

What's in Animal Vaccines? Accidental Injections and Needle Sticks: How Harmful Are they to People?

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Credits

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Overview

Accidental Injections

- Vaccine components
- Needlesticks
- Contact



Human vs Veterinary Vaccines

- 81 FDA licensed Human vaccines- 24 Influenza
- How many veterinary species have vaccines?
 - 27
- How many USDA licensed Veterinary Vaccines?
 - 1856



Veterinary Vaccines

Alligator - 1

Ape/monkey - 3

Bovine - 408

Canine - 271

Caprine - 35

Chicken - 373

Coyote - 1

Duck - 11

Elephant - 2

Elk - 3

Equine - 167

Fallow Deer - 4

Feline - 164

Ferret - 4

Fish - 15

Mink - 10

Mule Deer - 3

Ovine - 74

Pet Bird (parrot, canary) - 2

Pheasant - 2

Pigeon - 5

Rabbit - 1

Raccoon - 1

Reindeer - 1

Swine - 229

Turkey - 61

White Tailed Deer - 5



Vaccine Formulation Components

- Antigen(s)-
 - Live- Zoonotic-Brucella, Anthrax ORF, Newcastle Disease
 - Killed antigens – lots of Gram negative antigens
- Adjuvant
 - Immunostimulants- wide variety of molecules
 - W/or w/o vehicle- oil- emulsions are common



Vaccine Formulation Components

- Antigen(s)- Typically anywhere from 1 to 10 different organisms- often combination of both bacteria and viruses
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Vaccine Route of Administration

- Route
 - Intranasal/Aerosol-Cattle, Cats, Poultry
 - Oral-Cattle, Swine-water, Poultry-water
 - Parenteral
 - Needle-syringe
 - Needless



