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# Plague Inc: Distribution of Health Resources in the Modern World

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**Plague Inc: Distribution of Health Resources in the Modern World**

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With the advent of antibiotics and vaccines in the 20<sup>th</sup> century, both scientists and doctors proclaimed that the war on infectious disease was won. However by the end of the century it would be proved that this was far from true. New and terrifying diseases emerged from Africa and have served as a source of fear and fascination ever since. Two viral diseases in particular have tested the limits of international health policies both from an economic and medical perspective ever since their discoveries. Both HIV and Ebola, although vastly different, can be used to characterize the effect that economics and politics have on modern health care and its distribution. These effects include the cost of development and distribution of medication and allocation of medical personnel and equipment to treat outbreaks as well as spread of misinformation and political opposition to outside intervention. As the death toll in the recent Ebola outbreak rises and the number of people infected with HIV continues to increase, these issues become more and more important, and the need for solutions more pressing. In order to truly control or eradicate these diseases advancements will have to be made not only in medicine but in many other areas of the global health care system, so that the necessary care can be accessible to all who need it. However, before solutions can be suggested a cursory understanding of the history of disease and treatment must be obtained for both Ebola and HIV.

#### A Silent Killer: HIV in Recent History

HIV and the AIDS which it causes was first discovered in the 1980s (Weiss and Weiss, 2001). However, reports of patients with strange virus- induced lymphomas had been present since the 1960s (Ryan, 1997). Once the HIV virus was properly identified, scientists tried to determine both the origin and the scope of this new disease. With testing the genetic and symptomatic similarities of HIV to animal retroviruses, it was possible to determine where the jump from animal to human occurred. This link between humans and animals was found in our

close evolutionary relatives. Several similarities were found between HIV (specifically the HIV-2 strain) and the Simian immunodeficiency virus (SIV) found in non-human primates (Ryan, 1997). From this information it was determined that the virus had evolved from SIV or similar viruses and had obtained the ability to infect humans, the evidence also suggested that this evolution had occurred within Africa (Ryan, 1997). The stated African origin of the virus would be just the beginning for the association of HIV with the continent that it would soon ravage. Scientists began testing for it in other countries, such as Haiti, and soon found that this hitherto unknown virus was widespread (Weiss and Weiss, 2001). In 1985 the number of cases of AIDS in African cities was so high it led some experts to believe that AIDS in Africa predated AIDS in America and in Europe (Ryan, 1997). In 2000 53 million people were infected with the virus and 19 million had died (Weiss and Weiss, 2001). The hardest hit region in the world is Sub-Saharan Africa, with two thirds of the new infections in 1999 occurring in that region (Weiss and Weiss, 2001). In America it was estimated that there would be 20,000 new cases from 1983-1985 (Ryan, 1997). In retrospect this number is laughably low. Today up to 40% of women are infected in Africa, indicating that heterosexual contact is the main mode of transmission. Also due to the high number of infected women and high birth rates, mother to child transmission ensures that the infection is carried on to the next generation. (Weiss and Weiss, 2001). Perhaps the reason for its spread is that symptoms often go unnoticed, as the beginning stages often are marked only with only slight flu-like symptoms. In half of cases there are no early symptoms at all (Ryan, 2001). The disease then progresses slowly, often taking years to show any significant effects. Therefore without screenings it is very easy for people to unknowingly transmit it to others. Lu et al. states that up to 20% of infected people are unaware they are infected and therefore pass on the virus as stated above (Lu et al., 2013). Another factor that contributed to the

virus's spread and the difficulty of treating it was the high mutation rate of the virus. The rate of mutation is so high that only a few short years after its discovery the original strain was no longer recognizable (Ryan 1997). All of these factors kindled the flames of fear in the public's eyes and the media coverage reflected that. However the scientific community tried to keep a calm and objective demeanor, despite their numbers suggesting that the opposite reaction was warranted (Ryan 1997). Although the media did panic at the mounting numbers of those that were or could be infected with HIV, it focused on the wrong things. Homophobia, territory protectionism and general stigmatization were both the subjects and the results of the media's reaction; this however did nothing to stimulate actions that would help to stem the spread of HIV. Things such as expanded research budgets, and simple preventative measures got lost in the hype, and the world suffered for it (Ryan, 1997). This was the beginning of public health policies that would leave the scientific and health communities struggling to catch up for many years.

