The risk for a new COVID-19 wave – and how it depends on R_0, the current immunity level and current restrictions

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Abstract

The COVID-19 pandemic has hit different parts of the world differently: some regions are still in the rise of the first wave, other regions are now facing a decline after a first wave, and yet other regions have started to see a second wave. The current immunity level $\hat{i}$ in a region is closely related to the cumulative fraction infected, which primarily depends on two factors: a) the initial potential for COVID-19 in the region (often quantified by the basic reproduction number R_0), and b) the timing, amount and effectiveness of preventive measures put in place. By means of a mathematical model including heterogeneities owing to age, social activity and susceptibility, and allowing for time-varying preventive measures, the risk for a new epidemic wave and its doubling time, and how they depend on R_0, $\hat{i}$ and the overall effect of the current preventive measures, are investigated. Focus lies on quantifying the minimal overall effect of preventive measures p_{Min} needed to prevent a future outbreak. The first result shows that the current immunity level $\hat{i}$ plays a more influential roll than when immunity is obtained from vaccination. Secondly, by comparing regions with different R_0 and $\hat{i}$ it is shown that regions with lower R_0 and low $\hat{i}$ may now need higher preventive measures (p_{Min}) compared with other regions having higher R_0 but also higher $\hat{i}$, even when such immunity levels are far from herd immunity.

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