Mathematical Modeling for Malaria Transmission Dynamics

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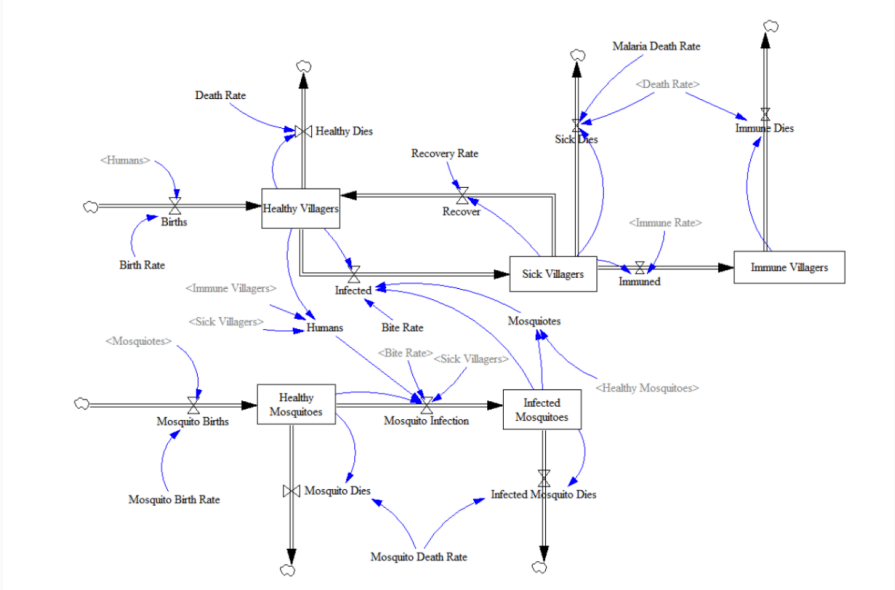
Overview

Flaws in the Model

Fertility of each Class

Conservation of infected population



Code

```
# Healthy Villagers =
#     = Currently healthy Villagers
#     - Deaths of currently healthy Villagers
#     + Births
#     + Recovered in this time step
#     - Infected in this time step
def Healthy_Villagers (i) :
    hV[i+1] = hV[i] \
            - (hV[i] * drV) \
            + ((hV[i] + sV[i] + iV[i]) * brV) \
            + (sV[i] * rrV) \
            - (hV[i] * brfM * (iM[i] / max(hM[i] + iM[i],1)))
```

```
# Immune Villagers =
#     = Current number of immune Villagers
#     - Deaths of currently immune Villagers
#     + Became immune in this time step
def Immune_Villagers (i) :
    iV[i+1] = iV[i] \
            - (drV*iV[i]) \
            + (sV[i]*irV)
```

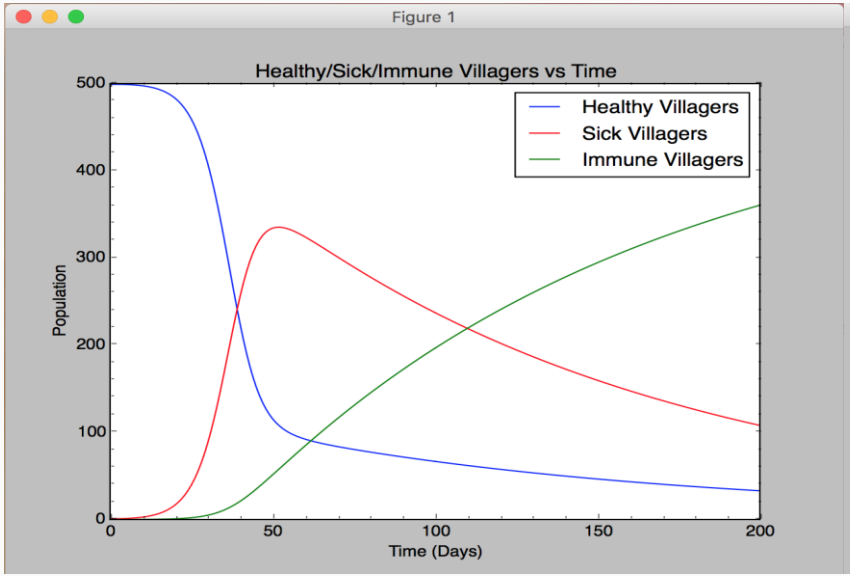
```
# Update current sick villagers
#     = Current number of sick villagers
#     - Deaths of currently sick Villagers
#     - Recovered in this time step
#     - Became immune in this time step
def Sick_Villagers (i):
    sV[i+1] = sV[i] \
            - (sV[i]*(midrV + drV)) \
            -(sV[i]*rrV) \
            -((sV[i])*irV) + (hV[i] * brfM * (iM[i] / max(hM[i] + iM[i], 1)))
```

