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The Soap Box

Immunocontraception to control rabies in dog populations

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The current world dog (*Canis lupus familiaris*) population is estimated to be around 500 million (MacPherson et al. 2000). About 75% of these animals, which often are referred to as stray or feral, are free to roam and reproduce and may have a negative impact on human activities (World Society for the Protection of Animals 2010). Problems caused by free-roaming dogs include zoonoses, predation on livestock, attacks on humans, and road traffic accidents (MacPherson et al. 2000). Among the 55,000 human deaths that occur each year from zoonoses, dogs are responsible for >90%. In addition, >14 million people per year receive post-exposure prophylaxis following a dog bite (Meslin 2008). The majority of deaths and post-bite vaccinations occur in Asian and African countries, which can barely afford this burden (Knobel et al. 2005).

The World Health Organization and the World Organization for Animal Health have targeted rabies eradication through mass dog vaccination, public education, and dog population management. The latter could be achieved by reducing the number of strays and by controlling the trade and movement of dogs. A reduction in the number of human cases of rabies in Europe, South America, Japan, and the Caribbean was achieved by vaccination of dogs. Vaccination is underway in other Asian and African countries (Cleaveland et al. 2006).

Traditional efforts to reduce dog populations have relied on capture and euthanasia, shooting, and use of toxicants delivered in baits. However, the lack of proven effectiveness of these methods, coupled with concerns about animal welfare, environmental impact of toxicants, and increased public antipathy toward lethal control, have made these techniques socially unacceptable (Hemachudha 2005). Recently, the management of stray dog populations focused on surgical sterilization through catch-neuter-and-release programs, which are expensive to run because they involve the use of drugs and specialized staff and facilities. In addition, surgical sterilization is unlikely to have a substantial impact on dog numbers in large cities such as Bangkok, Thailand, which has an estimated population of 900,000 dogs (Kasempimolporn et al. 2008). Assuming that a veterinarian can surgically sterilize 10 dogs per day, 10 veterinarians working 5 days per week would sterilize 26,000 dogs in a year. While these numbers are impressive, the rates of reproduction in the fertile dog population would more than offset the reduction in numbers by sterilization.

Fertility control through immunocontraception could offer a humane, effective alternative to surgical sterilization. Immunocontraceptive vaccines act by inducing antibodies against proteins or hormones essential for reproduction (Delves et al. 2002). Gonadotropin-releasing hormone (GnRH) vaccines elicit the development of antibodies that block the production of the GnRH which controls the synthesis and secretion of reproductive hormones. By blocking GnRH, ovulation and spermatogenesis are compromised. Injectable GnRH vaccines that require an initial dose and a second booster dose a few weeks later are commercially available for pigs, horses, and companion animals (Purswell et al. 2006). Single-dose GnRH vaccines, which cause infertility for several years after a single injection, recently also have been developed to control overabundant wildlife (Miller et al. 2008). Some of these vaccines, already registered for use in wildlife, will be available at a fraction of the cost of surgical sterilization. Immunocontraceptives that induce infertility for 2 to 3 years will probably cover the entire lifespan of most stray dogs (Kitala et al. 2001) and could be administered in conjunction with rabies vaccines. For dogs that live longer, a second dose of vaccine could be delivered 2 to 3 years later, together with the rabies vaccine that also must be re-administered after a similar period.

Theoretical models developed for wildlife suggest that fertility control, alone or integrated with disease vaccination, could reduce the prevalence and transmission of zoonotic diseases (Ramsey et al. 2005, Shi et al. 2002). For instance, in red foxes (*Vulpes vulpes*), fertility control and vaccination combined can increase the probability of rabies elimination more than if each method had been applied separately (Smith and Cheeseman 2002).

Future research should focus on validating these assumptions for rabies and stray dogs. We believe that feral dog control programs that combined rabies and immunocontraception vaccination would provide a means to reduce feral dog populations and the spread of rabies in developing countries. We advocate that the catch-neuter-and-release approach be replaced by a catch-inject-and-release method that would be limited only by catch effort. This new strategy would increase considerably the numbers of dogs that could be treated, while concurrently decreasing the costs of fertility control programs. Combined vaccination programs would enable maximum use of limited resources and reduce the risk of human deaths from rabies. The technology and the conceptual framework are available to implement these programs; we just need to use them.

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