Review Paper 1

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1 The SIR Model and the foundations of public health

Approach of this paper is to analyze a basic transmission model for a directly transmitted infectious disease. The model consisted of a system of three coupled non-linear ordinary differential equations of the SIR (susceptible-infected-removed) Model which does not possess an explicit formula solution. However, In this paper simple tools calculus is used to extract a great deal of information about the solutions. It also illustrates how this simple model helps to lay a theoretical foundation for public health interventions and how several cornerstones of public health required such a model to illuminate.

The SIR Model consists of three quadratic ODEs. Those are:
dS/dt = -BSI
dI/dt = BSI - vI
dR/dt = vI

where the disease transmission rate B ¿ 0 and the recovery rate v ¿ 0 (or in in other words, the duration of infection D = 1/v).

Now, The exponential growth of infected individuals at the beginning of an epidemic is shown as under a circumstance. Re is the number of new infections caused by each infected individual at the beginning of the outbreak. The parameter Re is a measure of the fitness of the pathogen. If at the beginning each infected individual infects three susceptible individuals, and each of these three infected individuals infects three additional susceptible individuals, then of course the number of infections starts growing exponentially.

In the analysis of the SIR model in this paper, several aspects were brought to light. Such as finding the long term limit, Dying out of the disease. In terms of dying out of the disease, Epidemic threshold theorem is discussed where, the entire population is initially susceptible and Re is the threshold value or tipping point that determines whether an infectious disease will quickly die out or whether it will invade the population and cause an epidemic.

Here the strategies that were given to prevent and epidemic are:
1. Reducing the duration of infection D with antivirals.
2. Reducing the contact rate k by self-isolation of susceptible individuals

(request that they stay at home and skip school or work).
3. Reducing S(0) by offering flu vaccines.
4. Reducing the transmissibility tau by encouraging frequent hand washing and, in some cultures, distributing face masks.

In terms of vaccination, vaccinating an entire population is very expensive. According to the SIR model we can follow a phenomenon which is called herd immunity where to prevent an epidemic, we require that Re 1 which is a fractional amount of the population. Moreover, we can also find the maximum number of infected individuals.

This paper also talks about the five key epidemiological roles of the reproduction numbers where it is shown that under which conditions an epidemic will occur, initial exponential growth rate, vaccination threshold etc.

Lastly the SIR model is tested by parameterizing using actual infection data and the output of the model is compared with the time series data.