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No Profit in Cure

The United States of America is a country founded upon independence, prosperity and liberty. We are a country unlike any other and have the largest budget of any Healthcare system- estimated at 630 billion dollars (Office of Management and Budget). However, for those concerned with the preservation of this prowess, the budget is in need of serious reform. The ignorance of such reform is not only undesirable but also impossible. The debate consists of everything from budget distribution to department leaders. There is much discourse hindering the search for an agreeable reform. Regardless of political position, there is certainly a need for effective reevaluation and modification of the dynamics of healthcare. With 46.3 million Americans uninsured, modification will not only make healthcare more available, but will also ease the effect of the largest contributor to our14.1 trillion debt- Health and Human Services (U.S. Treasury Department). Clearly, some issues are more pressing than others. Antibiotics, resistance and their residual effects are certainly one such issue. It is estimated that as much as 20 percent of the money spent on antibiotics is wasted because the antibiotic is being used for colds or flu- viruses which antibiotics cannot remedy.

Medically speaking, an antibiotic is a substance produced by one microorganism that selectively inhibits the growth of another. Essentially, this means that an antibiotic is a substance produced by one organism (usually some form of bacteria), used to destroy another. The evolution of these organisms are an aspect of health care that digs a hole deeper and deeper with every prescription. In the ultimate goal of reform, an extremely important factor to consider is the increasing ineffectiveness of antibiotics, for this reason: Antibiotics are used to treat every type of bacterial infection. Now the CDC (Center for Disease Control) recommends not seeking antibiotic treatment for ear infections, strep throat, bronchitis, and flues. Sixty years ago the same prescription that fought against any common infection is more than 25% less effective (CDC.gov). This notion has caused much controversy, and cost a fair sum of money for Americans. While the common cold is surely not the worst disease on the planet, we, as a nation, are at the mercy of something known as antibiotic resistant bacteria. This proper medical term is no more complicated than it sounds. The same bacteria that infected us decades ago have a new facet. However, the fault does not simply lie in the hands of the ineffectiveness of the medicine. The insurer, the doctor and even the patient all share responsibility for the ineffectiveness of this treatment. Lack of treatment options is an increasing reality in America and bacterial resistance is an essential aspect of this grim fact. Unfortunately, research thus far has been sparse and largely unrecognized. The impact of antibiotic resistance has left our medical budget in a dangerous predicament, limited treatment options, and proven ineffective for modern infections. If not addressed immediately it will seriously halt progress for reform, which is clearly necessary.

Currently, doctors have certain factors to consider when prescribing an antibiotic. These include: which conditions are commonly prescribed antibiotics, whether or not these are bacterial infections as opposed to viral infections, and the current recommendations of the CDC. “Yet these current factors for patient evaluation are limited and flawed” Dr. John McConaghy writes in an article for the *American Family Physician* titled “Controversy in Otitis Media Management: Should We Follow the CDC recommendations?” In his abstract, he concludes that the recommendations are useful in sub-populations but “they should not be generalized to primary care and family practice populations without solid, clinical, patient-oriented outcomes to support them” (quoted in Schmidt 312). The idea is urging to reduce indiscriminate prescription for antibiotics (such as an earache or sore throat) and identifying patients who are in actual need of such a treatment.

There is a vicious economic circle within the relationship between antibiotic use and mis-use. Fifteen billion dollars of the United States' budget is lost in the cultural status of antibiotics. The cultural status of antibiotics includes the faith and dependence of our society on treatment. This dependence stems from an authoritarian society and the precedence of past treatment, that is not necessarily the best choice right now. This practice has led to inappropriately prescribed, overused and resisted (ultimately useless) antibiotics. A prime example of the repercussions of this irresponsible behavior can be seen in the 1.3 billion dollars hospitals need to cover the cost of bacterially resistant microbes. It is this inappropriate use that drains the healthcare budget. Antibiotic research and development is driven by demand. A recent study by Dr. Jerry Avorn, Chief in the Division of Pharmacoepidemiology and Pharmacoeconomics at Harvard University, and Daniel H. Solomon, MD showed that at least 55% of visits to the doctor for a “cold” or any similar condition results in the use of an inappropriately prescribed antibiotic. The most significant issues in these prescriptions are over-prescribing, giving a stronger dose than needed, and prescribing for viral infections that are either resistant or not susceptible to antibiotic use by this point. The main question this raises is how can we as patients put our faith into doctors and pharmacists alike if they are clearly undervaluing the use of necessity of proper antibiotic use, and similarly being very irresponsible with it?

