Does control of animal infectious risks offer a new international perspective?

Camus E., Cardinale E., Dalibard C., Martinez D., Renard J.F and Roger F. (eds.)
IS RABIES CONTROL A PUBLIC GOOD IN DEVELOPING COUNTRIES?

DÜRR S.1*, MINDEKEM R.2, KANINGA Y.3, MELTZER M.4, ZINSSTAG J.1

1. Swiss Tropical Institute, PO Box, 4002 Basel, Switzerland
2. Centre de Support en Santé International, BP 972, N’Djaména, Chad
3. Clinique vétérinaire urbane, N’Djaména, Chad
4. Centers for Disease Control and Prevention, Atlanta, GA 30333, USA

ABSTRACT

In the discussion about policies and strategies for rabies prevention in developing countries, intervention costs arise as a major issue. We organized two pilot mass vaccination campaigns for dogs against rabies under equal conditions in N’Djaména, Chad. The first one was free of charge for the dog owners; the second one, four years later, assessed willingness to pay. 3000 dogs were vaccinated in the free campaign, 393 dogs in the second. The vaccination coverage and costs are assessed in both cases, showing the cost per dog vaccinated for the public sector and for society. In the pilot mass campaign with 3000 dogs, the average cost per dog was 1.69 € to the public and 2.45 € to society. During the second campaign only about 13% of animal owners were willing to pay for rabies vaccination at a rate of 3 € per animal. Nevertheless, mass dog vaccination could be a comparatively cheap and ethical way to both control the disease in animals and prevent human cases and exposure, especially in developing countries. Our result shows that effective rabies control by parenteral vaccination is a public responsibility and cannot be achieved by private funding only.

INTRODUCTION

Rabies is a neglected disease in developing countries with 55’000 deaths and 1’160’000 DALYs per year worldwide (Knobel et al., 2005). The dog is the main vector for transmission to humans. After exposure, usually through animal bites or contact with infected saliva, clinical rabies, which is always fatal, can only be averted by immediate vaccination. However, the vaccine for post-exposure treatment (PET) is expensive and not always available, making full PET rare in low income countries. Human rabies and rabies exposure can be effectively prevented through vaccination of the animal vector, the dog. WHO recommends 70% vaccination coverage of

*Contact author : E-mail : salome.duerr@unibas.ch
dog populations to interrupt the viral circle of rabies (WHO 2005). Zinsstag et al. (2007, submitted) developed the first dog-human deterministic transmission model with stochastic parameter specification of dog-to-human transmission. This model is a tool for assessing comparative cost-effectiveness of different rabies control strategies through simulation. Based on model outputs, we currently hypothesize that by a single parenteral mass vaccination campaign of all 23,560 (Mindekem et al., 2005) dogs in N’Djaména, the transmission of rabies can be interrupted and eliminated in the city area over a period of about 6 years. Bögel and Meslin showed that over a period of 15 years, dog vaccination combined with post-exposure treatment of dog bite patients is more cost-effective than PET alone which allows the virus to continue circulating in the dog population (Bögel and Meslin 1990). In our model, the cost per DALY averted in the mass dog vaccination scenario was inferior to the cost of PET alone, even after a period of only 5-8 years.

**TWO PILOT PARENTERAL VACCINATION CAMPAIGNS AGAINST CANINE RABIES**

In 2002, the Swiss Tropical Institute in collaboration with the Chadian partner institutions, the Central Veterinary Laboratory (LRVZ), the Non-Governmental Organisation Centre de Support en Santé Internationale (CSSI), and the Urban Veterinary Clinic of N’Djaména realized a pilot parenteral vaccination campaign of dogs in N’Djaména, Chad (Kayali et al., 2003). 3000 animals were vaccinated over 5 days and the vaccination was free to dog owners. Achieved vaccination coverage was between 64-87%. The performed cost analysis of the campaign yields an average cost per dog of 1.69 € (1€=1.27 US$) to the public and 2.45 € to society (Kayali et al. 2006). The private sector calculation included the owner’s income loss during the vaccination period and transportation costs. If all 23,600 dogs in N'Djamena were vaccinated, the extrapolated average cost would fall to 1.16 € to the public and 1.93 € to society. Private sector costs account for 31% of the cost of vaccinating 3000 dogs, and 40% of the cost of vaccinating 23,600 dogs. As a result of discussions about cost-sharing and financing of the campaigns, we organized a second similar campaign four years later, but this time with an owner’s charge of 3 € (Dürr, Mindekem et al., submitted 2007). If we were to succeed with this strategy and to achieve a vaccination coverage of at least 70%, we would demonstrate that it is possible to finance vaccination campaigns through the private sector alone. In the second
vaccination campaign, we vaccinated 393 animals under same conditions as in the first campaign. The achieved coverage was 24%. In a household survey, the owner’s estimation of the value of vaccination was obtained by asking them how much they would be willing to pay for it. The observed data from the dog vaccination campaigns and the owner-stated values correspond well (Figure 1). According to the observed data and the owner’s statements, to achieve the target vaccination coverage of 70%, between 0.50 € and about 0.80 € could be charged to the dog owners.

**Figure 1.** Probability of owners valuing dog rabies vaccination: Observed vs. owner-stated valuations.

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Parenteral mass vaccination of dogs, the host population in which the virus circulates, is a comparatively inexpensive and ethical way to both control the disease in animals and prevent human cases and exposure, especially in developing countries (Zinsstag *et al.*, 2007). Our result shows that effective rabies control by parenteral vaccination cannot be achieved by private funding only. The achieved vaccination coverage of 24% within the dog population is insufficient to interrupt the virus circle. The maximal possible charge to owners of 0.80 € per vaccinated dog doesn’t cover the full cost of the campaign. Hence, public responsibility for rabies control is needed and the reclassification of rabies control as a public good is not a rhetorical question, but a matter which has to be discussed seriously if this relatively easily eliminable disease is to be controlled effectively.
RECOMMENDATIONS FOR FURTHER RESEARCH ISSUES

According to simulation results of the dog-human transmission model, rabies can be interrupted after a single vaccination campaign with at least 70% coverage. This model prediction should be compared with the decrease of weekly incidence of dog rabies observed after conducting a mass vaccination campaign for the whole dog population of N’Djaména in order to assess the accuracy of simulation of interventions with the mathematical model. To achieve the 70% coverage target, the vaccination should be offered for free to the owners. The main uncertainty in the model is the dynamics of immigrating latently infected dogs. Hence, further research is needed to estimate the risk of reintroduction of rabies among unvaccinated dogs from outside sources. Additionally, more quantitative data are needed to evaluate the long-term cost-effectiveness of mass parenteral dog vaccination campaigns in developing countries.

Acknowledgements

The authors would like to thank the our funding partners, the Swiss Federal Veterinary Office, the Wolfermann-Nägeli Foundation, the Commission for Research Partnership with Developing Countries, the Emilia Guggenheim-Schnurr Foundation, and the NCCR North-South. Merial donated the doses of canine antirabies vaccine, for which we are grateful. We thank the international institutions, collaborators and campaign workers for their successful teamwork.

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