What Happens When Gonorrhea Can't Be Stopped?

New Mexico
SuperComputing Challenge
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Executive Summary

There is a rising trend in infections in teenagers across the state of New Mexico, as well as throughout our country and around the world. Sexually transmitted diseases are spreading very quickly, and we want to investigate methods of prevention, specifically preventing the spread of gonorrhea. Within the last fifty years, gonorrhea has become increasingly resistant to a variety of antibiotics. This is a major problem for health care providers and public health officials because STDs are easily spread, and gonorrhea can cause serious and lasting health problems. Over two years, we are collecting data to determine the populations most seriously effected by gonorrhea in New Mexico. Once we have analyzed the data, we will create a computer model for the spread of infection. We are also working to develop methods for preventing infection, such as education for the general public. We hope to develop a simulation that will show how prevention efforts can be effective for decreasing the spread of gonorrhea.

Introduction

Sexually transmitted diseases (STD) are a serious health problem in the United States, and the state of New Mexico has recently seen a dramatic increase in STD infections, not far from the national average. While these create health risks for the general public, there are also significant economic costs associated with STD infection. Around 19 million people contract STDs yearly in the United States, half of which are between the ages of 15 and 24 years. According to The Centers for Disease Control and Prevention, only 321, 849 new cases of gonorrhea were reported in 2011, but they estimate that the actual number of new cases is over 700,000. Gonorrhea causes serious and permanent health problems in men and women.

Neisseria gonorrheae is a gram-negative, coffee bean shaped diplococcic bacterium. When a person is infected with gonorrhea, sores and pus will appear in the genitals area. Specifically, the gonococci attack epithelial cells in the skin, causing blister-type sores. Like other STDs, gonorrhea infects the mucous membranes, and humans are the only natural host to the bacteria. One issue with reporting new cases is that the infection can be asymptomatic, which means people are not aware of the infection for a while.

Humans were able to easily treat gonorrhea with a single dose of antibiotics when the bacterium was first discovered. However, this little bug has been progressively acquiring resistance to each new agent that we try to throw at it. Today, gonorrhea is resistant to Sulfonamides, Penicillins/Tetracyclines, Fluoroquinolones, and most recently Cephalosporin. Treatment failures have been reported from east Asia and Europe. The Centers for Disease Control and Prevention has started the Gonococcal Isolate Surveillance Project, which monitors trends in the antibiotic susceptibility of gonorrhea. Clearly infection is a problem, and our objective is to find better ways to prevent it.

Description

After developing our proposal, we have been looking at data from various sources, such as the Centers for Disease Control and Prevention and the European Bioinformatics Institute. Since our project will continue into next year, we are still in the data collection phase. Our next steps will be to compare the data we have with that of the state of New Mexico and create visualizations that show who and where people are being infected with gonorrhea.

Once the data has been collected and analyzed, we will create a computer model using NetLogo. We will use an agent-based model, and we have looked specifically at the Endemic Model found on Wikipedia, the Endemic steady state.

Possible prevention methods that we propose could decrease the spread of gonorrhea include education on gonorrhea and other STDs for teens who are sexually active, as well as encouraging abstinence through high school. For those that choose to be sexually active, we also feel promoting safe sexual intercourse could help decrease infection rates, by having prophylactics available at the Teen Health Center. Anyone who chooses to engage in sexual intercourse with multiple partners should have regular testing for STDs in order to prevent serious health problems. This is also something that could be offered at a Teen Health Center to help prevent further infections.

Expected Results

We expect to obtain results from the simulation that are similar to real life. We hope to learn more about gonorrhea, how it is transferred, and how to fight infection. We hope that our program could be a starting plan that scientists could use in researching other similar diseases.

Reference List

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