RESUMO SIMPLES - OUTRAS ÁREAS TEMÁTICAS

ARTIFICIAL NEURAL NETWORKS FOR PREDICTING ZOONOTIC DISEASES IN IBSA COUNTRIES UNDER THE ONE HEALTH FRAMEWORK

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The increasing complexity of health risks—driven by human mobility, environmental change, and intensified production systems—highlights the interdependence of human, animal, and environmental determinants, especially in the Global South. Within this scenario, IBSA (India, Brazil, and South Africa) cooperation fosters joint solutions and incorporates Artificial Intelligence into zoonotic surveillance. Among AI methodologies, Artificial Neural Networks (ANNs) stand out for their ability to detect non-linear patterns and anticipate outbreaks, offering innovative support for One Health strategies and for the Sustainable Development Goals (SDGs). In countries marked by institutional fragmentation and heterogeneous data availability, ANNs provide robust alternatives to traditional statistical methods, improving the prediction of health conditions and optimizing resource allocation. Zoonoses continue to threaten

public health and food security in the Global South, accounting for nearly 75% of emerging diseases. Rabies, avian influenza, leptospirosis, and malaria are particularly relevant for IBSA countries due to their epidemiological burden and multisectoral determinants. Despite past advances in veterinary public health, surveillance systems in these nations remain largely reactive and insufficiently integrated across sectors. The absence of harmonized predictive models limits early response capacity, whereas ANNs offer opportunities to improve anticipation, coordination, and decision-making. This study aimed to operationalize One Health within the IBSA context by constructing ANN-based predictive models to estimate zoonotic risks, integrating human, animal, environmental, and socioeconomic indicators. Historical data from 2023–2024 were compiled into a multisectoral database comprising 51 variables distributed across 72 administrative units (36 in India, 27 in Brazil, and 9 in South Africa). Four priority zoonoses—rabies, avian influenza (H5N1), leptospirosis, and malaria—were modeled using the NeuroShell Predictor®, following structured steps of data organization, training, and validation. All variables originated from public, aggregated data sources, ensuring ethical compliance. Model performance was assessed using the coefficient of determination (R^2). The ANN models exhibited distinct predictive accuracies among the four diseases. Rabies ($R^2 = 0.83$) showed excellent performance, likely because its determinants—such as dog population dynamics, vaccination coverage, human exposure, and the role of wildlife reservoirs (particularly bats and, in some regions, cattle as spillover hosts)—are relatively stable and well represented in multisectoral datasets. Leptospirosis ($R^2 = 0.79$) also performed robustly, supported by environmental variables such as rainfall, sanitation indicators, and socioeconomic conditions that are consistently measured across the IBSA nations. Malaria ($R^2 = 0.71$) demonstrated good predictive capacity, reflecting its endemic nature and the influence of climate patterns, vegetation indices, and population density, all of which were adequately captured in the database. Conversely, the avian influenza model ($R^2 = 0.23$) showed poor accuracy. This is likely due to the absence of essential variables related to the ecology of migratory birds, wild reservoir distribution, viral introduction pathways, and farm-level biosecurity. Unlike the other diseases studied, avian influenza in IBSA countries is not endemic but introduction-dependent, and its occurrence is strongly influenced by ecological and migratory dynamics that were not represented in the available public datasets. Overall, the study demonstrates that ANNs are a promising tool for integrated One Health surveillance when the epidemiological determinants of each disease are adequately reflected in the

input data. By integrating human, animal, environmental, and socioeconomic indicators, the ANN models developed here showed solid potential to support early warning systems, guide proactive interventions, and strengthen multisectoral cooperation within the IBSA framework. These findings highlight the importance of expanding data availability—particularly environmental and ecological variables—to further enhance predictive modeling capacity and contribute to more resilient and sustainable health systems in the Global South.

Palavras-chave: zoonosis; one health; artificial intelligence; epidemiological forecasting.