

# Spatiotemporal dynamics of foot and mouth disease outbreaks in India, 2008-2016

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## Abstract

Foot-and-mouth disease (FMD) is endemic in India, where circulation of serotypes O, A and Asia 1 is frequent. In the past two decades, many of the most widespread and significant FMD lineages globally have emerged from the South Asia region. Here, we provide an epidemiological assessment of the ongoing mass vaccination programs in regard to post-vaccination monitoring and outbreak occurrence. The objective of this study was to quantify the spatiotemporal dynamics of FMD outbreaks and to assess the impact of the mass vaccination program between 2008 to 2016 with available antibody titer data from the vaccination monitoring program, alongside other risk factors that facilitate FMD spread in the country. We first conducted a descriptive analysis of epidemiological outcomes of governmental vaccination programs in India, focusing on antibody titer data from >1 million animals sampled as part of pre- and post-vaccination monitoring and estimates of standardized incidence ratios calculated from reported outbreaks per state/administrative unit. The percent of animals with inferred immunological protection (based on ELISA) was highly variable across states, but there was a general increase in the overall percent of animals with inferred protection through time. In addition, the number of outbreaks in a state was negatively correlated with the percent of animals with inferred protection. Because standardized incidence ratios of outbreaks were heterogeneously distributed over the course of eight years, we analyzed the distribution of reported FMD outbreaks using a Bayesian space-time model to map high-risk areas. This model demonstrated a ~50% reduction in the relative risk of outbreaks in states that were part of the vaccination program. In addition, states that did not have an international border experienced reduced risk of FMD outbreaks. These findings help inform risk-based control strategies for India as the country progresses towards reducing reported clinical disease.

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