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MATHEMATICAL MODELING OF THE INFECTIOUS DISEASE EXPANSION

© Zhurtova M.
Institute of Applied Mathematics and Automation, Nalchik, Russia
e-mail: zhurtova.93@mail.ru

Supposing the main operating characteristics of the infectious diseases are:
1) $V(t)$ - pathogenic multiplying antigens concentration.
2) $F(t)$ - antibody concentration.
3) $C(t)$ - plasma cells concentration , a population of antibody-producing cells.
4) $m(t)$ - relating characteristics of the affected organ.

The process of disease modeling, lead us to the following nonlinear system of ordinary differential equations [1, p. 116]:

$$\frac{\partial V}{\partial t} = (\beta - \gamma F)V, \quad (1)$$

$$\frac{\partial C}{\partial t} = \xi(m)\alpha V(t-\tau)F(t-\tau) - \mu_c(C - C^*), \quad (2)$$

$$\frac{\partial F}{\partial t} = \rho C - (\mu_f + \eta\gamma V)F, \quad (3)$$

$$\frac{\partial m}{\partial t} = \sigma V - \mu_m m. \quad (4)$$

Equation (1) describes the change in the number of antigens in the body, β - antigens multiplication coefficient; γ - probability ratio of antibody and antigen meeting resulted in antigens clearance. Equation (2) represent plasma cells growth where α- odd ratio for antigen and antibody meeting, $\xi(x)$ - is continuous and non-increasing function on the interval $0 \leqslant x \leqslant 1$ considering malfunction in the immune system, $\xi(0) = 1$, $\xi(1) = 0$; τ - time of plasma cells formation; μ_c - inverse value of lifetime of the plasma cells; C^* - a constant level of plasma cells in a healthy body. Equation (3) describes the number of antibodies, in which ρ -antibody production speed with singular plasma cell; μ_f - coefficient inversely proportional to the antibody decay time; η - antibodies number required for one antigen neutralization. The equation (4) is the relative characteristics of target organ damage, μ_m - inverse value of the body recovery period e times; σ - a constant, different for each disease.

We add to the obtained equations (1)–(4) initial data at $t = t_0$:

$$V(t_0) = V_0, \quad C(t_0) = C_0, \quad F(t_0) = F_0, \quad m(t_0) = m_0. \quad (5)$$

The equations (1)–(4) with initial data (5) are a mathematical model of a disease [2, p. 37].

In the work we investigate a stationary case of (1)–(4). We proved a theorem of asymptotic stability for the solution.

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ANALOGUES OF TITCHMARSH'S DIVISOR PROBLEM WITH SEMIPRIMES OF A SPECIAL TYPE

© Zinchenko N.
Belgorod State National Research University, Belgorod, Russia
e-mail: zinchenko@bsu.edu.ru

In the twenties and thirties of XX century G.H. Hardy, J.E. Littlewood and I.M. Vinogradov developed a General method in analytic number theory (circle method). It was used to decite ternary problem of Goldbach, problem of Waring, problem of Waring with primes and others. All these problems were worked out on the chart of solution of ternary problem. This metod was developed by I.M. Vinogradov. But this method failed when solving binary additive problems.

In 1930 E. Titchmarsh put and solved a binary additive problem about the receipt of asymptotic formula for the number of decisions of equation $p - 1 = xy$, $p \leqslant n$, where p – prime and x, y – naturals [1]. To prove it he used the Riemann Hypothesis. This problem got the name Titchmarsh's divisor problem. Yu.V. Linnik solved this problem using a dispersible method without assumming the Riemann Hypothesis [2].

A dispersible method succeeded in solving of other binary additive problems. Since 1965 the theorem of Bombieri-Vinogradov has been used instead of dispersible method [3]-[4].

In 1940 I.M. Vinogradov [5] used the method of trigonometric sums to prove the asymptotic formula for the number of primes in intervals of the form $[(2m)^2, (2m+1)^2)$, m – natural.

In 1986 S.A. Gritsenko [6] proved the asymptotic formula for the number of primes p such $p \leqslant x$ and

$$p \in [(2m)^c, (2m+1)^c), \ c \in (1, 2]. \quad (1)$$