



Low coverage of central point vaccination against dog rabies in Bamako, Mali



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ARTICLE INFO

Article history:

Received 14 November 2014

Received in revised form 23 March 2015

Accepted 13 April 2015

Keywords:

Dog rabies

Mali

Vaccination campaign

Intervention effectiveness

ABSTRACT

Canine rabies remains an important public-health problem in Africa. Dog mass vaccination is the recommended method for rabies control and elimination. We report on the first small-scale mass dog vaccination campaign trial in Bamako, Mali. Our objective was to estimate coverage of the vaccination campaign and to quantify determinants of intervention effectiveness. In September 2013, a central point vaccination campaign – free of cost for dog owners – was carried out in 17 posts on three consecutive days within Bamako's Commune 1. Vaccination coverage and the proportion of ownerless dogs were estimated by combining mark-recapture household and transect surveys using Bayesian modeling. The estimated vaccination coverage was 17.6% (95% Credibility Interval, CI: 14.4–22.1%) which is far below the World Health Organization (WHO) recommended vaccination coverage of 70%. The Bayesian estimate for the owned dog population of Commune 1 was 3459 dogs (95% CI: 2786–4131) and the proportion of ownerless dogs was about 8%. The low coverage observed is primarily attributed to low participation by dog owners. Dog owners reported several reasons for not bringing their dogs to the vaccination posts. The most frequently reported reasons for non-attendance were lack of information (25%) and the inability to handle the dog (16%). For 37% of respondents, no clear reason was given for non-vaccination. Despite low coverage, the vaccination campaign in Bamako was relatively easy to implement, both in terms of logistics and organization. Almost half of the participating dog owners brought their pets on the first day of the campaign. Participatory stakeholder processes involving communities and local authorities are needed to identify effective communication channels and locally adapted vaccination strategies, which could include both central-point and door-to-door vaccination.

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1. Introduction

Canine rabies remains as an important public-health problem with most cases occurring in Asia and Africa. An estimated 55,000 human deaths occur each year (Knobel et al., 2005). Rabies, an important virus in the genus *Lyssavirus*, affects the nervous system, and is transmitted through the bite of a rabid animal with the virus in its saliva. Most human exposures in urban African settings result from the bite of a rabid dog. Immediate wound cleaning and rapid administration of post-exposure prophylaxis (PEP) are required to prevent rabies following a bite incident (Rupprecht et al., 2002; Banyard and Fooks, 2011).

Children are at highest risk of rabies encephalitis, which is an important cause of death among African children (Kayali et al., 2003a; Fèvre et al., 2005; Mallewa et al., 2007). The disease is endemic due to the interplay of social and cultural attitudes toward dogs, weak public- and animal-health systems and poor surveillance systems. In some African countries, there has recently been an increase in incidence of the disease in domestic dogs (Hampson et al., 2007). No country has been reported to be rabies-free in Africa, leading to the formation of international, national, private-public partnerships and networks to raise awareness and funds and evaluate effective rabies-control strategies (Dodet et al., 2008; Taylor, 2013).

2. Rabies in Mali

Few studies have quantified the incidence of rabies in Mali. A 4-year retrospective analysis of bites in humans and animals in

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Bamako district identified 5870 animal bite cases, with 10 human-rabies deaths between 2000 and 2003. From 119 brain specimens tested by direct immunofluorescence, 116 dogs and 1 cow were positive. More than half of the human cases occurred in children under 13 years, with dogs implicated in most bites. The authors further noted that most patients lived on the outskirts of the district and did not receive pre- or post-exposure vaccination against rabies. The single-dose cost (9000 CFA or 15 EUR) was prohibitive for most citizens in Bamako (Dao et al., 2006). Between 2007 and 2012, forty cases of human rabies were reported in Bamako resulting in an incidence of 0.37 per 100,000 person-years (Kone, 2013). The biting animal was almost always a dog (95%). In Mali, rabies was identified as a priority disease within WHO/AFRO's framework of the Integrated Disease Surveillance and Response strategy in 2008, but more needs be done to improve the quality of epidemiological data.

A study on dog ownership in Bamako showed a low dog-human ratio of 1/121 (Mauti, personal communication) which is lower than that reported for Ndjamena 1/20–1/30 (Mindekem et al., 2005). However, many dogs are reported to be vaccinated by owners on their own initiative. In a household survey, 45% of the dogs were reported as vaccinated against rabies, even though only half of the owners presented a vaccination book (Mauti, personal communication). This indicates that dog owners perceive the need for dog rabies vaccination. Because the disease is fatal, it is important to administer PEP as soon after a bite exposure as possible. In settings where PEP is not always available, it is important for the human- and animal-health sectors to implement long-term control-and-prevention programs, such as vaccination of dogs.

