

# A Novel Multi-scale Immuno-epidemiological Model of Visceral Leishmaniasis in Dogs

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Leishmaniasis is a neglected and emerging disease prevalent in Mediterranean and tropical climates. As such, the study and development of new models are of increasing importance. We introduce a new immuno-epidemiological model of visceral leishmaniasis in dogs. The within-host system is based on previously collected and published data, showing the movement and proliferation of the parasite in the skin and the bone-marrow, as well as the IgG response. The between-host system structures the infected individuals in time-since-infection and is of vector-host type. The within-host system has a parasite-free equilibrium and at least one endemic equilibrium, consistent with the fact that infected dogs do not recover without treatment. We compute the basic reproduction number  $R_0$  of the immuno-epidemiological model and provide the existence and stability results of the population-level disease-free equilibrium. Additionally, we prove existence of a unique endemic equilibrium when  $R_0 > 1$ , and evidence of backward bifurcation and existence of multiple endemic equilibria when  $R_0 < 1$ .

## References

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