

Humans vs: Deadly “Superbugs”

What are “Superbugs”? Superbugs are Bacteria which are one-celled organisms without a true nucleus or cell organelle that belong to the kingdom of Procaryotae (Monera). In simple terms, Superbugs are bacteria strains resistant to antibiotics. It was reported by AOL on 10/17/2010 that there was a disease causing bacteria that can “stand up and walk”. They have always been around and over the past few decades, it seemed as though we had controlled them. Now we may be losing control. In the health care setting, the loss of control can be life threatening and very costly.

Some bacteria produce polysaccharides or a polypeptide capsule, this inhibits phagocytosis by the white blood cells. Phagocytosis means destruction or disintegration of phagocytes. Millions of these nonpathogenic bacteria live on human skin and mucous membrane, which are called normal flora. Bacteria that are capable of or cause disease are called pathogens. Pathogenic bacteria are the disease-causing species, and compared to the millions of bacteria it’s a very small portion of bacteria as a whole.

Bacteria have three principle forms; spherical (ovoid), rod-shaped or spiral. Bacteria mutates, like all living things. The environment determines the beneficial mutations, which have the survival value. We will talk about several different kinds of bacteria and how they affect the surgical environment and the cost of health care.

Bacteria can also be placed into three groups based on their continued response to gaseous oxygen.

1. **Aerobic bacteria** thrive in the presence of oxygen and require it to grow.
2. **Anerobic bacteria** cannot tolerate gaseous oxygen. These bacteria live in places like under-water deep sediment, or those that cause bacterial food poisoning.
3. **Facultative anaerobes** grow in the presence of oxygen, but can continue to grow without it.

Another way to classify bacteria is how they obtain their energy. Heterotrophs break down complex organic material that they take in from the environment and decaying material including fermentation or respiration. The second group is Autotrophs. Carbon dioxide allows them to make their own food. This process can include light energy, or oxidation of nitrogen, sulfur, or other elements. Bacteria's most important role is to release nutrients back into the environment as well as cycling nitrogen.

When one starts to look at the history of bacteria, the awareness has been around for a very long time. Around 3500 BC the Sumerian doctors gave their patients beer soup mixed with snake skins and turtle shell for its healing powers. Babylonians used ointments made of frog bile and sour milk. Each of these contained a "like" antibiotic.

The term "Antibiotic" came from the Ancient Greeks which itself was from the archaic period from the 6th to 8th century BC to about 146 BC.

It came from the Greek word *ἀντί* which means anti, or against, combined with *βίος* which means life. Antibiotics are what we use today to fight off infections caused by bacteria. An Antibiotic is a substance or compound that kills or inhibits bacteria. Antibacterial is an alternative name.

As we move through modern day history, we can see how fast and far we have come. We can also look back and understand that the Greeks knew something was there, even though they could not see it.

- 1796- Edward Jenner invented the first small pox vaccination.
- 1862- Louis Pasteur invented the Germ theory of disease. He was born in Dole France and Married Marie with whom he had 5 children. Three of his children died of Typhoid fever, which most felt lead to his drive to save people from disease. In early research Louis worked with the wine growers helping with the fermentation process. This was to pasteurize and kill germs. He was granted a U.S. patent for improvement in Beer and Ale Pasteurization.
- Louis Pasteur's main contributions were changes to minimize the spread of disease by microbes and germs. He discovered that weak forms of disease could be used to immunize against the stronger forms of disease. He also introduced the medical world to the concept of viruses.
- 1867- Joseph Lister invented methods for antiseptic surgery. By 1871, he began researching urine contaminated with mold and how it prevented growth of bacteria.
- 1874 - Anton Van Leeuwenhoek built a practical microscope which allowed him to see and describe bacteria, yeast, plants, and the circulation of blood in corpuscles in capillaries.
- 1882 - Paul Ehrlich invented the acid-fast stain.
- 1884 - Christian Gram invented the gram stain, a method using stain for the purpose of classifying bacteria.