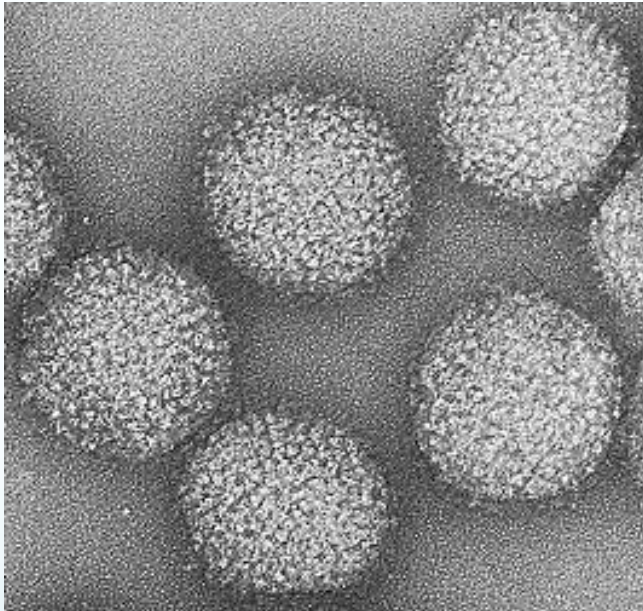
Vaccine Formulation Components

- Antigen(s)
 - Live
 - Viruses-

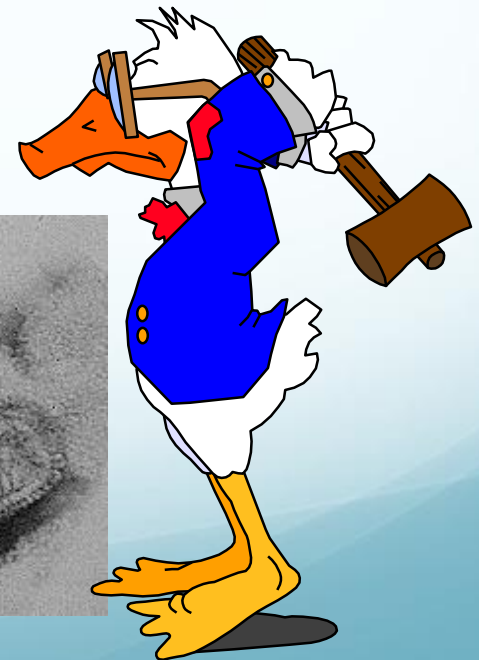
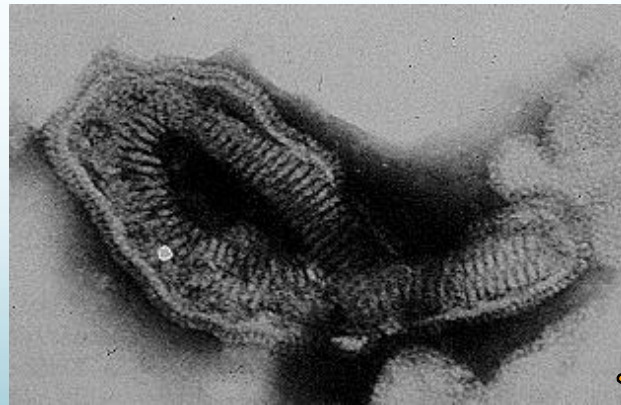


