Hospital- Acquired MRSA Infections and their Impact on Antibiotic Resistance

GCH: Health and Environment

Heather L Hoopes

George Mason University

Introduction:

Everyone has picked an annoying scab, skipped putting a Band-Aid on a little paper cut, or even shared a bathroom towel at a friends house. Those are all examples of mindless events that could lead to potentially fatal infections like MRSA. Scientifically named Methicillin- resistant Staphylococcus aureus, MRSA is also known as a "flesh eating disease" that is acquired through an abrasion or cut on the skin, no matter how big or small. An article in a journal by *Nursing Standard* explains MRSA infections as "major global prevention and control challenges (Gould, p.47)." MRSA infections have the capability to spread rapidly and cause deadly infections, sometimes without even displaying symptoms (Gould, p.50). Perhaps the scariest part is that these infections are becoming so resistant to antibiotic drugs that doctors are running out of effective prescriptions as treatment for MRSA pathogenicity in humans. The likelihood of acquiring a MRSA infection in a hospital is at a rapid incline, causing the prescription of more and more antibiotic drugs, which in turn feeds the fire of antibiotic resistance throughout the world, leaving essentially no treatment options for those infected with MRSA.

Body:

The first cases of MRSA infections date back to 1961, and by the 1990s, MRSA was reported as a widespread endemic in many hospitals (Gould, p.49). These infections are the result of resistant strains of a common bacterium called Staphylococcus aureus (Gould, p.48). Staph aureus is a bacterium that grows in circular grape-like clusters (Gould, p. 48), and is commonly carried in the nose and on the skin of a healthy person in its non-pathogenic form (MRSA and the Workplace, 2014). The most prevalent form of

Staphylococcus aureus presents itself as common skin infections, such as pimples or boils (MRSA and the Workplace, 2014). The Centers for Disease Control and Prevention follows a list of the "5 C's" which make the spreading of MRSA extremely easy: crowding, frequent skin to skin contact, compromised skin with cuts or abrasions, surfaces contaminated with the MRSA pathogen, and lack of cleanliness (MRSA and the Workplace, 2014).

MRSA infections exist in two different types; community associated MRSA infections (CA-MRSA), and hospital acquired MRSA infections (HA-MRSA) (MRSA and the Workplace, 2014). Community associated MRSA infections are the less common version of MRSA infections, and are defined by the CDC as being "acquired by people who have not been recently hospitalized or have not undergone a medical procedure in the past year (MRSA and the Workplace, 2014)." According to the CDC, these types of MRSA infections can be treated as "out patient" procedures, and are usually cured by various antibiotics (Vancomycin, 2014). In 2005, the MRSA Survivors Network stated that 85% of all MRSA infections are found in patients that stayed in some kind of health care facility, leaving 15% of MRSA infections to be acquired through the community, or in a "non-hospital" setting (MRSA Survivors Network).

As stated in a professional nursing journal called *Nursing Standard,* "more information has been written about prevention and control of hospital-acquired MRSA than any other pathogen in the world (Gould, p.47)." Unfortunately, MRSA bacterium live in various pathogenic strains that have developed resistance to a very large spectrum of antibiotics, and have also developed a non-specific and adaptive response to most antibiotics (Lindsay, p. 319). The most at risk candidates for acquiring MRSA infections

are young children and elderly men and women because of their underdeveloped and suppressed immune systems (MRSA Survivors Network). MRSA infections act similarly to latent viruses, such as AIDS, because once a person is infected, they become a reservoir for the bacterium, which never truly leaves its host and can continuously re-infect them (Gould, p.48).

