Perevaryukha A. Yu.(Saint-Petersburg, Russia)**Modeling of COVID waves outbreaks based on equations with stochastically disturbance delay.**

We construct model of COVID-19 epidemic in the form of waves of spread with description of an incompletely determined evolutionary confrontation without a stable equilibrium $N(t) \to \mathcal{K}$. With an increase in the number of recovered people, population immunity is formed, but random mutations with non-random selection lead to the formation of branches of the evolution of competing strains of the virus. The moment of activation of a new strain is probabilistically variable $[\tau_1, \tau_1 + \Delta]$. We take into account the stochastic perturbation τ_1 by random variable γ in the range $\gamma(\omega) \in [1, 2]$ we describe the delay $(t - \tau_1\gamma)$ of epidemic waves with a perturbed uniform random variable when changing the dominant COVID strain:

$$\begin{cases} \frac{dY}{dt} = R_2 Y(t) \exp(-\varsigma Y(t - \gamma\tau) - \varepsilon\sqrt{(J - N(t-\tau))^2}, \\ \frac{dN}{dt} = R_1 N(t) \ln\left(\frac{\mathcal{K}}{N(t-\tau\gamma)}\right) - \frac{\delta N^2(t-\tau_1\gamma)}{(J-Y(t))^2} - \varphi Y(t), \delta > q, \gamma(\omega) \in [1, 2]. \end{cases} \tag{1}$$

In system (1), we took into account the effect of strain struggle during evolution on evasion of binding to antibodies. When $Y(0) < J < \mathcal{K}$ $N(t) \to 0+\epsilon$ the characteristics of the oscillatory regime change. The position of the extrema of the oscillations $N(t) \to N_*(t), \max N_*(t) < J$, $\min N_*(t)$ depends on the delay perturbation. Strain competition supports evolution [1].
Theorem 1. *There is* $R_1 = \bar{R}$ *such that for the event* $\lim_{t\to\bar{t}} N(t; \bar{R}_1\tau) = 0$ *probability* $P > 0$ *and* $\exists\hat{R}_1 > \bar{R}_1, t < \infty$ *for a given event* $P = 1$. $\hat{R}_1$ is the limiting reproductive number of the virus. Model (1) describes changes in fluctuations in the number of patients when Delta is replaced by the Omicron branch and attenuation of infection fluctuations at equilibrium transitions to the stage of sawtooth outbreak with series of decreasing peaks.

REFERENCES

1. *Perevaryukha A. Yu.* "A Continuous Model of Three Scenarios of the Infection Process with Delayed Immune Response Factors Biophysics, 2021, V. 66, Iss. 2, 327–348.

The work was supported by the Russian Science Foundation, project 23-21-00339.