TRADITIONAL VACCINES

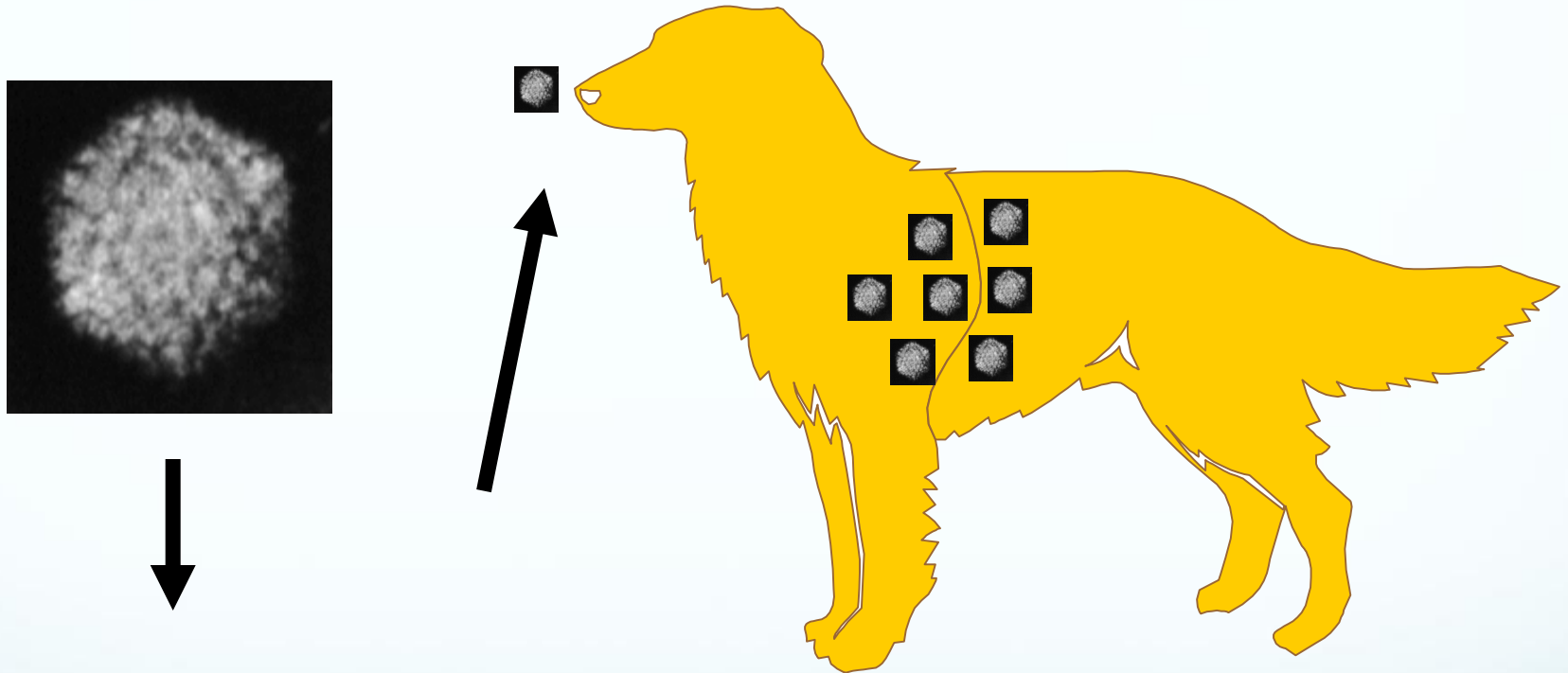
Live



Killed



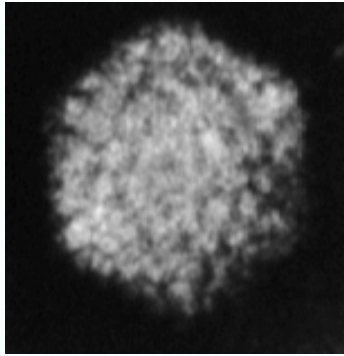
MODIFIED-LIVE VACCINES



Attenuated/temperature sensitive/spores

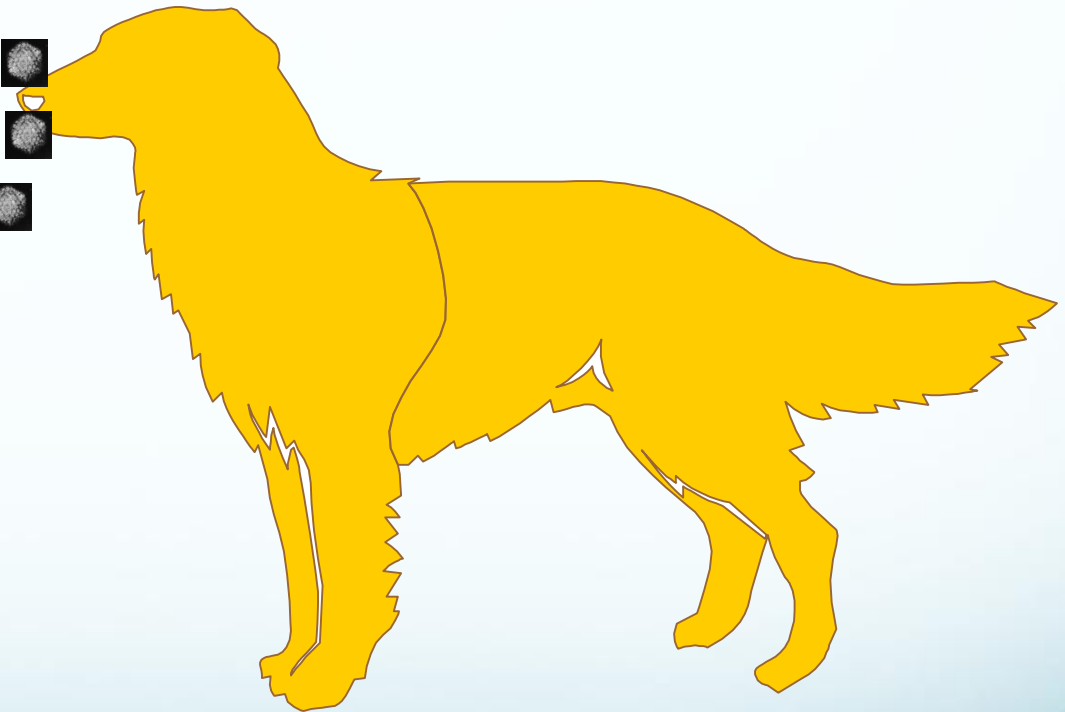
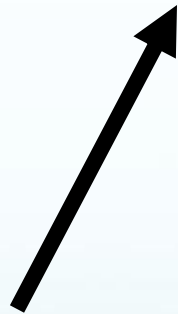
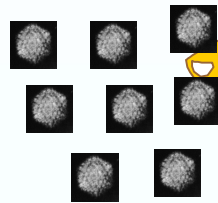
- Bacteria
 - Brucella
 - Anthrax
- Viruses-
 - Orf virus-parapox,
 - Newcastle Disease Virus- conjunctivitis humans

