Text Book Chapter

**Chapter 1: China and The Antibiotic Resistance Crisis**

**Introduction to Chapter 1:**

Beforewe jump into this chapter we are going to briefly discuss key factors and concepts to better understand the chapter. First, you need to understand what antibiotics are and how they are critical to everyday life. Antibiotics are an antimicrobial substance that plays an active role against bacteria, and they are the medication that is the most important type of antibacterial agent for fighting any type of bacterial infection. Antibiotics can only treat bacterial infections and not viral infections such as a common cold. Infectious diseases were why millions of people in the up until the early 20th century. Infectious diseases had a large mortality rate worldwide. However, in 1928 Sir Alexander Fleming discovered penicillin and the medical field was forever changed. In the 1950s and 1970s there was a “golden era” for the discoveries of new antibiotics. To put into perspective of how difficult creating and discovering new antibiotics are there has not been new classes of antibiotics since. If there is a new antibiotic that is discovered the medication does not last long or become resistance quickly.The way that antimicrobial drugs work is the B-Lactam (beta-lactam) and glycopeptide antibiotics work together by interloping and constraining with the cell wall synthesis of a particular target bacteria.

Now that we have talked about what antibiotics are and where they came from we can go into the antibiotic resistance crisis. Antibiotics are now becoming resistance, meaning that bacteria have the ability to resist the effect of antibiotics for which they are initially proposed to perform. Antibiotics can become resistant naturally, a mutation change in their genetic coding, or even by a particular species attaining resistance from another species which they go under selection pressures from antibiotic use. With antibiotics becoming resistance to the medical world it is a growing threat. If all antibiotics become resistance, then there will not a medication to cure infections.

**Chinas’ Antibiotic Crisis and More:**

 Imagine this, you go to your local hospital to get a common surgery such as hernia removal, gallbladder removal, or extracting your tonsils and then the antibiotics you are given after the procedure do not work because your body has a resistance to them. A common surgical procedure is now life threatening because your body cannot fight the infection with the antibiotics provided or any other microbial drug. You are now resistant to the all the antibiotics known in the medical field. This scenario can become real, and will become real if researchers and the public ignores the importance of the antimicrobial resistance crisis.

Do you know the importance of the antibiotic resistance crisis, or rather do you know what the antibiotic resistance crisis is? Let’s discuss what the antibiotic resistance crisis is and its importance globally but first you need to understand the definition of antibiotics and antibiotic resistance. An antibiotic is a medication such as penicillin or its derivatives that inhibits the growth or destroys microorganisms. Antibiotics cure common infections that are bacterial infections such as strep throat, urinary tract infections, and some pneumonia. Antibiotic resistance is microbe’s ability to resist the effects of medication that once could successful treat a microbe. Imagine if we did not have antibiotics, common infections would kill millions across the globe. Now, the antibiotic resistance is a health crisis that is affecting millions globally. This crisis occurred due to there being an overuse in antibiotics throughout the world in not only humans but also animals. The antimicrobial resistance (AMR) is increasing in attention across the globe and it is a public issue that is widely addressed and discussed. When we live in a world where bacteria are always ten feet ahead of the production of new antibiotics, it causes struggle and a crisis. It affects some countries more than others, and China is one of the countries who is profoundly being affected.

China is one of the world’s largest producers and consumers for the pharmaceutical industry and this country is witnessing first-hand the primary symptoms of the antibiotics resistance crisis. (Qiao, Ying, Singer, & Zhu 2018, p.160) First, as readers, we need to understand the importance as to why the antibiotic resistance crisis is affecting China the way that it is. The reason it is affecting China to a great extent is due to the fact that antibiotics are over prescribed, and including the agricultural industry it is overused and misused. In the lower income hospitals and less developed parts of China are the problematic parts. China is at the top of the chart for the use of antibiotics in everyday life. Researchers are predicting that China’s antibiotic consumption for people and the agriculture industry will be at 30% in 2030 and in 2010 it was at 23%. (Qiao, Ying, Singer, & Zhu, 2018, p.161) China has been reported to use 92,700 tones of antibiotics were consumed and of that 48% were consumed by humans and the remaining was consumed by animals. However, the rivers showed 46% of the antibiotic were released through the sewage. (Ying, et al.,2017 p.1072) With these numbers it shows that this daily dose is used 6 times higher than what the normal factor number should be.