#### A Violent Killer: Ebola in Recent History

Ebola was first discovered in 1967 when a strange hemorrhagic fever killed several people in the German town of Marburg (Simpson, 1977). Almost a decade later in 1975 the same strange febrile illness broke out twice in Southern Africa (Simpson, 1977). The illness broke out in two different countries (Sudan and Zaire), and then quickly spread throughout each region (Ryan, 1977). This time the culprit was Ebola, a disease which is very similar to Marburg. The disease is notable mainly for its terrifying and messy outcome. The mortality rate, depending on the strain, can be anywhere from 50% to 90% (WHO, 2014). Although the early stages of disease mimic that of the common flu, within a few weeks the disease progresses to full hemorrhagic fever. The unifying characteristic of hemorrhagic fevers is the destruction of blood vessels caused by the immune response to the pathogen. This manifests as bruising and bleeding

under the skin, and bleeding from the eyes, nose and bowels (Ryan, 1997). Since the virus can be spread only through direct contact with an infected person's bodily fluids, hemorrhaging is a very effective way to spread these diseases to caretakers or those close to the victim. Most secondary cases occur in family members and in doctors and nurses. The only way to prevent transmission in this way is to place the patient in isolation and employ barrier nursing protocols. Since the disease was unknown and difficult to diagnose in the early stages, no preventative measures were taken initially in the 1975 outbreak (Ryan, 2001). Since 1975 there have been sporadic outbreaks every few years in Africa but they have mainly only affected a few hundred people, and peter out after a few weeks to a few months. However 2014 has seen the largest Ebola outbreak since its discovery. This epidemic has killed more people since March of 2014 than all other epidemics combined and there seems to be no sign of it slowing down. Before this the epidemic with the most deaths was in 1995, with 316 infections and 244 deaths (Ryan, 2001). 2000 saw another large outbreak, it involved 425 cases and 224 deaths (WHO, 2014). As of December 3 the totals of the 2014 outbreak are nearing 18000 and 6700 respectively ("Ebola Response", 2014). Understandably the magnitude of this outbreak has put an incredible demand on local and global health care organizations. Unlike HIV, the rapidity and violence of the deaths associated with Ebola, along with the severe risk to those who care for the ill, has prevented the world from being able to push Ebola out of the collective unconscious. In another contrast to HIV, Ebola has very few ways to treat it. Some drugs are in clinical trials and have been used experimentally on one of the victims of the current Ebola outbreak, but the output volume needed to be effective is not feasible. The only current way to deal with Ebola, especially in poor countries is supportive care. This care basically consists of supplying the patient with fluids and nutrients and hoping for the best (WHO, 2014). Similarly to the beginning of the HIV

epidemic the media has panicked over the rising number victims, and yet again calling for unnecessary and unhelpful actions, such as ending all flights from infected countries. However in previous years Ebola has been all but ignored by the media and therefore there was no push or call to study it or develop treatments. During the first epidemic in 1976 it was six months before isolation and study of the causative agent began (Ryan, 2001). Today the exact origin of Ebola, as well as the reason for its sporadic reemergence is still unknown (Ryan, 2001). Perhaps the current outbreak will spur on more research so the next epidemic (and there will be one) will not be as devastating.

### Money Can't Buy Happiness: The Economics of Modern HIV Treatment

With history as context, a discussion of the treatment and policies that resulted can occur. Many things changed as a result of the discovery of HIV, gay men cannot give blood, donated blood is now screened for the presence of HIV and a discussion about it is included in sexual education classes. However these effects only pertain to those in the developed world, where the levels of HIV infection are relatively low. The discussion here will focus on the treatment plans and the limitations thereof that are implemented mainly in the underdeveloped world. Due to the fact that the countries with the highest infection rates are also those that are underdeveloped or resource-poor, it is vitally important that adequate action is taken in those areas to ease the lives of those infected and prevent others from being infected. This will include availability and distribution of anti-retroviral drugs as well as implication of education and preventative care. The cost of implementing these will also bring the economics of treating HIV into play. Although advances have been made in the thirty years since the first HIV case was diagnosed, limitations still dim the hope that the war on AIDs will be won anytime soon. The main limitation, especially in resource poor-countries is economics. Although the drug prices of retroviral have