- 1885 - Louis Pasteur invented the first rabies vaccination.
- 1887 - R. J. Petri invented the petri dish.
- 1890 - German doctors Rudolf Emmerich and Oscar Low were the first to use pyocyanase from microbes in hospitals, however the first antibiotic did not often work.
- 1929 - Sir Alexander Fleming, a Scottish bacteriologist, goes on vacation leaving a petri dish of staphylococci bacteria uncovered. When he returned home, mold had invaded the dish and where the mold grew, no bacteria was growing. Alexander named the mold “Penicillium”, and the chemical produced by the mold was named Penicillin. Penicillin is the first recognized antibiotic. Almost immediately after Penicillin was introduced, certain strains of staphylococci were recognized as being resistant.
- 1935 - Gerhard Domagk (1895-1964) a German chemist discovers synthetic antimicrobial chemicals (sulfonamides).
- 1942 – The term “Antibiotic” was used by Selman Waksman.
- 1942 - Howard Florey and Ernest Chain invent a manufacturing process for Penicillin G Procaine. They shared the 1945 Nobel Prize for medicine on their work for Penicillin.
- 1940s-50’s- Streptomycin, chloramphenicol, and tetracycline were invented. Selman Waksman made the drug Streptomycin from soil bacteria, which was used to treat tuberculosis. The side effects could be very severe.
- 1947 - Four years after companies began to mass produce Penicillin, Microbes begin to appear that could resist it.

- 1947 - Jonas Salk invented the Polio vaccine.
- 1948 - Andrew Moyer was granted a patent for a method of the mass production of Penicillin.
- 1950's - It was apparent that Tuberculosis (TB) bacteria was rapidly developing resistance to streptomycin, which at that time was used against TB.
- 1953 - Shigella outbreak in Japan, a certain strain of dysentery bacillus is found to be resistant to chloramphenicol, tetracycline, streptomycin and sulfanilamides.
- 1954 - Becton, Dickinson and company created the first mass-produced syringe and needle produced in glass.
- 1957 - Nystatin was patented and used to cure many fungal infections.
- 1967 - Benjamin A. Rubin invented a pronged vaccination needle used for smallpox.
- 1977 - W. Gilbert and F. Sanger invented a method to sequence DNA.
- 1981 - Smithkline Beecham patented Amoxicillin and they sold the first tradenames in 1998 for Amoxicillin, Amoxil and Trimox.
- 1983- Kary Mullis invented the polymerase chain reaction.

With each description of our Antibiotic resistant Superbug, we will discuss how each bacteria is treated.

http://www.cdc.gov/ncidod/dhqp/pdf/guidelines/SSI_tagged.pdf

Beta-Lactamase/ Extended-Spectrum Beta-Lactamases (ESBLs)

Beta-lactamase are enzymes that are produced by some bacteria and are responsible for their resistance to beta-lactam antibiotics like penicillins, cephamysins and carbapenems (ertapenem). The two most common bacteria are Escherichia coli (E.coli) and Klebsiella pneumoniae.

Cephalosporins are common in their molecular structure to beta-lactamase; they both have four-atom rings, these are known as beta-lactam. The lactamase enzyme breaks open the ring which deactivates the molecule's antibacterial properties.

Extended-Spectrum Beta-Lactamases (ESBLs) are enzymes that can be produced by bacteria, making them resistant to cephalosporins e.g. cefuroxime, cefotaxime, ceftriaxone and ceftazidime as well as monobactams e.g. aztreonam. Extended-spectrum are third generation antibiotics. These antibiotics are widely used in many hospitals. At this time they do not affect the cephamycins, which are cefotetan or cefoxitin. They also do not affect carbapenems including meropenem or imipenem.

ESBLs were first found in the mid 1980's and were mostly seen in Klebsiella species. Predominantly, they were seen in hospitals and often in intensive care units usually with patients with illnesses that make them opportunistic for bacterial infections. At that time, it was suggested that ESBLs (because of molecular analysis) may have derived from mutations. This problem was not a big issue at the time, however,

now we have a new class of ESBL. The new class of ESBLs is called CTX-M enzymes, and is detected among Escherichia coli (E. coli) bacteria.

E. coli is able to resist Penicillins and cephalosporins. These CTX-M enzymes are rapidly expanding. This is not just simple cystitis, concern because it is found in most urinary tract infections. Missing the presence of ESBL could result in treatment failure. It is hard sometimes to detect these because they do have different activity levels.

Other types of infections are caused by E. coli which could lead to bacteremia which is a blood infection that could be life threatening. K. pneumonia, which causes bacterial pneumonia, or wound infections in addition to UTIs. Patients with weak immune systems, patients with illnesses, children and the elderly are at increased risk.

The National Committee for Clinical Laboratory Standards (NCCLS) developed broth microdilution and disk diffusion screening tests. These tests have indicated that cefpodoxime and ceftazidime show the highest sensitivity of ESBL. Another problem is some ESBLs contain β -lactamases that can mask ESBL production.

Beta-lactam antibiotics are used to treat a broad spectrum of Gram⁺ and Gram⁻ bacteria. Examples of the many different bacteria would be Enterobacter, K. pneumonia, K. oxytoca, E. coli, Enterobacteriaceae (Salmonella), Proteus, Morganella, Mirabilis, Pseudomonas aeruginosa, Citobacter, and Serratia, which all produce ESBLs.

