Team Number: 113

School Name: Gadsden Middle School

Area of Science: Epidemiology

Tuberculosis outbreak

Team Members

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Executive Summary

Tuberculosis is a disease that still affects populations. It is incurable, having two stages: latent, which means not contagious and active, which is the contagious stage. The people with latent TB are being treated, and there is a fear that the disease will become antibiotic resistant and cause death.

The mortality rate of Tuberculosis is 12.3% mortality rate and a 11.4 % transmission rate (based on a population of 100,000.

This simulation experiment is looking at different numbers of population with the active Tuberculosis strain so that the CDC or city health departments can educate the public and themselves with the number of people infected leading to a large amount of population becoming infected with this incurable disease. The biggest jumps according to data started between the amount infected being 20 or 40 within different population sizes. The transmission rate slider had to be based on a population of a thousand, two thousand and then three thousand because slnova did not want to run on a population of 10,000 or bigger. The transmission rate had to be determined by running the transmission rate on an amount of 10 sick until the output was 11 percent for several runs to correlate correctly.

Introduction

Tuberculosis (TB) is an infectious disease that affects your lungs. Bacteria are spread from one person to another through tiny droplets released into the air via coughs and sneezes. Tuberculosis infections began increasing in 1985, many strains of tuberculosis resist the drugs most used to treat the disease. The CDC recommends that people who have an increased risk of Tuberculosis be screened for latent TB infection.

- People with HIV/AIDS
- IV drug users
- Those in contact with infected individuals
- Health care workers who treat people with a high risk of TB

People with TB never get cured, it may become Latent TB but they will have to be treated forever and hope that they don't become antibiotic resistance.

https://www.mayoclinic.org/diseases-conditions/tuberculosis/symptoms-causes/syc-20351250

Problem

The slnova project will be designed to determine what number of a population (100 thousand, 200 thousand, and 300 thousand) that will be affected at an outbreak rate (high number of

infected or dying) based on a number of people within that population infected. Eight million people, New York City has an annual tuberculosis case rate of 11.4 per 100,000

https://www.clinicalcorrelations.org/?p=2450

Solution

The research will show how many can be infected before CDC and the medical field need to make Courantyne rules or public awareness to prevent the disease from continuing to infect the population. Also it is important to know when to vaccinate children with bacillus Calmette-Guerin (BCG) vaccine because it can prevent severe tuberculosis in children.

Tuberculosis Mortality Rate

During the study of 2016 cases (males: 71.1%) of culture-proven Tuberculosis were identified. The average age was 59 (range: 0.3–96) years of age. The overall mortality rate was 12.3% (249 cases) and the average age of death was 74 years of age; 17.3% (43 cases) of all Tuberculosis deaths were TB-related. Most of the TB-related deaths happened early (median survival: 20 days), and the patient would die of septic shock.

Treatment

Drug-resistant TB is caused by TB bacteria that are resistant to at least one first-line anti-TB drug. Multidrug-resistant TB (MDR TB) is resistant to more than one anti-TB drug and at least isoniazid (INH) and rifampin (RIF).

Extensively drug-resistant TB (XDR TB) is a rare type of MDR TB that is resistant to isoniazid and rifampin, plus any fluoroquinolone and at least one of three inject able second-line drugs (i.e., amikacin, kanamycin, or capreomycin).

Treating and curing drug-resistant TB is complicated. Inappropriate management can have life-threatening results. Drug-resistant TB should be managed by or in close consultation with an expert. It's important to get treatment even if you have no symptoms. You can still develop pulmonary TB disease in the future. You may only need one TB drug if you have latent TB. If you have pulmonary TB disease, your doctor may You'll need to take these drugs for six months or longer for the best results.

The most common TB medicines are:

- isoniazid
- pyrazinamide
- ethambutol, or Myambutol, discontinued
- rifampin, or Rifadin and Rimactane, some brands discontinued

Doctors might recommend an approach called directly observed therapy (DOT) to ensure that treatment is complete. Stopping treatment or skipping doses can make pulmonary TB resistant to medicines, leading to multidrug-resistant (MDR-TB).

https://bmcinfectdis.biomedcentral.com/articles/10.1186/1471-2334-14-5

https://www.cdc.gov/tb/topic/basics/signsandsymptoms.htm

www.webmd.com/lung/tc/tuberculosis-tb-exams-and-tests#1

PROJECT slnova

The slnova agents are blue ghosts and the infected are red ghosts. The recovered ghosts are magenta. The population health is the total population at beginning. The recovery rate was based on 12 percent mortality rate.

The slnova model to run the program has a population slider based on a thousand, two thousand and three thousand. The transmission slider was ran until the amount infected came out to be 11 percent from the amount infected in a population of 1,000 which will correlate to the information from the CDC report in the NYU Journal research from the problem analysis. Then the population numbers were raised from 1,000 to 2,000 and to 3,000.

