

# SIS criss-cross model of infectious diseases in heterogeneous populations

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We propose a model of infectious diseases transmission in heterogeneous populations consisting of two different subpopulations. We use a criss-cross model to describe the illness dynamics. This criss-cross model is based on a simple SIS model with constant inflow into both subpopulations and bilinear transmission function. We find conditions for the existence and local stability of stationary states (disease free and endemic) and fit the model to epidemic data of tuberculosis from Warmian-Masurian Province of Poland. Basic reproduction number is considered as a threshold parameter for the general model. Considering two subpopulations which differ in epidemic behavior, we confirm the hypothesis that the disease may be transmitted from the "high-risk" subpopulation to the general population, which leads to the spread of the epidemic. It means that to control the spread of the disease in a heterogeneous population it is not enough to consider the disease dynamics in each subpopulation separately, in particular, when the subpopulations differ in the risk of spreading the disease.

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