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ANALYZING THE SPREAD OF A DISEASE WITH DUAL TRANSMISSION MODE VIA A METAPOPULATION MODEL: ROLES OF ACTIVE AND PASSIVE MOVEMENTS

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In order to investigate the spread of a disease between a larger urban city and a comparatively smaller satellite city, we formulate a metapopulation model which explicitly integrates vector-borne and sexual transmission and distinguishes between two distinct types of movements, active and passive. After finding the basic reproduction number of the model by means of the next generation method as being the spectral radius of a comparatively higher-dimensional matrix, we provide explicit estimations in terms of community-specific reproduction numbers which are somewhat less computationally intensive. We then perform a correlation analysis along with numerical simulations which lead to the conclusion that the disease is primarily transmitted via the vector-borne mode rather via the sexual transmission mode and that sexual transmission by itself can neither initiate nor sustain an outbreak.

The fact that active movements have comparatively little influence upon the global basic reproduction number of the model indicates that although travel restrictions restriction from the urban city to the satellite city may reduce the prevalence of the disease in the satellite city, significant control measures targeting the densely populated cities will be required in order to eradicate the disease in the entire region. After gauging the effects of mobility, we explore the potential effects of optimal control strategies relying upon several distinct restrictions on population movement.

References

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