dropped significantly since the 80s (\$10,000 to \$335 annually), this cost can still be prohibitive for those who live in extreme poverty. This struggle is demonstrated in Chaunetta Jones's article "If I Take My Pills, I'll Go Hungry": The Choice between Economic Security and HIV/AIDS Treatment in Grahamstown, South Africa." Jones studied the trend of people refusing ART<sup>1</sup> for HIV/AIDS in the interest of keeping their disability benefits and/ or having stable access to food (Jones, 2011). This certainly signals a problem somewhere in the system where someone must choose between their immediate survival and their long-term health. Participants in Jones's study also expressed concern that even if they were able to obtain the necessary drugs for HIV treatment; the drugs need to be taken with food, rendering them functionally useless (Jones, 2011). This problem, like many that face HIV patients is one of economics. Since unemployment is at least 80% in their city they must rely on disability assistance or relatives to get by. Since the CD4 count<sup>2</sup> for eligibility<sup>3</sup> for disability and ART's are the same, by taking treatment they may lose the only source of income available to them. Therefore it makes more economic sense to refuse treatment in order to remain eligible for disability. Other participants receive both disability and ART treatment; however they take their drugs only sporadically to maintain a CD4 count low enough to remain eligible. The problems created by this system and its manipulation are not just economic, they cause severe implications in public health. If drugs are not taken properly they can create resistant strains on the virus which will then go on to infect others. This causes more economic strain because the old drugs will be ineffective; leading to higher doses being prescribed and it will necessitate the development of newer and more expensive drugs. This situation only reinforces the fact that economics is tied deeply with public health and failure of one can lead to big problems for the other. Another problem that was apparent in Jones's article was the difficulty of obtaining HIV drugs. If a person is ineligible then they would have to

pay for the drug themselves, which is not feasible in the economic situation of most HIV patients. This again is tied more to economics than to public health. Studies have shown that the earlier a treatment plan is started the more effective it is for the patient (Lu et. al, 2011). Earlier treatment also significantly reduced the risk of sexually transmitting the virus to an uninfected partner (Lu et al., 2011). Therefore from a public health standpoint ART should be started as soon as possible, to improve the health of the patient and reduce the risk of new infections, both of which are main objectives. However from an economic standpoint this is a disaster. By starting treatment earlier the patients will live much longer and therefore have to be on ART for much longer. The age at diagnosis is generally 20's or 30's so there is a significant amount of time each person will have to remain on treatment (Lu et. al, 2011). Since new cases are diagnosed every day, the number of people on treatment will grow exponentially and so will the costs. Even in modern literature specifically about treatment of those in low income countries, the most cost-effective treatment is listed as treating those with high viral loads (due to the fact that they could infect others at higher rates) and those with low CD4 counts. This measure targets the highest risk patients while still keeping the number of those with treatment to economically sustainable number. This economic approach is obviously not ideal from both a public health and humanitarian standpoint. Ideally treatment would be available to all, not just those that are most in need or most risky and certainly patients would not have to choose between subsistence and treatment. However, with the amount of money donated to fund HIV/AIDS treatment declining<sup>4</sup>, this does not seem like it will be the case any time soon.

An Ounce of Prevention: Economics of Ebola in Resource Poor Countries.

Economics also plague Ebola and its victims, except instead of lack of availability of drugs (there are none), there is a lack of availability of equipment need to control the disease.

