

Emergence of Antibiotic Resistance: MRSA

In 1928 the first antibiotic, Penicillin, was discovered by Alexander Fleming. When brought into practice this medication was also referred to as a miracle drug (Chambers and Deleo 629). Antibiotics once cured infectious diseases that were before deadly and incurable. Though this was an incredible medical breakthrough, only a few years later antibiotic resistance emerged and became another medical problem that is difficult to combat (Chambers and Deleo 629). One of the major resistant infectious diseases, Methicillin resistant *Staphylococcus aureus* (MRSA), which is carried by many healthy people became a very prevalent issue for patients and healthcare professionals. “Methicillin resistant *Staphylococcus aureus* is one of the most common causes of infections, ranging from minor skin and soft tissue infections to severe, life-threatening infections” (Cataldo, Taglietti, and Pestrosillo 16). MRSA is a very serious infection that can be used to show how antibiotic resistance occurs and how it effects all people. MRSA helps us understand the severity of antibiotic resistance and how it not only effects the general population, but every individual around the world. The most important aspect of reducing risk of antibiotic resistant bacterium is the understanding of this issue in not only healthcare professionals, but the general public as a whole.

Staphylococcus aureus is a bacteria that can be found in up to fifty percent of people with no symptoms. Although it can exist in a harmless, asymptomatic state, *Staphylococcus aureus* can also cause serious bacterial infections (Haile-Mariam 347). *Staphylococcus aureus* was once susceptible to all penicillins, but the bacteria became resistant after a few years of penicillin treatments in patients. When penicillin became less effective patients were introduced to newer, more potent antibiotics such as methicillin, which also eventually became ineffective to many *Staphylococcus aureus* bacteria. *Staphylococcus aureus* bacteria that are resistant are typically

called MRSA (Haile-Mariam 347). Information on antibiotic resistance has been minimal in the general public and with the prevalence of MRSA and other multidrug resistant bacterium, patients need to be aware of how antibiotic resistance can affect people throughout the entire world.

Despite of the fact that MRSA is a growing problem, many patients have trouble understanding the details of this infection. In a study of “Patients’ perspectives of antibiotic resistance,” by Lauren Brooks, patients were aware of MRSA and had resilient feelings on its occurrence in the hospital setting (HA-MRSA). Though the patients knew what MRSA was, most patients had never even heard the term *antibiotic resistance* (Brooks, et al 343). This presents a problem because patients are only seeing the disease and not where the disease is stemming from. Lauren Brooks study involved getting to the root of patients views on antibiotic resistance. Overall throughout her research, Brooks noticed that there were four major themes that occurred between the patients sampled. These themes include: whether either the body or bacteria are affected by antibiotic resistance, who is to blame, who is at risk, and potential solutions to the problem (Brooks, et al 343-345). Patients had a hard time distinguishing whether antibiotic resistance had emerged by the body or the bacteria gaining resistance to the antibiotics (Brooks, et al 343). As mentioned before, when first discovered, Penicillin was a cure for almost all *Staphylococcus aureus* bacterium, but not too long after its discovery cases of resistance were found. “More potent antibiotics were introduced and again, resistant bacteria emerged and flourished” (Haile-Mariam 347). It is important for patients to understand that the bacteria are the organisms that are becoming resistant, not their bodies. Bacteria adjust in a way that can reduce or eliminate the efficiency of antibiotics. When an antibiotic is taken, sometimes a few of the bacteria may survive because it offset or escaped the effect of the antibiotic (“Antibiotic

Resistance Questions and Answers”). These bacteria that may have escaped can then reproduce and supplant all the bacteria that were killed off. The surviving bacteria then become more resistant. The bacteria can change and “develop the ability to neutralize the antibiotic before it can do harm, others can rapidly pump the antibiotic out, and still others can change the antibiotic attack site so it cannot affect the function of the bacteria” (“Antibiotic Resistance Questions and Answers”). MRSA, found first in hospitalized patients (HA-MRSA), began to appear in the community (CA-MRSA) as the bacteria gained strength and became more resistant. The question that began to arise was what was causing the rise of resistant bacteria and Lauren Brooks found that patients had a lot of trouble deciding who to blame (Brooks, et al 344).

Moreover, when a multidrug resistant bacteria develops the natural response is to want to point fingers at who has caused this epidemic, but in reality there is no single cause for an infectious disease as complicated as MRSA (Haile-Mariam). Causes of antibiotic resistance can be pinned on just about every person who distributes or uses antibiotics. These people include: Physicians, patients, and pharmacists. When physicians write prescriptions, it is very common that it may have been written on a theoretical belief rather than proof of an infection (Thomas and Nandave 2064). Inappropriate use such as: theoretical belief of infection, incorrect dosage and length of prescription all lead to antibiotic resistance and can be helped with scientific proof of infection and physicians spending more time interpreting the type of bacteria causing this illness (Thomas and Nandave 2065). Patients’ role in antibiotic resistance is much more difficult to control. Patients fail to follow prescription directions, demand prescription from physicians when an infection is not present, and use leftover antibiotics for a different illness. Antibiotics are very specific and work only to kill bacterial infections (Thomas and Nandave 2065). Viral infections will not be cured by antibiotics and only certain antibiotics may be used to exterminate each

different bacterium. Pharmacists' play a part in antibiotic resistance by: improper reading of prescriptions, not giving patients sufficient direction for prescriptions, and improper labeling of drugs (Thomas and Nandave 2065). The entire community plays a role in antibiotic resistance and blame cannot be placed on a single group of people. Antibiotic resistance requires change on the individual as well as the community as a whole (Brooks, et al 345).

