

Modeling of the immunological process of HIV infection development at an early stage

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Motivation and Aim: The human immunodeficiency virus (HIV) attacks the immune system and weakens protection against many infections. So far, there are no methods to achieve complete elimination of HIV from the body of an infected person. However, due to increased access to HIV prevention, diagnosis and treatment with the help of HAART, HIV infection has moved into the category of controlled chronic diseases. Mathematical modeling methods are actively used to study the kinetic mechanisms of the pathogenesis of HIV infection and the development of personalized treatment approaches based on combined immunotherapy. One of the central tasks of HIV infection modeling is to determine the individual response parameters of the immune system in the acute phase of HIV infection.

Methods and Algorithms: A system of ordinary differential equations is considered [1]. The model consists of eight equations describing four states of CD4+ T cells, two types of CD8+ T cells that relate to human cellular immunity, and two equations for viral load. The Sobol method was used for sensitivity analysis. The search for the optimal value of the parameters was performed using a stochastic optimization algorithm.

Results Taking into account the sensitivity analysis performed by the Sobol method, the inverse problem was solved for the parameters of the model, the reconstructed solution of which describes the dynamics of the acute phase of HIV infection according to clinical data [2].

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References

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