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Vaccination: Host, human error, and vaccine problem

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Vaccination has proved itself over the past 120 years to be the most efficient and cost-effective method for controlling infectious diseases. The eradication of smallpox from the globe in humans, the elimination of hog cholera and brucellosis from North America livestock, control of diseases such as Marek's disease, Foot-and-Mouth Disease, pseudorabies and rinderpest would not have been possible without the use of effective vaccines. In swine production vaccines are an important tool to combat infectious agents. Many vaccines are currently being employed. Yet vaccination is not always an innocuous procedure, and its use must be accompanied by a careful assessment of the risks and benefits of the procedure. Two major criteria must be satisfied in determining whether vaccination should be used to control a specific disease. First it must be established that the host immune system can protect against the disease in question. In some diseases, example equine infectious anemia, Aleutians disease in mink, the host immune response can be responsible from some of the disease processes. In other infectious the very poor or no protective immunity can be induced. The host immune response needs to be appropriately targeted. In African swine fever antibodies, in spite of being produced in large quantities, are unable to cause virus neutralization. In Foot-and-Mouth Disease in pigs the immune response is transient and relatively ineffective so that animals that have been clinically infected become fully susceptible to re-infection as soon as 3 months later. Thus for a vaccine to produce prolonged effective immunity it must be immunity superior to that produced by natural infection. Second, before using a vaccine it must be ensured that the risks of vaccination

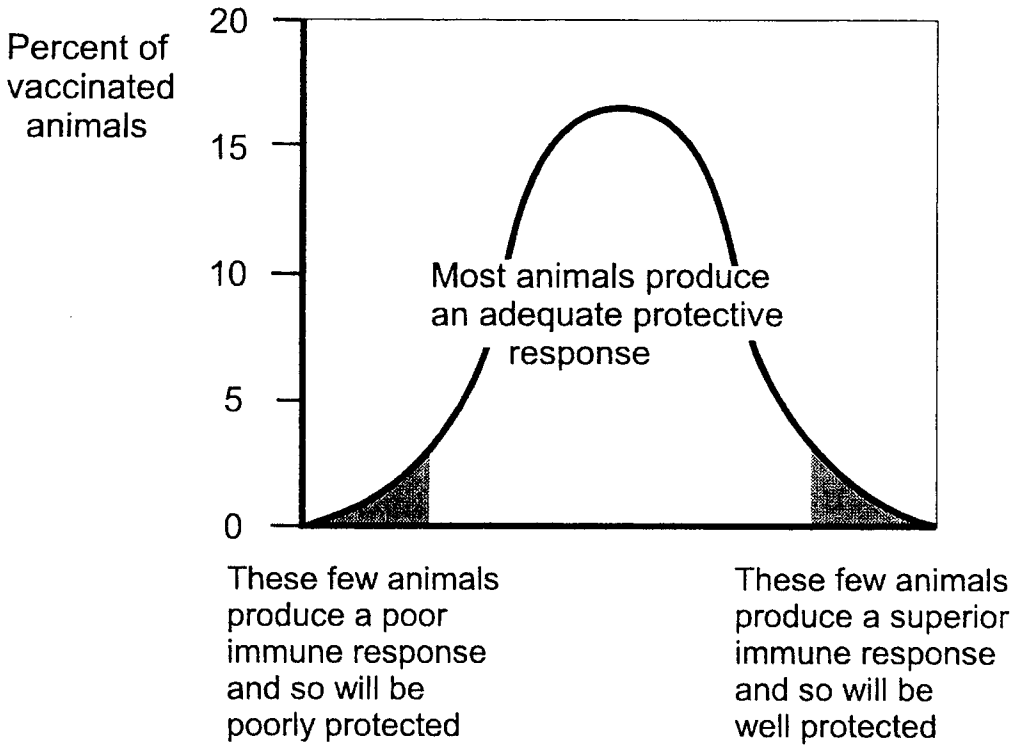
Figure 1. Vaccines available to control: Viral diseases in swine

Virus	Type of Vaccines	Developments
Pseudorabies	Live: gene deletion (non-essential proteins, i.e.: gX-TK/gE-TK) Subunit : viral envelope proteins	Vaccinia recombinant: single gene insertion Small pox virus recombinants: gD-gI
Parvovirus	Inactivated: whole virus	
Swine fever virus	Modified live vaccine	Recombinant E-1 proteins Pseudorabies virus as vector for E1
PRRS virus	Inactivated whole virus Live virus	Subunit vaccine using recombinant vectors (baculovirus)
Influenza virus	Inactivated whole virus Subunit vaccine	
TGE virus	Modified live vaccine Inactivated whole virus vaccine	
Rota virus	Modified live virus vaccine Inactivated whole virus vaccine	

Figure 2. Vaccines available to control: Bacterial diseases in swine

Bacteria	Type of Vaccine Available	Development
E. rhusiopathiae	Modified life attenuated Inactivated whole cells	
Leptospira	Inactivated whole cells	
P. multocida + *B. bronchiseptica*	Bacterine + DNT* toxoid (*dermonecrotic toxin)	
B. bronchiseptica	Inactivated whole cells	Subunit vaccine: 68 kD OMP
M. hyopneumoniae	Inactivated whole cells	Subunit vaccine: 85 kD MP
A. pleuropneumoniae	Inactivated whole cells	Subunit vaccine: Cytolysin + 42kD OMP
Enterotoxigenic *E. coli*	Inactivated whole cell Fimbrial vaccine	Recombinant fimbriae expressed in *S. typhimurium* G 30 vector for oral delivery
C. perfringens type C	Inactivated whole cell + ? toxoid	
S. hyodysenteriae	Inactivated whole cells	
S. typhimurium	Live attenuated deletion (aroA) mutants	