MRSA

What is MRSA? It has been brought to the forefront of many people's minds lately, because it's been a subject of many news features. Why has MRSA been featured? Because of the spread of the "super disease" and new cases. Health care workers are more and more concerned about its transmission process and contracting it themselves.

Staphylococcus aureus is a common cause of healthcare-associated infections reported to the National Healthcare Safety Network (NHSN). The percentages reported are Coagulase-negative staphylococci the leading infection is 15%, while Staphylococcus aureus is 14%.

Staphylococcus Aureus is the most common cause of surgical site infections at 30% and causing ventilator associated pneumonia at 24%. Of all the healthcare associated S. aureus infections, it is suggested that 49-65% are caused by Methicillin resistant strains.

MRSA: Methicillin Resistant Staphylococcus Aureus is a type of "staph" **bacteria** that does not react to certain beta-lactam antibiotics called antimicrobial-resistant and will normally cause skin infections. Bacteria is a one-celled organism without a true nucleus or cell organelles, belonging to the kingdom of prokaryotae (Monera). Millions of non-pathogenic bacteria live on human skin and mucous membranes; these are called normal flora. Bacteria that cause disease are called pathogens. Bacteria, like all living things, undergo mutations. It is the environment that determines which mutations are beneficial to bacteria. Mutations may be beneficial to bacteria and may not be to humans, because mutation provides resistance to the potentially lethal effects of antibiotics against bacteria.

MRSA can cause other infections that CAN BE FATAL! MRSA occurs most frequently with patients who undergo invasive procedures. Examples are catheters or surgery and with patients who have weakened immune systems. MRSA in the healthcare setting commonly cause bloodstream infections, surgical site infections as well as pneumonia.

History of Methicillin-resistance:

Methicillin-resistance in *S. aureus* was first identified in the 1960's usually among hospitalized patients.

- Starting in 1974, MRSA infections accounted for about 2% of the total number of staph infections.
- By 1995 it was up to 22%; in 2004 it was 63%. The CDC estimates that each year approximately 27 million surgical procedures are performed.
- The CDC estimated 94,360 invasive MRSA cases occurred in the US in 2005, and of these cases, 20% were associated with death.
- In 2006-2007, MRSA is viewed as “stabilizing” at 56% after evaluation of this trend.

When dealing with the serious MRSA disease that is predominantly delivered by healthcare exposures, about 85% are associated with healthcare. When dealing with the two-thirds outside of the hospital infections, about one-third of those happened during a hospitalization.

About 14% of all infections occurred in persons without obvious exposures to healthcare. The overall rates of disease were consistently highest among persons older than 65, black and also males.

MRSA is resistant to antibiotics including methicillin, oxacillin, penicillin and amoxicillin including cephalosporins (e.g., cephalexin). Since these strong drugs are no longer effective against MRSA, these infections are sometimes called multidrug resistant organisms (MDROs). According to the CDC, high prevalence influences unfavorable antibiotic prescribing, which possibly could contribute to further spread of bacterial resistance.

MRSA is seen most frequently among patients who undergo invasive medical procedures or often occur with people who have weakened immune systems and are in hospitals and/or healthcare facilities. This includes nursing homes, dialysis centers and prisons. MRSA in healthcare settings commonly causes serious and potentially life threatening infections such as bloodstream infections, surgical site infections or pneumonia.

What is a surgical site infection?

An infection that occurs at the site of surgery within thirty days of an operation or within one year of an operation if a foreign body (e.g., artificial heart valve, joint or mesh) is implanted as part of the surgery. Most surgical site infections, approximately 70% are superficial infections which involve the skin only. The remaining, more serious infections may involve tissues under the skin, organs or implanted material.

An example of this would be orthopedic surgery, according to the CDC, who estimates more than 4 million orthopedic surgeries are performed each year and over 500,000 of these surgeries involve the knee. Typically depending on the type of surgery, less than 1% of most surgeries result in surgical site infection. Of these infected cases, 50%

are caused by MRSA. You can watch these statistics at National Healthcare Safety Network's annual update.

This infection spreads because of skin-to-skin contact, sharing or touching personal items from a person who has infected skin. MRSA can be spread from touching a surface or item that has been in contact with someone with MRSA. In the case of MRSA, patients who already have an MRSA infection or who carry the bacteria on their bodies but do not have any symptoms (Colonized) are the most common sources of transmission.