In addition, patients had a hard time deciphering whether MRSA and antibiotic resistance could affect them personally or whether it was just a problem that affected others in the community (Brooks, et al 345). "Antibiotic resistance leads to failed treatments, prolonged hospitalizations, increased costs and death" (Gyssens 12). *Staphylococcus aureus* is a very adaptable bacteria and effects healthy and sick people (Chambers and Deleo 629). The fact that MRSA can effect healthy and sick people is proof that every individual should understand the risks for them at a personal level and also of their community. MRSA affects overall healthy individuals by a strain called community associated MRSA (CA-MRSA) and ill people by a strain called healthcare associated MRSA (HA-MRSA).

MRSA was once isolated to cases only in the hospital, but it since it epidemiology has been altered and can be observed more often in the community. HA-MRSA refers to a strain that was attained after recent contact with a healthcare facility (Cataldo, Taglietti, and Pestrosillo 16). Risks that may lead to HA-MRSA include: being in the hospital in the last twelve months, recent dialysis procedure, living in a long-term care facility, and "presence of an indwelling catheter" (Cataldo, Taglietti, and Pestrosillo 17). CA-MRSA is characterized by a patient that has no prior infection of an antibiotic resistant infection and no recent exposure to a healthcare facility. CA-MRSA is typically contracted by skin-to-skin contact between an individual with MRSA and another individual (Cataldo, Taglietti, and Pestrosillo 17). There are also risks involved in

contracting CA-MRSA that are the major reasons for infection. These risks include: “Compromised skin integrity, skin-to-skin contact with infected or colonized persons, suboptimal personal hygiene, sharing of contaminated objects and surfaces, and living in crowded conditions” (Cataldo, Taglietti, and Pestrosillo 17). CA-MRSA can typically occur in three different types of infections. The most common routes of infection are skin and soft tissue, musculoskeletal, and pneumonia. The most complicated infection to treat is pneumonia and the mortality rate of this infection is significantly higher than the other routes. Pneumonia caused by MRSA has been reported much more often in recent years in the community and demonstrates just how important limiting risk of MRSA and antibiotic resistance is (Cataldo, Taglietti, and Pestrosillo 18).

Currently, there are some methods that are used to cure MRSA, though there are cases in which these methods are not effective. These methods include medications such as Clindamycin, Cotrimoxazole, Doxycycline, and most commonly Vancomycin. Vancomycin, usually in an intravenous form, has the capability to fight against the most severe MRSA infections (Cataldo, Taglietti, and Pestrosillo 19). Though it is the most commonly used, but resistance still remains a huge factor in the effectiveness of this therapy (Chambers and Deleo 638). Considering that these medications that are commonly used to treat MRSA can still become resistant, new policies and ideas have been brought up in order to reduce the prevalence of antibiotic resistance rather than hope the medications work once the disease is already contracted. There have been “Antibiotic Stewardship” programs in which give patients guidelines on antibiotic use (Gyssens 12).

Before modern day antibiotics were created, illness such as *Staphylococcus aureus* were fatal in almost every case. The problem that antibiotic resistance creates is that this problem is

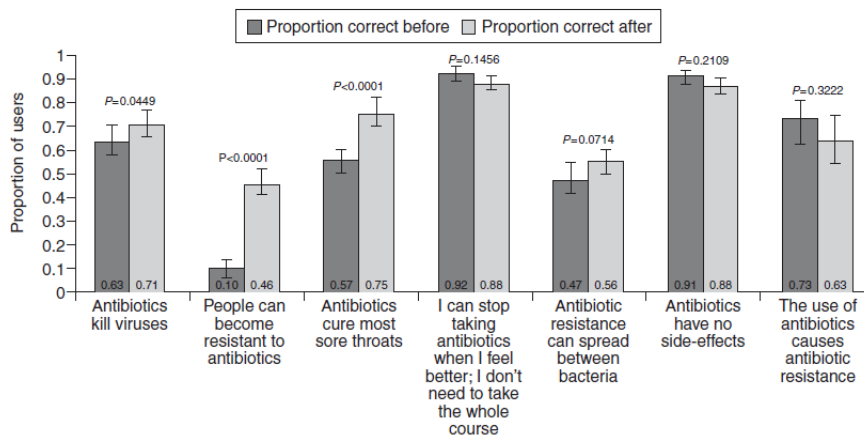
occurring again. With resistance on the rise and the likelihood that our society will one day be resistant to almost all antibiotic is a reality (Haile-Mariam 346). Patients often believe that multidrug resistant bacteria will not affect them, but this is simply not the case. “They [patients] did not consider themselves to be at risk, because they either portrayed themselves as ‘responsible’ users of antibiotics or perceived that they had not consumed sufficient quantities of antibiotics” (Brooks, et al 345). Patients also do not understand that irresponsible patients that are misusing antibiotic can affect the entire community. Abuse of antibiotics has the capability of effecting people all over the world (Brooks, et al 345). “There is a clear association between antibiotic use and resistance both on the individual and population levels” (Gyssens 12). While resistance becomes more prevalent, the treatment options become scarce. This scarcity can eventually lead patients to high risk situations including death (Gyssens 12). In order to help prevent this problem, the key is to reach patients so they understand the severity of this problem.

