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How To Prevent Out Bursts of Anti-Biotic Resistant Bacterium Using New Technology

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ABSTRACT

Multi Drug Resistant Bacteria are bacterium that have evolved and changed their proteins where antibiotics have little to no effect on these types of bacteria. This bacteria spreads commonly through contaminated food and water. The leading cause of superbug outbursts is a misuse of antibiotics. Doctors incorrectly prescribe patients with antibiotics causing the bacteria that infects the human body to eventually evolve which leads to regular antibiotics being ineffective against the bacteria. Decreasing the overuse of antibiotics can control the outbursts of Multi Drug Resistant Bacteria (MDR). Technological innovations like AI and new chemicals are being developed by researchers to effectively kill MDR bacteria. Society should know about MDR bacteria since it is increasingly getting worse as the bacteria evolves. Understanding how these types of bacteria work is vital to create a definite cure for Anti-Biotic resistant bacteria in the coming future.

Introduction

Superbugs will affect humans in the future and how are we going to prevent a misuse of antibiotics to grow superbugs? How can we create a solution to this problem that may be more dangerous than any virus that has faced humans since it is a bacterium and contains a resistant cellular structure to antibiotics. Super bugs are a strain of bacteria that have a high resistance to antibiotics and can cause pneumonia and infections. One common superbug increasingly seen outside hospitals is methicillin-resistant Staphylococcus aureus (MRSA). These bacteria do not respond to methicillin and related antibiotics. “MRSA can cause skin infections and, in more serious cases, pneumonia or bloodstream infections.” (newshealth.gov)

Methodology

The purpose of this paper was to introduce what superbugs are and how to prevent out bursts by analyzing research the data of the symptoms and the different variants of superbugs, Anti-biotic resistant Bacterium. The method primarily used was data collection and analysis using google scholar and research websites. Keywords are Anti-biotic resistant bacterium, MRSA, Candida Auris, Enteric Campylobacteriosis, Shigellosis Clostridium difficile and bacterium. These keywords were important for analyzing and finding sources for superbugs and the different bacterium.

Types of Multi Drug Resistant Bacteria

Super bugs are a strain of bacteria that is resistant to most antibiotics due to a misuse or a mutation causing it to not be affected. Some examples of superbugs referenced by Pritish K. Tosh (2024) Bacteria. Infection with some strains of Acinetobacter bacteria may cause hard to treat urinary tract, bloodstream, or wound infections. Superbug Neisseria gonorrhea bacteria can cause gonorrhea that leads to pregnancy complications. And staph infections with methicillin-

resistant Staphylococcus aureus, also known as MRSA, can lead to surgical complications, pneumonia, or bloodstream infections. Human immunodeficiency virus. Strains of this virus, also called HIV, that do not respond to medicine can lead to complications or higher rates of death. Plasmodium parasites. This parasite causes malaria, which may cause more serious illness and wider spread of the disease. Candida auris fungus. Strains of C. auris are linked to bloodstream infections in people who are already sick.

Enteric Campylobacteriosis

According to Raihan Khalid (2017), Enteric Campylobacteriosis is a bacterium that causes an infection at one part of your small intestine. This Bacteria is resistant to most antibacterial medication. This Bacteria is causes the most amount of diarrhea around the globe. Some of the symptoms may include abdominal pain, abdominal cramping, fever, headaches, and muscle pain, which are usually experienced during the first 24 hours of infection. Enteric Campylobacteriosis usually targets older people with a weaker immune system, with the Guillain-Barre syndrome it can be more severe because during the initial stage of the bacterial infection this syndrome can occur causing your immune system to attack your nerves which can lead to paralysis. This bacterium can infect humans through raw meat, contaminated water, and unpasteurized milk.

Shigellosis

This bacterium attacks the digestive system in small groups called shigella. Erica Roth (2023) writes “The Shigella bacterium is spread through contaminated water and food or through contact with contaminated feces. The bacteria release toxins that irritate the intestines, causing the primary symptom of diarrhea.” Erica Roth (2023) writes, this bacterium effect 450,000 people in the United States, and children are more likely to get infected since they put their hands in their mouths causing a higher chance of infection. The symptoms of Shigellosis are vomiting, diarrhea, their stool has blood, and they may have a fever. Most doctors take a stool test to identify if a patient has Shigellosis. Shigellosis can be contracted by encountering stool that is contaminated. Cleveland Clinic (2022) writes “Shigellosis is a worldwide problem, with about 188 million cases per year that result in about 1 million deaths per year. In developed countries, there are about 1.5 million cases per year.” Cleveland Clinic (2022) writes, Shigellosis is infecting more people by the year and causing deaths in the millions. When having Shigellosis, it is important stay hydrated since diarrhea causes severe dehydration which can be deadly for older people and babies. Children can also have seizures while having Shigellosis. Taking medicine is not advised since Shigellosis can continue to worsen. Drinking lots of water and electrolytes is beneficial to combat dehydration from dysentery.