Colonization of MRSA:

Colonization of MRSA generally proceeds to infection and in this case colonization can be long lasting. This means it could last from months to years in some subpopulations.

MRSA infections that occur in otherwise healthy people who have not recently (usually within the last year) been in the hospital or had surgery are known as Community-associated MRSA infections (CA-MRSA). In the community at large these infections are usually skin and soft tissue (SSTIs) infections such as pimples, furuncles (abscessed hair follicles or "boils"), Carbuncles (coalesced masses of furuncles), abscesses and other pus-filled lesions. The role of MRSA in cellulites without abscess or purulent drainage is less clear since cultures are rarely obtained. However, these infections may also lead to more serious illness, such as pneumonia.

Major strides have been made in recent years to reduce the numbers of MRSA infections in healthcare settings.

What to look for:

When considering a patient has an MRSA infection, you will find skin with a red, swollen and painful area. This area of skin will be warm to the touch and possibly be full of puss or other drainage. Another patient symptom is fever.

The CDC encourages an MRSA in the differential diagnosis of SSTIs compatible with *S. Aureus* infections, especially those that are purulent (fluctuant or palpable fluid-filled cavity, yellow or white center, central point or “head” draining pus. It may be possible to aspirate pus with a syringe). A patient may present with a complaint of a “spider bite,” this should raise suspicion of a *Staphylococcus aureus* infection.

How is MRSA spread in the healthcare setting?

Although MRSA can come from the environment and be transmitted to people, the most common method of transmission is from person-to-person. The main mode of transmission in the healthcare setting from patients is through human hands, especially healthcare workers’ hands. Health care workers hands may become contaminated with MRSA bacteria by contact with infected or colonized patients. If appropriate hand washing with soap and water or use of an alcohol-based hand rub is not performed, the bacteria can be spread from a healthcare worker who has come in contact with MRSA to a patient. It is also appropriate to ask all visitors to wash their hands before visiting patients. When possible it is best for patients if friends and relatives do not visit while a patient is ill.

Colonization means the growth of microorganisms, especially bacteria, in a particular body site. A patient who has acquired MRSA colonization during a hospital stay has increased risk for MRSA infections after discharge from the hospital or a transfer to a long term acute admission. These MRSA carriers can transmit the disease as they move through and across the healthcare facilities.

If appropriate hand washing with soap and water or using an alcohol-based hand sanitizer is not performed, the bacteria can be spread when the healthcare worker touches other patients.

MRSA:

Common microbes including MRSA are becoming resistant to most commonly prescribed antimicrobial antibiotics and treatments. In some cases, this means no antibiotics are effective against these mutated “Super” bacteria. However at this time, MRSA for healthcare-associated treatment still exists.

People with antibiotic-resistant organisms like MRSA are more likely to have extended and more expensive hospital stays. These patients are at higher likelihood of serious complications and possibly serious health issues resulting from this infection. Extended treatments create a greater burden and expense to the healthcare system. Because of this issue the CDC, state and local health departments, and other health partners nationwide are collaborating to prevent MRSA infections in the healthcare settings.

Of the pathogens that are causing the antibiotic resistant infections, most strains are associated with MRSA infections and are usually

caused by traditional strains associated within the healthcare community. However, the strains traditionally associated with the community transmission are now being identified in the healthcare system as well.

One test to know if you are dealing with MRSA is to culture patients who are suspected to have colonized or have MRSA. Cultures can be expensive to the facility, however, culturing can be less costly than other tests and it is a more common practice. It takes 72 hours to identify if MRSA is present. Start treating patients as if they are positive while waiting for results. This way, there is less chance of spreading if a patient is positive.

The Polymerase chain reaction test is a very fast way of testing patients. This test is very expensive, and it is a more difficult test for lab personnel to perform. Another issue with this test is which body site to use; most common choices are wounds, axilla and groin.

The CDC recommends testing patients who are in high risk areas like ICU. However, anywhere in the facility would be acceptable.

It is very important that Healthcare providers frequently review updated policies and procedures when dealing with MRSA.

Preventing MRSA:

There are ways to prevent infection in MRSA-colonized patients. The CDC calls these “Core Prevention Strategies.” These strategies include:

- Assessment of the staff for hand washing/hygiene practices

- Implement contact precautions for patients with MRSA during hospital stay
- Recognize previously colonized patients
- Rapidly reporting MRSA lab results and making sure to give this information during handoff reports.
- MRSA education for all healthcare providers, this includes all staff members who interact with patient's care.

