On the Impact of Quarantine Policies and Recurrence Rate in Epidemic Spreading using a Spatial Agent-based Model

Supplementary Materials

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Section S1. Real-world COVID-19 Data

In this study we use data on daily cases and deaths during the COVID-19 pandemic to demonstrate the usefulness of our epidemic model. We chose data from the European Centre for Disease Prevention and Control (ECDC) to showcase the evolution of cases, at national level, in Romania and Hungary [1]. The dataset spans from 14/03/2020 to 24/10/2022. Since we address the original SARS-CoV-2 strain (mostly the period 2020) and start with a susceptible population, we chose a representative interval in the dataset, namely 01/10/20 to 01/06/21, when both countries witnessed their first two impactful epidemic waves.

Since there are high variations in the data from day to day, we recompute the daily values as the average over the previous two and next two days. For deaths, the daily variations in the data are higher, so we compute the average over the last 5 days and next 5 days for each day. An illustrative example is given in Figure S1.

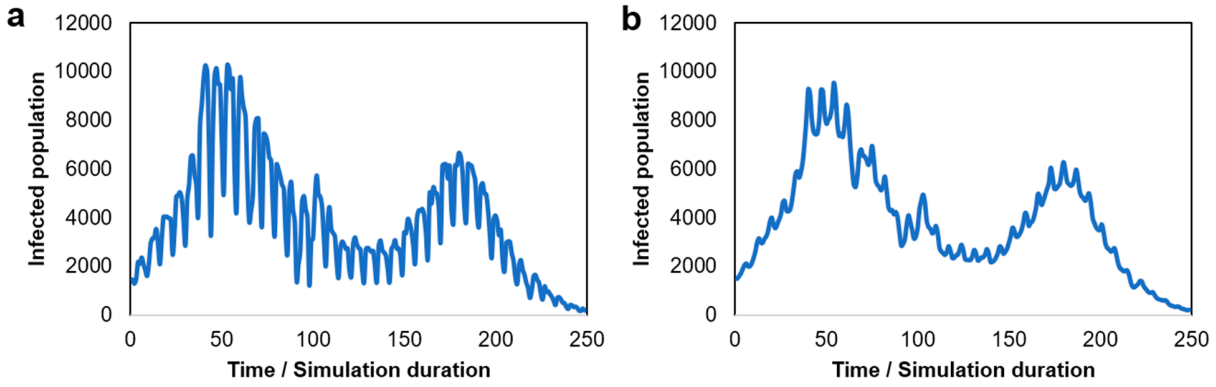

Figure S1. Time series data on daily COVID-19 cases in Romania between 14/03/2020 and 24/10/2022. **(a)** The raw data obtained from ECDC [1]. **(b)** The data with reduced noise.

Section S2. Fitting the Epidemic Model for COVID-19 Data

We present two scenarios of fitting data from our simulations to real-world COVID-19 data in Romania and Hungary. Based on the infectious parameters enumerated in Table 1 (main manuscript), Figure S2 plots the real data (blue line) and the simulation data obtained from the ABM (orange). Here we initialized the ABM with a react-Q policy (more likely to reflect the real-world quarantine policy), a long-R recurrence scenario, and the quarantine ratios r_{qrnt}=0.6, respectively r_{qrnt}=0.8. The later example induces a higher second wave than the former scenario.