Clostridium difficile

Clostridium difficile known as C.diff is a bacterium that causes diarrhea and abdominal pain. Jill Seladi-Schulman (2024) writes “C. diff, is a form of infectious bacterium. It can cause a range of symptoms but most commonly results in colitis, which is the inflammation of the wall of your colon.” Jill Seladi-Schulman (2024) also writes, symptoms of C.diff are dehydration, loss of appetite, blood in stool and abdominal pain. You can encounter C.diff when you touch a surface that has encounter stool contaminated with C.diff. Jill Seladi-Schulman (2024) writes “According to the American College of Gastroenterology, between 4% and 15% of healthy adults have C. diff in their intestines. Up to 70% of infants have C. diff at birth, reports the Centers for Disease Control and Prevention (CDC).” You can be at a higher risk of contracting C.diff if you are of older age, take multiple antibiotics, weakened immune system, have gastrointestinal surgery and chronic kidney or liver disease. Doctors diagnose you with C.diff by asking your medical history and symptoms. Doctors will take a stool test to identify for the toxins and bacteria within the stool. To determine the severity of the bacteria, doctors will do a colonoscopy. A colonoscopy is a procedure that inserts a

sigmoidoscope into your colon to check the severity of the infection and would need to perform fecal microbiota transplant. Simone Marie (2024) writes that Fecal transplants involve inserting stool from a donor into a recipient's gastrointestinal (GI) tract to treat a condition or disease.

Candida Auris

Candida Auris, also known as C.auris is a fungus that infects and can cause illnesses to humans. C.auris was first discovered in 2009 in the country of Japan and the first infection happened in. S.Srakocic (2022) writes, "since its identification, unrelated strains of the fungus have been found in multiple countries worldwide, including the United States. The fungus is a type of yeast that can enter the bloodstream and spread throughout the body. Treatment is often complex because most people who become seriously ill with C. auris already have an acute or chronic condition." This fungus does not respond to anti-fungal medication as it is more complex and needs higher dosage. C.auris is mostly transmitted in the hospital environment. The fungus can spread from person to person or contaminated surface like medical equipment since it can last up to a week on any surface, S.Srakocic (2022). C.auris has been found in North America, South America, East Asia, South Asia, and Southern Africa. Testing on C.auris strains has found that each strain is vastly different. The CDC believes that the strains of C.auris have not spread from each continent like other bacteria and viruses but rather developed independently in various parts of the world. People who work in a hospital or live in nursing homes are at risk for C.auris. Some risk factors include diabetes, blood related cancer, multiple use of antibiotics, and weak immune systems.

Causes of Super bugs

Superbugs can be deadly when misinformation is spread, or nurses/doctors incorrectly prescribe medication which can lead to more outbursts of this bacteria. Covid 19 has had a significant impact on superbugs. Sophia Papa (2023) explains by saying the COVID-19 pandemic has had a detrimental effect on antimicrobial resistance. The U.S. Centers for Disease Control and Prevention released an urgent impact report in 2022 displaying how years of gains in reducing antibiotic-resistant pathogens were entirely reversed during the pandemic because of the extensive use of antibiotics even though COVID-19 is a viral disease that does not respond to them. Covid 19 caused a panic amongst people and lead them to buy antibiotics for protection against the virus even though Covid 19 is not affected with most antibacterial medication. Most bacteria become resistant to antibiotics since they evolve to defend themselves against antibiotics. This misuse of antibiotics helps bacteria evolve and reproduce a stronger version of itself. Jon Johnson (2019) states that "what people call "superbugs" have appeared partly because of the natural evolution of germs. Infectious germs, such as bacteria, multiply very quickly. This allows them to overpower the body's immune system and cause an infection." Superbugs are an evolved version of their previous pathogen and if there continues to be more evolution, biotechnology will not be able to keep up with new strands of stronger bacterium.

Decrease the Misuse of Anti-Biotics

Superbugs have been spreading rapidly and there are ways to stop the spread of superbugs. "When used properly, antibiotics can help destroy disease-causing bacteria. But if you take an antibiotic when you have a viral infection like the flu, the drug will not affect the viruses making you sick. Instead, it will destroy a wide variety of bacteria in your body, including some of the "good" bacteria that help you digest food, fight infection, and stay healthy. Bacteria that are tough enough to survive the drug will have a chance to grow and quickly multiply. These drug-resistant strains may even spread to other people." (nih.gov) The spread of superbugs can be mostly due to a misuse of antibiotics and doctors incorrectly prescribing antibiotics to patients.