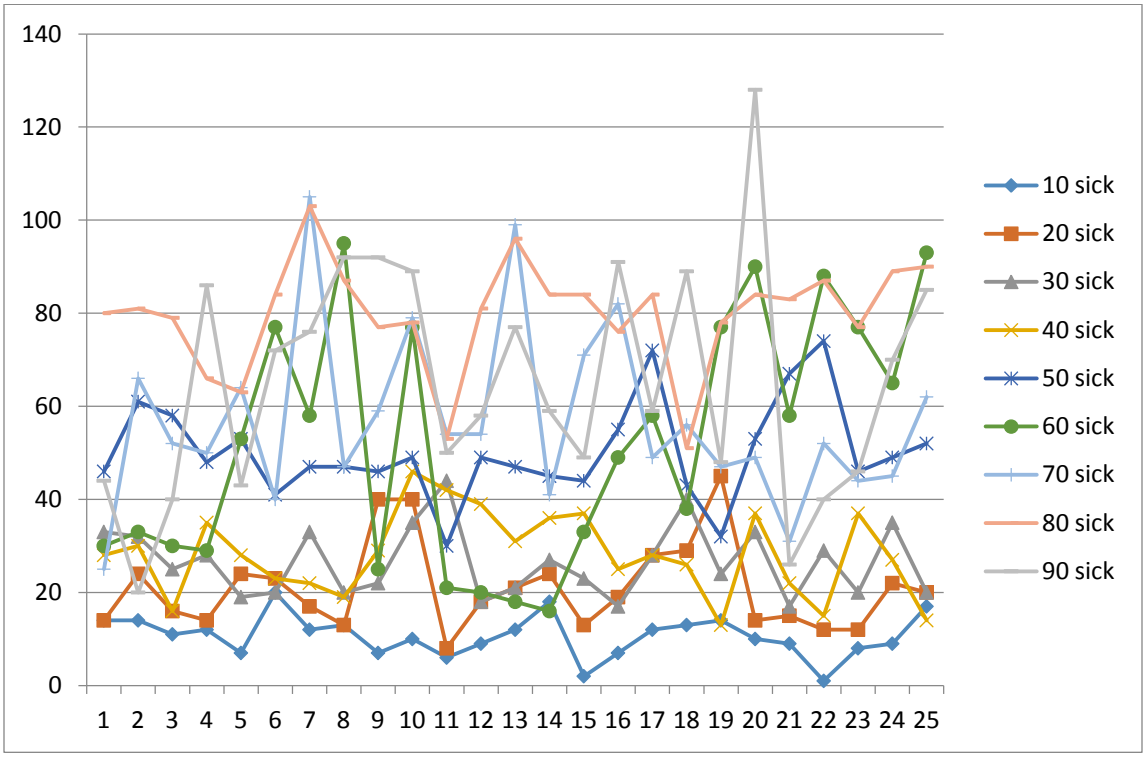
The interaction of the healthy and the infected population is tracked by color. The infected are red Spheres and the other uninfected people are blue spheres. When the red spheres touch the blue spheres they convert into a different color (red).This shows that the red spheres (tuberculoses) are spreading through touch. Then the blue spheres convert into the color red to show they are now sick.

The data was collected after 20 ticks of each run. Each population and amount of people being infected from ten to in increments of 10 until 100 were infected. Each amount of infected was ran 25 times to get data. The conclusions are based on high numbers of populations that became infected due to the amount of people in the population that have active TB.

The sliders will allow populations with an outbreak to see how to monitor the condition. The population of healthy slider can be correlated to populations based on 100,000, which is the one that established the infection rate for a rate of 11.4% infection rate.