This problem can again be blamed on economics. Hospitals in East Africa (the epicenter of the current outbreak) do not have the proper equipment to safely house an Ebola patient and properly protect health care workers. Also most of these hospitals do not have plans for Ebola in place. This is a direct risk to other patients and especially to health care workers who are at the highest risk for infection. Even in developed countries there is often not a set protocol to follow if an Ebola case is suspected. In the U.S. a man in Texas died of Ebola and managed to infect a nurse caring for him (CDC, 2014). This was most likely due lack of an official protocol, and failure to comply with proper barrier nursing procedures. It was only after this chain of events that the CDC was prompted to formulate a plan for all hospitals with a suspected Ebola case (CDC, 2014). The CDC also formed an Ebola response unit that would be deployed upon notification of a suspected case (CDC, 2014). Due to the unprecedented scale of the outbreak and the world's subsequent inability to stop or slow it down, the quality of care provided has been negatively impacted. In previous outbreaks the lack of personal protective equipment was even greater. During the first outbreak in 1976, several of the sisters that ran the local hospital reported to a visiting Belgian doctor that they were running out of gloves (Ryan, 2000). Although now I'm sure the situations are not so dire, especially with the influx of foreign, missionary, and international health care workers that have descended in the infected countries of Africa, there is a lot of equipment need to properly protect against the virus. The WHO states that every time a patient's room is entered personnel a must don a minimum of gloves, closed toed shoes with covers, gown, mask and eye protection (WHO, 2014). In addition to having the proper equipment its proper use is vital to prevent the spread of Ebola. Most secondary cases appear in those that care for the sick and the 2014 epidemic is no exception. Two Americans were infected during their time as aid workers in the current epidemic and had to be flown back to the United

States for treatment (CDC, 2014). However there is room for hope, even in the most remote areas people have been able to successfully care for the sick by using their own makeshift protective equipment. The incredible part is that sometimes this homemade protection can be as effective as the professional-grade equipment. A Liberian nursing student, Fatu Kekula, was able to successfully care for four of her relatives using only trash bags a decontamination protocol (Cohen, 2014). Her protocol involved tying trash bags around her legs with rubber boots over them and more trash bags over top of the boots. Then she tied her hair back with pantyhose and wrapped in another trash bag. Then she used a raincoat and four pairs of gloves for her torso. After leaving the decontamination room, which was an outbuilding, she sprayed all gear with chlorinated water and burned all waste (Cohen 2014). This type of effective innovation is exactly what is needed for the outbreak. Not only is more cost effective than traditional methods, it also does not require the need of multiple professionals on site. This type of homemade method even has advantages over hospitalization. Often in hospitals patients are crowded and beds are scarce, this crowding makes Ebola more dangerous than it already is since the number of people in contact with the patient increases. The home method allows for family and neighbors to care for the sick in relative isolation and thus reduces the ability of the virus to spread. Again Fatu's success in caring for her family reflects this, not only did she prevent herself from contracting Ebola, three of her four relatives were able to recover, this is a much higher survival rate than the 70% that is seen throughout the country (Cohen, 2014). As for official protocols on housing the WHO suggested that each patient be isolated with their own room and bathroom, additionally these rooms must have showers, sinks, running water, alcohol sanitizer, PPE stocks, medicine stocks, and ventilation (preferably with negative pressure)<sup>5</sup> (WHO, 2014). Again for small hospitals in rural area (where the infection began and continues to be the worse), this can present

a problem in terms of being able to provide these accommodations. Larger hospitals in more urban areas may be able to cope better, but with the large number of cases, patients might still have to share rooms (WHO, 2014). Again this is a difference of economics, where the more rural towns usually have less funds to devote to accommodations like those mandated by the CDC. Unfortunately, the disease often starts in rural areas, where the resources are often the scarcest. Hopefully with the help of larger organizations hospitals can become better equipped overall and perhaps have allow for a permanent stock of supplies for epidemics such as this one.

#### Time is Money (and Lives): Economic Solutions for the Modern Plagues

The issues previously discussed obviously are pressing in today's world, and represent the vast inequalities that exist throughout the world. In terms of health care it seems as if most of the inequality stems from an economic source. Those with capital can have access to the best care, while those that cannot must sometime choose between having enough to eat and having medicine to combat their chronic illness. In order to fix these inequalities the economics of health care must be reformed. First of all an emphasis on prevention would both save money and reduce the need for expensive procedures. Also solutions could be found to reduce the amount of money it takes to make and distribute treatments. There have already been great strides in this area for HIV drugs, as stated before the cost of an annual core of retroviral therapy has dropped from tens of thousands of dollars to a few hundred (Lu, et. al). If the price could be reduced further and for more illness, it would mean that it would be economically feasible to cover more people and not just the ones that are the highest risk. Also Jones suggests in her article that changing the requirement for ART and disability so they are not the same would help with patients refusing drugs or taking them improperly. If this works and becomes more effective it may even stimulate the creation of similar programs, which would reach and benefit more people