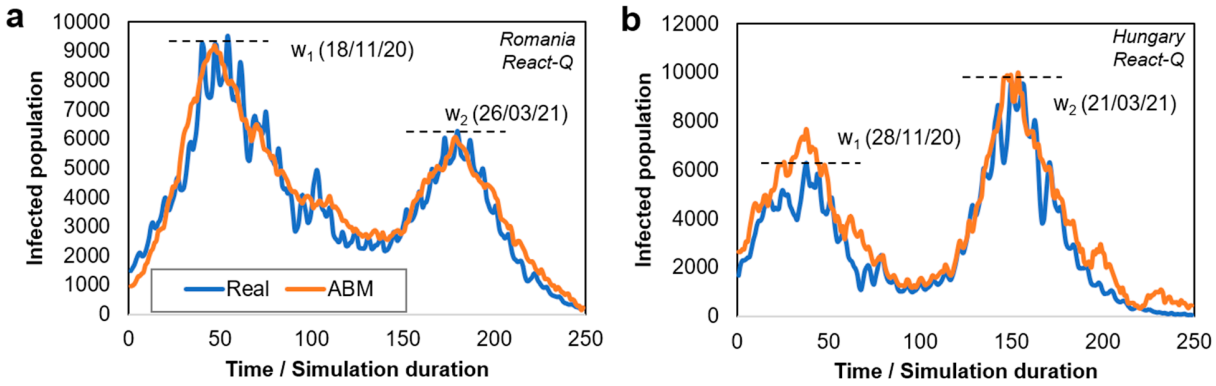

Figure S2. Fitting data on daily infectious cases for (a) Romania and (b) Hungary between 14/03/2020 and 24/10/2022. The two waves (w1, w2) in each country are marked on the plots. Real data is shown in blue and the simulated data using our ABM is shown in orange.

Using data on deaths from the same datasets and simulation scenarios, we fit the resulting data in Figure S3.

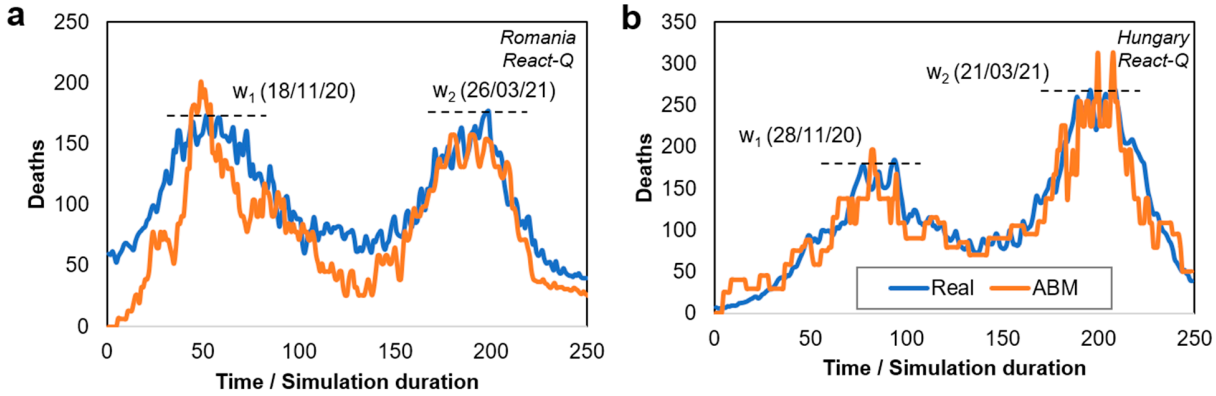

Figure S3. Fitting data on daily deaths for (a) Romania and (b) Hungary between 14/03/2020 and 24/10/2022. The two waves (w1, w2) in each country are marked on the plots. Real data is shown in blue and the simulated data using our ABM is shown in orange.

The fitting precision of the ABM data with the infectious time series data is further measured using the following accuracy measures: the root mean squared error (RMSE), the mean absolute deviation (MAD) and the mean absolute percentage error (MAPE). Table S1 presents the accuracy measures for infectious cases and deaths for the two fitted datasets.

Table S1. Fitting accuracy of the epidemic model for COVID-19 data.

Accuracy Index	Infectious Cases		Deaths	
	Romania	Hungary	Romania	Hungary
RMSE	627.78	975.50	31.22	26.56
MAD	506.32	731.03	26.02	20.76
MAPE	19.14	87.11	29.17	32.46

References

[1] European Centre for Disease Prevention and Control (An agency of the European Union), *Data on the daily number of new reported COVID-19 cases and deaths by EU/EEA country,* 27.10.2022 (archived), https://www.ecdc.europa.eu/en/covid-19/data