

Scientists from St. Petersburg Polytechnic University and the Smorodintsev Research Institute of Influenza created a mathematical model of the spread of coronavirus

Competence Center of the NTI of Peter the Great St. Petersburg Polytechnic University (SPbPU) together with experts from the Institute of Biomedical Systems and Biotechnology of SPbPU and the Smorodintsev Research Institute of Influenza. The Several other organizations included in the consortium of the NTI SPbPU Center also took part in the project. Alexey Borovkov, Vice-Rector for innovative projects (SPbPU) and Head of the NTI Competence Center was managing the project.

The mathematical model was developed in coordination with the RF Ministry of Health. Vice Governor Vladimir Knyagin has earlier presented the results of its application to the Governor of St. Petersburg Alexander Beglov.

A system-based research has been underway since February 3, 2020. The simulation was performed using a mathematical SEIR model of Kermak - Mackendrick type, which is classical for describing the spread of dangerous epidemics on the basis of a system of differential equations; it takes into account:

- The initial ratio of susceptible individuals in the population
- Confidence intervals of incubation periods
- The numerical strength of susceptible individuals / individuals in the incubation period / infected individuals / recovered individuals
- Coefficients of the intensity of recovery / intensity of transition to the stage of infected individuals / intensity of contacts among individuals /...

and many other parameters.

The research is also based on a spatial multi-agent model.

To calibrate the developed mathematical models, the experts sequentially examined and described with a high degree of accuracy the situation of the spread of coronavirus infection in the Wuhan agglomeration in China, on the Diamond Princess liner, in Italy, etc. This was a kind of convergent process of Model & Expert Learning.

The scientists forecast the possible duration of the outbreak of coronavirus infection in St. Petersburg until June - July 2020, i.e., for 4 to 5 months from the date of confirmation of the first diagnosed case (March 4). The total duration will depend on the effectiveness of sanitary and epidemiological measures which should reduce both the number of cases at the peak of the incidence and the load on the healthcare system. "Optimistic scenarios with the introduction of control measures, such as self-isolation, distance learning, quasi-quarantine, absolute monitoring of dormitories and hospitals with infected people, and so on, and

without the introduction of control measures, can differ at peak by 50 times! The number of infected individuals may increase from a huge number of 40,000 to the over-the-top two million, and this number is already unmanageable for any healthcare system,” commented Alexey Borovkov.



In the expert’s opinion, it is too early to weaken control measures and self-isolation. “Results in just three weeks can change in five times, and the complete removal of control measures can cause an unregulated and almost uncontrollable exponential increase in the number of infected people,” concluded Alexey Borovkov

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