in need. As for Ebola the success of Fatu Kakula has shown that it is possible for those even in the most remote or resource poor areas to be able to overcome Ebola effectively. Using her model, the economics of outside agencies sending supplies and doctors may be overcome. Not only would people be able to more easily obtain the supplies needed but they would be able to help their own families and assist in their care. This not only would alleviate the feeling of helplessness that many family members feel when handing over their loved ones to foreign aid workers for care and burial. It would also reduce the number of foreign workers in any one area and allow them to be distributed to other areas in need of help. Although home-based care won't solve an epidemic of this size it is a step in the right direction. Obviously the problems presented here are highly complex and therefore do not have easy answers, but merely by discussing them more effective solutions can be found and current systems can be evaluated and improved.

Both HIV and Ebola are highly infectious and highly deadly diseases that have shown humanity that the war on disease is far from over. In addition to the deadly outcomes of the diseases themselves, economic factors do not allow for equal access and distribution of health care, which only makes these diseases worse for those who suffer in poor economic climates. For HIV the main barrier of health care is distribution of life saving ARTs. Even though earlier treatment has been shown to be much more effective in reducing viral load and preventing transmission, economics makes it impossible. Instead treatment is only reserved for those that are the last stages of the disease or those that are high risk patients. Without early intervention and treatment patients will deteriorate to the point where they can no longer work and therefore must rely on governmental assistance to meet their daily needs. However a catch-22 is present for these patients, either they take treatment and improve but risk losing their only means of income, or they forgo treatment to ensure that they will still have something to eat. Either way

these patients' health is at risk. For Ebola economic factors threaten not access to drugs, but to the equipment that prevents the spread of the disease to others. Without this equipment the virus is quickly spread, from person to person, and attempts to care for the sick just perpetuate the epidemic. Small changes in policy such as changing requirements of disability may help alleviate these problems in some way but there needs to be bigger changes implemented to make the global health system more equal for all. If we truly want to rid ourselves of these epidemic diseases we must not only focus on advancement in science and medicine, but also maybe more importantly we must focus on advancements in economics.

### The Dose Makes the Poison: Modern Medicine, Modern Plagues

It is easy to think that economics and politics affect only the health of those in far off developing countries, but this is far from true. They affect everyone, including those of us who are healthy and surrounded by solutions to almost every ailment. Several modern scourges of the developed world occur not only in spite of our wealth and medical intervention but because of it. Diseases such as allergies, autoimmune diseases, including celiac disease and diabetes may be caused due an overabundance of resources such as antibiotics or food itself. Different from both Ebola and HIV which are infectious and constrained by a lack of economic resources, these diseases not only are individual but driven by the accumulation of economic resources. In this section the dangers of this economic abundance is explored.

### The End of Infectious Disease: An Age of Antibiotics

In this age of antibacterial hand sanitizer and Clorox, people are afraid of germs, of getting sick. But it could be that being afraid illness is making people ill. The hygiene hypothesis is a scientific idea that many autoimmune disorders are appearing due to lack of exposure to

bacteria, especially early in life. A part of this lack of exposure to disease is antibiotics. Not only do they effectively kill the bacteria<sup>6</sup> that is making someone ill, they also kill those that are already present in the body. This is true especially of broad spectrum antibiotics, which as their name suggests clear a wide variety of bacteria. This may seem insignificant, until you realize that there are more bacterial cells in and on your body than the ones that comprise your body. In his book *Missing Microbes: How overuse of antibiotics is fueling our modern plagues*, Dr. Martin Blaser likens our microbe population to an organ, with a function and essential in its own right (Blaser 2014). Just like any other organ when part of it is damaged or destroyed there are consequences. The importance of these organisms is quite clear when the sheer number of them is calculated. There are about 30 trillion human cells that comprise the average person; in addition there are also around 100 trillion microorganisms on each person (Blaser, 2014). With this comparison it is easy to imagine the havoc that would be wreaked on the body if suddenly a majority of these bacteria would disappear. These cells must be there for a reason or evolution would have eliminated by now. The reason for a lot of these bacteria seems counterintuitive; often bacteria are present on our bodies to protect us from disease. Even though most bacteria are thought of the agents of infectious illness, their very presence prevents it. The bacteria that are naturally found on skin and mucus membrane utilize resources in these places that prevent the growth of pathogenic species by outcompeting them (Brock, 2012). The consequences of destroying the natural flora of the body can be seen most clearly in *Clostridium Difficile* infections. This bacteria cause infects the gastrointestinal tract of humans and causes severe gastroenteritis. This infection is most commonly seen in hospitals especially among patients that are on heavy antibiotics (Brock, 2012). Now imagine that instead of heavy antibiotics that a person is put on multiple low dose antibiotics over several years. Instead of killing all the

