ABSTRACT

Human Immuno deficiency Virus (HIV) causes the viral infection that leads to Acquired Immune Deficiency Syndrome (AIDS). It breakdown the body’s immune system, rendering the victim vulnureable to a host of life threatening infections, neurological disorders or unusual malignancies (Centre for Disease Control, CDC 1987). The occurrence of HIV infection and the consequent AIDS has become a matter of great concern not only to the public but also for the governments in the different countries of the world. The consequences of HIV infection involves suffering as well as shortening the life span of those who are infected. It involves greater expenditure for the government in the process of rehabilitation of the infected and giving antiretroviral therapy to them. Hence the medical personnel and researchers devote considerable attention for the development of a vaccine against HIV and it is not yet fruitful.

The transmission of HIV by different modes of transmission is the causative factors for the spread of this epidemic. The spread of this infection has assumed alarming proportions in the past two decades all over the world. The increase in the number of HIV infected is a matter of concern not only for the government but also for the non government organizations. The rehabilitation of infected providing then with Anti Retroviral Therapy (ART) is very expensive and considerable amount has to be set apart for this purpose. The psychological problems and social apathy are all adding to the magnitude of the problem. Hence considerable efforts have been put up to contain this problem. Since no drug is still available, the medical researchers are devoting a considerable time for finding solution to arrest the spread of HIV infection as well as to reduce the suffering of the infected.
The antigenic diversity of a transmitted antigen through different modes of transmission has been a matter of investigation by several researchers. The estimation of the antigenic diversity threshold beyond the immune system has been attempted by several researchers. Stochastic models have been developed to estimate the likely time which is otherwise known as expected time to seroconversion. This topic has been a matter of research interest. These stochastic models provide the basis for developing the suitable methods to estimate the likely time at which the seroconversion takes place. This would help a lot to take all precautionary measures in advance
(1) To contain the progression of the infection,
(2) To find out the possible drugs and methods of intervention so that the process of seroconversion can be delayed and
(3) To find out the factors which contribute to the process of seroconversion.

Stochastic models are developed to predict the life time and likely number of persons who would become seropositive cases. Even though it would be very difficult to get the relevant data from the individual concerned, the hospital records may be used for the purpose of data collection. The main factors which are socio economic, physiological individual behavior can be taken and their contribution and significance in the process of seroconversion can be identified.

Chapter 1 contains a brief introduction regarding the various aspects of HIV infection in general and its implications. Some preliminary mathematical results used in the thesis are briefly explained in this chapter.

Chapter 2 is devoted to give a brief account of the biological aspects of HIV infection.

A brief summary of research work carried out by various authors in this area of study is given as the Review of Literature in Chapter 3.
In Chapter 4 stochastic model for estimation of expected time to seroconversion of HIV infected and its variance are derived. In arriving at the expression for $E(T)$, the expected time to seroconversion and its variance $V(T)$, the shock model and cumulative damage process as discussed by Esari et al. (1973) are applied. The contributing variables to the antigenic diversity of the HIV are assumed to be identically independently distributed random variables (i.i.d) $X_i$, $i = 1, 2, \ldots, k$. Assuming that there are ‘$k$’ contacts over the period $(0, t]$ and the interarrival times are also taken to be i.i.d random variables $U_i$, $i = 1, 2, \ldots, k$. In this model it is assumed that the threshold follows Geometric distribution. The expressions for $E(t)$ and $V(t)$ are obtained in closed explicit form. Numerical illustrations are also furnished.

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In Chapter 5 a stochastic approach to determine seroconversion time of HIV infected under alertness is presented. It is assumed that a person may be alert during any contact with probability ‘$p$’ and inalert with probability ‘$q$’ so that $p + q = 1$. At the same time the transmission of HIV during a contact is not a sure event. So it is assumed that the probability of transmission or infection during a contact is with probability $\beta < 1$.

In this chapter, using the concept of alertness and preventive strategy, a stochastic model for the estimation of expected time to seroconversion and its variance are derived under the assumption that the threshold level of antigenic diversity is a random variable which follows an exponential distribution. Numerical illustrations are also provided with graphs.

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In Chapter 6 a stochastic model to estimate the expected time to two sources of HIV transmission due to the sharing of unsterilized needle is presented. The contribution to antigenic diversity will be more due to the fact that there are two sources of infection, which in turn suppresses the immune ability. The expected time to seroconversion and its variance are derived. It is assumed that the threshold distribution is exponential. Numerical illustrations are provided using simulated data.

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In Chapter 7 a stochastic model for the estimation of time to seroconversion of HIV transmission using order statistics has been discussed. In this model, it is assumed that the threshold follows exponential distribution and interarrival times are i.i.d random variables that are not independent.


In Chapter 8 of the thesis a brief summary of the conclusion drawn on the basis of the various models is presented. For further research in this area of study the possibilities are also indicated.