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The challenge and opportunity for genetic engineering to provide unique solutions to complex biomedical practices: the rabies paradigm

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Abstract

Over the past several years, genetic engineering has evolved from a basic scientific concept to applied practice in the field, with multiple translations in daily practice. Unfortunately, the perception of genetically modified molecules, biologics, and living systems has limited the beneficial realization of the actual potential of such powerful biotechnology, often rooted in social hyperbole and personal opinion rather than anchored solidly with available evidence. One clear example of a solution provided by such tools is the obvious connection in the infectious disease field related to successful releases of recombinant rabies vaccines in nature, and the novel alternatives provided towards long term prevention and control. Such an outcome was counter-intuitive to human and veterinary science, because rabies is an acute progressive encephalitis caused by multiple lyssaviruses that perpetuate in free-ranging wildlife. Moreover, this zoonosis is global in distribution, has the highest case fatality of any infectious disease, and all mammals are susceptible. Nevertheless, over the past 40 years, hundreds of millions of doses of safe and effective oral rabies vaccines have been distributed throughout Europe and North America to foxes, raccoons, and other carnivores, leading to selective interruption of viral transmission cycles that had been operative throughout the 20th century. As most emerging infectious diseases are zoonootic in nature, and many of these zoonoses arise at the human, domestic animal, and wildlife interfaces, such solutions defined via genetic engineering as epitomized by rabies can be offered as a model paradigm to emulate objectively towards a myriad of other modern biological challenges.