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A GEOSTATISTICAL FRAMEWORK FOR COMBINING SPATIALLY REFERENCED DISEASE PREVALENCE DATA FROM MULTIPLE DIAGNOSTICS

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Multiple diagnostic tests are often used due to limited resources or because they provide complementary information on the epidemiology of a disease under investigation. Existing statistical methods to combine prevalence data from multiple diagnostics ignore the potential over-dispersion induced by the spatial correlations in the data. To address this issue, we develop a geostatistical framework that allows for joint modelling of data from multiple diagnostics by considering two main classes of inferential problems: (1) to predict prevalence for a gold-standard diagnostic using low-cost and potentially biased alternative tests; (2) to carry out joint prediction of prevalence from multiple tests. We apply the proposed framework to two case studies: mapping Loa loa prevalence in Central and West Africa, using miscroscopy and a questionnaire-based test called RAPLOA; mapping Plasmodium falciparum malaria prevalence in the highlands of Western Kenya using polymerase chain reaction and a rapid diagnostic test. We also develop a Monte Carlo procedure based on the variogram in order to identify parsimonious geostatistical models that are compatible with the data. Our study highlights (i) the importance of accounting for diagnostic-specific residual spatial variation and (ii) the benefits accrued from joint geostatistical modelling so as to deliver more reliable and precise inferences on disease prevalence.