One key reason it seems that professionals tend to do this is patients are in high demand of a cure; simply “resting” does not seem to cut it in the examination room anymore. It is clear that patients desire something tangible to guarantee a swift and effective recovery; they simply do not understand that sometimes antibiotics are simply the wrong route to take. This, coupled with doctor's desire to satisfy patient demand, and pressure from companies to increase distribution of their products, puts the prescriber in a position that almost demands an antibiotic for almost any treatment option, even when it would hold no beneficial effect and a detriment to the patient's health. A surprisingly prevalent and, admittedly, embarrassing reason is a very dangerous lack of information on the part of the doctors. Many of them have been found to prescribe an antibiotic for a completely benign or inappropriate infection (Schmidt 37). The main dilemma in the current state of antibiotic prescription is haste and lack of proper rationale. All of these factors lead to one huge detriment for both the economic aspect of development and the future of the human race's susceptibility to increasingly virulent diseases. This issue is antibiotic resistance. Antibiotic resistant bacteria are dangerous because they are stronger and harder to kill.

The concept of antibiotic resistance is easy to grasp. Think of it like Lysol: kills only 99.9% of germs. After washing your dirty kitchen counters, you now feel secure in their hygienic safety. It would seem that after 5 years of doing this, the germs would not even dare to go near the kitchen. Yet, after such a long period of use, the same 0.1% of germs you have not been killing not only adapted and evolved, but also proliferated. It is then time for you to buy a new disinfectant. Similarly, antibiotic resistance is a product of overuse and time.

Bacteria have a remarkable ability to mutate and acquire resistance genes from other organisms and thereby develop resistance to antimicrobial drugs. When an antimicrobial is used, the selective pressure exerted by the drug favors the growth of organisms that are resistant to the drug's action. Essentially, during antibiotic use, the bacteria "steal" gene information from surrounding organisms and have subsequently adapted them to the functions of any antimicrobial agent. In some cases, the microorganisms have become so resistant that no available antibiotics are effective against them.

Antimicrobial drug resistance occurs everywhere in the world. Hospitals and other healthcare settings are combating drug-resistant organisms that spread inside these institutions as well (FDA). Resistant infections also spread in the community at large. Some examples might include pneumonia, sexually transmitted diseases, and skin and soft tissue infections.

People infected with drug-resistant organisms are more likely to have longer and more expensive hospital stays, and may be more likely to die as a result of the following infection. When the treatment of the infection doesn't work, second and third choice drugs (that may be less effective, more toxic, and more expensive) are chosen for treatment. This means that patients with an antimicrobial-resistant infection may suffer more and pay more for treatment.

Antibiotics have been over-prescribed so frequently that the infectious bacteria have adapted and become even stronger. For every infectious disease, antimicrobial resistant properties have made them more dangerous. Unfortunately, the development of novel drugs has not kept pace. The development of an antimicrobial resistant infection generates ineffective treatment, delayed recovery, recurrent infection, and sometimes even death. While these diseases are certainly dangerous because they are stronger and harder to kill, they also present an extremely serious economic threat to health care (Heys).

Recently, the Chicago Cook Country hospital analyzed data taken from an elaborate, government sponsored study on antibiotic resistance (documented in the Oxford Journals- Center for Infectious Diseases). By looking at a high number of samples from their data and extrapolating it to a national scale they found reasonable estimations of economic and societal costs of antibiotics. Antibiotic-resistant infections cost the United States $20 billion annually, more than $35 billion in societal costs and 8 million additional days spent in the hospital (Heys). Societal costs include those indirect repercussions which are a product of antibiotic resistance. These include lost productivity due to hospitalization, loss of life, quality of life, and the communicative nature of infectious disease.

