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Modelling the second wave of COVID-19 infections in France and Italy via a Stochastic SEIR model

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COVID-19 has forced quarantine measures in several countries across the world. These measures have proven to be effective in significantly reducing the prevalence of the virus. To date, no effective treatment or vaccine is available. In the effort of preserving both public health as well as the economical and social textures, France and Italy governments have partially released lockdown measures. Here we extrapolate the long-term behavior of the epidemics in both countries using a Susceptible-Exposed-Infected-Recovered (SEIR) model where parameters are stochastically perturbed with a log-normal distribution to handle the uncertainty in the estimates of COVID-19 prevalence and to simulate the presence of super-spreaders. Our results suggest that uncertainties in both parameters and initial conditions rapidly propagate in the model and can result in different outcomes of the epidemics leading or not to a second wave of infections. Furthermore, the presence of super-spreaders adds instability to the dynamics, making the control of the epidemics more difficult. Using actual knowledge, asymptotic estimates of COVID-19 prevalence can fluctuate of order of ten millions units in both countries.