**So What’s China’s Issue?**

The issue with China and the AMR is that the growth rate of AMR in China is much higher than any other country. China is a primary cause and reason for the rise in AMR within their country and globally. “In China, this substantial antibiotic use has given rise to the dissemination of antibiotic residues and antibiotic resistance in the environment.” (Qipao, Ying, Singer, & Zhu, 2018, p.166) However, China decided they needed to put a stop to it before the crisis is too far gone. The Chinese government decided enough was enough and the government called a national action plan in 2016 for the country. When China announced efforts to help pave a way to decrease antibiotic use, scientists said it was bold and responsible. With the alteration of feed stock given to animals there could be negative affects within the human population. This is not the only thing China has been implementing to raise awareness about the antibiotic resistance. China is acting now to reduce the use of antibiotics across its country and is taking measures as the following; Infection Control, Research and Development, Surveillance and Monitoring, Regulation and Law Enforcement, and Education and Training. The goal by taking these actions and measures were implemented to increase knowledge about this topic. China wanted to develop more of a detailed structure for the surveillance network of the AMR, they wanted to promote the health aspect of the AMR, to improve the understanding of the AMR, to regulate the sale and cost of antibiotics, and to encourage large pharmaceutical companies to invest into research.

With that, China is implementing ideas and going through a trial and error process, but they are struggling in other ways as well. China is not succeeding in producing new antibiotics, they are not finding a consistent antibiotic to share to its country and to the world. Researchers say it takes time and money, which most countries do not have to give to this particular problem. (Lowe, 2016) Chinese research labs are not receiving or getting the funding to successfully find a new antibiotic. The money that is being put into the research of new antibiotic is flowing out but not ever flowing back in. (Lowe, 2016) When the companies are not investing in the production of new antibiotics, the lack of funding continues to bring down the field. In the past 20 years, with the expectation of tigecycline, China has not produced a new extensively used drug that is resistant to gram-negative bacteria. (Wang & Minggui, 2018) China’s continuing industrial development could also cause setbacks in the development of antibiotics. They are a country who has a significantly large population with growing social and economic development.

**Antibiotics in Chinas’ Agriculture World:**

A big push that the Chinese government is implementing for the decrease of the antimicrobial resistance is within the agriculture industry and the environment. First, let’s understand why the Chinese government is pushing for the agricultural industry to significantly decrease the AMR use. Antimicrobial resistance genes (ARG) are all around the world and they are a huge part in the agriculture world. ARGs are in every part of the environment, they are a natural component in soil, water, and microbiomes. For human health the environment and agriculture of the AMR is critical and it has serious implications for impairing the effectiveness of antibiotic treatment and compromising public health. (Qipao, Ying, Singer, & Zhu, 2018, p.167)

In China, livestock are being over-medicated with antibiotics to kill off bacteria. Scientists in China are concentrated in swine, poultry, and cattle production more specifically for the AMR. These particular animals have driven the demand for antibiotics to help regulate infection control within the farms. China has a very dense population therefore meaning more people calls for more food. In China there are several animal feeding facilities to accommodate their population. Antibiotics are put in the feed to promote growth and help with disease prevention. The way that China farms their food must be changed and more of a hygienic approach must be implemented to decrease the use of antibiotics within livestock. In large farming industries there is little to no hygiene within those farms. Hundreds of animals being kept in a pin made for a size about half to what is supposed to be kept in. In 2017 China entirely quit using antibiotics in animal feed, and before they were the country who had the highest amounts of antibiotics within the feed. (Banin, Ehud, Diarmaid, Kuipers, & Hughes, 2017) China’s usage of antibiotics in animals is far more than any other country, reaching to 84,240 tons. For comparison the United States was 14,618 tons. The manure of these animals reaches over 2,000 million tons, and manure within these livestock animals are a major source in antibiotics. (Qipao, Ying, Singer, & Zhu, 2018, p.162) If livestock is continually used to produce these numbers then it increases the resistance within AMR.

Not only is antibiotics in livestock and their manure affecting the crisis, but so does the soil. Within the soil antibiotics can be introduced into the soil by irrigation from “reclaimed water, sludge and manure land application to crops or landfill, and the use of livestock wastes as soil fertilizers”. (Qipao, Ying, Singer, & Zhu, 2018, p.163) If more antibiotics are continually to be found in the soil and not reduced then it leads to resistance. The Chinese government is hoping to improve and decrease the production of antibiotics within the agriculture industry. They are also pushing veterinarians in China to help contain the AMR from increasing within their practices. They are pushing farmers and livestock industries to cut down or cut out antibiotics in those animals. If these two things, and the 5 implications the Chinese government is implementing in China could see a decrease in the AMR and be heading in the right direction.

