Chapter 7
Network and Epidemic Model

ABSTRACT

Infectious diseases transmitted and networks and the epidemiology are fundamentally linked. Population-wide random mixing is the fundamentals for the epidemiology and its models, but in reality, each person will have a countable set of contacts, which is the root cause for the spread of the diseases. The mixing network is nothing but the collections of all such contacts. From the point of view of the individual-level behaviors, the network computes the epidemic dynamics of a complex population. Hence, for the prediction of epidemic patterns, its dynamics and the characteristics of the population can be understood only with the help of the deep study of the networks. Hence, the study of the networks is critical for the epidemiologist for understanding the spread of the diseases.

INTRODUCTION

Networks and its study have transformed the way the spread of epidemic is analyzed. The interaction between the individuals in a large population can be view easy through the network analysis. The study of network has found applications in all most all fields however the epidemiologists have taken the maximum advance of the same. The power of computing in the present age has also helped a lot to understand the network. Network theory and epidemiology are very closely related from a very long time. In mid-1980s (Klovdahl AS et al., 1985, May RM et al., 1987). Moreover network itself is nothing but the movement of the individual or group or the connections

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between the nodes. Hence naturally the study of network gives us a clear insight about the spread of the diseases. The epidemiological dynamics is clearly given through the study of networks. Understanding the structure and dynamics of the networks helps in understanding the early growth of the infection, distribution of the infection and improve predictions. Moreover the networks predict the spread of the disease, gives a concrete method of control of the diseases. For example the contact tracking gives a transition route of infected cases, identifying the same one can contain the contacts and help in controlling the spread of diseases. This techniques is used for public health measure .Hence the study of networks is a vital tool for disease control.

Researchers like Matt J Keeling, Ken T.D Eames et al., (2005), Leon Danon, Ashley P. Ford, Thomas House, Chris P. Jewell, Matt J. Keeling, Gareth O. Roberts, Joshua V. Ross, Matthew C. Vernon et al., (2011) Kermack & McKendrick (1927); Anderson & May (1992), Grenfell 1992; Rohani *et al*. 2000). The pioneers in network and epidemic model have exhaustively recorded their observation in the academic literature as given below

TYPES OF NETWORKS MODELS

Standard Epidemic Theory

Most of the models that are used in the study of epidemiology is based on characterizations of every individual according to the status of their diseases. (Kermack & McKendrick 1927; Bailey 1957; Anderson & May 1992). The simple modes give us the information about the vulnerable or susceptible, infected, and recovered of a particular disease. Other parameters are ignored but still this basic model has been successful in explaining the course of the disease for a long time. The susceptible-infectious-recovered (SIR) model and the susceptible infectious (SIS) model are the two standard models used in almost all epidemiological study. The set of differential equations given below defines the model in a very simple way