commensal bacteria only some are killed, and the number of species and their ratios decline until only a few prolific species are left. Although still protective against infectious agents the environment and therefore the activity of the gut is changed. This might have few consequences or it could have drastic consequences. These consequences could be manifested in the form of modern illnesses, such as asthma and allergies. No matter the cause the rate of these conditions has certainly risen in the latter half of the last century and into the new one. This coincides with the rise in the use of antibiotics, beginning in the 1940's with small experimental doses and becoming more and more common every year. It is estimated that more than 41 million doses of antibiotics were given out to children in the US in 2010 (Blaser, 2014). This number is huge especially considering that up to 80% of upper respiratory infections, which are the most common reason for antibiotic prescriptions, are caused by viruses and not bacteria (Blaser, 2014). However antibiotics are cheap and safe so they are prescribed 'just in case'. To contrast with the number of antibiotics prescribed the number of people with autoimmune disorders in the US is now between 14.7 million and 23.5 million people, up to eight percent of the population (NIAID, 2005). While this may not seem like very much, the diseases that fall under this umbrella are virtually nonexistent in the developing world<sup>7</sup> and in much smaller proportion in the developed world until recently. The places most affected are normally rife with a diverse world of bacteria. Crohn's, and celiac disease all affect the gut while asthma and allergies affects the respiratory passages and eczema and affects the skin. Without the normal flora of bacteria that usually coat these areas interacting with the natural immune cells present, the immune cells become confused and attack the body's cells. Through a series of experiments Dr. Blaser was able to link several immune diseases with the presence of unique bacteria, *H. pylori*. This bacterium is often thought of as a pathogen since it does play a role in stomach ulcers, it is also

found naturally in some people's intestines. While it is unlikely that all of these problems are linked to a single bacterium the idea remains the same. The use of antibiotics to drastically alter our natural symbiosis with bacteria affects our health and drastically.

Given this evidence that antibiotics are no longer the magic bullet that they were once thought to be it should seem obvious that their affect on our health needs to be investigated further and the use of antibiotics needs to be drastically reduced. However that is easier said than done. The use and overuse of antibiotics are protected by both economic and societal barriers. Pharmaceutical companies, the meat industry and peoples fear and rejection of change are all barriers that need to be overcome. Pharmaceutical companies have a large economic interest in the continued use of antibiotics but ironically not new ones (Blaser, 2014). They are both cheap to produce and heavily prescribed if they are already established. Also broad-spectrum antibiotics are more profitable than narrow spectrum. This is not only because they have a wider variety of applications but because they are more prescribed more often (Blaser, 2014). Antibiotics however produce almost no profit when compared to those that are used to treat chronic illnesses such as the modern autoimmune scourges. If antibiotics the cause of these diseases then, they also drive the profits from the lifetime of medications used to treat those illnesses. Unlike the rather quick treatment caused by infectious illnesses, chronic illnesses like the autoimmune diseases described in this section and HIV discussed earlier require a lifetime of medicine, and that lifetime can span many decades. Several pills everyday for many years adds up very quickly. This is especially true in developed, wealthy nations where the majority of afflicted people reside; a person in these nations can afford these pills for a lifetime, thus making these drugs more profitable than those that are also needed in poorer areas such as HIV. In addition to economic interests stalling development of novel antibiotics and driving the market