In 2009, the CDC reported that over 50 billion dollars were spent dealing with antibiotic resistance infections alone. Nine and a half billion of these dollars were spent by hospitals alone. Unfortunately, as is common knowledge, hospitals are not the safest place to go with an antimicrobial-resistant infection. The main threat to hospitals is Staph infection. Staphylococcus aureus, is the most common cause of hospital infections that can spread to the heart, bones, lungs, and bloodstream with fatal results. The antimicrobial resistant strain of Staph (methicillin-resistant Staph aureus), better known as "MRSA" accounts for 50% of infections in intensive care units and 40% of infections in the general ward (CDC.gov). These are important statistics to note because in 2007 the CDC released an 11 year study of the effects of MRSA in over 1200 Intensive Care Units. In 1992 they discovered that over 36% of MRSA cases were resistant to available treatments- a startling number in itself. In 2003, 64% of the instances were shown to be resistant. This increase is currently being put to discussion by both the Infectious Disease Society of America (ISDA)and the CDC. Hopefully it is not too late.

Independent of the economic involvement in health-care, the history of antibiotics is a singular phenomenon in itself. The word is of Greek origin: *anti*, meaning against, and *bios*- life. The meaning of the word itself gives insight into the seemingly contradictory nature of the substance- something that ironically speaks to our position today. This "position" (the results of antibiotics economic pitfalls) was no coincidence. In fact, it has a long and important history that has brought us to where we are today.

The use of bacteria in medicine turns out to be very common among medicine men around 2,350 BCE in Africa. The Egyptians used a thick, nutritious porridge type mixture with naturally high amounts of the antibiotic tetracycline. The mixture would often be ingested before death to ensure a smooth passage. This mixture was, strangely enough, called “beer.” However, do not assume that the ancients were boozing around just to deal with their death: the actual term “beer” refers to a non-intoxicating "sour porridge." The mixture was fermented, similar to antibiotics today. This “beer” is referenced numerous times in the Coffin Texts, Pyramid Texts and even the Book of the Dead. The ancient Egyptian practice of brewing beer, documented through archeology and ancient art, is believed to have been a long-standing practice in the region at the time. Brewing beer using fermentation mixtures containing Streptomyces, which excrete tetracycline, appears to have been the only way these people could have produced the quantity of the antibiotic necessary to explain the fluorescent [tetracycline] signal found in their bones. So they likely, intentionally, added the bacteria to their fermenting brews”(Parry). For millennia they believed it to be one of the Gods' greatest gifts.

Fast forward more than 4,000 years later to 1877. Up to this point there has been little development in the use of micro-organisms to treat infection. Renowned French chemist and microbiologist Louis Pasteur was the first to offer scientific insight to the function of antibacterial compounds. He stated that “if we could intervene in the antagonism observed between some bacteria, it would offer ‘perhaps the greatest hopes for therapeutics’"(quoted in Schmidt 38). In 1877, Pasteur and partner Robert Koch noticed that the airborne bacteria could be used to defend the development of another bacterium. Twelve years later, in 1889, Pasteur’s student Paul Vuillemin distinguished them as antibiosis. It was in 1942 that the term “antibiotics” was coined. Originally the definition was limited. Because of sheer lack of knowledge it did not encompass the myriad of possible functions. It excluded anything that primarily functioned as a bacteria (i.e occurring naturally and kills bacteria) but was not created by a microorganism. An example of these include gastric juices and hydrogen peroxide. Second, it excluded synthetic antibacterial compounds, as they had not been invented yet. The definition was eventually modified to fit a broader spectrum.

The first natural antibiotic discovered is one that is certainly no secret. Penicillin, a natural derivative of the *Penicillium notatom* fungus, was discovered, not invented, by Scottish scientist and Nobel prize winner Alexander Fleming, in 1928. Interestingly enough, a fortuitous vacation led to the discovery of the world's first “miracle drug.”

Legend has it that Fleming merely stumbled upon the penicillin bacteria and had no intention of discovering a bacterial inhibitor. This simply is not true. In fact he had been searching for some type of microbial agent. Since 1922 he had been conducting studies testing mucus, egg whites and tears which led to the discovery of an enzyme called a lysozyme. The lysozyme is considered the “little brother” to antibiotics, as they cause bacteria to burst after a specific reaction (Wong). Though this would prove invaluable to him in the future,his knighthood would come from something far more influential.

Surprisingly enough, Fleming was considered a capable yet disorganized, even sloppy, scientist. His lab was frequently in disarray and his culture dishes were often contaminated by airborne molds. In 1928, after returning from a month long vacation, he shortly found his culture dishes of staphylococci completely contaminated by some unknown fungus. He immediately disposed of every single dish: except for one. A former lab member had been visiting at the time of Fleming's return and he saved one dish to show him what he had been working on. It was at this time that he noticed an interesting area of inhibition around the fungus. Clearly this fungus had some unique effect on the original culture of bacteria.