Hand hygiene is one of the most important parts of the prevention efforts. This prevents transmission of MRSA by the hands of healthcare care professionals. Make sure soap and water, as well as alcohol-based hand creams or gels are easily available to the entire staff, including family and visitors. Educate not only health care professionals, but include the patients and family. Observe how the health care providers put these practices into action. Make sure all employees are following policies and procedures correctly. Always do what the CDC calls “Just in time feedback” when staff members are not washing their hands according to policy.

Contact Precautions is another core prevention to put in place with someone with or suspected of having MRSA. Use a gown and gloves prior to entering the patients' room. Remove this Personal Protective Equipment (PPE) prior to leaving a patients' room to prevent spread. Put these patients in their own room, or if confirmed MRSA put them with another confirmed colonized/infected patient. Always use dedicated disposable items such as blood pressure cuffs and stethoscopes. Leave the IV poles and pumps in the rooms for the entire stay. These patients could be in the hospital for months.

Education is a huge part of the core prevention measure. Education helps improve adherence to hand hygiene by health care workers and patients, including family and friends. It also helps to improve interventions, including Contact Precautions. Understanding this problem helps to encourage behavioral change.

What can patients do to protect themselves? There are several things a patient can do to protect themselves from MRSA. It is important for patients to maintain a healthy weight. If a patient smokes, educate the importance of quitting at least 30 days prior to surgery. If a patient has diabetes, they should work with their doctor to keep blood sugar levels under control, especially prior to surgery. Make sure patients take a shower or bath prior to surgery, at least the day before. Make sure patients do not shave an area prior to surgery. Explain to the patient that hair may be clipped if necessary in surgery.

Patients need to be proactively involved with their care. They can ask that doctors use antibiotics correctly prior to and after their surgery. They can make sure staff is washing hands prior to touching them.

Decolonization therapy for MRSA carriers is one way to try and suppress or possibly eliminate colonization. This is the use of topical and/or systemic agents. This therapy may reduce risk of subsequent infections in MRSA carriers as well as decrease transmission. One of the problems with decolonization is determining which body parts to target, whether it be just the nares, or the whole body. Then, should intra-nasal Mupirocin be used only, or just a Chlorhexidine bath? The other option is to do both. There are also oral agents available now. There would be a concern of emergence of Mupirocin resistance.

Prevention is our main goal when talking about MRSA, and prevention in surgery is an Operating Room nurses goal. Health care facilities should put prevention measures in place, which can affect surgical site infections. Active surveillance testing is one of the strategies used. Another more controversial method is Chlorhexidine bathing. There are also impregnated pre-packaged wash cloths that some surgeons are having patients use prior to surgery.

It is the Operating Room Nurse's responsibility to post contact precaution signs on doors when necessary. It is also extremely important to pass this information on to each other in our hand off reports and briefings. This information should be written on the O.R. count boards for all staff entering the room. When possible, have the patients' bed completely cleaned while a surgical case is in progress. Make sure to communicate information about MRSA to environmental services personnel to wear protective equipment. Make sure to completely clean the patient of all bodily fluids before they leave the Operating Room suite.

Again, communicate all information to recovery room staff so that they are prepared to receive the patient appropriately attired, and if possible, separated from other recovery room patients. This will ensure we help prevent surgical site infection throughout the perioperative phase.

Post Surgical Infection Prevention:

Once a patient is discharged, it is very important that the patient takes home this MRSA prevention information. Make sure they know that

everyone is to wash their hands for at least 15 seconds when they wash their hands. Keep hand sanitizer available at all times after surgery. Do not use sanitizer when hands are visibly soiled (dirty).

When educating a patient and patients' family, remind them it is important for everyone to wash their hands 15 seconds prior to preparing or eating meals. Always wash hands after using the toilet. Keeping this in mind, do not share hand towels. Use fresh linens. Wash hands after handling dirty clothes, towels, and linens. Wash all items in contact with the patient in hot water to kill any contaminants that could possibly present. Once home from surgery, patients should not share items such as razors, clothing or exercise equipment. Everything should be wiped down prior to use. Always keep wounds covered with clean, dry bandages. It is important to keep all shared items and surfaces clean for the surgical patient. These important precautions will help keep the patient from contacting MRSA after surgery.

http://www.cdc.gov/mrsa/mrsa_initiative/skin_infection/PDF/provider/MRSA_HCPKitLetterF.pdf

http://www.cdc.gov/mrsa/mrsa_initiative/skin_infection/PDF/provider/MRSA_Physician_EcardF.pdf

http://www.cdc.gov/mrsa/mrsa_initiative/skin_infection/PDF/provider/MRSA_ProviderBrochureF.pdf

http://www.cdc.gov/mrsa/mrsa_initiative/skin_infection/PDF/GP/MRSA_ConsumerFactSheet_F.pdf

