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|  | ***Abstract***  Currently, the face of the medical world is being transformed by a biological revolution. Physicians are being faced with increasing antibiotic resistance to common bacterial infections. At the beginning of the Antibiotic Era, physicians believed they were ensured cures to so-called bacterial infections, but the overuse of those "miracle drugs" led to a disastrous outcome.  Physicians throughout the world are being faced with resistant organisms that are either unrecognized or unfrequented by the medical community. Also, many common bacterial diseases such as Pneumonia, Lyme Disease, Tuberculosis, and Malaria have become resistant. Pharmaceutical firms reacted to the problem by chemically designing new miracle antibiotics at a rate of five to ten per year. At first, it seemed technology was winning, but now it appears that bacteria has caught up to man. The fear is that the evolution of resistant strains may soon outplace the development of new drugs, leaving the medical world powerless to treat what were once routine bacterial infections. Humans interfering with nature has been illustrated through the overkill of antibiotic use. Humans have indirectly created a pattern of multiple drug resistant strains. This is among one of the most serious problems facing the medical world.  ***Antibiotics***  Antibiotics are chemical compounds used to kill or inhibit the growth of infectious organisms such as bacteria. Originally, antibiotics were organic compounds, but as a result of technology they encompass synthetic and semi-synthetic organic compounds. Usually, antibiotics are absorbed through one's intestine and circulate throughout one's body via the blood stream. Antibiotics are specific to the bacteria, and will enact only where there is an infection.  Antibiotics kill bacteria in one or more of the following ways: They inhibit cell wall formation to alter the function of cell membranes. When an antibiotic is successful in dissolving the cell walls, it wrecks the ability of the bacteria to produce life-sustaining proteins. Antibiotics also interfere with the genetic material (DNA or RNA) which prevents the reproduction of bacteria and impede the manufacture of certain proteins that are essential to sustain bacterial life.  The concern today with antibiotics are being used too frequently and often in inappropriate situation. Incorrectly prescribing antibiotics helps breed germs resistant to the bacteria. Any antibiotic can leave behind some bacteria which can then mutate and form a strain that will be resistant in the future.  Some important rules to follow when taking antibiotics: 1) Finish the bottle because bacteria can still be lurking, 2) Do not take left over prescriptions from previous illness because this sets the stage for resistance in the future, and 3) Do not skip doses because doing so gives the bacteria a "breather" in which more can reproduce.  ***Bacterial Resistance***  Because bacterial cells contain a single chromosome, the bacteria usually needs more information than the amount provided on a single chromosome to ensure survival. So, in addition to the DNA contained in the chromosome, bacteria carry supplemental pieces of DNA separate from the chromosome called plasmids. These plasmids are self-duplicating genetic elements that depend on the bacteria.  A spontaneous DNA mutation can occur at a plasmid within a bacterial cell. This mutation could be one in which antibiotic-resistant genes arise from. The genetic information that the plasmids carry are not used to kill off the host, but instead carry vital information for survival. The plasmids replicate inside the host cell and then the replicated plasmid is transferred to another bacterium through the use of a pilus, which is a protein structure that reaches out and draws another bacteria near it. This type of transfer is called conjugation.  This exchange occurs between both bacteria of the same species as well as different species. In addition to the fact that plasmids may exchange genetic information between bacteria of different species, it is also capable of carrying resistant genes for more than one type of antibiotic which make it even more difficult for scientists or doctors to keep infections under control.  Transposition is a way genetic transfer using transposons, which are even smaller pieces of DNA that deliver genes, including those responsible for antibiotic resistance. The transposon can jump off of one plasmid and then integrate itself into a new host's DNA or into a resident plasmid after conjugation occurs. Consequently, the genetic information that is carried by the transposon is still alive even though the plasmid that transferred the information has died. Transposons do not need to rely on a particular host cell to multiply and survive since they simply integrate themselves into the bacteria's chromosome or into a residing plasmid.  ***Evolution***  Charles Darwin's theory of Natural Selection is the key factor to understanding evolution amongst all species and organisms. Darwin's theory of evolution states that there are groups or individuals that are better suited to survive in their environment and therefor they survive longer and perpetuate the species. Selection is the consequence of events that act directly and indirectly on the reproductive abilities of individuals in the populations with a large amount of genetic variation (Lappe 32). Individuals of a species reproduce and in turn their genetic material is carried to the next generation. Because bacteria can reproduce so quickly, approximately every twenty minutes, and their generations are so short-lived, they can evolve quicker than any other organism. As a result of quick reproduction, bacteria acquire mutations that are beneficial to their survival. Consequently, these mutations or adaptations to their environments are passed onto future generations. In the end, more offspring with a resistant genetic make-up will survive and continue to reproduce with contributes to the evolutionary process of bacteria.  ***Vancomycin***  In order to effectively treat antibiotic resistant bacteria, the pharmaceutical and scientific industry have had to develop new antibiotics such as Vancomycin. Vancomycin was first developed in 1956 and became openly available in 1962. Phycians have since prescribed Vancomycin for bacterial infections that either do not respond to treatment or are resistant to other antibiotics. It is still today considered the most powerful antibiotic against antibiotic resistant bacteria. But, due to the misuse of Vancomycin, it has caused some bacteria to be resistant to it as well. It took thirty years of use for Vancomycin to become resistant.  Vancomycin works by interfering with the construction of the bacterial cell wall, but its action can be interrupted if bacteria modify the building blocks on their cell walls by substituting a molecule of lactic acid for one called alanine.  