Penicillin Mold Fungus

He subsequently isolated an extract from the mold and named it penicillin. The publications of his findings were well respected in the medical community, yet, went largely unnoticed until 1939 when Dr. Howard Florey and three colleagues at Oxford University began to intensively research Fleming's work.

Inspired by Fleming's process, Florey gathered his team and began intensive, thorough research on penicillin's antimicrobial qualities. Unfortunately for them, WWII drained the government of industrial and economic resources, which resulted in a lack of funding for their research. The Oxford team soon contacted a lab in Illinois, the Peoria Lab, whose scientists were already working on fermentation methods to increase the growth rate of an isolated fungus. July 9th, 1941, Florey packed his bags and his team shipped to the U.S. and with a small vial of penicillin intended to change medical practices and the world (Bellis).

Their ultimate goal was to make penicillin commercially practical. Their first challenge was creating an efficient production process that was much speedier than the original surface growth method. Essentially, Peoria researchers and Florey pumped air into deep vats containing a non-alcoholic by-product of milling called corn-steep liquor. Eventually, to enhance the growth he added other key (admittedly complex) ingredients and larger amounts of penicillin. Strangely enough, it was a Peoria Lab researcher who found a moldy cantaloupe at a local market, tested the mold, isolated the strain and eventually discovered the fastest growing strain of penicillin know to date (Bellis).

Soon the lab began to increase their research capability exponentially with this new, faster-growing penicillin. By November 1941, the lab was able increase its yields of penicillin 10-fold. 1943 is a foreboding year in antibiotic history. Clinical tests were run that showed antibiotics to be the most effective drug to date. Still, no antibiotic has been as effective an antimicrobial agent as the original strain of penicillin. The tests they ran yielded prolific results. Unfortunately, it was these results that were the ultimate catalyst to give infections the resistant qualities they possess to this day- the “hype” would eventually lead to the misunderstanding and subsequent over-use that we are victims of today (Bellis).

Clearly the medical opportunities and potential for cure penicillin provided excited the researchers at the Peoria Lab. Dr. Andrew Moyer and Dr. Norman Heatley, the lab's experts on the nutrition of molds, quickly began to market the product. The effectiveness was undeniable and soon penicillin production was scaled up and shipped to Normandy in 1944 to treat wounded D-Day soldiers (Bellis).

In 1945, Dorothy Crowfoot Hodgkin determined the chemical structure of penicillin. This was valuable for mass producing the product, as it allowed the production process to be significantly sped up. Her discovery of the molecular layout made it easier to produce penicillin and lead to the production of newer antibiotics. It also proved just as valuable for antimicrobial resistant bacteria, because two years later the first strains of resistant bacteria were detected (Bellis). Not withstanding this, since then, Penicillin has been the most widely used antibiotic to date, and though there are an increasing quantity of resistant bacteria, many derivations of the strain are still used today and can be used to treat diseases as serious as Syphilis and even Gonorrhea. Because of the rarity of more serious diseases, antibiotics will fortunately continue be of some, limited, use in the future (Bellis).

Let's look at a typical, contemporary situation "necessitating" the use of antibiotics. A very common issue reported to the CDC is that of Lyme disease. Lyme disease is the result of a bacterium carried by all species of deer tick (*Borrelia burgdorferi*) that latches itself onto a host for at least 48 hours. These hosts range from small mammals and deer to humans. When contracted by over 20,000 U.S citizens per year, the infection yields a large, circular rash around the area, muscular/joint pain and irritation over a period between 3-30 days. However, in more serious cases, it causes arthritis, facial paralysis and other neurological problems and an abnormally slow heart rate. Lyme disease is diagnosed upon visual inspection by a qualified physician coupled with a laboratory blood test. Usual treatment involves 10-28 days of oral antibiotics. Thus far, antimicrobial treatment has proven effective for 95% of all U.S. patients- a statistically significant amount (Heys). This is great news because Lyme disease is neither long term nor is it a chronic condition. However, this does not mean it cannot be contracted a second time. What happens when the body encounters new and foreign resistant strains of the same disease? Not only will it be more susceptible to the more serious and recurrent sides of Lyme disease, patients will also be subject to a longer treatment with different medicine. This is the safest options because, as was seen earlier, if one is trying to avoid a bacterial infection, hospitals are not the safest place. The new treatment is not antibiotics. Long term use of antibiotics can lead to blood infection if used intravenously which is a serious risk physicians and insurers are not willing to take when there are alternative, presumably better, options (CDC.gov). This scenario is not nearly specific to Lyme disease. In fact many cases of everything ranging from a runny nose to gonorrhea, experience similar circumstances.