Group A Streptococcal (GAS) Disease

Group A Streptococcus (GAS) is a beta-hemolytic streptococci bacterium often found in the throat and on the skin. Some people may be carriers of streptococci in their throats and or skin and may never have any symptoms of illness. Most GAS infections are relatively mild illnesses. Examples include strep throat, pharyngitis, tonsillitis, sinusitis, otitis media and pneumonia. When thinking of skin issues they could include cellulitis, scarlet fever, erysipelas, necrotizing fasciitis and impetigo. Impetigo is a bacterial infection of the skin caused by streptococci or staphylococci and marked by a yellow-to-red, weeping and crusted or pustular lesion. These lesions are usually around the nose, mouth, and cheeks or on the extremities. There are several million cases of Strep Throat and Impetigo reported each year. Group A Streptococcus infection may have immunologic sequelae such as rheumatic fever and acute glomerulonephritis.

Rheumatic fever can develop approximately 18 days after a bout of strep throat, and it may cause heart disease with or without joint pain. Sydenham chorea is a disorder where the muscles of the torso, arms and legs move involuntarily in a dancing or jerky manner.

Occasionally these bacteria can cause severe and even life-threatening diseases including sepsis. When GAS disease is spread to parts of the body where this bacteria is normally not found, it can become severe and life-threatening. Examples include when it's found in places such as

muscle, blood (bacteremia) or lungs. When found in these places the infections are termed invasive GAS disease. There are about 9,000-11,500 reported cases of invasive GAS disease each year in the U.S.

There are two forms of this infection that are the most severe kinds of this disease. The first would be Toxic Shock Syndrome (TSS). TSS is most commonly related to tampon usage. The bacteria strains that caused exotoxin to be produced were *Staphylococcus aureus* and Group A *Streptococci*, which in turn caused TSS. TSS has also been linked with not only vaginal tampons, but has included contraceptive sponges, diaphragms and surgical wound packing. Approximately 10-15 percent of patients with Invasive group A *Streptococcal* disease die from the infection. This relates to approximately 1,000 to 1,800 deaths annually in the U.S.

This infection usually presents with a fever of 102° (38.9°C) or greater, Diffuse, macular (flat), Erythematous rash, followed by 1 to 2 weeks of peeling of the skin. The peeling usually occurs in the palms of the hands and soles of the feet. The patients may have hypotension or orthostatic syncope.

Patients could have involvement in one of the three or more organ systems.

- When the gastrointestinal system is involved, the patient may have vomiting or diarrhea at the onset of the illness. If the Muscular system is involved, they may have severe myalgia (pain or tenderness).
- The mucous membrane may include any or all of these areas: the vagina, oropharyngeal, or conjunctival. A patient may have issues with hyperemia, unusual amount of blood in a part, including hepatic and hematological (platelet) problems.

- When the central nervous system is involved, the patient may experience disorientation or alteration in consciousness without focal neurological signs when fever and hypotension are absent. Culture results are usually negative when taken from blood, throat, and cerebrospinal fluid.

The second very serious form is Necrotizing Fasciitis most commonly known as the “flesh eating disease,” which is a rapidly aggressive spreading bacteria. Even though it is the least common of this disease, it destroys muscle, fat and skin tissue.

Streptococcal toxic shock syndrome (STSS) results in rapid drop in blood pressure and organs (e.g. kidney, liver and lungs) begin to fail. STSS is not the same as TSS, as it is a different bacteria. About 25% of patients with Necrotizing Fasciitis and more than 35% with STSS die, according to the CDC. Aggressive and early surgical intervention is often needed for a person with Necrotizing Fasciitis to remove the damaged tissue and to try and stop the disease from spreading. Amputation of limbs may occur.

GAS is spread through direct contact of persons who are infected. The bacteria comes from the mucous of the nose or throat and from infected wounds or sores from an infected persons’ skin. Patients who have strep throat or skin infections are most likely to spread the infection. However, a person may have the bacteria without any symptoms, but could still pass on the bacteria. When a patient is treated with antibiotics for 24 hours or longer, it usually eliminates the possibility of spreading bacteria. Always reinforce with patients to finish the entire course of antibiotics as directed.

Invasive Group A Streptococcal disease can get past a person's defenses when they have sores or breaks in skin, and this allows the bacteria into the tissue. A person with chronic illness or an immune deficiency may be more susceptible to virulent strains that cause severe disease.

