

11.036 Visceral leishmaniasis in the Indian subcontinent: modeling epidemiology and control

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Background: In the Indian subcontinent about 200 million people are at risk of developing visceral leishmaniasis (VL). The governments of India, Nepal and Bangladesh started in 2005 the first regional VL elimination program with the aim to reduce the annual incidence to less than 1 per 10,000 by 2015. Optimal intervention strategies may include measures ranging from treatment of humans to control of sand flies, and mathematical models can help investigating the expected effects of different strategies. Yet, many biological parameters within the transmission cycle of VL are still uncertain.

Results: A mathematical model describing VL transmission dynamics suggests that transmission of VL is predominantly maintained by asymptotically infected hosts. Immunity assessed by the Leishmanin skin test (LST) lasts on average for roughly one year, and re-infection occurs in intervals of about two years, with variation not specified. In contrast to vector control, treatment of cases has almost no effect on the overall intensity of transmission as only patients with symptomatic disease are eligible, with asymptotically infected hosts not treated.

Methods and Materials: We developed a mathematical model with parameters for transmission, disease and intervention. The model has been fitted to data from a community intervention trial on bednets (KalaNet project). Parameters on the natural history of *Leishmania* infection were estimated and used to predict the effects of different intervention strategies.

Conclusion: Treatment of Kala-azar is necessary on the level of the individual patient, but may have almost no effect from an epidemiological view if transmission of infection is strongly maintained by asymptotically infected hosts. In contrast, vector control or exposure prophylaxis can efficiently reduce transmission. Based on these findings control of VL should re-consider vector-related interventions.

11.037 Cost-effectiveness of treatment alternatives for visceral leishmaniasis in Sudan

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Background: Visceral leishmaniasis (VL) is an important public health problem in Sudan, particularly in eastern, central and southern regions. Pentavalent antimonials, mainly sodium stibogluconate (SSG), are the current mainstay of treatment for VL. However, the treatment needs prolonged parenteral administration (30 days) and is costly to both the health provider and the patient (especially in terms of lost labour time). Over the past decade there have been a number of important drug developments including liposomal Amphotericin B (L-AmB), oral miltefosine (MF) and paromomycin (PM). Each of these compounds has advantages and disadvantages; MF is teratogenic and has a long half-life, PM although low cost requires intramuscular injections by health workers while L-AmB remains very expensive despite recent price decreases for the public sector. An additional issue is the potential rapid selection of resistance for both PM and MF. Combination therapies may delay the emergence of resistance, reduce treatment duration and toxicity, improve compliance and reduce the burden to the health system and the patient. In this study we examine the cost-effectiveness of various treatment options for VL in Sudan.

Results: The Delphi and costing survey were done between March 2010 and April 2011. Results are not yet available but will present the cost per patient treated and average and incremental cost-effectiveness expressed as cost per death averted. The results will present a rank order for different potential treatments in the region.

Methods and Materials: We compare from a societal perspective 7 options, including 3 combination therapies: L-AmB with MF, L-AmB with SSG and SSG with PM, and 4 monotherapies: MF, L-AmB (10days), SSG and meglumine antimoniate. Primary data was collected in Sudan and combined with data from the literature and a survey among VL clinical experts (Delphi method). We consider both direct costs incurred by health providers and direct and indirect costs incurred by patients and relatives. Sensitivity and threshold analysis are carried out to examine the effect of changing parameter values on the rank-ordering of strategies.

Conclusion: The study provides important information to both the Sudanese government and the international community on feasible treatment options for VL from an economic point of view.

11.038 Characterization and prediction of high risk areas for the occurrence of visceral leishmaniasis using socioeconomic indicators and remotely sensed data

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Background: Since transmission of visceral leishmaniasis (VL) is a focal process, the identification of high-risk areas for VL can be a useful strategy to increase the effectiveness of control measures and reduce operational costs in the urban context. The objective of this study is to characterize and predict areas at greatest risk of VL in the urban area of Teresina, Brazil, using socioeconomic indicators and remotely sensed data.

Results: The developed model was able to discriminate 15 subsets of census tracts (CTs) with different probabilities of containing CTs with high risk of VL. The subset with higher probability of containing CTs with high risk of VL (92%) included CTs with percentage of illiterate heads of households above the median (>64,2%), with higher area covered with dense vegetation, and with percentage of households with >3 persons/room above the third quartile (>31,6%). The model showed, respectively, in the training and validation sets, sensitivity of 79% e 54%, specificity of 74% e 71%, global accuracy of 75% e 67% and auROC of 83% e 66%.

Methods and Materials: Average annual incidence rates, socioeconomic indicators and remotely sensed data (Landsat-TM) for each census tracts of Teresina (n=430) from 1993–1996 were used for characterizing areas of high-risk and for developing a predictive model for VL occurrence. Data for the years of 2001–2006 (n=653) were used to validate the model. The model was developed using classification and regression trees. We use sensitivity, specificity, global accuracy and the area under the Receiver Operating Characteristic curve (auROC) for assessing the predictive performance of the model.

Conclusion: This study confirms the well-known relationship between the risk of VL and features associated with the hectic process of urbanization commonly seen in the developing world, such as rapid environmental changes, substandard living conditions and poverty. The model showed only fair predictive performance which reinforces the complexity of factors involved in the introduction, spread and maintenance of VL in urban settings. New efforts to develop such models should include a more broad set of variables, such as historical data on prevalence of infection in dogs and incidence of human VL and remotely sensed data derived by high-resolution sensors.