

## Antibiotics: A double-edged sword

By Vignesh Raj

Antibiotics are merely the collection of chemical compounds that inhibit the growth of or kill bacteria. However, according to a few sources across the internet, they have saved an estimated 200 million lives [\[1\]\[2\]](#) since the first antibiotic, penicillin was accidentally created in Professor Alexander Fleming's laboratory back in 1929. Since then, antibiotics have expanded into a multi-billion dollar industry known today as the 'Generic Antibiotic Industry' [\[3\]](#). Along with the expansion came the presence of more antibiotics that were also significantly more potent than that of Penicillin. As a result, considerably lesser people were dying or being affected by severe bacterial infections such as meningitis [\[4\]](#) or scarlet fever [\[5\]\[6\]](#).

However, in the 21st century, came the one thing that would make 'Cabin Fever' and its comic book or fictional counterparts a reality. As popular information content creator Kurzgesagt puts it, 'We treat this powerful medicine as a commodity instead of the game-changing achievement of science that it is' [\[7\]](#) in his video that discusses on the various problems overconsumption of antibiotics bring. The usage of the drug as a frontline medicine is not practical and a severe problem that has governments and organisations around the world scratching their heads to solve.

The outcome of how this kind of usage is dangerous for the human race can be summarised in an analogy.

There used to be a guy named Bob. Bob was a heavy antibiotic user; he used it every time he coughed or sneezed. He only used one type of antibiotic, the commercial name of which shall be altered for this essay, Liposome. The coughs and sneezes would also disappear every time Bob took in the medicine. However one day, Bob fell ill with pneumonia that is caused by *Streptococcus pneumoniae*. Feeling lucky, Bob took in Liposome. However, this time, he did not get cured. Instead, his lungs flooded with mucus and Bob died of suffocation.

The thing is, Bob would probably have lived if it had not been for his overnecessant usage of the antibiotic. The fictitious antibiotic, Liposome and many other antibiotics are meant as last minute resorts. When all medicines, homoeopathic treatments have failed, antibiotics are the final frontier for which to defeat the bacterial infection. This is due to their very destructive nature. Think of it as dropping a nuclear bomb on a highly populated area. When the bomb

detonates, it kills everything. The same with antibiotics; they kill good and bad bacteria. The good bacteria are vital to the survival of a human. Without them, the body cannot synthesise proteins and other enzymes that do the basics such as catabolising starches, on a massive scale needed for the body to function normally. The good bacteria are also responsible for preventing bacterial infections in the first place, which is the reason why antibodies should be a last resort. The body's soldiers do not want to be killed in the first inning.

Another thing about antibiotics is that they are easy to be adapted to by bacteria. The chances look slim, but one in one million or ten million [\[8\]](#) bacteria genetically mutate to obtain the Antibiotic<sup>R</sup> gene; which is the antibiotic resistance gene that doctors and researchers are worried about in the future. In fact, their worries have already come into reality when in 2017, certain bacteria are found to be resistant to Colistin, a last resort antibiotic [\[10\]](#). Things like this occur because of the highly ubiquitous usage of very potent antibiotics to treat infections as minor as the common cold which cannot even be killed by antibiotics because they are caused by viral infections which are not in the jurisdiction of antibiotics.

To elaborate on how bacteria become resistant to antibiotics, here is a little script:

Hi.

I am Bacter Bacillus known by humans as a 'bacteria'.  
I was brought into a healthy human body by my parent less than 2 seconds ago.  
I like this place.  
Time to metabolise.

Oh no!  
The Immune system found that I was dumping toxins which are a byproduct of my metabolism into the human body.  
Time to fight them with my fellow brothers that have existed for about the same time I have  
200 million of them to be precise

Immune system has been overwhelmed!

Ha!  
The immune system is of no match to my brothers and I!

20 minutes later,

Oh no!

I can see antibiotics floating in the distance disarming and killing each one of my brothers

I am next to die

20 seconds later,

I am still alive?

How?

I should have been killed by the antibiotics

Every one of my brothers are dead except for me!

I guess I must have the wild card which is the Antibiotic<sup>R</sup> gene

A rare and blessed thing for bacteria like me to obtain

Time to run.

I see Macrophages that would eat me if I stay here for too long as alive.

32 minutes later,

I am back with my army of 216 number of bacteria.

All of which contain the Antibiotic<sup>R</sup> gene I have and more

2 hours later,

Yes, we have defeated the antibiotics and the immune system and have taken over the body

And just like that, bacteria resistant to antibiotics dominate the immune system and any additional players. All of this happened because one bacteria that was immune to the antibiotic escaped from macrophages, our body's bacteria eaters. Once that happened, the bacteria population rebounded, and antibiotics were unable to cure the person. If this happens to just one person eating antibiotics, thinking about the number of people this can happen to is shuddering to think of. And this is under the assumption that the person is isolated from other people which is not probable in real life. As a result, if humans carrying this bacterium that is resistant to

antibiotics and transmits it to someone unknowingly, this cycle can continue and, eventually, end up with a superbug that trumps all antibiotics thrown at it.

While this problem sounds like there is no end to it at this point, the future can declare an end to this. And the solutions are straightforward to figure out. The first of the solutions would be that of ranking the medicines based on their potency. While this is already implemented in a way [\[10\]](#), it only covers cost and plans as opposed to restricting its usage. As a result, a first step to solving this problem would be ranking the medicines in a hierarchy that is recognised on a global level. This hierarchy would determine how the medicine would be reached to the general populace. For instance, the lowest tier would contain run of the mill antibiotics that have lower affinity and potency would be readily available to consumers in the way that they can directly purchase it from their local pharmacy. And for the highest tier of the hierarchy, they have to get special clearance from medical specialists working in hospitals who would then allow for the medicine to be sent to them from the manufacturer directly. In this way, the last resort antibiotics such as ceftriaxone [\[11\]](#) are only available to those who dearly need it to survive. This restricted access to certain drugs ensures that bacteria cannot become immune to certain antibiotics because the antibiotics are not used to kill the bacteria just yet, which results in really having a final fighting chance with bacteria, usually ending in curing the ill.

If the solution above comes into fruition, it must be accompanied by education to the public regarding the matter so that the public do not get alarmed or angry that they cannot find their highly effective antibiotics on the shelves of the pharmacies they visit.

Also, more funds must be put into R&D of more 'last-resort' antibiotics. This is to, for one, increase the probability of curing when the disease comes to the end stage, and for another, evolution has taught us a lesson that no matter how much antibiotics are avoided, bacteria still find a way to become immune to that antibiotic due to the way probability and mutation works.

Hopefully, the problems mentioned above, solutions, reasons, analogy and script were enough to emphasise why antibiotics are such a double edged sword and how to solve it in the long run. That would mainly be because they kill... everything; which is a good and bad thing because the good thing is that harmful bacteria would, for the most part, die and the bad thing is that the good bacteria would go along with it, causing the body to be impaired in certain functions. Also, while most bacteria die because of antibiotics, some immune ones remain and strike back,

usually in a fatal way. So, to tackle them, the solutions would be that to restrict access to drugs with a hierarchy system plus education, with the investment of funds into Research and Development programmes catered to pioneering new, more potent drugs with more affinity to sustain us humans for a long time.

**The end**

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