Although rabies-control methods vary across different geographic, cultural, and social settings, the most preferred is a combination of measures which includes canine vaccination and reduction of the stray-dog population (Macpherson et al., 2012). Morders et al. (2013) reviewed population density-reduction methods of rabies control such as culling and birth control, which assumes density dependent transmission of rabies and concluded that vaccination is the most effective method in all species (Morders et al., 2013). Currently, dog mass vaccination is the recommended intervention to control and eliminate dog rabies (Cleaveland et al., 2006; WHO, 2007). Recent research has shown that dog-rabies mass vaccination is a more cost-effective method than human post-exposure treatment in an urban African setting, if sufficient coverage is achieved (Zinsstag et al., 2009). WHO recommends a dog mass-vaccination coverage of 70%, which is supported by evidence from dog-human transmission models where such coverage prevents outbreaks of canine rabies (Coleman and Dye, 1996). In N'Djamena, high coverage was achieved in a campaign that was cost-free to dog owner (Kayali et al., 2003b), whereas coverage was low when owners were required to pay (Durr et al., 2009).

Prior to initiating dog mass vaccination, it is important to know the effectiveness parameters of interventions. Even if a vaccine is highly efficacious, it is important to know whether it can be widely applied in a community. Several effectiveness determinants have been identified for interventions, including vaccine efficacy, accessibility, availability, affordability, adequacy, provider compliance, acceptability, and dog-owner compliance (Obriest et al., 2007; Zinsstag et al., 2011). In preparation for dog-rabies control and elimination in Bamako, it is important to know what the achievable coverage in the intervention area and level of community participation in the target area are likely to be. The objectives of our study was to estimate the achieved coverage of a mass dog rabies vaccination campaign; to estimate effectiveness parameters, such as community participation; and to assess the feasibility of carrying out a free-to-owner central-point mass vaccination campaign.

3. Methods

3.1. Study site

Our study took place in Bamako district, Mali in September 2013 (rainy season). The national census recorded 1,800,000 people in 290,000 households in Bamako (R.G.P.H. 2009). The vaccination zone covered Commune 1, which includes 335,000 people living in 9 quartiers (neighborhoods), Banconi, Boukassombougou, Sikoroni, Djelibougou, Doumanzana, Fadjiguila, Sotuba, Korofina North and South Korofina, over an area of 35 km². Bambara is the main language, and most people engage in formal employment, trading, or self-employment. Commune 1 was selected for the small scale trial due to its large population and close proximity to the Central Veterinary Laboratory (Laboratoire Central Veterinaire, LCV). An overview map is provided in Appendix A.

3.2. Dog-vaccination campaign

3.2.1. Campaign operation

The vaccination campaign was approved by the Ministry of Live-stock and Fisheries (Ministre de l'Élevage et de la Pêche), Mali. Approval was granted by the Malian state authority because no animal-ethics committee exists in Mali. Three months before the start of the vaccination campaign, preparatory work involved pre-exposure vaccination of vaccinators and identification and pre-visit of vaccination points within the commune. A stakeholders' meeting with municipal authorities, chiefs of the quartiers, and religious leaders was held three weeks prior to the campaign to discuss the campaign and request their cooperation. During the same time, an information campaign was organized which involved distribution of posters in prominent places (next to schools, houses of local leaders, vaccination points) and radio messages broadcast in the local language.

3.2.2. Campaign design

The campaign had 17 teams, each with two veterinary officers from the National Veterinary Services and the Central Veterinary Laboratory. The positions of the vaccination points are provided in Fig. 1. Each team was equipped with chairs, table, vaccination certificates, needles, syringes, registers, animal markers, collars, first-aid kits, disposal bins, scissors, muzzles, and 10 doses of vaccine (Rabisin[®], Merial) stored in a cooler box. The chief of the quartier was present at most vaccination points. Most vaccination posts were placed close to the residence of the chief of the quartier, with a few additional posts in front of well-known meeting points and schools. Campaign posters were hung in prominent places near the vaccination posts. Radio announcements in Bambara (local language) about the free vaccination campaign were broadcast from two local radio stations twice daily during the campaign period. Dog owners were invited to bring their dogs between 8 am and 5 pm. At midday, supervisors drove between the vaccination posts to receive a progress update, change the cooling agents in the storage boxes, and drop off any additional supplies required by the teams. Most teams took a break to pray and eat.

3.3. Vaccination and marking of dogs

The campaign took place on 3 consecutive days during the school holidays, starting on Friday 6th September with posts positioned in all neighborhoods of Commune 1. Merial (France) provided 3000 doses of Rabisin[®] vaccine, together with collars and vaccination certificates. Each dog was vaccinated using 1 ml Rabisin[®], after which the dog description, age, and owner's address were recorded in the register. Finally, the dog was marked using a

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