Team ID : UBMS187, Upward Bound Math and Science

Area of research: Pathology

Project title: Simulation of Smallpox

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Problem Definition: Smallpox: a disease that first occurred approximately 68,000 years ago. This disease is known to be extremely lethal, but modern medicine has made it easier to prevent or cure.There are different strains of the virus, each of them with different infection rates. Strands such as hemorrhagic smallpox strains exhibit higher fatality rate whereas others have a low fatality rate of 1% . There are also a variety of research materials and scientific findings that our group can compare and/or improve upon. Viruses can mutate their genes for most part this is true for smallpox too which causes it to be different and hard to cure.

Problem Solution: We will be modeling the spread of smallpox through a simulation known as cellular automata. The tools we will using are programming languages such as C, C++, Python, and simulation software like Netlogo. Our goal will be to reduce the rate at which the virus (smallpox) spread through certain conditions that we will have to research further on. After we display how the virus originally spreads, we will demonstrate how our variations will affect the simulation in a way that will reduce the rate of the spread of smallpox in a given society.

Progress to Date: We started with research and programming simultaneously, for the first attempt of making a simulation we tried Conway's Game of Life. The simulation had a grid with entities which would change their status of being alive or dead with each new generation. This set up a basis for what we did to visualize the viral infection and how a population mutates and varies over time. Next, we moved on to generating a 3D model of the spread of viruses using C++. We started researching Ebola and other viruses and how they originated. We were able to simplify our topic down to Smallpox through a group discussion with Steven Bradfute, an Assistant Professor at UNM Center for Global Health. During our research, we explored the infection rate, lethality rate, and symptom rate of smallpox and how it was discovered. We used many resources by watching videos and movies on the spread of smallpox. We also researched on the genetics and how certain genes make people immune to certain viruses. We mentioned how the virus struggles and how it adapts/mutates from the pustular rash. The first vaccination was made by Edward Jenner.

Expected Results: We plan to simulate and explain the prevention through the process of examination and trial and error of the disease through research and coding. In the end we plan to find a new way to cure or prevent smallpox. This will be mostly done through research and simulation. We are doing this to create a method which should be applicable to other viral infections and outbreaks. Smallpox is a good topic to test our process and hypothesis because of the massive amount of documentations from the past to check our claims. Smallpox also is an overall good disease to choose because of how infectious it is and its methods of transference in a population.

Resources:

Bradfute2-bio.pdf, UNM Infectious Diseases Department,

https://medicine.unm.edu/common/documents/infectious-diseases/bradfute2-bio.pdf

Fleischmann, W. Robert, and Jr. “Viral Genetics.” *Medical Microbiology. 4th Edition.*, U.S. National Library of Medicine, 1 Jan. 1996, www.ncbi.nlm.nih.gov/books/NBK8439/.

“Home - PubMed - NCBI.” *National Center for Biotechnology Information*, U.S. National Library of Medicine, www.ncbi.nlm.nih.gov/pubmed/.

“Smallpox.” *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 7 June 2016, www.cdc.gov/smallpox/symptoms/index.html.

“Viral Hemorrhagic Fevers (VHFs).” *Centers for Disease Control and Prevention*, Centers for Disease Control and Prevention, 18 June 2013, www.cdc.gov/vhf/virus-families/index.html.