Team Number:

School Name: Monte Del Sol Charter

Area Of Science: Microbiology

Project Title: MRSA and the Population

Problem Definition:
MRSA (methicillin-resistant *Staphylococcus aureus*) poses a serious health risk is our modern world. It is a strain of *Staph* that is resistant to many types of antibiotics and thus is hard to treat. Antibiotic resistance has developed as a result of multiple mutations rising in *Staph* populations as they interact with human use of antibiotics.If an antibiotic that can successfully treat MRSA can be synthesized, then MRSA can effectively be eradicated. 90,000 Americans are affected by MRSA each year and about 22% of those infected die, many of which are children.We plan to calculate mutation rate of MRSA by using the mutation equation:

$$\mu = \frac{r_2}{N_2} - \frac{r_1}{N_1} / \ln(N_2 / N_1)$$

We will incorporate this into NetLogo to model the rate of mutation and then extend this to simulate multiple mutations and their interaction with antibiotics, which causes this growing problem of antibiotic resistance. We also will examine the effect of horizontal gene transfer and how we suspect that this will amplify the spread of the mutation throughout the population. A set population size will be placed in the torus set as “normalization ”or unmutated. As various types of antibiotics are introduced, we will then measure the rate at which MRSA arises and spreads through the population. We hypothesis that, with each type of antibiotic, each mutation will have its own growth rate.

Problem Solution:
The environment in which this simulation will be tested is an isolated lab sample. Our program is going to create normal MRSA cells and then introduce various antibiotics into the MRSA population and model how the cells mutate/die. The program will test how MRSA cells become resistant and the rate at which how quickly they become resistant.

Progress to date:
Presently, our model creates the MRSA cells and makes them move around randomly as if they were in a lab environment. The cells are positioned randomly around the NetLogo world. As they move they have a chance to run into and antibiotic, if they do the MRSA cells can either die or randomly become resistant and reproduce with a chance of passing on the resistant trait.

Expected results:
After we program, test, and further advance this code we will expect to find out how quickly MRSA evolves and becomes resistant to antibiotics. We can then determine which, if any, antibiotics are the way to treat MRSA infections. Using models like this can help revolutionize the medical fields and hopefully put a stop to this horrible infection.

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REFERENCES

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