**The Fight Against Bacterial Drug-Resistance**

Author: Sophie Oates
Major: Microbiology
Department of Microbiology and Molecular Genetics, Oklahoma State University, Stillwater, OK 74078, USA

**Key Words:**

Antibiotic, Resistance,

Bacteria are something that has been around long before mankind. Bacteria can often cause infections in the human body, and this is where antibiotics come into play. Antibiotics are generally used as antibacterial drugs. In the past few decades, because of the overuse of antibiotics, some bacteria have, through time, become resistant in order to survive in the environment. This has become a crucial issue for clinical treatment, and has caught a mass of attention. The current discoveries of the mechanisms of the drug-resistant bacteria have given new hope in finding a solution. The goal of new research may just put a stop to the battle between human and bacteria.

**Introduction**

Modern medicine continues to change with the changing needs of patients. Theses needs are directly correlated to the changes in pathogens that are becoming resistant to antibiotics. The medical field is racing to keep up with these changes in pathogen-causing bacteria. The use of antibiotics seems to be an old fashioned way of medicine, but they can save a great deal of lives for people with severe infections. Antibiotics destroy microorganisms or stop their function. Microorganisms are pathogens like bacteria that can cause illness by damaging our cells. For a simple illness, like the common cold, your white blood cells can destroy these microorganisms and release antibodies to help. Although, when a virus is severe enough you may need more antibodies to inhibit the virus or to treat the illness more abruptly. The most commonly known antibiotics are penicillin and tetracycline1. Since antibiotics have become so popular in recent decades, bacteria are beginning to evolve, through generations, to the environment causing antibiotic resistance as a result of the abuse of antibiotics. This adaptation of bacteria brings many problems for clinical anti-infection treatment.

**Recent Progress**

Drug resistant bacteria can be divided into two kinds of drug-resistance, genetic resistance and external resistance. Genetic resistance is a change made by natural selection; when a new bacterium is produced it inherits a change in its genome to protect them against other bacteria1. As a result of this advantage other organisms have developed a resistance to disease. External resistance, like genetic resistance, is when bacteria have a natural immunity to certain antibiotics determined by the bacteria’s chromosomes1. Bacteria acquiring drug resistance could be caused by the use of antibiotic when not necessary, or the use of antibiotics to kill bacteria that are no harm. The incorrect use of antibiotics by patients and doctors is the most common source of antibiotic resistance. When taking an antibiotic, they should be taken for the entire time they are prescribed3. Even if you no longer see symptoms, it is still essential to continue the antibiotic because the virus could still be in your system. In addition to taking the antibiotics in full length, they should only be taken when truly necessary. Antibiotics are frequently prescribed to treat illnesses that are not bacterial. They should not be given for viral infections, like influenza3. The bacteria that survive an antibiotic are the ones who reproduce bacteria that are drug resistant.

In recent discoveries, researchers have found that there are three main mechanisms of antibiotics resistance1. A majority of resistance mechanisms in bacteria are encoded with plasmid, which is a microscopic DNA molecule separated from a chromosome that can duplicate self-sufficiently2. First, some bacteria can use a mechanism called efflux pumps. These pumps can reverse transport systems in the membrane that pump the antibiotics out of the cell2. This is the type of resistance used in the bacteria resistance against tetracycline1. Next, an enzyme can alter the effect of the antibiotic making it lose its function and not do its intended goal2. Lastly, an enzyme is created that degenerates the antibiotic making it useless2. In penicillin, a beta-lactamase enzyme degrades the antibiotic reducing the fact that the penicillin will combine with the bacteria’s ribosome and it loses it antibiotic effect1.

As drug-resistant bacterial infections are becoming more prominent, society is up against a very serious issue. The only way to control the spread and creation of drug-resistant bacteria are to use antibiotics responsibly. It can be hard to find the precise amount of antibiotics needed; if too little is given then it can be easier to turn to broad-spectrum antibiotics. Also, the use of more than one antibiotic at the same time can also misattribute the functions of the antibiotic. To fix the prolonged growth of antibiotic resistance, it will take effort form both physicians and patients.

Clinical doctors normally suggest the use of a new drug rather than an older one because the changes to the drug could limit the drug-resistance. As an example, many drugs will have a first, second, and third generation. Though the first generation is normally stronger and the most effective, the third generation has been changed due to bacteria with an antibiotic resistance1. However, for a harsh infection the first generation could be chosen opposed to the third generation. There can also be differences other than strength; for instance, indication and therapeutic drugs have many differences. Therapeutic drugs have duality, meaning it heals but can also have toxic side effects1. Even frequently used antibiotics like penicillin can have dreadful side effects like anaphylactic shock2.

The main objective that could prevent antibiotic resistance is the funding and research of antibiotic drugs. The development of new drugs and drugs with high stability, or drugs with the ability for a dosage to maintain the chemical, physical, microbial and therapeutic effect during a time of storage or usage is a main purpose for research1. Finding new drugs is an enormous part of the effort, but improvement of other drugs can also be a solution. The development of enzymes that can inhibit the drug resistant bacteria, simply decrease it’s activity and improve the level of repressor proteins within an antibiotic are two of the recent progresses in the lab for new drug and in new generations. Eliminating the main activity of the drug resistant bacteria, including, efflux pumps and enzyme functions is the central goal in labs today.

**Discussion**

The use of antibiotics is so critical to today’s medicine that the only option is to work our way around the issue of antibiotic resistant bacteria. With more education to the community as a whole, more research, and more strict regulations, the issue can be resolved. New strategies are underway to find new antibacterial compounds and developing new trials and research. The complexity of bacteria allows it to constantly evolve; therefore the medicine must as well. The discovery of the bacterial mechanisms is a huge step. Bacteria drug-resistance can also be the root to many other unknown topics like genetic variation. The use of antibiotics reasonably by doctors, along with patients is crucial. The desire to learn more should grab attention everywhere. Every new revelation in these microorganisms is opening a door to more possibilities and scientific breakthroughs.

**References**

[1]Cui, H., Dong, Y, Wen, J. (2015). Analysis on the Bacterial Resistance Mechanism and the Rational Use of Antibiotics. Atlantis-Press. National Science Foundation, Retrieved from [www.atlantispress.com/php/downloadpaper.ph](http://www.atlantispress.com/php/downloadpaper.ph) p?id=25837606

[3] Mayo Clinic Staff. 2014. Antibiotics: Misuse puts you and others at risk. Mayo Clinic: Consumer Health. Retreived from [http://www.mayoclinic.org/healthy- lifestyle/consumer-](http://www.mayoclinic.org/healthy-%09lifestyle/consumer-)health/in- depth/antibiotics/art-20045720

[2]Todar, K., (2012). Bacterial Resistance of Antibiotics. Textbook of Bacteriology. University of Wisconsin: 4(3). Retrieved from [http://textbookofbacteriology.net/resantimicrobia l\_4.html](http://textbookofbacteriology.net/resantimicrobia%09l_4.html)