# Computational Modeling of the Scenario of Resumption of Covid-19 Waves under Pulse Evolution in New Omicron Lines

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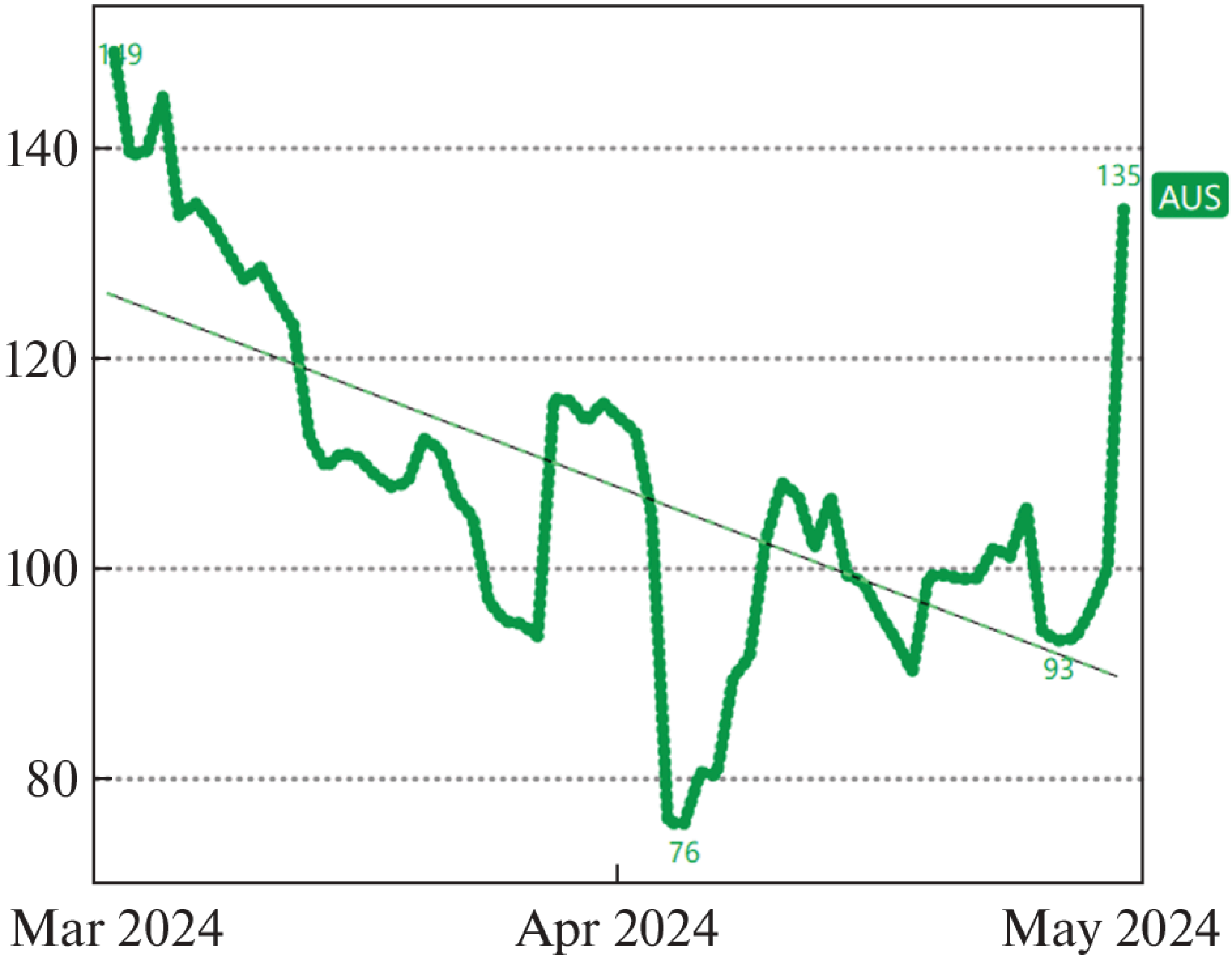



