of resistance. Since the production of ingredients for antibiotics are mainly based in India and China, if there is a problem occurring at one factory, it causes global shortages.

WAYS IN WHICH ANTIBIOTIC RESISTANCE IS BEING PREVENTED

In schools, students are taught about antibiotic resistance which raises awareness in hope that they will understand the importance of prevention and share with others as they grow up. Healthcare professionals can be involved in the prevention by only prescribing an antibiotic if it is the only way to benefit the patient and ensuring that they use the antibiotic as instructed. Pharmacies are not permitted to sell antibiotics over-the-counter to the public thus, if anyone desires to use an antibiotic, they must visit a doctor to consult them and decide whether or not the patient needs it. There is plenty of information online about how an individual can go about to help prevent resistance.⁴ Vaccinations that are carried out on children in the UK leaves a great impact on reducing the rate of antibiotic resistance because if there was a virus in one's body, their immune system is able to fight it off so that less people will demand for antibiotics for their viral infections.

Good sanitation and hygiene in hospitals and clinics also contributes to preventing resistance. In surgical theatres, there is excellent infection-control and practice which prevents any patients that come in from being infected.



HOW CAN WE IMPROVE ON CURRENT METHODS TO PREVENT ANTIBIOTIC RESISTANCE?

Firstly, water, sanitation and hygiene needs to be improved in public places whether it may be investing in more clean water worldwide, keeping public toilets clean at all times or promoting hygiene in school to kids from a very early age to prevent transmission of bacteria and infections. In East Asian countries like Japan, China, Vietnam and Korea, children and adults wear surgical masks wherever they go to reduce the risk of them getting an infection or virus

⁴ <https://kreftforeningen.no/antimicrobial-resistance/how-can-we-prevent-antibiotic-resistance/>



from anyone and anything. This is an extremely fundamental but basic practice in those countries which can also be practiced in Western countries like the UK to prevent infections so that antibiotics will not need to be used in the first place.

Instead of companies having ingredients of their antibiotics being produced in a few factories in a couple of countries, it can be spread out in other countries which have higher reliability and efficiency in production. Another step forward is that more universities worldwide can invest into research to develop more effective antibiotics. In order to stop the prescription of less-appropriate antibiotics which still leaves microorganisms in the patient's body and essentially wasting the antibiotics, we need to do everything above.

If antibiotic resistance continues to increase exponentially, there will be one day where common infections will be untreatable and although it is easier said than done, we must start with at least one of those things and progress.

Bibliography:

- <https://www.cdc.gov/antibiotic-use/community/about/antibiotic-resistance-faqs.html>
- <https://www.theguardian.com/society/2018/may/31/antibiotic-resistance-crisis-worsening-because-of-collapse-in-supply>
- <https://www.livescience.com/44201-how-do-antibiotics-work.html>
- <https://www.livescience.com/58038-bacteria-facts.html>