INACTIVATED (KILLED) VACCINES



Inactivated

- Viruses- no problem
- Bacterins-
 - Exotoxins from Clostridial vaccines
 - Endotoxins from gram negative bacteria



TOXOID VACCINE

- Exotoxins that have been chemically altered (usually by formalin)
 - Loss toxicity
 - Still immunogenic
 - Less- reactive-alum-tetanus toxoid-, C&D toxoids same as human vaccines
 - Often in combination with whole cell- Clostridials

SUBUNIT VACCINES



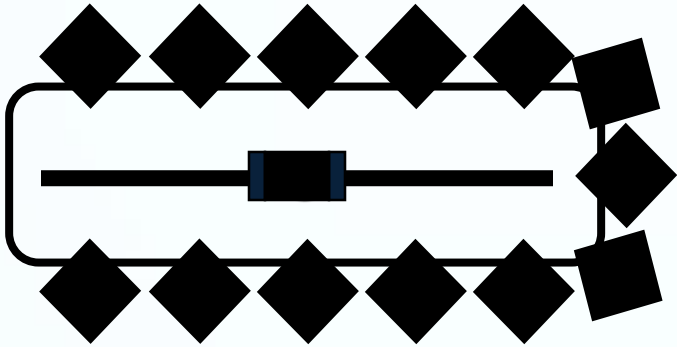
- Protein Subunit vaccines
 - purified from wild-type organism
 - Leukocell™ FeLV- Feline
 - StrepVax II Strep equi purified M-protein antigen Equine
 - cloned and expressed *in vitro* in bacteria or yeast, or in plants
 - RM Canine Lyme™ (GenetiVac™ FeLV)

Recombinant vaccines

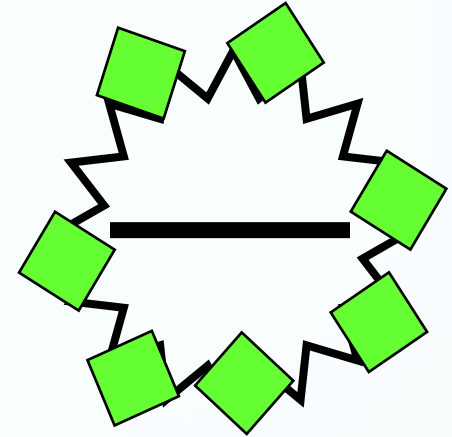
- Recombinant Vector Vaccines
- Naked DNA Vaccines- Plasmid



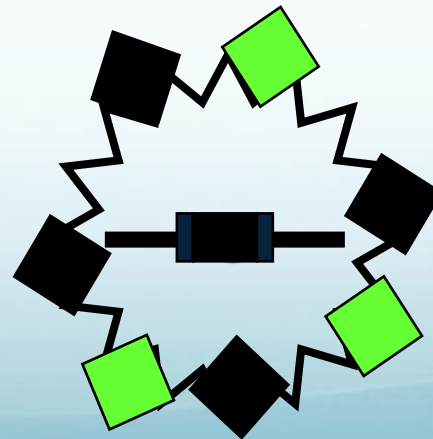
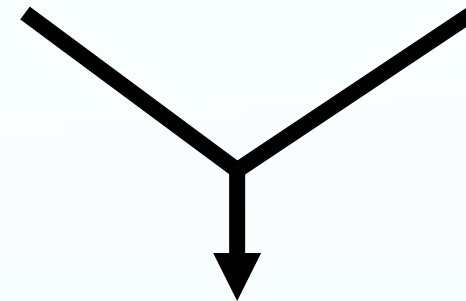
RECOMBINANT VIRUS VACCINES