Persons with cancer, diabetes, chronic heart or lung disease, as well as steroid users, chemotherapy patients, or people with suppressed immune systems are at higher risk. Persons who have open wounds, surgical wounds, chicken pox, who are elderly, and those who have a history of alcohol or drug abuse are also at higher risk for this disease. Patients who are burn victims are also at very high risk. This disease may occur in patients who are otherwise healthy and have no known risk factors.

Once you have GAS infections, it can be treated with many different antibiotics. For STSS and Necrotizing Fasciitis, high doses of Penicillin and Clindamycin are recommended. Supported care in ICU also may be necessary.

How do we stop the spread of Group A Streptococcal infections? It can be as easy as washing one's hands. Good hand washing practices help to stop the spread of many diseases. Remind anyone who is coughing and sneezing to wash their hands often. Always wash your hands before preparing and eating foods. Persons with sore throats should be seen by a doctor to be tested for strep throat. If results are positive, stay home with treatment for at least 24 hours to prevent spreading.

All wounds should be watched for signs of infection and kept clean and dressed properly. Patients with strep throat, but more often with GAS skin infections can also develop inflammation of the kidneys. This rarely happens in the United States because of prompt intervention. If signs of

infection arise, seek medical attention immediately to prevent a GAS infection. At the time of surgery, most patients receive a dose of antibiotics prior to incision. Make sure to document this information correctly.

Mycobacterium Tuberculosis

Tuberculosis (TB) is bacteria that could have a class of its own, however, this lesson will just hit on some important points related to drug resistance. TB is a bacteria that attacks not only the lungs, but also kidneys, spine and brain. TB is spread through the air from one person to another. It is usually passed when an infected person coughs, sneezes, or speaks. According to the CDC, it cannot be spread by kissing or sharing a toothbrush.

Not every patient infected with TB becomes sick, in fact most people are able to fight off the TB bacteria from growing. This is called Latent TB Infection (LTBI). About 5-10 percent of patients with (LTBI), who do not receive treatment, will develop TB. TB sometimes is discovered through the tuberculin skin test or special TB blood test. You could have the disease for years before it becomes active. If the TB bacteria is able to become active, due to a weakened immune system for instance, it could likely begin to multiply, and eventually the patient may become sick.

Extensively drug-resistant tuberculosis (XDR-TB) is caused by Mycobacterium Tuberculosis. XDR TB is a rare type of multidrug resistant tuberculosis (MDR TB). The first line of medication used to

treat TB is Isoniazid and Rifampin, which now are no longer effective against MDR TB. XDR TB is also resistant to the best second line medications including Fluroquinolones, and at least three of the injectable drugs being Amikacin, Kanamycin, and Capreomycin. At this time, patients have bad outcomes due to less effective treatments.

Today, patients with weak immune systems are at higher risk of death once infected with TB. Symptoms of a patient with TB may include prolonged flu-like symptoms. A patient may experience chest pain, weakness, fatigue, weight loss, (due to suppressed appetite), possible chills and fever. Some patients may complain of night sweat. A patient may complain of coughing up phlegm, which may contain blood. Symptoms will vary when a patient is affected in a different part of the body.

Persons that have these conditions, including babies and young children who are also at greater risk are:

1. HIV infected
2. Substance abuse
3. Silicosis: a form of pneumoconiosis which are inhaled
4. Diabetes mellitus
5. Severe kidney disease
6. Low body weight
7. Organ transplants
8. Head and neck cancer
9. Patients on corticosteroids or taking rheumatoid arthritis

C. Diff

Clostridium Difficile (“C. Diff”) is a bacterium found in feces that causes diarrhea as well as otherserious intestinal conditions such as pseudomembranous colitis. About 30% of people have C. Diff as one of the normal germs in their intestine that help digest food. Other complications that result from C. Diff are serious intestinal conditions such as toxic megacolon and perforations of the colon, sepsis and even death in rare cases. C. Diff is a spore-forming, gram-positive anaerobic bacillus that produces two exotoxins. It is a common cause of antibiotic-associated diarrhea.

Symptoms for C. Diff include watery diarrhea, loss of appetite, fever, nausea, and abdominal pain or tenderness. Treatment for C. Diff is usually 10 days of antibiotics and has few side-effects. In some cases it may be necessary to have multiple treatments.

To test for C. Diff, a stool culture can be done, although it is very difficult. Antigen detection can also be done, but it must be done in combination with toxin testing to verify diagnosis.