for treatment of chronic illnesses, there is also a societal aspect of overuse of antibiotics. Most people in the developed world where antibiotics are ubiquitous, want a solution to every health problem. If there is an easy way to resolve an illness with no side effects than that is certainly the way to go. Antibiotics fit this bill for a long time, if there was a problem, a cough, a sore throat, there was an antibiotic to fix it, and with no consequences, lots of antibiotics were prescribed even if they weren't needed (Blaser, 2014). Thus after generations of having antibiotics, the public not only trust them they rely on them to solve minor issues and use them as a placebo effect. Even if the disease would have gone away on its own, the use of an antibiotic is attributed to the resolution of the problem. Even if the antibiotic doesn't make the problem better it makes the patient feel better which is sometimes almost as important as a solution to a problem. Also antibiotics are also used as a precaution against infection rather than a treatment for it. Often antibiotics are prescribed for dental procedures to ward off infection, even though the rates of infection are relatively low. The same principle is used in the treatment of strep throat; lots of antibiotics are prescribed to not only treat strep throat but also to prevent rheumatic fever which can develop from strep throat. Again the chances of this complication are rare but prevention and protection against litigation is a powerful motivator especially in the medical community. Cutting back on antibiotics may incite some patients, who feel like nothing was done to cure them and others who did have complications from their illnesses, however something must be done to turn the tide of societal expectation of antibiotics as a cure all. This is not only in the interest of reducing antibiotic resistance (which is another large problem facing the medical community but also reducing the unexplored side effects of three quarters of a century of antibiotic use.

The reduction of use of antibiotics must be accomplished using several approaches. These include public service campaigns to inform the public of its necessity, incentives for medical professionals to stop prescribing so many doses, better detection of viral vs. bacterial disease and alternative treatments. Several European countries, most notably France has implemented campaigns to remind citizens and doctors that antibiotics are not always necessary and should be given out sparingly (Blaser, 2014). This will and has reduced the number of patient-requested prescription filled. With these campaigns there should also be increased incentives for doctors to properly diagnose infections and determine if an antibiotic is necessary. Right now the most lucrative option for many physicians especially those in non-specialized fields such as pediatrics and family medicine is to see as many patients as possible in a day. With increased pay incentives for those that spend time discussing symptoms and treatment options with patients, not only will money be saved on unnecessary tests but on the antibiotics themselves. More time with patients will allow the physician time to determine if the problem is either bacterial or viral and order only the necessary tests. This will not only reduce the number of antibiotics prescribed overall it will also reduce the number of broad spectrum antibiotics and allow a more narrow focused treatment. Cooperation from both patients and doctors will most likely bring about the highest reduction in the use of unnecessary antibiotics since they are the providers and consumers of the products. Finally there needs to be funding to find alternative treatments, whether that is simply new antibiotics or something entirely new, solutions are out there. Just this year a recipe from a medieval monk was found to be able to kill even extremely resistant bacteria such as MRSA (Thompson and Smith-Spark, 2015). No matter what the solution the important fact is that the use of antibiotics needs to be slowed down in order to preserve our health.

Although at first glance HIV, Ebola and modern autoimmune disorders may have little in common, what they do have in common is a complex series of economic and social issues that make treatment difficult. By breaking down these barriers, especially the economic ones, and changing attitudes and expectations of treatment solutions to these complex and problems may be found. It will take cooperation between many disciplines but for the health of our human population it is a necessity.

#### End Notes

1. ART stands for antiretroviral treatment, and is a cocktail of drugs given to patients to combat HIV infection (Murphy, 2012)
2. CD4 count refers to the CD4 lymphocyte, which is a type of immune cell, which seeks out and destroys pathogens. Loss of CD4 cells signals a decrease in the body's ability to fight infection. In this case it is used as marker to mark the progression of HIV and eventually diagnose the patient with AIDS. (Murphy, 2012)
3. In this particular case the CD4 count required to be eligible for both ART and disability is 200. At this point the patient is generally considered to have AIDS (Murphy, 2012). For more information on HIV progression See Janeway's Immunobiology 8<sup>th</sup> edition.
4. Lu et al. attributed this drop in donation to the financial crisis that began in 2008 (Lu et. al, 2013)
5. Negative pressure refers to a space in which the air pressure is lower than that of the surrounding space. It is used for laboratories and isolation rooms because if there is a leak, air will rush into the space, not out. If air were to rush out it could contaminate the surrounding areas.
6. It is important to note here that antibiotics are only effective against bacterial pathogens. Antibiotics will not be able to clear a viral infection.
7. It is interesting to note that when fecal cultures taken from remote tribes in South American were analyzed they had the most diverse population of gut microbes currently know(2015)

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