Effectiveness of Vaccines in Disease Prevention in Dogs

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When determining the effectiveness of a vaccine, one must look at several aspects. Vaccines are meant not only to protect the animal to which they were given, but to protect the rest of the population as well. The more vaccinated animals there are in a population, the less likely a disease will spread. When discussing vaccine efficacy, we need to discuss effectiveness in an individual animal, effectiveness in a population, effectiveness against multiple strains, and how long the protection lasts (duration of immunity).

Effectiveness in protecting individual animals

There is no vaccine which will protect every individual to which it is given. Even rabies vaccination does not protect every animal from rabies. When a vaccinated animal still acquires the disease even though it was vaccinated against the disease, it is often referred to as vaccine failure. In the vast majority of cases, there is nothing wrong with the vaccine - it did not fail. Instead, there was something wrong with the body's response to the vaccine. Some vaccines are effective in almost all animals; others are not. Canine distemper vaccine, one of the more effective vaccines, protects at least 90% of individuals to whom it is given. Vaccines against *Bordetella* and *Leptospira* in dogs are much less effective in protecting animals from disease.

> No vaccine produces protection in 100% of the population to which it is given.

Effectiveness for disease control in the population

For certain diseases, it is not necessary to protect 100% of the individuals to prevent an outbreak of the disease. Research studies have shown that if 70% of dogs in a population are immune to rabies, the occurrence of rabies drops to about zero. This is also true of diphtheria in humans. However, human measles is a different story. Measles is transmitted among humans and a disease outbreak will occur if the percent of humans immunized against measles is less than 95%. From this discussion, we can see the percent of animals which must be immune in order to prevent disease varies with the different diseases. For many diseases in dogs and cats, this percentage is unknown.

Effectiveness against multiple strains

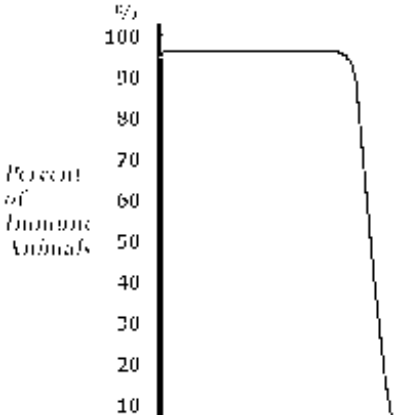
Some vaccines will protect the animal from all the known strains of a particular virus or bacteria. Other vaccines will protect against only certain strains. A good example of this is leptospirosis. Until the beginning of the year 2000, leptospiral vaccines only protected against *L. canicola* and *L. icterohaemorrhagiae*. Many new cases of leptospirosis caused by other *Leptospira* were being seen. Some new vaccines now also protect against *L. grippotyphosa* and *L. pomona*.

Duration of immunity (length of protection)

We know that the duration of immunity following measles vaccination in people can last 15 years. Durations of immunity from vaccines for animals are not as well studied. We know that some vaccines tend to have relatively long durations, e.g., parvo vaccination in adult dogs. Other vaccines, such as *Bordetella* in dogs have relatively short durations of immunity. Now, more extensive research is being performed to determine how long immunity from various vaccines lasts. These studies may demonstrate that many vaccines do not need to be given on an annual basis, but some vaccines may need to be given more than once a year.

How do we determine the duration of immunity? We would look at a population of vaccinated animals and determine how many weeks each of them is protected from developing the disease against which they were vaccinated. In those few animals who do not respond to the vaccine, the duration of immunity would be zero weeks. So we can not define the duration of immunity of a vaccine as that length of time in which 100% of the vaccinated animals remain immune, since we will never reach 100% immunity. Instead, we must choose for each disease what percent of animals we want to be immune.

Looking at an example may make this more clear. First, we would need to determine a cutoff for how many animals we want to have immunity. Let us say that for Disease 'A' we have performed the complicated studies to determine that at least 95% of the population would need to be immune to prevent a disease outbreak. Then, let us say that for Disease 'A' a study of a large number of animals is performed and we find that 95% of animals have immunity that lasts for 3 years after being vaccinated, but after three years, the number of immune animals decreases rapidly. We would then decide that to maintain the level of immunity we want, every animal in the population should receive the vaccine every three years. We understand that some animals in the population would have immunity that only lasts 1 year. To keep them immune, those individuals would need to be vaccinated annually. We also realize that the immunity in some animals may last 4 years; by vaccinating them every three years, we are vaccinating them more often than is necessary. But without testing each individual animal, we do not know which animals fall into these categories.



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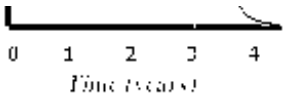

If you are not totally lost after this complicated discussion, and even if you are, you can understand that this is a very complex issue. Considerable research would need to be done to first determine how many animals in a population need to be immune to prevent a disease outbreak. Then, it would still need to be determined how often animals would need to be vaccinated to keep that portion of the population protected. Realize that these studies would need to be made for each individual brand of vaccine for each individual disease, and would take years to complete.

Summary

Although no vaccine is 100% effective, vaccines have played an extraordinary role in disease prevention. Because of vaccinations, diseases (e.g., canine distemper, human polio) which were common several decades ago are seldom seen today. When discussing effectiveness though, we must not only look at effectiveness within a population, but effectiveness in individual animals and against various strains of the disease agent. In addition, the duration of immunity is an important aspect of determining effectiveness. Vaccines are a cornerstone of disease prevention, but because vaccines are not 100% effective, we cannot rely on them alone for controlling disease. By keeping animals well-nourished, free of parasites, and protected from exposure to animals with disease, we can augment the protection from disease resulting from vaccinations.

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