Mathematical models of infectious disease: Validation of the simulation of rabies mass vaccination and its potential to Switzerland

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Key words
Rabies, dog, mathematical model, transmission dynamics, economics, profitability, cost-effectiveness

Aim of the study
Most human deaths from rabies occur in tropical resource limited countries. In Africa and Asia, an estimated 24,000 to 70,000 people die of rabies each year. Rabies in humans can be prevented by appropriate post-exposure prophylaxis (PEP), a treatment not always available and affordable in resource-limited countries. Human rabies can also be prevented through vaccination of the animal vector. In most countries however, little is known about the real cost of mass vaccination of dogs, and quantitative data are urgently needed to evaluate the cost-effectiveness of different rabies-control strategies. The objective of this project was to develop and validate a deterministic model of dog-human rabies transmission in an African urban centre

Material and methods
Data concerning the number of confirmed dog-rabies cases was collected during the period of January 2001 to November 2006 (305 weeks) from routine passive surveillance at LRVZ. This dataset was used to fit the model parameters. We extended existing deterministic models of rabies transmission between dogs to include dog-to human rabies transmission. Further data was collected on human dog bite frequency in N'Djaména.

Results and significance
A single parenteral dog rabies-mass vaccination campaign achieving a coverage of least 70% appears to be sufficient to interrupt transmission of rabies to humans for at least 6 years. PEP does not reduce future human exposure. Its cost-effectiveness is estimated at US $46 per disability adjusted life-years averted. Cost-effectiveness for PEP, together with a dog-vaccination campaign, breaks even with cost-effectiveness of PEP alone after almost 5 years. Beyond a time-frame of 7 years, it appears to be more cost-effective to combine parenteral dogvaccination campaigns with human PEP compared to human PEP alone. Further, during his sabbatical at the Ontario Veterinary College, Canada, J. Zinsstag examined dog population dynamics in Jodhpur India in the framework of the PhD of Sarah Totton. These findings should inform future locally adapted rabies control policies in Africa and Asia. Results were presented and discussed in a workshop bringing together South American and African scientists at the RITA rabies conference in October 2009 in Quebec

Publications, posters and presentations
Durr S et al (2009) Effectiveness of dog rabies vaccination programmes: comparison of owner-charged and free vaccination campaigns. Epidemiol.Infect 1-10.

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