Figure 3. The normal distribution of protective immune responses in a population of vaccinated animals



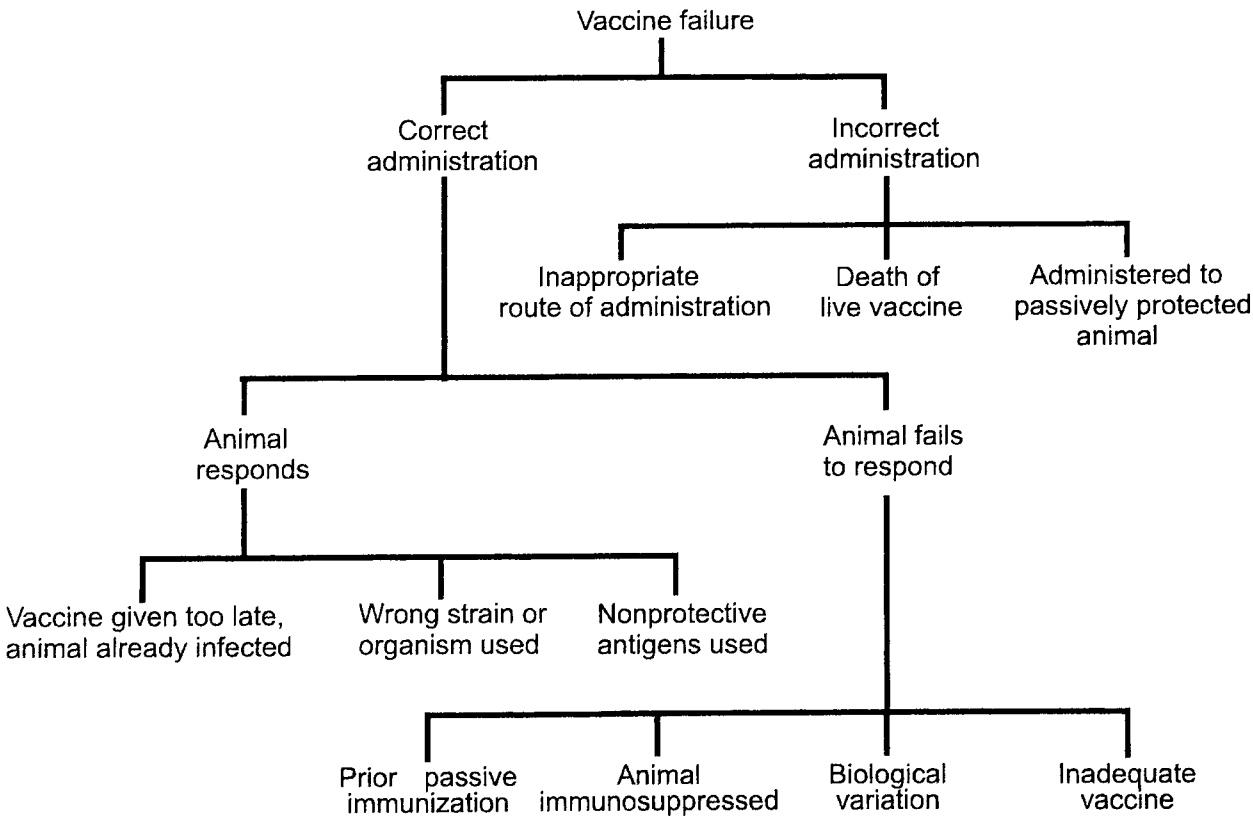
Veterinary Immunology: An Introduction, 5th Ed., Ian R. Tizard 1996, pp 280 (Fig. 21-10)

Figure 4. Risks versus benefits

Risk of Occurrence After

Problem	Vaccination	Disease
Seizures	1:1750	1:25-1:50
Encephalitis	1:110,000	1:1000-1:4000
Severe brain damage	1:310,000	1:2000-1:8000
Death	1:1,000,000	1:200-1:1000

Figure 5. A classification of the ways in which a vaccine may fail to protect an animal



Veterinary Immunology: An Introduction, 5th Ed., Ian R. Tizard 1996, pp 279 (Fig. 21-9)

Figure 6. Human error

- Poor antigen choice, poor delivery
- lack of understanding of proportions, diluents, and dilutions
- Incorrect route of administration
- Inadequate staff training
- Management (commercial animal flocks)

do not exceed those associated with the chance of contracting the disease itself. It may be inappropriate to use a vaccine that is rare or against a disease that is not associated with high morbidity.

The use of approved, tested vaccines does not always result in successful prevention of disease. The vaccine failure could be due to a variety of reasons including inappropriate host response human error in application of the vaccine or inadequate vaccine. The objectives of this session are to raise issues associated with vaccine usage and provide some examples of vaccine failure and how these failures were addressed.