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MODELING FOOT-AND-MOUTH DISEASE DISSEMINATION IN BRAZIL AND EVALUATING THE EFFECTIVENESS OF CONTROL MEASURES

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RESUMO

SUB-ÁREA: Princípios e métodos epidemiológicos Foot-and-mouth disease (FMD) infects multiple food-animal species and thus is capable of disseminating among ungulate species with distinct transmission rates. Here, we present a multilevel compartmental stochastic model, taking into account population dynamics such as births and deaths, and explicitly accounting for species-specific transmission dynamics. This work was aimed to describe epidemic curves of FMD while describing the role of the main spread of disease routes and examining different scenarios to control outbreaks. The model considered two major modes of dissemination, between-farm animal and spatial transmission, within and between three host species populations (bovines, swine, and small ruminants) through a Susceptible-Exposed-Infected-Recovered model. Our model outcomes are the number of secondary infected animals and farms, spatial dissemination distances, and effectiveness of depopulation and vaccination along with surveillance and movement restrictions. We demonstrated that after 20 days of FMD dissemination, the median number of infected farms when considered all species was 8 (IQR: 3-22), and 7 (IQR: 3-22) when considered only bovine, 3 (IQR: 1-6) for swine farms, and 1 (IQR: 1-1) for small ruminants. Our results showed that animal movement dominated dissemination in the first ten days of epidemics, while after that infection of bovine was dominated by the spatial transmission. However, for swine infections, animal movements were the most relevant transmission route throughout the first 20 days post seeded infections. Furthermore, we estimated effectiveness of different control actions in outbreaks to eliminated 93.4% of the epidemics with a median of 9 (IQR: 3-23, max: 221) infected farms and about 80% of infected farms. In conclusion, the developed transmission model allows for cross-species transmission to be considered in FMD policy-making, and the software implementation facilitates the adaption of scientific-based support to FMD planning.

PALAVRAS-CHAVE: SEIR models, infectious disease spread, epidemiology, foot-and-mouth disease, Brazil

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