Some doctors argue that patients and hospital staff should be held accountable for the spread of these deadly infections. Proper hand washing techniques and hospital sterilization plays a crucial role in helping to prevent the onset of infection in patients and staff exposed to the pathogens. Most MRSA infections occur in individuals that are immunocompromised, or have weak immune systems, and are susceptible to the bacteria even if exposed to the smallest trace (Duggal, 2012, p.95). Scientists have been working endlessly for years trying to find a more efficient way to reduce the risk of contracting a MRSA infection, especially in hospitals and other medical facilities. MRSA infections are mainly spread through direct contact, but can also be transmitted through the air and contaminated hospital equipment (Duggal, 2012, p.94). According to the CDC, medical professionals should be taking all measures to ensure that they have done all that they can to treat the patient before they begin administering antibiotics (MRSA and the Workplace, 2014). *Nursing Standard* says that the guidelines for MRSA care and treatment include surveillance of the infected patient and infection, performing decolonization strategies, practicing standard infection prevention, and taking precautions to reduce transmission (Gould, p. 49). Cross contamination of bacteria from patient to patient via a health care provider is a huge cause of spread of disease and infection of many pathogens. Precautions to reduce spread of bacteria include proper hand washing

and correct sterilization techniques of hospital rooms and equipment (Spellberg, 2009, p.55).

Case Study #1:

In a documentary presented by Frontline called, "Hunting the Nightmare Bacteria," a series of three different and completely unrelated rare MRSA infections were documented and explained in depth to demonstrate how these bacterium can live in the most unexpected cases and can completely take over the human body.

The program featured a young girl named Addie who was infected with a bacterium called Stenotrophomonas, which is prevalent in hospitals and breathing tubes. Doctors at her hospital originally diagnosed her with a virus, then re-diagnosed her with pneumonia shortly after. She had infected boils all over her body, which was a result of the staph infection, and they were eventually diagnosed as community spread MRSA infections. Doctors said that Addie acquired the MRSA through picking her scabs. The Stenotrophomonas damaged Addie's lungs so severely that she was placed on ECMO as life support, and her condition and the spread of infection only continued to worsen even after numerous rounds of different antibiotic treatments. Unfortunately, the ECMO treatment left a lot of room for further spread of the Stenotrophomonas, since the bacteria thrives on environments like breathing tubes and other kinds of medical plastics. The antibiotics would show improvement for a little while, but a few weeks later, the infection would appear again due to its ability to remain in the body. Doctors diagnosed the bacteria as "pan-resistant," meaning it was literally resistant to everything. What started as a young child picking her scab ended up to be a child on complete life support, who was eventually forced to undergo a complete lung transplant to get rid of some of

her infection. Since the infection spread all throughout her body so rapidly and invaded her body so intensely, she had to re-learn how to walk, talk, and breathe on her own again. Addie was one of the lucky ones to receive a full lung transplant and make it out alive from such a fatal bacterial infection. She still has to visit doctors monthly to be sure that there are no signs of any MRSA infections active in her body, and she will have to remain on maintenance medication for the rest of her life to keep her body stable and from rejecting her new lungs.

Case Study #2:

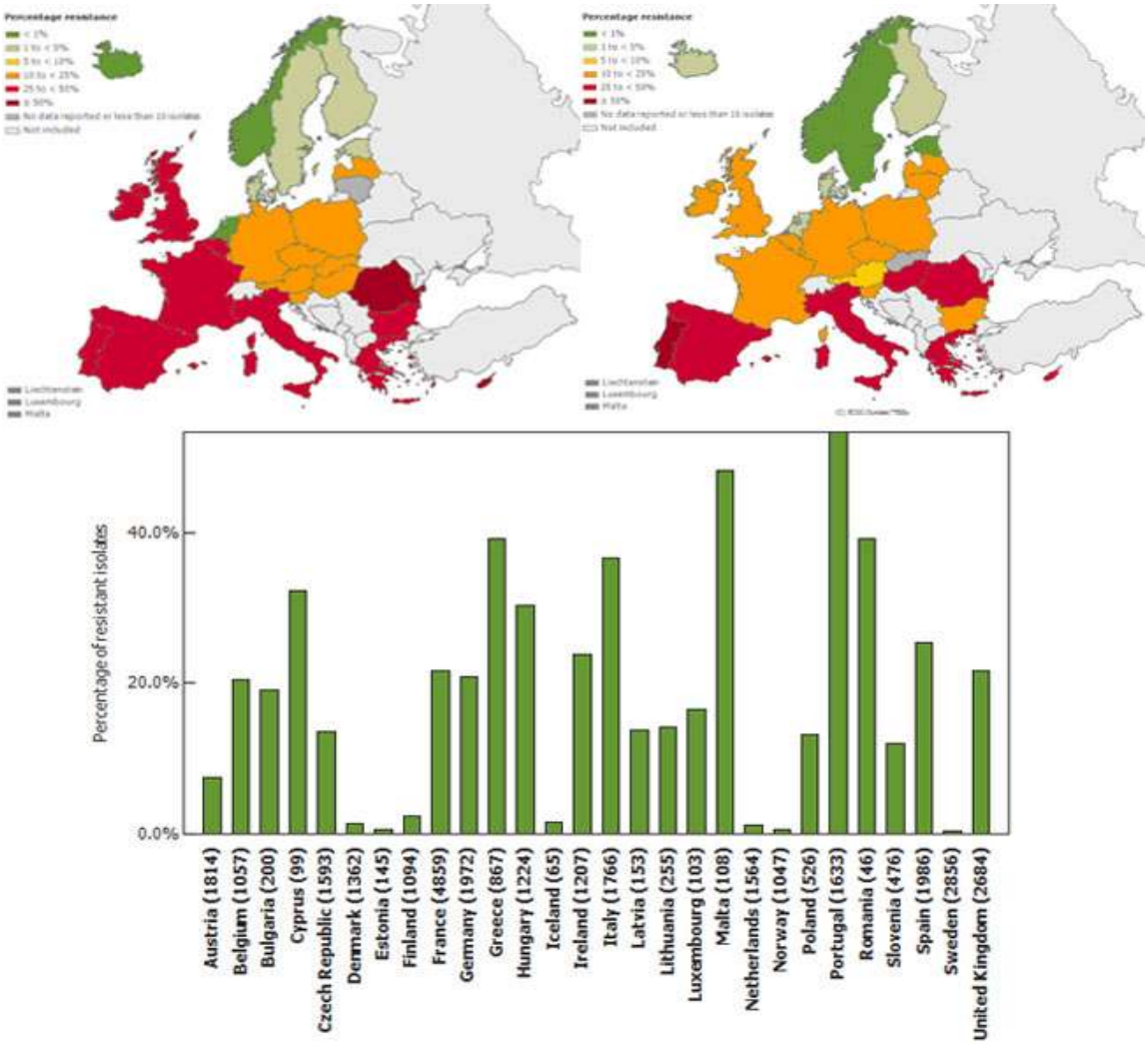
In the same documentary was the case of an American teenager who traveled to the slums of India on a mission trip, where MRSA causing bacteria are extremely prevalent and spread in very unexpected ways. He was hit by a train, lost a ton of blood, and was taken to an Indian hospital where the doctors amputated his leg in very unsanitary conditions and without the proper surgical techniques. He was then transported to another hospital where they told him he didn't have much longer to live. To keep up with decreasing the rapid spread of his infection, he was undergoing about a surgery per day in order to clean out the infection in his leg. Finally, the boy was transported to an American hospital where he was diagnosed with a bacterial "super bug" named NDM-1, which is also pan-resistant to all antibiotics. The problem with NDM-1 is that it carries a resistance gene that it is able to give to surrounding treatable bacteria within the body and gives them resistance, too. NDM-1 is also very different from other bacteria because it is able to exist outside of a human host, and can live and replicate all over the place, even in puddles on the streets. Since he brought NDM-1 into the US, he was put in isolation, and doctors realized that their only hope or option of medication for

his was to try an old 1940s drug called Colisitin and cut off even more of his leg, which eventually seemed to be the answer doctors were looking for. The boy still lives to tell his story about his extremely rare MRSA infection, and like Addie, will remain on medication for the rest of his life to insure that the NDM-1 does not re-activate itself within his body.

