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Human rabies focusing on dog ecology—A challenge to public health in Sri Lanka

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ABSTRACT

Sri Lanka is among the top ten countries in the world that report the highest rate of human rabies deaths (2.8 per 1,000,000 in 2007) and animal bites requiring anti-rabies post-exposure treatment (PET) (755 per 100,000 in 2003). Dogs are the main reservoir and transmitters of rabies in Sri Lanka. Present study evaluates the effectiveness of dog rabies control strategies on reducing incidence of human rabies deaths. Analysis is based on data from last three decades and showed strong correlations between the interventions and human rabies incidence. GIS maps provided a method for illustrating the district distribution of human rabies deaths and dog population density and for recognizing districts at risk. Interrupting the natural transmission cycle of rabies in dogs would be a logical approach in eliminating dog rabies in Sri Lanka. However, interventions implemented so far, such as dog vaccination, elimination of stray dogs (abandoned in 2005), and animal birth control have been inadequate to do so. Better understanding of the ecology of stray and owned dogs (e.g. population density, population structure, confinement status) in the context of the human environment and culture, are needed to strategize the control activities, requiring coordination among regional Public Health and Veterinary services.

1. Introduction

Sri Lanka is among the top ten countries in the world that report the highest rate of human rabies deaths (2.8 per 1,000,000 in 2007) and potential rabid animal bites requiring post-exposure treatment (755 per 100,000 in 2003) (WHO, 2008). Human rabies deaths are reported from most of the 25 districts of Sri Lanka each year (Fig. 1) (Public Health Veterinary Services (PHVS), 2008). In Sri Lanka, only 42.8% of human rabies deaths were confirmed with laboratory testing in 2007 (WHO, 2008).

Due to the limited island wide surveillance on animal rabies by veterinary health authorities, the incidence of animal rabies is largely undetermined. Dogs are the main reservoir and transmitter of rabies in Sri Lanka, wildlife plays a much lesser role in transmission (Matter et al., 2000; Wimalaratne, 2007). Nearly 90.0% of rabies cases diagnosed in animals at the Medical Research Institute (MRI) during 1995–2005 were among dogs; proportion of wild animals such as mongooses and jackals were less than 5% and bat rabies was not reported (WHO, 2008). It is not known whether separate sylvatic rabies cycles occur in Sri Lanka; rabies among wild animals and domestic animals other than dogs and cats observed are stated as probably due to spill-over from rabies in dogs (Arai et al., 2001). As depicted by phylogenetic analysis by Arai et al. (2001) and Nanayakkara et al. (2003), in Sri Lanka, there are no lyssavirus other than the rabies virus. Among human rabies deaths notified during the years 2000–2006 to the Epidemiology Unit, deaths recalled as due to a dog bite varied from 62.6% to 85.4% and as due to a stray dog bite varied from 24.2% to 48.0% (Epidemiology Unit, 2000–2006).

Data on dog ecology including their population densities, population structure and characteristics in different districts in Sri Lanka are scarce. A dog ecology study conducted in 1980s in Sri Lanka has revealed a dog: human ratio of 1:8 (WHO, 1988). Another study carried out in 1997 in Meerigama Divisional Secretariat area in Gampaha District, has found a dog: human ratio of 1:4.6 (95% 4.3; 5.0) (Matter et al., 2000). According to the same study, 19.4% (13.5, 25.4%) of the dogs were ownerless; among owned dogs older than 3 months, 39.6% were either chained up or locked, while 60.4% were free-roaming (50.7% free-roaming on the dog owner's premises and 9.7% free-roaming at variable distances from their owner's household).

Main rabies control strategies adopted by the Ministry of Health, Sri Lanka, are: mass dog vaccination, dog population control and provision of post-exposure treatment (PET) for at risk animal bite victims. Dog rabies control is primarily the responsibility of the Public Health Veterinary Services (PHVS), Ministry of Health. Dog vaccination, first launched in 1975, is carried out annually; free of charge, by certified vaccinators in the district rabies control units. During these vaccination campaigns, vaccination of owned dog is carried out at pre-arranged temporary vaccination posts while stray dog vaccination is carried out using a special device called 'Auto

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Plunger'. The owner is given a vaccination certificate. Animal rabies vaccines available in Sri Lanka are killed-virus vaccines and confer 1–3 years immunity (Perera et al., 2000). Elimination of stray dogs had been carried out since 1975 in Sri Lanka as a method of dog population control (Harischandra, 1997); however it was abandoned in 2005 and was replaced by surgical and chemical animal birth control (ABC) methods. Post-exposure treatment (PET) is provided free of charge to all eligible animal bite victims coming to government hospitals in Sri Lanka At present, 85% of patients seeking PET are administered tissue culture vaccine intradermally (Wimalaratne, 2007). It is estimated that about 375,000 animal bite victims seek treatment each year; out of which, about 200,000 are administered PET (Wimalaratne, 2007).

2. Materials and methods

Human rabies death rates, for the period of 1973–2007, were calculated using the published data: total number of human rabies deaths reported by the Public Health Veterinary Services and the midyear human population estimated by the Department of Census and Statistics, Sri Lanka, for each year. Calculations were carried out for the entire country and for administrative districts which correspond to the district Public Health units as presented in Fig. 1.