Rabies virus



Vaccinia virus



*Recombinant
vaccinia virus...
“Infect” an animal
to immunize it!*

RECOMBINANT VIRUS VACCINES

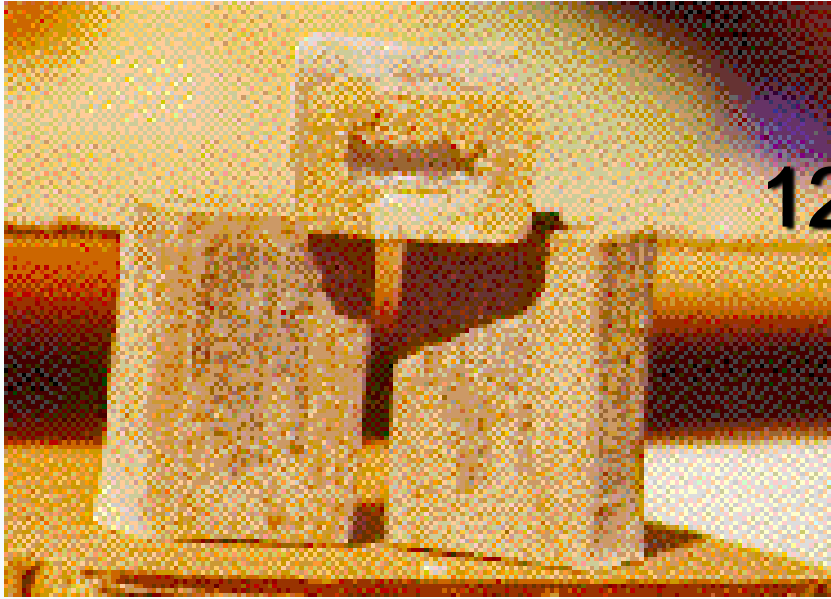
- Rabies/vaccinia virus (Raboral V-RG™)
- Canine distemper /Corona/ Parvo/ Adeno/
parainfluenza/canarypox virus (RM Recombitek™)
- Rabies/canarypox virus (Rabisin™)
- Newcastle disease/fowlpox virus
(Newcastle Disease-Fowlpox Vaccine™)



