Multi-Drug Resistant Tuberculosis

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In this project we attempted to model the multi-drug resistant tuberculosis epidemic. Tuberculosis is a lung disease that is fatal to many people. We are trying to model the disease to find out more about it and to find ways to predict where the disease will go before it becomes a problem in an area. Lately in the past Tuberculosis has started becoming resistant to drugs and medications, thus becoming harder to combat. The Multi-Drug Resistant TB has no effects with 6 of the most commonly used drugs so it is very lengthy and difficult to kill.

Purpose:

The purpose of this project for us is to model the Multi-Drug Resistant Tuberculosis disease, maybe detect patterns so we can predict where the disease will strike next and stop it.

Problem:

Tuberculosis has started becoming drug resistant and has affected many people worldwide. The disease becomes drug resistant to one of the drugs when a patient does not follow up their medication or are not taking enough drugs if they are already resistant to one drug. Tuberculosis is very contagious when it is in its active stage. When it is in its dormant or latent

stage it can survive in a cavity for many years on end or until the patient's immune systems weakens. Testing for Tuberculosis is very time consuming because the TB bacteria double every 15-20 hours, unlike others, of 20 minutes, so testing for drugs that weaken the patient's bacteria can take months. This process can take even longer for patients with Multi-Drug Resistant bacteria because it is not affected by the most effective and common so much more drugs need to be tested. Because of this Multi-Drug Resistant Tuberculosis has become a global problem affecting many countries.

Background:

Tuberculosis is a bacterial disease (*Mycobacterium tuberculosis)* transmitted through the air by means of speaking, spitting, sneezing, or coughing. It mainly affects the lung and is known to spread to affect the bones and other organs. When the bacterium is inhaled, it goes down the lungs and into the alveoli. There, if not killed by white blood cells, it forms a protective colony of bacterium and starts to multiply. The new bacterium goes to different parts of the lung or body and forms colonies there too. The colonies of bacterium start to kill off the lung cells around it, slowly advancing to the point in which the person suffocates. There are two types of

the disease: active and latent. Throughout the active stage, the patient would cough up sputum; mucus like substance that contains bacterium of Tuberculosis rejected by the body by retching. The disease is only contagious when in the active stage. In the latent or dormant stage, all tests for the disease shows up negative. Many people who have latent Tuberculosis might never develop the active stage in their lifetimes and do not even know it, unless they get a special TB skin and blood test.

Method:

Our model was an agent based simulation done in netlogo. The agents moved by a basic wiggle where they turn right a random number of degrees, turn left a random number of degrees and then go forward. This creates a random movement around the world that allows the disease to be transmitted from agent to agent. When an agent gets the disease it has a random chance of the disease first becoming dormant or immediately becoming active. When an agent gets the dormant stage it has a random amount of time before it becomes active again. When a patient has the active stage it has a probability of getting drugs and being cured. There is a variable that gives the agents a certain chance of being too poor to afford the drugs. When an agent does get drugs it has a certain period of time before it is cured. Agents

receiving drugs also have a chance of becoming resistant to them. In this case the agent again has a chance of not being able to afford the second drugs to cure it. When being cured on the second drugs the agents must wait longer to be cured. In our model are data is collected on a graph that contains the amounts of people resistant, on drugs, people with the active and dormant stage and people that are currently healthy.

Code

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