We must not forget that antibiotics have certainly had their successes. In cases of war and emergency treatment, they have revolutionized trauma management. Modern surgical practices would not be possible without the proper defense against opportunistic infections. Impressively enough, antibiotics have an astounding capability as immuno-suppressive drugs. Cancer treatment and organ transplants are procedures which call for such a repellent. With these benefits in mind, we must continue wisely and understand we are living in the world of the microbe.

So, we have the information. Buy why are we so afflicted by antibiotic resistance? The problem started in 1943 after use in WWII when penicillin began to be marketed as a "miracle drug." Soon, it was mass-produced and made available by prescription to the public. After that the cost dropped drastically within 3 years. An initial price of $20.00 per dose of penicillin in 1943 soon turned to $0.55 per dose (Bellis). Coupled with inflation, the lowered prices, naturally, made the treatment all the more appealing and available to the public and health insurance companies. In addition to the economic appeal, and marketing strategy (calling it a "miracle drug") penicillin also had credibility. Both Moyer and Fleming were the recipients of Nobel Prizes (Bellis). This ensured that this was not some "scam" or claim to rid the world of every bacterial infection.

Soon, newer and more diverse strains began to find themselves into America's offices and pharmacies. In 1943, the American Selman Waksman developed streptomycin from soil bacteria. This was the first of a new class of drugs called aminoglycosides and they were known to treat tuberculosis (Bellis). Twelve years later Tetracycline was patented by Lloyd Conover. This strain eventually became the most versatile and prescribed antibiotic in the United States. Two years later in 1957, Nystatin was patented and used to cure many intensely disabling fungal infections (Bellis). Finally in 1981, Amoxicillin was developed and finally sold in 1998 under a few different trade names: Amoxil, Trimox and Amoxicillin/Clavulanate. Of course there were more antibiotics developed between this 40 year period. These are simply the most major, influential or longest lived antibiotics (in the case of amoxcillin).

These 40 years were such an influential time in medical history. Quality of life improved, diseases were cured, wartime treatment was expedited and most importantly competition was ignited between rival corporations which yielded many benefits for the consumer- as is natural in a capitalist society. Such corporations include Aventis, Vicuron, Merck, Eli Lilly, Intermune, Cubist Pharmaceuticals, Johnson & Johnson, Bristol-Meyers Squibb and Pfizer. The companies each vied for the better or cheaper product in order to increase sales volume which would then be made available to the consumer at a lower premium. For a while, it worked.

So what we have here is a four decade period of medical advancement. The patient is happy and feeling better, the doctor is pleased with his or her work and diagnosis, medical corporations are bringing in larger sums of money and health insurance companies are able to offer the same premium with a higher profit.

Unfortunately, the steadiness of antibiotic development began to decline shortly after the introduction of Amoxicillin. Antibiotic resistance was experienced so early and the production process could not keep up with resistant infections, leading to this decline. Over 16 new antibiotics were approved between 1983 and 1987, dropping to 10 between 1994 and 1997, and just three approved between 2003 and 2004 (Schmidt 42). The future seems bleak in the wake of novel drug production and antibiotic resistance.

Interestingly, there is plenty of evidence indicating that there has been an overall decline of infectious diseases since the inception of anti-microbial treatment, that was proven to be independent of the rise in treatment (Schmidt, 39). This makes the situation seem not only preventable but also unnecessary. Had scientists, researchers and developers taken the time to look at data we not only would have experienced a natural decline but we would have halted and possibly eliminated any worry for antibiotic resistance and the subsequent hospital infections.   This is a paradoxical situation: had researchers not immediately instituted antibiotics into culture we could have not only prevented more serious disease, the use of the “miracle drug” would not have been overused to the point of its ineffectiveness.

