

Apply It.

The math behind... IMMUNOLOGY



Some technical terms used:

Dynamical systems, ordinary differential equations, competitive/cooperative systems, stability analysis of equilibria, bifurcation analysis

Uses and Applications:

Immunology can be used to study the interactions between virus-infected cells (or tumor cells) and the immune system. New therapeutic strategies can be formulated based on the predicted immune response for the respective diseases.

How it works:

In the simplest form, immune system dynamics can be modeled by a system of two ordinary differential equations representing the interactions between the target cell (e.g. virus-infected or tumor cells) and immune effector cell populations. The immune system detects a new target when it recognizes a foreign antigen (a peptide on the cell surface). It then stimulates the production of the effector cells. The effector cells will then attempt to kill the invading targets. The dynamics of such an interaction is analogous to a predator-prey ecological system. In addition, the various reaction processes, such as the stimulation of the effector cells and the growth and decay of the target cells, are included in the model as individual terms of the differential equations. In a therapeutic intervention, treatment can, for example, bolster the growth rate of the effector cell populations. The efficacy of such treatment in the eradication of the target population can be predicted using mathematical models. Depending on the modeling objectives, detailed chemical reactions and/or sub-cellular populations of the immune system can be added to produce a more comprehensive understanding of the immune system behavior.

Interesting Fact:

A nasal spray flu vaccine reduces the infected rate in children by 55 percent compared to those who receive the traditional flu shot in the arm. The two vaccination methods stimulate different types of immune responses. While the flu shot stimulates antibodies in the blood, the nasal spray vaccine stimulates antibodies both in the bloodstream and in the nose, which is where the flu virus usually enters the body [1].

Reference:

[1] Saint Louis University (2007, February 16). Global Study Concludes 'Attack Rate' Of Flu In Kids Is 55 Percent Lower With Nasal Spray Vaccine. *ScienceDaily*.

Retrieved January 30, 2008, from <http://www.sciencedaily.com/releases/2007/02/070215141532.htm>

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