CHART BASED ON 11% INFECTION RATE

FOR POPULATION OF 1,000

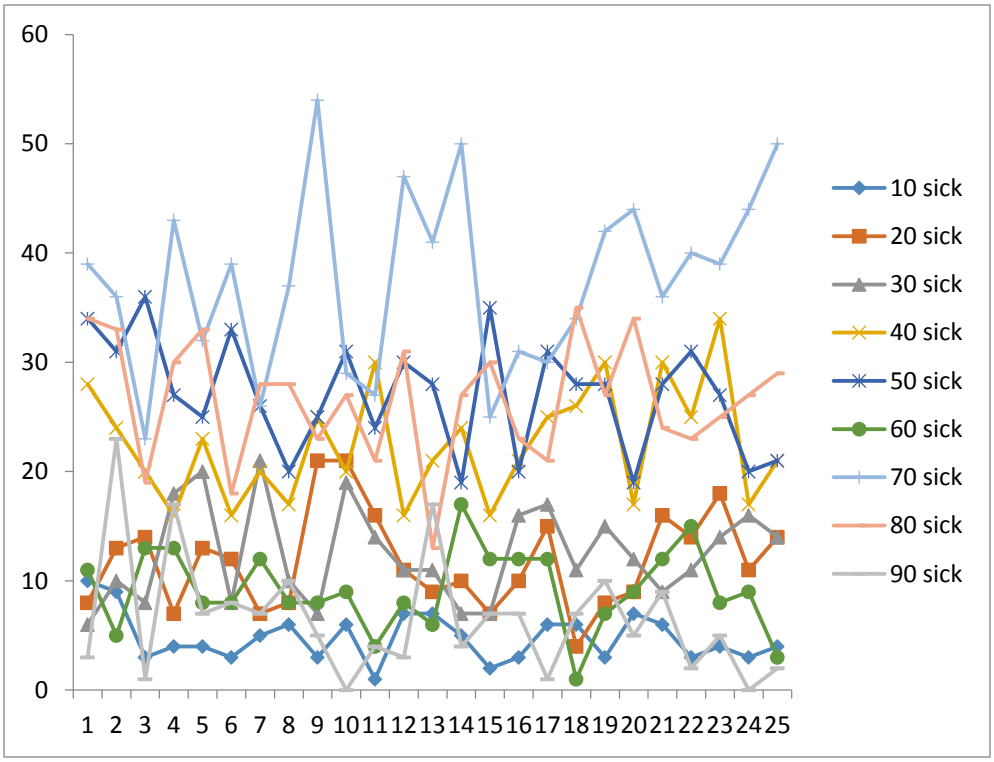


CONCLUSION:

In conclusion there were different amounts of people sick for the rate of population of 1,000. The largest spike in this graph was 70 people sick. There were some spikes in the number of people infected started at 20. It starts to show large spikes as early as 40 sick.

CHART BASED ON 11% INFECTION RATE

FOR POPULATION OF 2,000

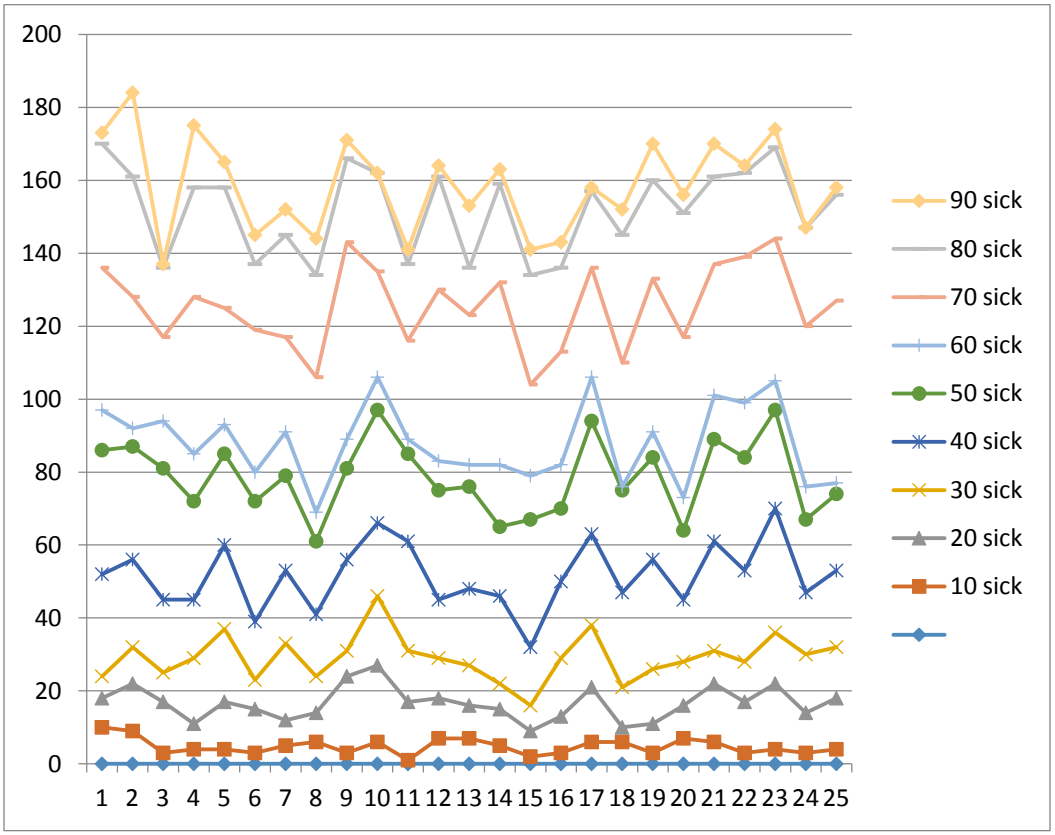


CONCLUSION:

In conclusion there were different amounts of people sick for the rate of population of 2,000. The largest spike in this graph was 90 people. There were spikes in the amount of people infected as early as 10 people being sick. The spikes really start in large amount with intervals of more than a 20 person spread at 20 sick.

CHART BASED ON 11% INFECTION RATE

FOR POPULATION OF 3,000



CONCLUSION:

In conclusion there were different amounts of people sick for the rate of population of 3,000. The largest spike in this graph is when 100 people start the infection rate. . The smallest spike was 10 people sick. This is expected information. There were few spikes in the amount infected until over 30 were sick at the beginning of the simulation.

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