Analysis of COVID-19 based on SEIR epidemic models in a multi-patch environment

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Abstract

In this paper, an n-patch SEIR epidemic model for the coronavirus disease 2019 (COVID-19) is presented. It is shown that there is unique disease-free equilibrium for this model. Then, the dynamic behavior is studied by the basic reproduction number. Some numerical simulations with three patches are given to validate the effectiveness of the theoretical results. The influence of quarantined rate and population migration rate on the basic reproduction number is also discussed by simulation.

Full Text

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Figures

Figure 1

The disease transmission in each patch.

(a)

(b)

(c)

(d)

Figure 2

Time evolution of individuals when $P = P_0$, $q_i = 0$, $z_i = 0$, $i = 1; 2; 3$. Case II: Migration of people is restricted and quarantine strategy is taken.

(a)

(b)

(c)

(d)

Figure 3

Time evolution of individuals when $P = 0$, $q_i = 0.5$, $z_i = 0.3$, $i = 1; 2; 3$.

(a) $p_{ij} \in [0, 0.0005]$

(b) $p_{ij} \in (0.0005, 1]$

Figure 4

The effect of migration rate on R_0 .

Figure 5

The effect of quarantined rate on R_0 .