Not only are they trying to push major efforts into the agriculture industries, they are encouraging physicians in China to take a stand. The Chinese government stated that they are demanding doctors to cut back on the antibiotic medications they prescribe. Physicians in China prescribe antibiotics to patients compared to other countries. Out of the patients that leave any hospital in China, 50% of those patients leave with some kind of antibiotics. Out of those 50% of patients that are prescribed antibiotics 25.3% of patients are prescribed more than two antibiotics to be taken at once, leaving 74% of patients that are only prescribed one antibiotic. (Qipao, Ying, Singer, & Zhu, 2018, p.161) The top 5 antibiotics prescribed in China were; amoxicillin, cephalexin, norfloxacin, ofloxacin, and tetracycline.

 One of the reasons China was over prescribing prescriptions was due to there being no regulation on the medication until 2011. In 2011 the Ministry of Health in China effectively started regulating the medication. During this year the percentage of hospital patients that were prescribed antibiotics dropped by 10% and decreased by 10% in the outpatient part of the hospital. There have been many instances that were reported in China that have showed the overuse of antibiotics affecting other countries. For instance, previous antibiotic resistant bacteria that was reported has now lead to cause infections in other countries. (Qipao, Ying, Singer, & Zhu, 2018, p.161) China also needs to address their public in greater detail of the importance of the AMR issue. “In China, the public has long held misconceptions regarding antibiotics and mistakenly believes they are general antimicrobial agents, leading to patients placing excessive pressure on clinicians. These misconceptions must be corrected”. (“A National Act Plan to Contain Antimicrobial Resistance in China: Contents, Actions and Expecations”,2016)

**The Fight to End the Antimicrobial Resistance Crisis:**

Ultimately, China is and will not be the country who makes the AMR disappear, it is going to take all countries across the globe. However, China has a great opportunity to serve as a leader through this process. “China has this opportunity to serve as an example to the rest of the world by demonstrating how the same multi-sector collaboration that delivers its national action plan on AMR must be followed by multi-sector implementations”. (Schwartlander, 2016) All of China’s industries will have to come together to help educate their public about the issue and they will have to come together to increase the efficiency for the betterment of each field. Health care, the environmental researchers, and farming companies will have to work alongside each other to reach a step in the right direction for the AMR.

 The antibiotics resistance is present in every country around the world and it is continuing to threaten the treatment of antibiotics. It is a global issue not just a China issue. Countries are going to have to become one to decrease the AMR before it spreads into something much larger than it already is. If the AMR is not discussed through nations globally then it continually increases to be a global public health issue. If this crisis is not reduced or resolved in some way researchers are estimating AMR related deaths will be 4.73 million in Asia each year and almost 10 million globally by the year 2050. (Ying, et al.,2017, p. 1072) China will need to work closely together with other countries and international organization in years to come to help address this rising issue.

References

A National Action Plan to Contain Antimicrobial Resistance in China: Contents, Actions and Expectations. (2016). Retrieved from http://resistancecontrol.info/2017/a-national-action-plan-to-contain-antimicrobial-resistance-in-china-contents-actions-and-expectations/

Banin, Ehud, Diarmaid, Kuipers, & Hughes. (2017, May 09). Editorial: Bacterial pathogens, antibiotics and antibiotic resistance. Retrieved from https://academic.oup.com/femsre/article/41/3/450/3806588

Lowe, D. (2016, May 13). A Plan for New Antibiotics. Retrieved from https://blogs.sciencemag.org/pipeline/archives/2016/05/13/a-plan-for-new-antibiotics

Qiao, M., Ying, G., Singer, A. C., & Zhu, Y. (2018). Review of antibiotic resistance in China and its environment. *Environment International,110*, 160-172. doi: 10.1016/j.envint.2017.10.016

Wang, & Minggui. (2018, November 13). Antimicrobial Resistance in China: Challenges and Actions. Retrieved from https://academic.oup.com/cid/article-abstract/67/suppl\_2/S127/5181269?redirectedFrom=fulltext

WPRO | China can help stop misuse of antibiotics. (2017, July 12). Retrieved from http://www.wpro.who.int/china/mediacentre/releases/2016/20160922-amr-op-ed/en/

Ying, G., He, L., Ying, A. J., Zhang, Q., Liu, Y., & Zhao, J. (2017). China Must Reduce Its Antibiotic Use. *Environmental Science & Technology,51*(3), 1072-1073. doi: 10.1021/acs.est.6b06424