## Abstract

The new COVID-19 waves in 2024 are oscillatory modes with different characteristics than those that we modeled in 2021. The global dynamics of SARS-CoV-2 infections changed its oscillation mode twice: after the global peak of Omicron BA.1 in the spring of 2022 and in December 2023 because of the appearance of the Pirola evolutionary branch. The SARS-CoV-2 outbreaks in the spring of 2024 differ from the fluctuations in the first two phases of the pandemic and waves of infections in the third phase, which began after the spread of the first version of Omicron in the winter of 2022. In the Pirola dominant branch, the situation was repeated in 2023. In 5 months, more than a dozen weak strains from the JN/KP subbranches, which became regional, were formed. The local dominant variants from the Pirola branch were again active in the regions. As a result, after the spread of the original Omicron faded, the epidemic process was restarted with new properties. The JN branch was estimated by us as

having no evolutionary prospects according to the growth dynamics of its share among all infections. The reason for the aggravation of the epidemic situation is not only JN antibody evasion, but also reinfection. The spread of chronic post-Covid syndrome with a specific immunodeficiency condition has been noted. Most of the reported COVID-19 diseases in hospitals in 2024 are severe repeated infections. After the global Omicron BA.1 wave, the formation and attenuation of the wave series of local epidemics became asynchronous in nature. The continued emergence of new strains in the regions in the spring of 2024 necessitates forecasts of new methods of formal description by mathematical means of the epidemic evolution. The author consistently develops a method of computational modeling of the transformations of nonlinear oscillations in biophysical systems by analogy with discontinuous processes in technical physics. A comparative analysis of the differences in the development of the COVID epidemic waves in terms of hospitalization and mortality rates in the United Kingdom, Japan, and New Zealand has been carried out. There are different scenarios and forms of oscillatory dynamics in infections and mortality in terms of frequency, duration of COVID waves, and pauses between peaks. We have classified the scenarios according to the characteristic features of nonlinear dynamics. We have shown that the fading trend after the primary peak is easily destroyed by a mass infection event, thus causing an outbreak and a new mode of fluctuations. A method for modeling the impulse development of the epidemic based on equations with the threshold regulation functions and the choice of the forms for the situational functions damping the amplitude of infection waves has been proposed. In a hybrid structure on the right-hand side of the equations, we have indicated the rearrangements that determine the shape of the oscillating attenuation of the number of infections during evolution. In our computational experiment, a variant of the coronavirus activity peak caused by the effect of a single mass infection in a large logistics center after the stage of the attenuation of the local epidemic waves was simulated as a bifurcation scenario. In the model, this provokes a global wave because of the change of the dominant among the branches of the strains. In 2024, the entire epidemic dynamics describes a fading general trend, but one interspersed with brief bursts of waves. The virus has now begun to be defeated by the immune system, and new variants do not bind well to the ACE2 receptor. It is necessary to further analyze the effect of a sharp loss of immunity in vaccinated people. According to the author's forecast, the likely scenario is a spiral trend in the virus evolution with a return to early forms of the Spike protein and seasonal waves in 2025. A new wave of COVID is launched after a pop concert in Madrid.



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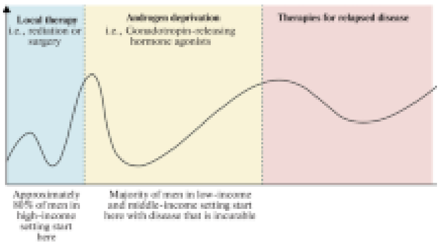

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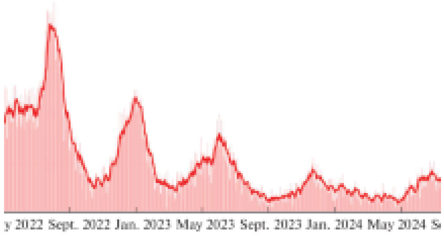


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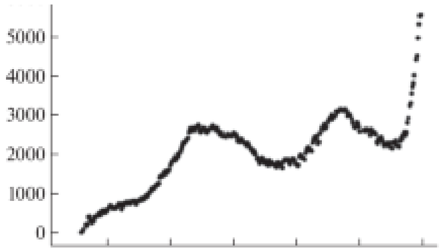


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## Ethics declarations

The author of this work declares that she has no conflicts of interest.

## Additional information

*Every experiment destroys some of the knowledge of the system which was obtained by previous experiments.*

*Werner Heisenberg*

Translated by N. Petrov

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