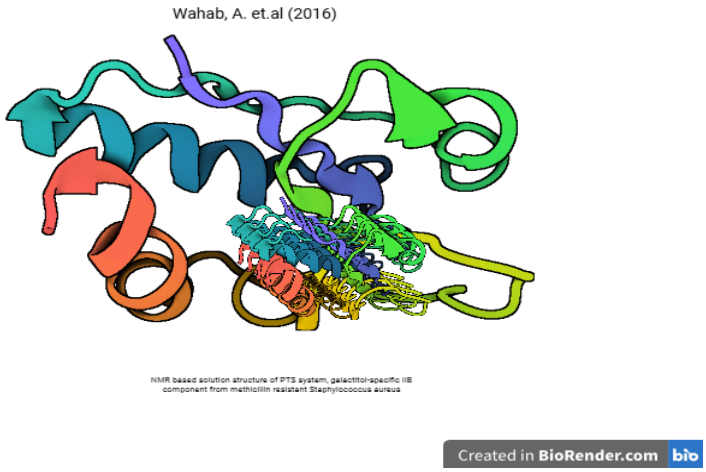

Figure 1. This picture is a protein strand from the bacterium MRSA. This protein strand depicts how the superbug looks like on a smaller scale.

Different Cures That Are Being Developed

Most antibiotic drugs do not affect Anti-biotic resistant bacterium without new developed technology. Nano technology, Ai, and new drugs are being tested to see if there are any efficient cures to Anti-biotic resistant bacterium. Bacterium like K. Pneumoniae that are drug resistant have a different type of protein, Penicillin-binding proteins are important for the structure of bacteria. When Penicillin-binding proteins (PBPs) mutate, changing their cell membrane. Shahper, N. et.al (2016) says "With course of time, sustained selective pressure by various antibiotics has culminated into organisms augmenting ancillary resistance mechanisms that led to multidrug resistance (MDR)—novel penicillin-binding proteins (PBPs), enzyme dependent drug alteration, altered membrane permeability, mutated drug targets and increased efflux pump expression." To counter this protein DsbA is a chemical that works alongside antibiotics to shutdown PBPs and kill the bacteria. Michael Irving writes "To get to work thwarting drugs, these resistance proteins need to be folded up into extremely specific shapes, and the researchers discovered that another protein, named DsbA, helps perform that folding. So, the team reasoned, targeting DsbA should effectively shut down production of resistance proteins." DsbA is effective but it is not safe for use in humans, but further research is developing a safe way to input this drug into patient's bodies to defend against bacterium like Methicillin-resistant Staphylococcus aureus (MRSA).

How AI Will Change the Way We Fight Anti-Biotic Resistant Bacterium

AI has changed the medicinal field by creating new antibiotic drugs/vaccines or nanotechnology to fight of deadly viruses or bacterium. Using generative AI, we can help address one of the most generational diseases antimicrobial resistances. BBC news shares that researchers in Canada and the USA have both used generative AI to combat anti-resistant bacterium. A newfound drug known as abaucin has been tested as a new antibiotic drug to combat these bacteria. BBC author, James Gallagher, writes "They took thousands of drugs where the precise chemical structure was known, and manually tested them on Acinetobacter baumannii to see which could slow it down or kill it. This information was fed into the AI so it could learn the chemical features of drugs that could attack the problematic bacterium. The AI was then unleashed on a list of 6,680 compounds whose effectiveness was unknown. The results - published in Nature Chemical Biology - showed it took the AI an hour and a half to produce a shortlist." Although

this maybe the cure or solution to stopping Anti-Biotic resistant Bacterium, AI has not developed this drug to be compatible with a human body.

Conclusion

Anti-biotic resistant bacteria have proven to be difficult to contain and stop them from spreading. Although the there is a rise of out bursts of anti-resistant bacterium cures like DsbA which breaks down the mutated penicillin binding protein, or AI using a newly developed drug known as abaucin to combat Acinetobacter baumannii which is a deadly superbug. The outbreaks of superbugs can be limited by decreasing the use of anti-biotics. Antibiotics are the reason bacteria can mutate and become resistant towards antibiotics. Anti-biotic resistant bacteria have very similar symptoms like regular viral infections based on the type of Anti-biotic resistant bacteria you are infected with. Enteric Campylobacteriosis symptoms are in older people or weakened immune systems.

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