

Landscape Epidemiology of Emerging Infectious Diseases in Natural and Human-Altered Ecosystems¹

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Abstract

A central challenge to studying emerging infectious diseases (EIDs) is a landscape dilemma: our best empirical understanding of disease dynamics occurs at local scales while pathogen invasions and management occur over broad spatial extents. The burgeoning field of landscape epidemiology integrates concepts and approaches from disease ecology with the macro-scale lens of landscape ecology, enabling examination of disease across spatio-temporal scales in complex environmental settings. We review the state of the field and describe analytical frontiers that show promise for advancement, focusing on natural and human-altered ecosystems. Concepts fundamental to practicing landscape epidemiology are discussed, including spatial scale, static versus dynamic modeling, spatially implicit versus explicit approaches, selecting ecologically meaningful variables, and inference versus prediction. We highlight studies that have advanced the field by incorporating multi-scale analyses, landscape connectivity, and dynamic modeling. Future research directions include understanding disease as a component of interacting ecological disturbances, scaling up the ecological impacts of disease, and examining disease dynamics as a coupled human-natural system.

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