Antibiotics did not cause this decline. Tuberculosis, scarlet fever, diphtheria, pneumonia, whooping cough, and rheumatic fever have either declined significantly or been completely eradicated from medical concern in various parts of the world. However, this is not simply because we now have antibiotics. “Nearly 90 percent of the total decline in the death rate during this epoch (1860-1965) had occurred prior to the introduction of antibiotics” (Schmidt 36). Reputable Birmingham physician and professor of social hygiene, Dr. Thomas McKeown summarizes, saying “Deaths from common infections were declining long before effective medical intervention was possible” (McKeown in Schmidt 36). Clearly, the improvement of living standards, intelligence and hygiene have allowed for this improvement. McKeown emphatically concludes that “[T]herapy made no contributions” to the decline of infectious disease and the subsequent lowering death rate (quoted in Schmidt 37). Antibiotics have been almost obsolete in serious cases of disease since 1877. To further that point, Boston University researchers John and Sonja McKinlay conducted a reliable and extensive analysis of the 10 most common infectious diseases. Their aim was to research the impact of medicine on infectious disease. In 2004 their research was released, suggesting that no more than 3.5

percent of the total decline in mortality rates can be attributed to medical measures. Their conclusion was brought about by a historical trend in treatments. They realized that when a new treatment had been introduced (antibiotics, prophylactic treatments, etc.) a marked decline had already begun and so influence was not detectable. It would seem that numerous other factors play into the frequency of death rate from infectious disease and cannot necessarily be attributed to antibiotics.

Ideally, antibiotics will become a viable tool in the future of medicine. However, this notion may become impossible in the wake of antibiotic resistance.

Thankfully, it turns out that the CDC has an extremely aggressive plan to combat the overuse and over-prescription of antibiotics. March 2011, the public was able to view a "Public Health Action Plan to Combat Antimicrobial Resistance," written by the inter-agency task force. This task force consists of the CDC, NIH and FDA and was founded in 1999 to coordinate the efforts of these major agencies in combat of antimicrobial resistance. In 2001 an initial plan was developed that outlined specific issues, goals, and actions to address the issue at hand. The first focus area is *Surveillance*. They wish to improve the characterization and detection of resistant bacteria in humans and animals and to better define and measure the impact of antimicrobial drug use in the United States. The second focus area is *Prevention and Control* where they hope to effectively implement and evaluate strategies to reduce the emergence and transmission of such bacteria. Third is *Product Development* which will aim to develop newer drugs and recommend clinical trials for new design. An extremely pressing need is for vaccines and remedies for the resistant infections, which also falls under product development. For over 10 years, this agency has worked to merely develop a plan against antimicrobial resistance (Heys). It could be years before we actually see a plan put into place and even decades before we measure any change in the economic and social pitfalls of antibiotic resistance.

Whatever becomes of this plan remains to be seen, yet there are a few definite things that need to take place. It is clear that the United States has taken a huge economic toll as a result of its irresponsibility with antibiotics. This means that we have to completely diminish the overuse of antibiotics and possibly find a way to limit them for the more serious and less common infections. This would mean that doctors and GP's switch to a more narrow spectrum of antibiotic prescriptions whenever possible. If possible this narrow spectrum should include a shorter course of higher potency antibiotics as opposed to a longer course of a lower dose. This would ensure that patients are finishing their prescription and that the bacteria are being dealt with swiftly and efficiently. In hospitals, where funding is available, isolation of patients, even staff, who have contracted a resistant strain is a reasonable measure to prevent the spread of the strain throughout the institution. All of this eventually becomes the responsibility of patients to be informed enough to understand when antibiotics or similar treatment is unnecessary and for skilled experts to be able to recognize and control the prescription of antibiotics in practices, hospitals and clinics.