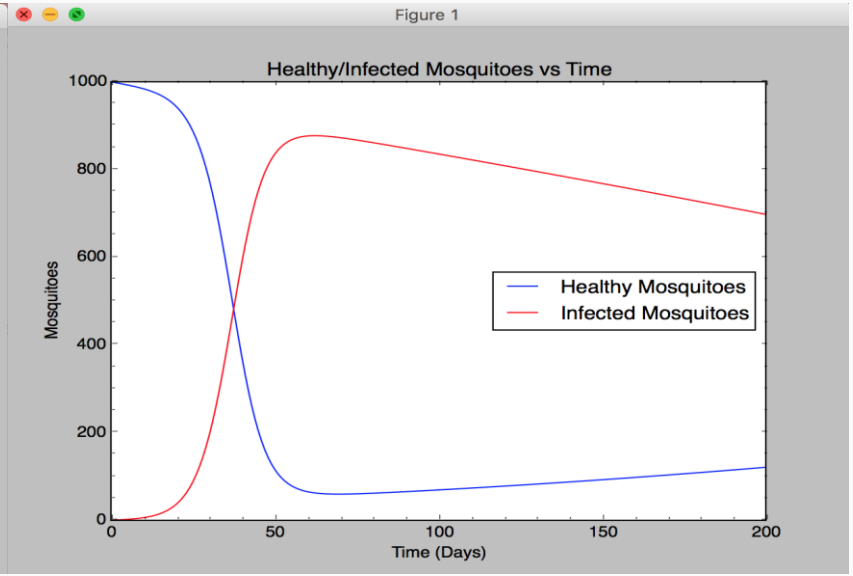
Code

```
# Healthy Mosquitoes =
    #      = Current number of healthy Mosquitoes
    #      - Deaths of currently healthy Mosquitoes
    #      + Mosquito Births
    #      - infected in this time step
def Healthy_Mosquitoes (i):
    hM[i+1] = hM[i] \
            - drM * hM[i] \
            + brM * (iM[i] + hM[i]) \
            - (sV[i] / ((hV[i] + sV[i] + iV[i]) + 1)) * hM[i] * brfM
```

```
# Update current infected Mosquitoes
    #      = Current number of infected Mosquitoes
    #      - Deaths of currently infected Mosquitoes
    #      + Infected in this time step
def Infected_Mosquitoes (i):
    iM[i+1] = iM[i] \
            - (iM[i] * drM) \
            + ((sV[i] / ((hV[i] + sV[i] + iV[i]) + 1)) * hM[i] * brfM)
```

Model run for 200 days





Summary - I

Model clearly shows:

- Reduction of healthy humans while number of sick and immune humans increase over time as epidemic breaks out.

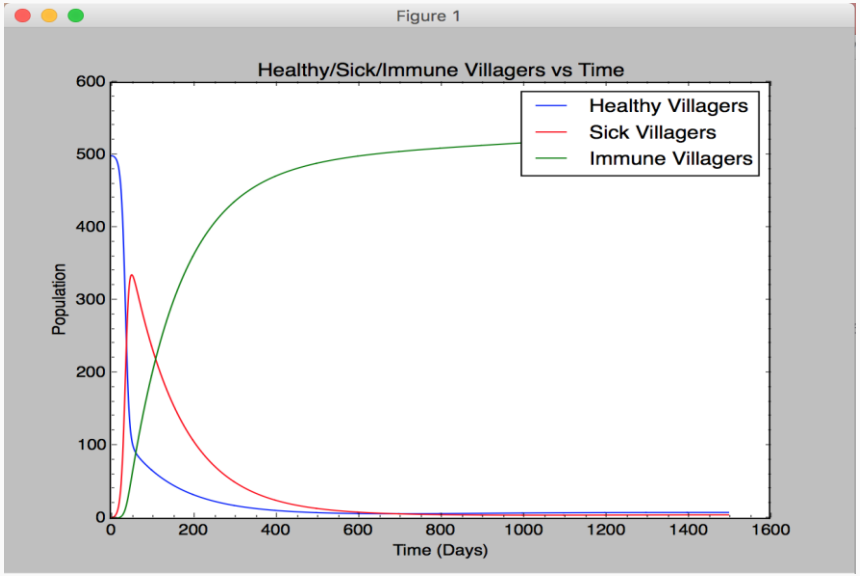
When run for longer time we see the count of healthy humans increase due to:

