Oscillations in the agent - based model of the mucose virus spreading indicate and explain the general failure of lockdown measures in combatting the SARS-CoV2 in European countries

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We have examined some of the origins of oscillatory behaviour in agent-based models which include our current knowledge on SARS-CoV-2 infectiousness and immunisation. We discuss only the model that correctly predicts the 11-week oscillation period observed in the Czech Republic and the mechanisms behind the successful 2020 spring virus suppression. Lockdown in strict sense or its weaker version - oscillation dampening after first wave - was not achieved in any European country.

The model is based on following concept: (1) Agents move for a given length of the step in the random direction. (2) An infected agent infects all non-immune agents present at a given field. (3) The infected agent is infected for a given time, then becomes immune or dies. (4) For the mucosal virus, we added the attribute system infection, which makes the agent susceptible for infection but not dying by the infection. (5) Immunisation is modelled as change of given number of agents into system immune. (6) Agents have finite lifespan and may reproduce. *The starting parameters are:* (1) Population density. (2) Initial number of infected agents.

The length of the step is a simulation of lockdown. At the step 0, the strict lockdown, infected agents infect only agents initially present at a given field and the virus dies out. A step 1, which was used all agent-based models before, leads to heavily dampen first oscillation. Any larger step leads to dampened oscillations with period determined by combination of population density, duration of the disease, duration of immunity and probability of infection. We know the period of oscillations in the Czech Republic, 11 weeks, and we determined parameters satisfying this criterion. *This is the main conclusion of this work.* The decrease of population density has similar effect as lockdown, the heavy dampening. We suggest that the reason of success of the spring anti-covid measure in Czechia was dilution of the population by re-location of people into countryside cottages. The system immunity (prevention of deaths) is more complicated to predict since we do not know its average duration. Nevertheless, one of the conclusions from our model is that the existence of oscillations means that the whole population was infected and is now system immune. The effectively low impact of vaccination on the level of mucosal infection – as observed by PCR test - is then caused by the fact that (1) we vaccinate mostly the system immune and (2) the effect of system immunity on mucosal immunity is very small, if any. *The dampened oscillations are consequence of spatial inhomogeneities which fade-away in time. In the homogeneous/equilibrium state we observe stable infection of over 20% and mucose immunity of over 35% of the population.*