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Delay Differential Models in Immunology and Infection Diseases in an Individual

Summary:

Many mathematical models related to bioscience problems are governed by differential equations that depend in part on the history rather than only the current state. Examples occur in population dynamics (taking into account the gestation and the maturation time), infectious diseases (accounting for the incubation periods), biological immune response (in which the antibody production by the B-cell population depends on the antigenic stimulation at earlier time). Delay Differential Equations (DDEs) are qualitatively and quantitatively consistent with the phenomena mentioned above. They also have rich mathematical framework compared with ordinary differential equations.

Salmonellosis is one of the most frequent cause of bacterial disease in Abu Dhabi, according to the Emirate's Health Authority (ADHA). It has been reported that Salmonellosis and E.coli are the main public health concerns in the UAE; See Gulf News, February 25, 2010.

Our central concern is to investigate the rôle of delay differential equations that plays in modelling immune system and the infection diseases interactions. The research in this project is focused on immunological dynamics for bacterial infections and transmission of the diseases in humans. The research has three directions: (i) To develop some mathematical models to represent the dynamics of E.coli and Salmonella bacterial growth in a host; (ii) To study interactions of antigens and immune system in an infected person by a viral or bacterial disease; (iii) To find a best-fit mathematical model that provides an accurate approximation to the observed (or experimental) data. The models will be based on a wide range of delay differential models.

Beneficiaries:

The practical illustration is used to convey more general insight to biologists. The expected results are essential to gain a better understanding of transmission mechanisms. They will help in determining and evaluating control strategies for the ADHA. The study will also bridge the gap between mathematics and biosciences research.