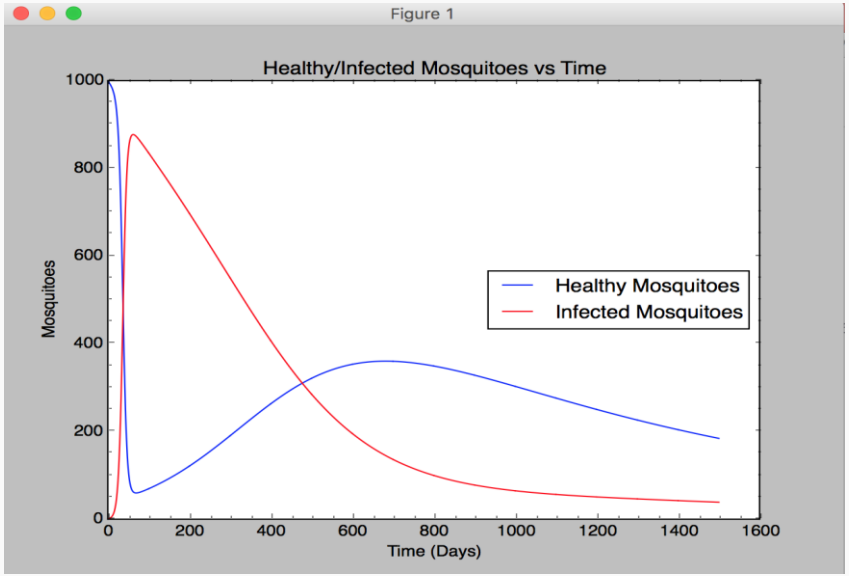
- Mosquitoes are all dead so no more of them to spread
- Immune generation dies off leading to healthy generation

Count of infected mosquitoes peak when the epidemic breaks out and gradually falls as they die out.

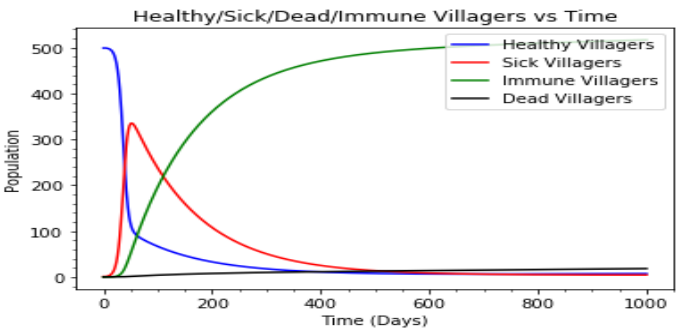
This modeling allows us to analyze physical phenomenon with elaborate filters.

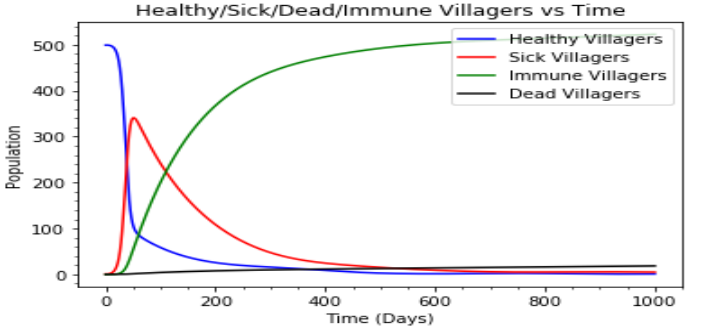
Model run for 1500 days





Extra 2. Model run for 1000 days with Seasonal changes of mosquito population





Summary - II

We can clearly see the changes of mosquito population with seasonal changes in tropical areas

As infected no. of mosquitoes goes to minimum, healthy no. of mosquitoes reaches to its maximum and vice versa

This would help public health professionals to identify the worst periods of the year and establish preventive methods

Furthermore, we can improve the model according to the different regions of the world. And it would help to focus on most affected countries.

THANK YOU!