For the purpose of calculating the annual coverage (percentage) of rabies control activities implemented in Sri Lanka, it was necessary to obtain an estimate for the total dog population. As data on the dog population for the districts or for the country are not available from veterinary or public health sources or published reports, our estimates were based on *human: dog* ratios. The ratio estimates for Sri Lanka are from sample surveys which do not represent the whole country (WHO, 1988; Matter et al., 2000), thus the dog population per year was estimated using ratios published for Asia by Knobel et al. (2005). This was considered equivalent to the ratio expected in Sri Lanka, given the fact that the authors have calculated the estimates based on all the available reports from Asia including the two from Sri Lanka. The mean ratio estimated for Asia is 9.5:1 (95% confidence interval 4.5:1–14.6:1). We assumed a constant *human: dog* ratio from 1975–2007. Dog population, estimated above, was used as the denominator for calculating the annual coverage (percentage) for rabies control activities implemented in Sri Lanka, based on the numbers reported for dog vaccination, dog elimination and dog animal birth control (ABC) by the Public Health Veterinary Services.

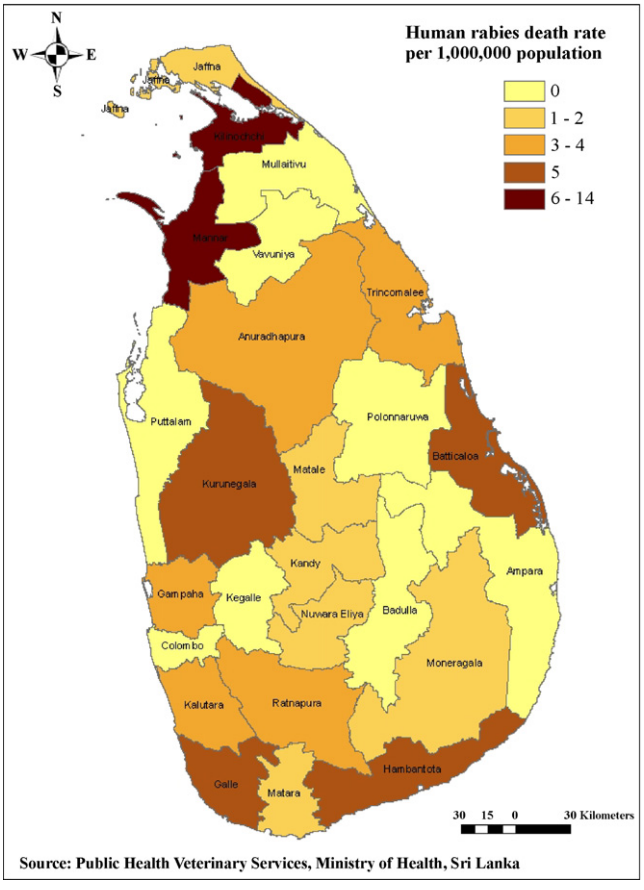

Fig. 1. Human rabies deaths by district, Sri Lanka, 2007.

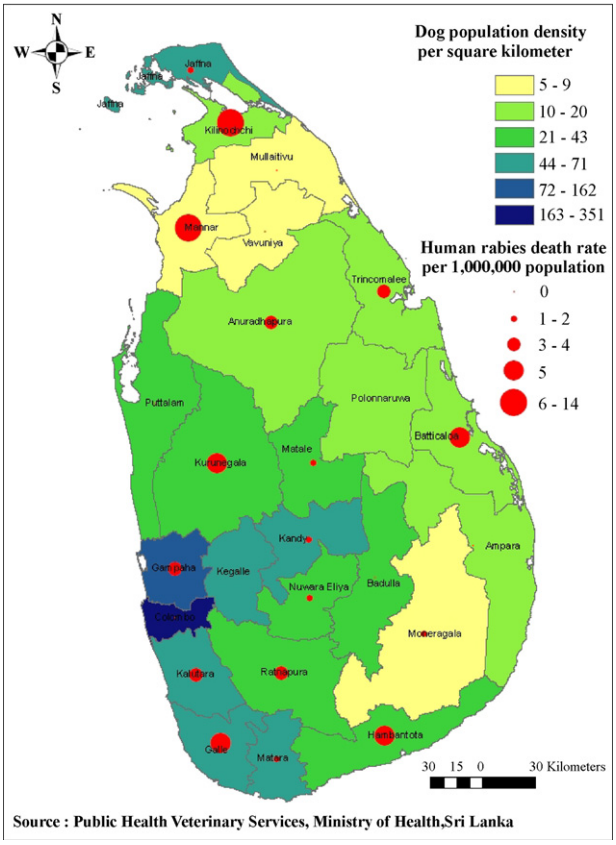

Fig. 2. Estimated dog population density and human rabies deaths by district, Sri Lanka, 2007.

Correlations were calculated between annual human rabies death rate and dog vaccination rate for the period of 1975–2007, and between annual human rabies death rate and dog elimination rate the period of 1975–2005. Geographic Information System (GIS) was also used to illustrate the district distributions of human rabies deaths and the estimated dog population density, aiming to identify areas of susceptibility (Fig. 2).

3. Results

Human rabies deaths have declined substantially in Sri Lanka from 310 deaths (22.2 per 1,000,000) in 1977 to 56 (2.8 per 1,000,000) in 2007; the 55 cases reported during 2005 were the lowest during the last 3 decades (Fig. 3). However, country wide surveillance data were not available for calculating the annual dog rabies death rates.

Rate of mass dog vaccination had increased from 3.2% in 1975 to 49.3% in 2007. The rate of dog elimination was less than 10% throughout the period of 1975–2005. The highest rate of ABC