RABORAL V-RG™ RABIES VACCINE



RABORAL V-RG™ RABIES VACCINE

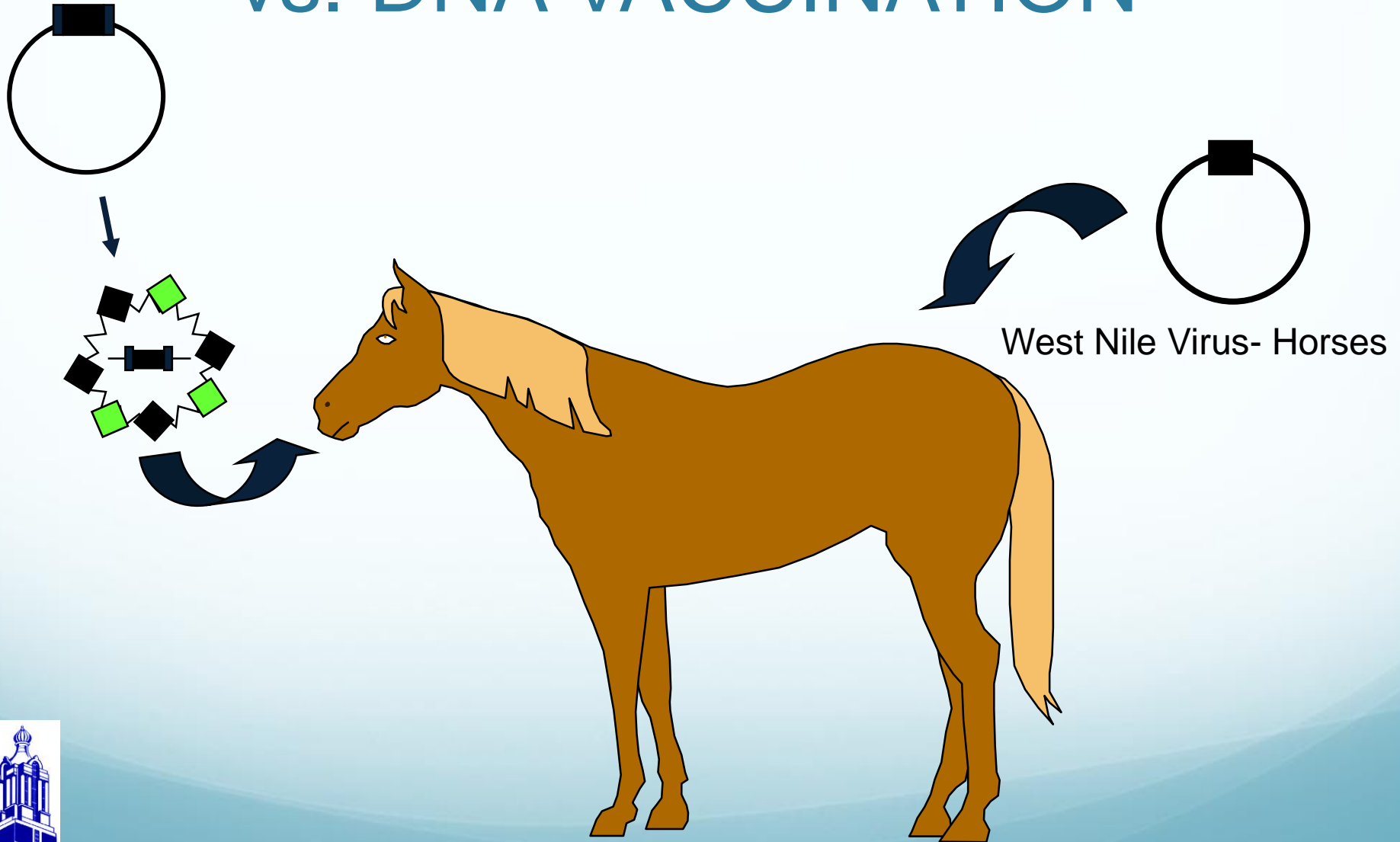


12 million doses in US annually
63 million doses worldwide



(From: Texas Department of Health)