Analysis:

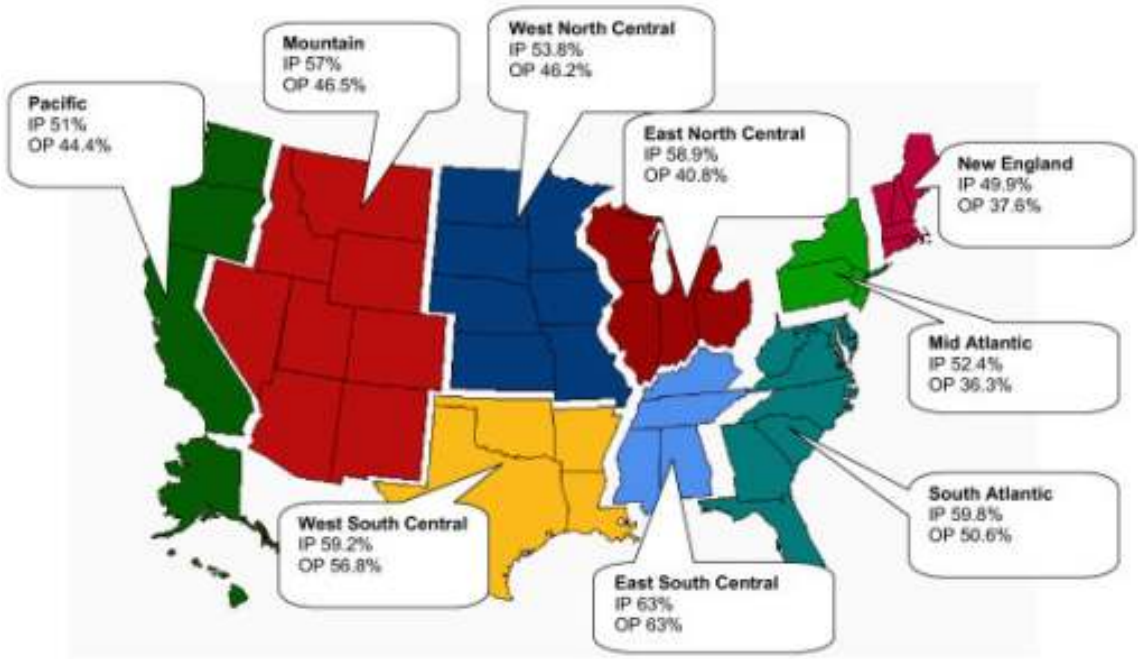
According to the International Journal of Medical Microbiology (IJMM), MRSA infections are the most common cause of "multi-drug resistant healthcare associated infections in American hospitals (Lindsay, p.318)." In 1995, 22% of Staph infections were a result of healthcare associated MRSA. By 2004, that percentage drastically increased to 64% (MRSA Survivors Network). Importation of MRSA strains from other countries into the US remains a problem for healthcare in the US (Duggal, 2012, p.94). Different strains of pan-resistant MRSA bacterium live in different parts of the world, and when they are brought together to one part of the world, they mate to create new and more virulent strains of the MRSA infecting bacteria that doctors have never dealt with before, nor do they know how to treat.

The graphs below show the rate of MRSA infected countries throughout Europe. The top left is a picture of 2005 data and the right is of 2010 data. This graph exemplifies how the number of resistant strains of MRSA are continuing to grow throughout Europe, and that about 20% of all MRSA strains in Europe are already completely resistant to antibiotic treatment.



Below is a graph constructed of data provided by the US Census Bureau Regions that shows rates of in-patient (IP) and out-patient (OP) MRSA infections throughout different regions of the United States. Results of the study by the NIH showed that within the nine different MRSA infected regions of the US, all except for the New England region showed an in-patient MRSA infection rate of 50% or higher, showing that these MRSA infections are extremely prevalent in hospital settings. The NIH concluded that frequency of both in- and out-patient settings, MRSA infections only continue to increase. The NIH stated that multi-drug resistance was the common “phenotype” for

these statistical outcomes, meaning if the MRSA bacterium were not so drug resistant, doctors would be able to treat them and decrease the rate of infection.



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Conclusion:

MRSA infections have surpassed the state of epidemics in different countries and have become a pandemic across the world. Prevalence of these infections are becoming more numerous by the year, and without the proper prevention and treatment methods, even studies and data have shown that MRSA infections will only continue to become more virulent and resistant to a wider range of treatments.

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