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Berkeley Scientific Journal

Title

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Permalink

<https://escholarship.org/uc/item/4mw6f48c>

Journal

Berkeley Scientific Journal, 21(1)

ISSN

1097-0967

Author

Zhang, Yizhen

Publication Date

2016

DOI

10.5070/BS3211033744

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Undergraduate



ANTIBIOTICS: FROM MODERN MEDICINE TO GLOBAL RISK

BY YIZHEN ZHANG

REVIEWING THE EVOLVING OPINIONS AND EFFECTS OF ANTIBIOTICS

You probably heard this story before, but you probably don't know how the story evolves. In 1928, a messy scientist forgets to check his bacteria cultures for a few days and comes back to find a mold growing in it. The key discovery was that no bacteria were growing around the mold. That scientist, Alexander Fleming, then worked with two other scientists to develop a drug from the mold to inhibit and kill bacterial growth. This finding was so invaluable that these three scientists won a Nobel Prize in Medicine in 1945. This drug is Penicillin. Penicillin, a group of antibiotics, revolutionized the world.

Antibiotics were the first effective drugs used to treat infections caused by bacteria. As a result, antibiotics immediately played a vital role in saving millions of people around the world. People who would have died from a fever or something as small as an infected animal bite survived. Today, however, the negative

effects of antibiotic use, or shall we say misuse, grow clearer and clearer. When antibiotics are overly consumed, they will not be effective when needed. This is known as antibiotic resistance. Thus, with the improper antibiotic usage, over time, the opinion of antibiotics and antibiotic research has shifted dramatically.

In September, the United Nations had a meeting, declaring antibiotic resistance “the greatest and most urgent global risk.” This is actually only the fourth time the United Nations had a meeting regarding a health issue, last time was in 2014 regarding Ebola. The significance of the antibiotic problem is so big that Margaret Chan, the World Health Organization's executive director, also asserted that antibiotic resistance “poses a fundamental threat to human health, development, and security” at the conference. If world leaders are now scrambling to control this major problem, how did such a miracle

medicine go so wrong?

When antibiotics first rolled out onto the streets in the 1940s, the effects were immediate. Within two decades, life expectancy increased by over 7%, which is approximately eight years¹. As expected, the increase in life expectancy was immediately followed by a great population boom. In America alone, the population grew by 33% in the 1940s, according to the United States Census. This evidently shows that antibiotics have an overwhelmingly positive value in improving the quality of life. However, this clear benefit of antibiotics also led to a curse. To support growing populations, antibiotics began to be used in the food industry. This began the path to antibiotic abuse.

Logically speaking, a larger population requires more food to support it. Thus, to meet the growing society's demand on meat, research in antibiotics' effect on animals began to develop. Soon

“Poses a fundamental threat to human health, development and security”



enough, antibiotics were discovered to increase life span and increase the weights of first rats and hamsters, then farm animals such as cows and chickens⁵. It has been found that antibiotics can help animals become healthier, live longer, and grow faster. In the short term, it was a blessing for the meat industry. More animals could be grown in the same space faster. This resulted in incredibly low meat prices, something we still have today.

Meanwhile, parallel research in understanding the threat of antibiotic resistance grew. The first report of a resistance to antibiotics was in

the 1950s in Japan. Antibiotics were used to treat a woman with diarrheal disease caused by bacteria, but to no effect². The first defined strain of antibiotic resistance is Methicillin resistant *Staphylococcus aureus*, commonly known as MRSA.

Interestingly enough, this risk was predicted from the very beginning. The discoverer of antibiotics, Fleming, himself had warned, “The time may come when penicillin can be bought by anyone in the shops. Then there is the danger that the ignorant man may easily underdose himself.” This is what he had said in his Nobel Prize acceptance speech in 1945, when the world listened. Like most advice

and warnings, little actions were taken.

From the very beginning, Fleming had pinpointed the danger in antibiotics – underdosing. In other words, the negative effects of antibiotics are caused because antibiotics will kill both the good bacteria that protect the body and the disease causing bacteria. Thus, if antibiotics are consumed at low doses, it will allow some of the drug resistant bacteria to remain, thrive, and takeover. If the disease causing bacteria don't have any effects immediately, it will render any future antibiotic use as fruitless. Therefore, if antibiotics were misused, one would need a higher dose or a new strain of antibiotics every time a bacterial infection occurs. That is just the “easy” part because the resistant bacteria will also grow stronger and stronger. So in a perfect world, we may be able to consume however much antibiotics needed or to create unlimitedly strong antibiotics to combat all the bacteria and the future evolutions. However, realistically, the human body is not strong enough, medicine is not advanced enough to achieve this, and the process would be too inefficient.

Thus far, the largest misuse of antibiotics remains in the food industry. Livestock is fed antibiotics in the hope of getting fatter and growing faster. As the consumers, we will also ingest the antibiotics that were fed to these animals, indirectly building up our own tolerance. As a result, in 1969 a Swann report was published raising awareness to the dangers of antibiotic use in the food industry for growth promotion⁴. Only in 2006, the European Union banned the use of antibiotics to fatten up livestock. By 2013, 46



Colonies of bacteria are grown on an agar plate. Only colonies of bacteria that are resistant to the antibiotics on the plate grow while the rest were killed off. This principle is very important in biological research.



Poultry is most commonly raised on a large amount of antibiotics. This allows producers to raise more chicken in the same confined space. Additionally, the chicken are larger in size and grow significantly faster. This is the reason why most of the poultry we have are

Compared to 30 years ago, it is much harder to get an antibiotic prescription.

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different countries passed regulations controlling the use of antibiotics in meat production. Considering the current food industry, unfortunately, it is significantly easier to regulate the use of antibiotics than to completely ban them. The primary problem is costs. If antibiotic use is eliminated, animal product costs would increase dramatically hurting the rest of the population³.

Since this antibiotic resistance affects the entire world and is a major public health issue, doctors around the world are getting educated. Compared to 30 years ago, it is a lot harder to get an antibiotic prescription from the doctor today. It shows how our society adapting and improving. Doctors are wearier of the other effects of the prescribed medication, and patients take the extra step to do more research.

We, as a society, are always moving forward and adapting. Even though the view of antibiotics is no longer as black and white as before, antibiotics still play a significant role in medicine. At its inception, antibiotics quickly shook

the entire world. Many people argue that it marks the beginning of “modern medicine.” After decades of improper usage, opinions of antibiotics became more gray as people became more aware of the negative effects. Currently, much more research needs to be done to better understand ways to treat bacterial infections. Nations still need to have legislation to prevent misuse antibiotic misuse. Looking back, antibiotics are similar to almost any type of cutting edge technology, such as cell phones. While it changes all of our lives and is impossible to imagine life without it, it comes at a cost.

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