# Deterministic and Stochastic Modeling of Zika Virus

**Transmission** 

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#### Abstract

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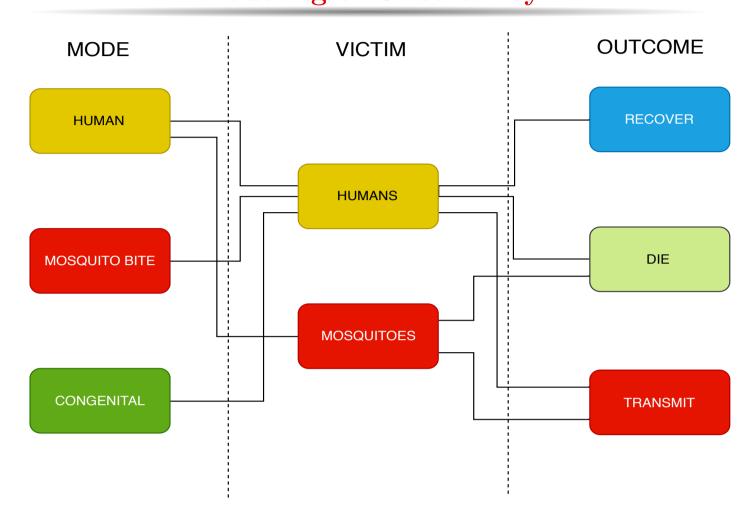
Transmission of Zika virus is one of the most widespread mosquitoborne diseases. By modeling the spread of a contagious disease we can find trends which can help in formulating policies and damage control in case of an epidemic.

The SIR model, approached with deterministic and stochastic models, can help in finding trends in each type and each step of disease transmission. The reproduction number of deterministic models is an essential threshold to predict whether an epidemic will spread or die out. In particular, we find that Zika outbreak is more likely if the disease is introduced by infected mosquitoes as opposed to infected humans.

#### **Problem Formulation**

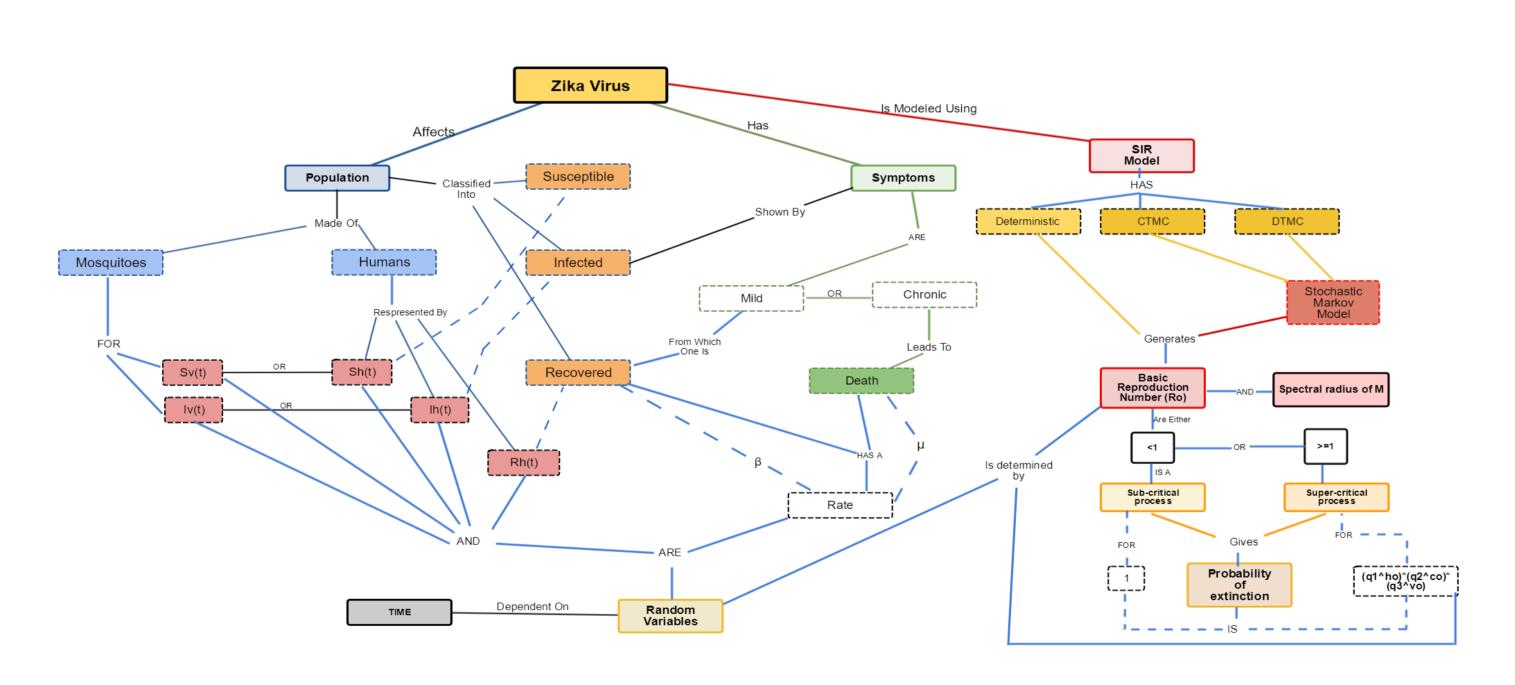
Three different approaches to find the trends and probability of extinction have been used namely, the deterministic model and 2 stochastic models, CTMC(Continuous Time Markov Chain) and DTMC(Discrete Time Markov Chain). From this modeling and random variables related to transmission parameters, we can get a reproduction number (threshold) to find the nature of outbreak and likelihood of disease extinction.

### **Modeling of Uncertainty**



Dividing the uncertainty in transmission w.r.t. the contributors, we can formulate the random variables.

### Concept Map



# Results

#### Probability of disease extinction Plot of human population against time 450 0.7 350 E 250 O.5 0.4 0.3 150 0.2 50 (a) Probability of (b) Trends in Outbreak extinction

# Conclusion

Our analytical and numerical results showed that both deterministic and stochastic models predict disease extinction when  $R_o < 1$ . The points q1,q2,q3 are the parameters for determining the probability of extinction when  $R_o > 1$ . The extinction curve shows that the probability of extinction is reduced greatly by infected mosquitoes as compared to infected humans.

### References

Zevika, Mona and Soewono, Edy, "Deterministic and Stochastic CTMC models from Zika disease transmission" *American Insitute of Physics*, 2018.