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Assessing the rabies control and surveillance systems in Brazil: An experience of measures toward bats after the halt of massive vaccination of dogs and cats in Campinas, Sao Paulo

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ABSTRACT

Bats are less vulnerable to forest fragmentation than any other mammal, and for that reason, some species can disperse to peri-urban or urban areas. Insectivorous bats are abundant in urban areas due to the density of artificial roosts and insects attracted by city lights. Inter-species transmission of the rabies virus between bats can occur, and this is the most probable mechanism of virus circulation in bat populations. Bats can also transmit the rabies virus to other mammal species, like dogs and cats. With the halt of dog and cat vaccination campaigns in 2010, the importance of rabies surveillance in bats has increased in Brazil. A cross-sectional study performed in Campinas, Sao Paulo State, using data from the passive surveillance system for bats showed that rabies-positive bats from the families Molossidae, Phyllostomidae and Vespertilionidae were found in a peri-urban area. In these areas, dog and cat emergency vaccination (vaccination blockage) was recommended after the halt of the massive vaccination campaign in 2010. This control strategy was able to increase the proportion of vaccinated animals around a critical value of 50% and even with a higher probability of infectious contact between bats and dogs or cats in the vaccination blockage areas, no dog or cat rabies case was observed, evidencing the importance of the implementation of strategic rabies control measures in this new epidemiological scenario.

1. Introduction

Rabies is a zoonotic disease caused by a RNA virus of the genus Lyssavirus, family Rhabdoviridae that poses a serious risk to human populations in several regions, including Latin America (Schneider et al., 2009).

Rabies virus can be transmitted to humans from a number of species, including dogs, cats, non-human primates

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and bats. In Brazil, from 2000 to 2009, 163 human rabies cases were reported to the Brazilian Ministry of Health. Out of those cases, 45.4% were transmitted by bats (Wada et al., 2011).

In fact, bats are the main reservoirs of rabies, according to antigenic studies (Favoretto et al., 2002). Out of the 1120 species of the Chiroptera order, 167 occur in Brazil (including the three hematophagous species) and to date, 41 have been identified as rabies-positive. From 2001 to 2007, 863 cases of rabies in bats have been diagnosed in Brazil, with 49.1% being non-hematophagous species, 29% hematophagous species and 21.9% unidentified (Sodré et al., 2010).

Some bat species are less vulnerable to forest fragmentation than other mammals due to their ability to disperse to peri-urban fragments and the urban environment itself. Insectivores for example, are abundant in urban areas due to the density of artificial roosts and insects attracted by city lights (Barros et al., 2006). From the three most abundant and diverse bat families in Brazil, Molossidae and Vespertilionidae bats are insectivorous and Phyllostomidae bats are frugivorous (Bredt et al., 1996; Pacheco et al., 2010). The ecology of these bats in urban areas has been sparsely studied.

Inter-species transmission of the rabies virus between bats can occur during disputes, since several species may share the same roost (Barros et al., 2006; Streicker et al., 2012). This is the most probable mechanism for the maintenance of rabies virus circulation in bat populations (Streicker et al., 2010, 2012).

Bats are not only capable of maintaining rabies virus circulation between them (i.e., aerial cycle), but transmission between bats and other mammal species has been described in Brazil (Favoretto et al., 2002). Until the time of the writing, the last case of human rabies in Sao Paulo State was due to the transmission of a vampire bat virus variant (AgV3) by an infected cat in 2001 (Kotait, 2003; MS, 2012).

In Brazil, the surveillance system for both human and animal rabies is fragmented between federal, state and local health and agricultural authorities. In general, livestock and bat rabies surveillance is performed by federal and state agricultural authorities in rural areas (MAPA, 2009). Dog, cat and bat rabies surveillance is performed by local health authorities in urban areas and human rabies surveillance is performed by local health authorities (MS, 2005). However, hunting or killing a native wild species, such as bats, is a federal crime and should only be performed with the authorization of the federal environmental authority.

Considering all instances, the rabies surveillance system is based on: (a) monitoring the occurrence of rabies in animals, both domestic and wild; (b) surveillance of 0.2% of the dog population (brain tissue samples of deceased and euthanized dogs showing neurologic symptoms in public shelters are sent to reference laboratories) (SVS, 2009; Schneider et al., 1996).

On the other hand, rabies control is based on: (a) mass vaccination of at least 80% of the dog and cat populations; (b) clinical observation of dogs and cats that have bitten a human for up to 10 days after the attack; (c) post-exposure prophylaxis for the attack victims and (d) in the presence of a suspicious dog or cat case, performance of an emergency vaccination of all unvaccinated dogs and cats within a 5 km buffer area (i.e., blockage area) (SVS, 2009; Schneider et al., 1996).

During the vaccination campaign, several vaccination teams are distributed throughout the city in predetermined points (i.e., vaccination points). Each vaccination point works a single day in each location.

The official recommendation is that, in the presence of a suspicious human case transmitted by bats in rural areas, the State agriculture authority should be contacted to identify the bat species and apply control measures, such as culling of hematophagous bats, in a 12 km buffer area (SVS, 2009).

If a bat (dead or alive) is found inside buildings or households, especially during the day, the recommendation of the local health authority is to send it to a diagnostic laboratory (SVS, 2009).

Campinas is the third largest city in the State of Sao Paulo, the most populous Brazilian State. With one million inhabitants, the city is located 96 km northwest of Sao Paulo city, occupying an area of almost 800 km^2 (IBGE, 2010). The last human and animal (dog and cat) rabies cases occurred in 1981 and 1999, respectively (SMS, 1986; IP, 2011).

The rabies vaccination campaign strategy began in 1972 in Campinas and was halted in 2010 in all of Sao Paulo State after a high incidence of vaccine accidents due to the change of the Fuenzalida-Palacius vaccine for the BHK-cell vaccine in Sao Paulo and Guarulhos, the two biggest cities in Sao Paulo State (MS, 2010).

During the last rabies vaccination campaign, 90,085 dogs and 9001 cats were vaccinated by the local Sanitary Surveillance Service of Campinas in 2009.

The city has had a structured passive surveillance system for bats since 1994, and the increasing number of notifications reached its peak in 2010 ($n = 488$). After a notification call, the Animal Control Authority (CCZ) personnel go to the location to capture alive or deceased bats and send them to the diagnostic laboratory. After laboratory confirmation, a house-to-house communication of the rabies case is made, with the distribution of rabies education material including a phone number to report further bat findings. During the household visit, dog and cat owners are interviewed and the number of animals and date of last rabies vaccination is recorded.

The aim of this paper is to assess the probability of infectious contact between dogs and cats and rabies-positive bats based on data from passive rabies surveillance in the northern region of Campinas city, Sao Paulo State, Brazil. Furthermore, the rabies surveillance and control systems were assessed in a scenario where bats are the main reservoirs and no rabies vaccination campaigns are performed.

2. Materials and methods

2.1. Study area

The study area consists of one of the Campinas health districts, with an area of 174 km^2 and containing 64,480 occupied households and a human population of 185,954