So where does the future lie? Clearly, the same practices that have efficiently provided a 50 billion dollar debt and countless deaths in hospitals can no longer be tolerated. Though there are many options, justified by differing opinions and experiences, it seems there is one overarching theme for a solution: balance. There needs to be a fine balance in deciding which infections are to be treated by antibiotics and which are not. The most sensible options would be to treat only the most serious disease, such as Malaria, HIV, Hepatitis, Cholera, Gonorrhea and the like. The sensibility lies in the rarity of these diseases (as opposed to Lyme disease or strep throat), which would allow for limited use thereby limiting the increase of resistant infection. By doing this, research could also be isolated to treating only the more serious infections, and other research could be dedicated to treating the minor diseases. This isolation is important from an economic standpoint because it could allow companies to have ample time to create newer drugs while the originals are used sparingly in the United States. As well as this, there would be more confidence in their product and their investment. This seems more logical than treating *every* bacterial infection, and have pharmaceutical companies try to keep up with development of novel drugs in the wake of antibiotic resistance. It also is a question of ethics. When a life is in danger, it is the medical community's responsibility to exhaust all options for a cure. With a more effective cure there would be less money spent on these options. As opposed to a minor infection, such as strep throat which almost never threatens lives. Another massive benefit to be mindful of is the reduction in hospital infections- which add another 8 million additional days spent in the hospital and 9.5 billion dollars to the $50 Billion dollar deficit caused by antibiotic resistance. Hospital infections (particularly Staph and MRSA) are more than 64% resistant and can account for 50% of the infections in the ICU- effectively classifying them as serious infections. If pharmaceutical companies were able to isolate their research and initiatives to serious infections, hospitalization would then become the safer, cheaper and more effective resource they were intended to be.

So, while some responsibility lies in the hands of doctors and pharmaceutical companies, the patients and national government also have a role in this cure for antibiotic resistance. As far as patients are concerned there is a general obligation to be informed and concerned with their personal well-being. It is as simple as that. In a society that thrives on an infinite amount of information at their fingertips, it should not be too difficult. As far as well-being is concerned, we live in a country where we have many countless opportunities, resources and options as far as the immune system is concerned. Nutrition, fitness, hygiene, and general activity are all things that the fair citizens United States can not only take part in but also use to strengthen their immune system with. These improvements would greatly reduce the need for antibiotics and, subsequently, antibiotic resistance would drop.

The national government is in a tricky situation. There are two sensible options to limit the occurrence of antibiotic resistance. The idea is to satisfy the undeniable need for research. The first option is for the government to fund the research done by a research University. There are some downsides. One is the lack of economic interest vested in the research of the University, for they will not seek profit. For example, they may be given a certain amount of money to study a particular bacterium or strain but might end up struggling to find its practicality and use. However, they may discover something useful on another level, but it would not be for the economic "cure" for antibiotic resistance.

Another option is for the government to subsidize research for the pharmaceutical companies. However, there is one major pitfall to this route- a heavily vested economic interest. It is no secret that pharmaceutical companies have been dishonest in the findings and publications. “Pharmaceutical companies frequently mis(use) statistics in their promotional material to present a biased picture about the value of their products. In promotion to doctors, companies make claims about statistical significance where they are not justified based on the cited references; they misuse or omit confidence intervals and discussions about power; they use graphs and charts that have design features that lead to visual overestimation or underestimation of metrics; and they present benefits as relative risk reductions instead of absolute risk reductions” (Lexchin). When pharmaceutical companies may not explicitly use statistics to lie about their products, it is reasonable to assume that they would use them to present their drugs in the best possible light to encourage patients to request medicines and physicians to prescribe them. So with this in mind, the ultimate downfall is that, while all research will be dedicated to finding the best and most efficient antibiotic, the data might be skewed so that the research money would not appear to have been misappropriated. The end result of this that while there is a drug available, it is not an effective or accurately used treatment for antibiotics. It would only matter that the product sold.Even in the unlikely case that these pitfalls are eliminated, there would certainly be some money lost for a time. Given judicious support and research there could be a slow but steady decrease in the appearance of antimicrobial resistant drugs.

Though there is no definite, foolproof, or quick solution, there is certainly cause for one. Hundreds of billions of dollars are lost dealing with antibiotic resistance. Thus far, we have seen these effects have their way with more than just the national debt. Resistance has left our medical budget in a dangerous predicament, limited treatment options, and proven ineffective for modern infections. Hopefully we will never see the day when antibiotics become completely obsolete, and while there is still a light at the end of the tunnel there is certainly a need for a conscientious and collective effort on the hands of medical corporations, hospitals, doctors, practitioners, and patients. At the hands of a unified nation antibiotic resistance stands no chance, yet when divided it could unleash a maelstrom of turmoil the would go well beyond the $630,000,000,000 healthcare budget.