Vancomycin has a package of nine genes that when left in motion create a stratagem to fight bacteria. One gene enables the bacterium to make lactic acid while another codes for an enzyme that will cleave the alanine from the cell wall building blocks. The product of the building blocks pt lactic acid in the alanines place. Two more genes control the action of these three, insuring that they are active only when Vancomycin is present.  Now, Vancomycin has evolved to become resistant to enterrococci or VRE (Vancomycin Resistant Enterrococci). The fear is that enterrococci may transfer the resistant-causing plasmid to another, more virulent bacteria and resistance will spread further.  Like enterococci, many strains of staphylococcus have exhausted all but Vancomycin as their last line of defense. If one of these strains becomes resistant to Vancomycin, it could set off a major epidemic of infections that could be untreatable. The final conclusion would be that bacteria will have the selective advantage over organisms.  ***Lyme Disease***  Certain diseases are spread to humans by insects or insect-like animals called arthropods - organisms that crawl with jointed legs. A mosquito transmits the deadly Malaria; a fly transmits Sleeping Sickness; a flea transmits the Bubonic Plaque; and a tick transmits Rocky Mountain Spotted Fever. More than two hundred diseases (Lappe 35) are transmitted to humans by arthropods. Through pest control, improved sanitation conditions, and antibiotics, most pest-born diseases have been brought under control in the developed nations of the world. One disease that has not been put under control is Lyme Disease, in which transmission requires forty eight hours or more of feeding. Between 1982 and 1993 (Zimmerman 90), more than fifty-three thousand cases (Zimmerman 90) have been reported nationwide.  When humans enter a previously undisturbed ecosystem, the ticks have an opportunity to parasitize to a new host (Lappe 23). When a tick born agent infects a human, it is often highly virulent because the new host has had little or no opportunity to evolve defenses against the invader. As a result, the Lyme Disease organism is being subjected to selective pressures where humans may then become a new intermediate host.  Many physicians prescribe antibiotics for everyone with a real or imagined tick bite to be on the "safe side". Often patients demand treatment with an antibiotic, but this is discouraged by public health officials unless a rash is present. The behavior of providing an antibiotic in every case encourages the emergence of antibiotics that are resistant to Lyme Disease. If Lyme Disease is not treated properly, it could become a threat to the human population.    ***Malaria***  Any disease with a long history within the human population is likely to shape the genetic population that it occurs within. This is especially true for a disease that strikes a wide variety of people within a population. A disease such as this is Malaria. Malaria is a mosquito born parasitic disease that has played a large role in human evolution for as long as 40,000 - 50,000 years (Lappe 176). Ecological disturbances have given rise to this disease over the years and the number of people infected has risen.  Malaria is a devastating disease that is characterized by night sweats, weakness, and high fevers. It is caused by one of four species of the protozoan parasite known as plasmodium (Lappe 180). The disease is transmitted to humans through the bite of a female mosquito. The periodic resurgence of new parasites from one's red blood cells produce the characteristics of Malaria. If enough Red Blood Cells are filled with parasites, they can clog venules, which causes kidney failure and brain damage.  The disease Sickle Cell Anemia has developed in populations where Malaria is present. Sickle Cell is a natural defense of the human body against Malaria. While Sickle Cell has been successful in controlling the present Malaria epidemics, not much success has been made with antibiotics. The malarial parasites have developed a resistance to the traditional and newest antimalarial diseases with an alarmingly high frequency. Because of dependency on the antibiotic such as chloroquine, selective pressures continue to create new strains of Malaria. In addition to the overuse of certain antibiotics, sub-optimal doses and sporadic treatments have contributed to the problem of resistance.  ***Tuberculosis***  Tuberculosis is not a new disease, it dates back at least seven thousand years (Zimmerman 63). Tuberculosis is the most common serious infectious diseases in the world. About seven million new cases (Brown 1), and slightly more than two million deaths (Brown 1) occur each year. In the 1930's when Penicillin was discovered, many thought the disease would be eradicated, but it is now coming back with resistance to multiple drugs.  Mycobacterium Tuberculosis is the bacterium which causes tuberculosis usually infects the lungs which allows for TB to be transmitted through the air, especially in crowded or enclosed environments. The microbe breathes oxygen and has a very way cell wall that gives it particular staining properties called, acid fast, and makes it resistant to destruction by drying and be chemical agents. Consequently. TB germs that are coughed out into the air can remain alive and viable for weeks or months - much longer than most other bacteria.  About one and ten new cases of Tuberculosis is resistant to at least one of the common drugs used to treat the disease (Brown 1). Resistance to multiple drugs is a problem that renders the disease untreatable in most parts of the world. Drug-resistant strains of the bacterium almost always arise from strains that are initially drug susceptible, but survive inadequate causes of therapy. The new antibiotic resistant TB bacteria develop by mutation when patients discontinue antibiotic treatment early. Public health officials are trying to prevent this from occurring by ensuring that TB is correctly treated when first diagnosed and encouraging patients to finish their antibiotic treatment even if they are feeling better.  Decreasing the spread of antibiotic resistance requires that the selective pressures placed in using antibiotics also be decreased. Both physicians and consumers play a large role in the misuse of antibiotics and at the same time can play a large role in using antibiotics correctly and decreasing resistant strains. Physicians must change their prescribing habits and practices and patients must reduce the demands they place on physicians to prescribe antibiotics when they are not necessary.  In order to see if the doctors in the Tri-Valley area are contributing to the problem of antibiotic resistance, we developed a survey consisting of ten objective questions. The survey was handed out to doctors at the local hospital. |

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