There are several ways of reaching patients that are currently being used by healthcare professionals and evidence that there has been many benefits of these campaigns. Some common methods used to reach patients include: antibiotic education in schools, education sessions for prescribers, health education websites, television programs, and educational materials mailed to homes (Hemo, et al 19-23). The benefits of these programs are excellent and help patients grow in their understanding in this growing epidemic of antibiotic resistance.

To illustrate how patients benefit from the programs, a study on antibiotic education in schools and education sessions by Diane Harris produced brilliant results. In schools students would take a quiz on their knowledge on antibiotics and then take home key facts about suitable use of antibiotics (Harris 2425). The children were taught about the use of antibiotics were shown to enjoy it and through the leaflet they brought home to parents Harris two different

groups of people by basic education in schools by trained school health assistants (Harris 2427). During education sessions a local microbiologist, microbial pharmacist, and an infection control nurse would be present to help inform antibiotic prescribers. These sessions included information on antibiotic prescribing, followed by a discussion (Harris 2427). The end result of these sessions was prescriber’s knowledge on helping patients understand risks of antibiotics through pamphlets at their primary care physician. Not only did the prescribers think that these sessions were helpful for themselves, but they felt they had more confidence in reaching out to the public with information on antibiotic resistance (Harris 2427).

Health education websites have been known to be very helpful to patients and make it easier to cover a large audience. Gemma Madle launched a website that informed patients of



The error bars show the 95% confidence intervals for the proportions

Figure 1. Improvement Statistics. (Madle, et al 21). This image shows how patients answered questions on their questionnaire before and after they viewed a health education website on antibiotic resistance.

frequently asked questions about antibiotic resistance and evidence-based resources that go into greater depth about antibiotics (Madle, et al 20). In order to find out how effective

informative websites on antibiotic resistance were,

Madle asked patients to fill out a questionnaire on antibiotic before and after they viewed the website. All of the patients thought that their knowledge had grown about antibiotics and forty-seven percent of patients showed an improvement in knowledge of antibiotics from the first questionnaire (Madle, et al 21). Figure 1 displays data on the questions that patients may have improved or worsened on their questionnaire. Though this evidence demonstrates that not all

patients had an improvement of their knowledge, it is excellent that this showed some improvement. Also this information can help healthcare professional see where they can make improvement on getting the right information to their patients. A physician who saw the educational website even said “I would recommend this to my patients instead of rushing in to see me as their general practitioner” (Madle, et al 25). This evidence indicates that with just small steps to reach patients, such as website, patients’ knowledge can improve. Though this source is about ten years old, using the internet as a mode of information to reach patients is more helpful now because knowledge of computers, as well as access to computers is more prevalent at this point in time.

Beatriz Hemo conducted a study on how a “nationwide media campaign can affect antibiotic use” (Hemo, et al 529). This campaign included: television presentations, pamphlets and educational resources mailed to the home. Hemo found that the most effective way to help patients understand implications involved in antibiotic use was by a combination of strategies (Hemo, et al 529). As seen in Madle’s study, only forty seven percent of people improved on their questionnaire after they viewed the educational website (Madle, et al 21). Through both of these studies, it becomes apparent that in order to have the full effect of knowledge about antibiotic resistance, a few different modes of information will work best. Collecting information from a multitude of different sources will help patients get a tighter grasp on how antibiotic resistance affect them as well as the community. The results of the nationwide campaign by Hemo, demonstrated that there were not only short-term results, but also a change in attitude of patients about the prescription of antibiotics. Overall through this study it is apparent that nationwide campaigns about misuse of antibiotics can reduce overuse of antibiotics (Hemo, et al 534).

Therefore, since only a few years after antibiotics were invented, antibiotic resistance has been a problem. There is a lot of information that patients lack, as well as lack to understand. MRSA has shown us the harsh reality of antibiotic resistance and how adaptable it can be. Though there are medications that can rid the body of these bacteria now, the bacteria become more resistant every time antibiotics are used (Haile-Mariam 347). Patients are responsible in knowing basic information about their bodies and how antibiotic resistance can affect them and everyone around them. Though the many modes of information that have been used over the years, it has been proven that antibiotic education in schools, education sessions for prescribers, health education websites, television programs, and educational materials mailed to homes can help patients be more aware of the epidemic of antibiotic resistance.

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