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Letter to the Editor

Sand Fly-Borne Leishmaniasis in the Era of Climate Change: The Need for One Health Surveillance and Resistance Monitoring in Iran

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Dear Editor-in-Chief

Leishmaniasis remains a major arthropod-borne disease of global public health importance, particularly in endemic regions, including Iran (1,2). Its transmission is sustained by the interplay of sand fly vectors, animal reservoirs, environmental conditions, and human population movement (3, 4). Despite advances in diagnosis and treatment, the epidemiology of leishmaniasis is becoming increasingly complex due to climate change, land-use alteration, urban expansion, and ecological disruption, all of which can alter vector distribution and transmission intensity (3, 5).

Sand fly ecology is highly sensitive to temperature, humidity, rainfall, vegetation cover, and altitude. These factors influence vector survival, seasonal abundance, biting activity, and the probability of parasite transmission (6). As a result, climate-driven ecological change may expand the geographic range of competent vectors or increase transmission in areas that were previously considered low-risk (7). This makes reliance on static endemicity maps increasingly inadequate for public health planning.

Because many forms of leishmaniasis are zoonotic, a One Health framework is especially relevant. Human cases represent only one component of a broader transmission system involving vectors, reservoir hosts, and the surrounding environment. Integrated surveillance that combines entomological monitoring, veterinary data, clinical reporting, and climate/environmental indicators is therefore essential to identify evolving hotspots, anticipate outbreaks, and transition from reactive

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control to predictive prevention (8). Genomic, population-based, and spatial approaches can further enhance this framework by characterizing sand fly population structure, dispersal, and pathogen associations that may shape local transmission dynamics (9).

Another critical challenge is the long-term sustainability of vector control. Chemical interventions remain important in endemic areas, but their effectiveness is threatened by insecticide resistance. Reports of resistance patterns and resistance-associated molecular mechanisms, including *kdr*-related mutations in Iranian *Phlebotomus* populations underscore the need to institutionalize routine susceptibility testing and molecular resistance surveillance as core program components (10). Such monitoring can guide evidence-based insecticide choice, reduce operational failure, and support resistance management strategies.

Taken together, these developments indicate that leishmaniasis control must move beyond traditional case detection and vector reduction alone. Climate-informed risk assessment, One Health surveillance, and systematic resistance monitoring should be integrated into a unified national framework to strengthen early warning capacity, optimize resource allocation, and improve preparedness for emerging and re-emerging transmission foci in Iran.

Conflict of interest

The authors declare that there is no conflict of interests.

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