RECOMBINANT VIRUS VACCINATION vs. DNA VACCINATION



DNA VACCINATION

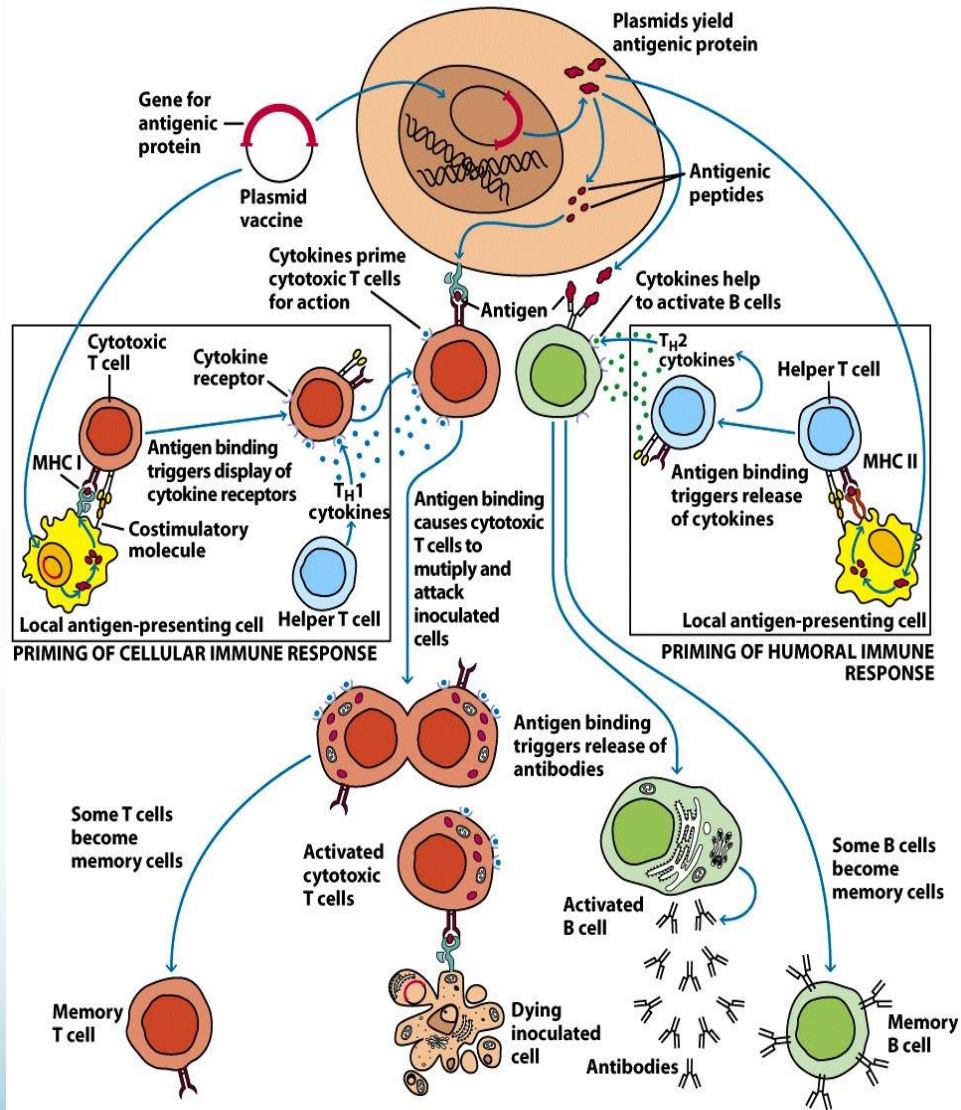


Figure 19-7
Kuby IMMUNOLOGY, Sixth Edition
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Autogenous Vaccines

- USDA Licensed Facility- inactivated- tested only for safety
- Serum immunization- PRRSV- swine- inoculate gilts with serum from viremic animals- live



Adjuvant

- Agent added to a vaccine to induce an enhanced immune responses to vaccine antigens
- Used for over 80 years
- Technology continually evolving
 - Advances in immunology
 - Advances in chemistry
 - Recombinant proteins and peptides can be poorly immunogenic

Vaccine Adjuvants Currently Used in Licensed Vaccines

Species	Humans	Humans	Livestock
Location	US	United Kingdom and European Union	Worldwide
Adjuvants/ Vehicles	Aluminum hydroxide, aluminum phosphate, potassium aluminum sulfate (alum)	Aluminum hydroxide, aluminum phosphate, potassium aluminum sulfate (alum)	Aluminum hydroxide, aluminum phosphate, potassium aluminum sulfate (alum)
		Calcium Phosphate	Saponin (QS-21)
		MF-59 (Squalene), AS03 (oil-in-water emulsion),	Oil Emulsions ^b paraffin, mineral oil, lanolin, squalene, ISA-70, Montanide (IMS)
		AS04 (liposome formulation), virosomes	Glycerin, Carbopol (polymer)

Categories of Adjuvants



Immune Potentiators

Cytokines

- IL2, IL12, IFN- γ – Drive Th1 response
- IL -10 – Drive Th2 response

Microbial Derivatives

- PAMP's – induce Th1 response
- LPS – interacts with APC, releases pro-inflammatory cytokines
- CpG – Bacterial DNA

Mucosal

- Heat labile enterotoxin (LT)
- Cholera toxin (CT)