Patients in good health usually do not get C. Diff. Patients with other illnesses or conditions requiring prolonged antibiotics are at greater risk. The elderly or immunocompromised patients are also at greater risk of C. Diff. Patients who have had gastrointestinal surgery or intestinal manipulation are at greater risk. Patients usually become

infected after coming in contact with items or surfaces contaminated with feces, then touch their mouth or mucous membranes. Health care workers can spread the bacteria to other patients or contaminate surfaces if they do not wash their hands after contact with a patient's contaminated feces.

A patient with C. Diff should be placed on Contact Precautions and their room should be cleaned regularly with disinfectants because surfaces harbor the bacterium and is a source of contamination. If possible, place these patients in private rooms because of surface contamination of the C. Diff spores. It is recommended to clean with Hypochlorite-bases, disinfectant for environmental surface disinfection.

Always wash hands with soap and water especially after using the restroom. Always wash hands prior to preparing or eating food. Alcohol-based disinfectants are not effective against C. Diff and should not be used to disinfect environmental surfaces.

Treatment options for C. Diff includes Metronidazole or oral Vancomycin, Even with treatment, the patient may still remain colonized.

Klebsiella Pneumoniae (K. pneumonia)

T. A. Edwin Klebs was a German Bacteriologist and American Pathologist (1834-1913). He identified Klebsiella, which is a genus of gram-negative, encapsulated bacilli of the family Enterobacteriaceae.

Edwin Klebs also demonstrated the presents of bacteria in wounds. K. pneumoniae is a species that may cause sinusitis, bronchitis or pneumonia.

Klebsiella pneumoniae in today's healthcare setting has caused infections that include pneumonia, bloodstream infections, wound or surgical site infections and meningitis. Klebsiella is joining the list of bacteria that have developed antibiotic resistance.

Carbapenems are the most recent class of antibiotics that Klebsiella has formed resistance to. When Klebsiella pneumoniae bacteria produce an enzyme know as carbapenemase, they are also known as KPC producing organisms or carvapenem-resistant Klebsiella pneumoniae (CRKP). Carbapenem antibiotics are often the last line of defense against gram-negative infections that are resistant to other antibiotics.

Other Resistant Bacteria

Burkholderia Cepacia (B. Cepacia) : A group or “complex” bacteria which is found in water or soil and is often resistant to common antibiotics. It does not pose great risk to the healthy population. It is usually a problem for patients with weakened immune systems. Patients who have cystic fibrosis (CF) or chronic lung diseases are at higher risk. B. Cepacia pneumonia has been reported in patients who were exposed either by person-to-person contact, contaminated surfaces or devices, and just ordinary exposure to the environment

(VANCOMYCIN-INTERMEDIATE) VISA/Vancomycin Resistant (VRSA): Are specific types of antimicrobial staph bacteria. Most staph is taken care of by Vancomycin; today VISA and VRSA are no longer susceptible.

Streptococcus Pneumoniae disease: Resistant to more than one commonly used antibiotic. Invasive disease is usually caused by Pneumococci. S. Pneumoniae which causes 60,000 cases per year of the invasive disease. Risk groups include people who work at child care centers, and people who recently used antimicrobial agents. Children are also at increased risk.

Resistant Pseudomonas Aeruginosa: Commonly found in soil or water. It enters into the body through a cut or other breaks in skin and potentially can become deadly. Mortality rate is 50% of infected patients which can happen with burn patients, and patients with cystic fibrosis. It causes other illness as well UTIs, bone and joint infections.

Resistant E. Coli: Associated with GI infections and dehydration. Resistant E. Coli can come from animal feces. This strain causes approximately 3,000 U.S. deaths a year.

Acinetobacter Baumannii: Also found in soil and water, but can be found on the skin on otherwise healthy people. This rarely occurs outside the health care setting. Most commonly occurs in patients in the ICU.

These are only a few more resistant strains. More can be found at the www.CDC.com website.

Remember, your best line of defense against these diseases is strict hand washing and hygiene. For patients, education is very important to prevent the spreading of bacteria.

References

1. WWW.CDC.COM
2. WWW.AOLhealth.COM
3. AORN Journals
4. [Http://Library.thinkquest.org](http://Library.thinkquest.org)
5. [Http://inventors.about.com](http://inventors.about.com)
6. [Http://Wikipedia.org](http://Wikipedia.org)
7. [Http://www.ucmp.berkeley.edu/bacteria/bacterialh.html](http://www.ucmp.berkeley.edu/bacteria/bacterialh.html)
8. www.jama.com
9. http://.hpa.org.uk/infections/topics_az/esbl/default.htm
10. <http://.niaid.nih.gov/topics/strep/pages/diagnosis.aspx>
11. Taber's cyclopedic medical dictionary 21st edition 2005