Saponins

- Plant derivative – Primary function is induction of cytokines
- Potentiates Th1 response (IL2, IFN- γ , IgG2a)
- Can be toxic in certain species (humans, mice)
- Commonly used in veterinary vaccine formulations

Adjuvants

Traditional – Main adjuvant platform were the mineral salts - primarily aluminum hydroxide

- Primary driver – Safety (injection site reactivity and anaphylaxis)
- Short withdrawal period
- Formulation - Large combinations, manufacturing

Today – New formulations – oil/water emulsions

- New formulation technologies
- Increased efficacy (Duration of immunity)
- Increased safety

Mineral Salts

- Primarily aluminum adjuvants
- Used extensively in veterinary vaccine products
- Most commonly used adjuvant in human vaccines
- Strong inducer of Th2 responses
- Examples
 - Aluminum hydroxide
 - Aluminum potassium sulfate (often called “Alum”) - Used in many toxoid formulations (Clostridial vaccines)



Oil Emulsions

- Detergent-stabilized emulsions of oil and water
- Precise mode of action is still not clearly understood
 - Depot
 - Induction of MHC responses
- Primarily used in veterinary vaccine formulations
- Gaining acceptance in Human vaccine formulations (MF59)
- 3 basic forms – multiple formulations
 - Oil in Water (O/W)
 - Water in Oil (W/O) (Freund's)
 - Water in Oil in Water (W-O-W)

Needle sticks

- Over 80% of farm workers vaccinating animals have accidentally stuck themselves
- Using the estimated rate of unintentional needlestick injuries among health-care workers in U.S. hospitals for veterinarians, 11,000 needlestick injuries per 5.5 million injections (i.e., the number of Brucella vaccine doses administered in 1996)(this vaccine can only be administered by veterinarians
- Most inflammation from needle sticks is the result of contaminated needles
- Pain, swelling, redness, and irritation can occur at the injection site.
- Gram negative bacterins- endotoxins
- Clostridial bacterins- exotoxins



Needlesticks-Parenteral Vaccines- Disease or Severe Local Reactions

- Brucellosis (Bangs Disease)-cattle
 - Strain 19- undulant fever- Veterinarians- disability- discontinued in the 1996
 - RB51- much safer- less immunogenic
- Erysipelas (live vaccine)-swine
 - Erypsipeloid- local or systemic-
- Contagious ecthyma (Orf) poxvirus- sheep
 - Applied by scarification-Skin vesicles
- Johne's Disease (Mycobacterium avium spp paratuberculosis)-cattle
 - Killed- Complete Freund's adjuvant- severe abscesses
- Anthrax (Sterne strain)-ruminants
 - Not a problem-



Other Common Veterinary Drugs and Needlesticks

- Antibiotics-
 - Tilmicosin (Macrolide) 3,168 exposures- 13 fatalities
 - Injection of this drug in humans has been associated with fatalities. The cardiovascular system is the target of toxicity and should be monitored closely. Cardiovascular toxicity may be due to calcium channel blockade. In dogs, administration of intravenous calcium offset Tilmicosin-induced tachycardia and negative inotropy (decreased contractility)
 - Penicillin, sulfonamides
 - Allergic reactions
- Hormones-
 - Prostaglandins, Oxytocin
 - Miscarriages



Oral Vaccines-Disease or Severe Local Reactions

- Recombinant vaccinia/rabies bait vaccines-wildlife
 - (humans immunosuppressed or pregnant)



Locally Applied Vaccines-Disease or Severe Local Reactions

- Newcastle Disease virus-poultry- live
 - Aerosol- conjunctivitis and systemic flu-like symptoms humans
- Bordetella bronchiseptica-canine-intranasal-live
 - Pertussis like symptoms in humans

On line Resources- University of Minnesota Animal Safety and Health (UMASH) Center

- <http://umash.umn.edu>



Summary

- Vaccine components
 - Endotoxins
- Adjuvants
 - Oil adjuvants
- Needlesticks
 - Vaccines
 - Drugs
- Other vaccine reactions



