

Immunity and Vaccination

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Immunity

What is immunity?

- the ability of the body to fight off infection or disease
- The response the body initiates as a protective mechanism when exposure to a foreign protein or organism occurs

Immunity

- Two basic types of immunity
 - Innate Immunity
 - Acquired Immunity

“Innate” Immune Defenses

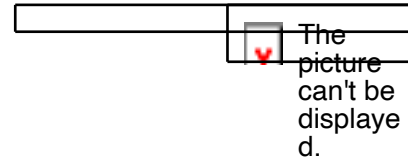
- Present at birth
 - Some individuals may be born with more or better “natural” resistance than others.
- Non specific: *not* targeted to a specific harmful agent
- 1st levels of defense
 - Non specific: Mechanical
 - Non specific: Natural chemical and cellular immunity

Innate: 1st Line of Defense



If this barrier breaks down...

Mechanical:



- Skin
- Tears
- Mucus
- Saliva
- tetanus, blackleg, etc.
- pinkeye
- pneumonia, urinary/repro disease
- dental decay, canker sores

Second Line of Innate Defense:



- Fever
- Inflammation
- Certain WBC's
- Chemical Warfare
 - interferon
 - complement

Innate Immune System

...is fully developed at birth

Fights infection even in the absence of prior exposure to a pathogen

...is complex

Comprises biochemical and cellular pathways whose function is to recognize, and actively remove, invading pathogens, and to activate the adaptive immune response

...recognizes pathogens

Detects markers on pathogens and acts quickly to contain infection

...activates further immune responses

Without stimulation by innate cells, there would be no highly specific, long-lasting adaptive immune response

“Specific” Immune Defenses

- Acquired after birth (requires exposure to an “antigen”).
- Protection is targeted to a specific foreign agent:

Lepto pomona vs Lepto hardjo vs Clostridium perfringens type C vs Clostridium sordelli vs tetanus toxin vs Mannheimia toxin vs K99 E. coli ... etc. etc. etc.

- Even more complicated than innate defenses.
- Dependent upon “**lymphocytes**” to operate.
- Has unique feature of creating “*memory*”.

“Specific” Immune Defenses

Depending upon the type and location of the foreign target, **lymphocytes** will deploy :

Antibodies

Killer cells



AFP



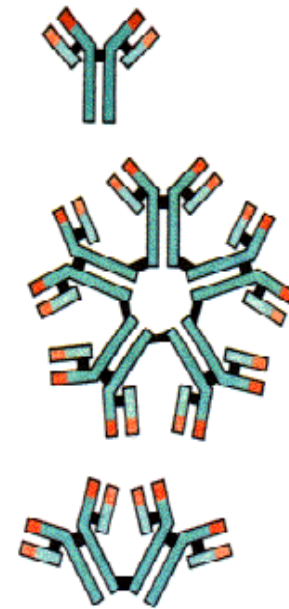
Reuter



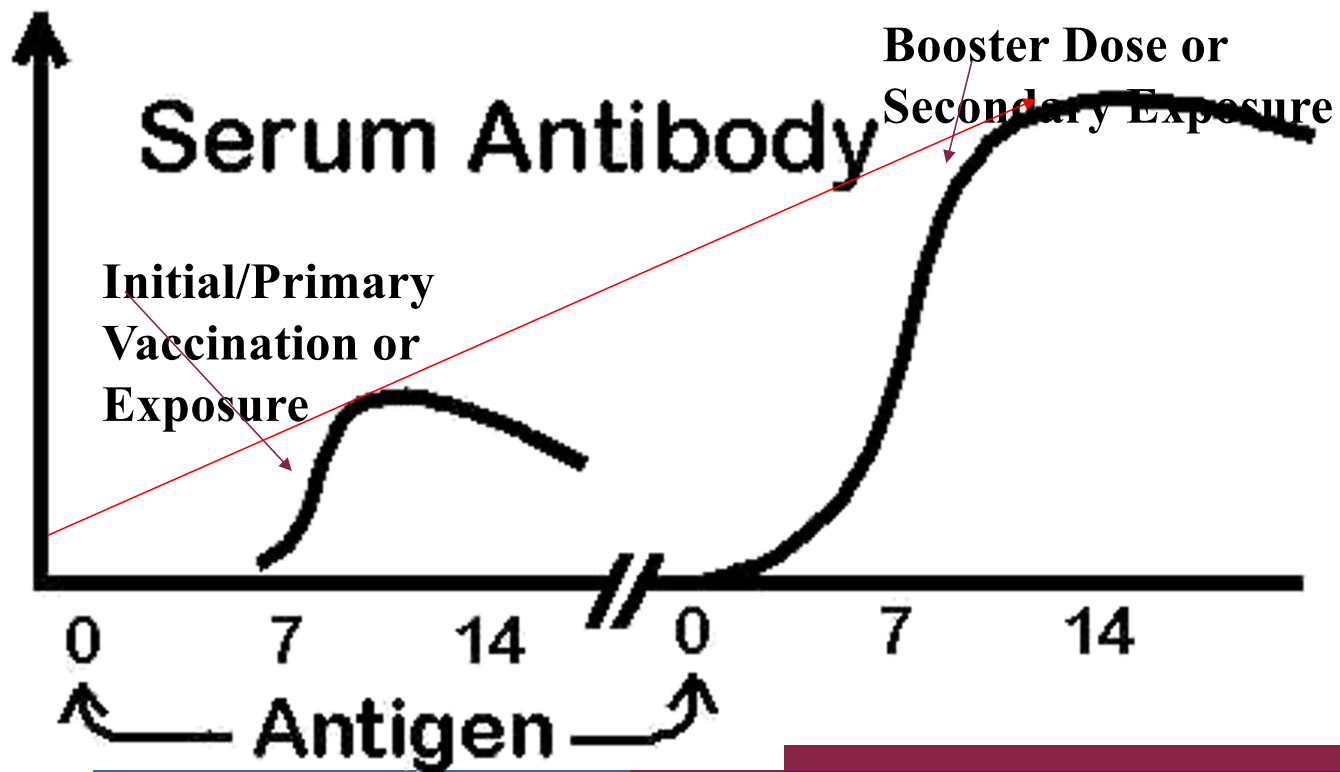
NBC News

Antibodies

- **Protein** structures in blood & lymph fluid.
- Secreted by 'B' Lymphocytes
- Neutralize bacteria, viruses, toxins, and other foreign agents
- Make it easier for other WBC to "eat" the invader.
- "Humor" = Fluid
 - ***Humoral Immunity***
- Measured by "titers"



Vaccine or Exposure Titers



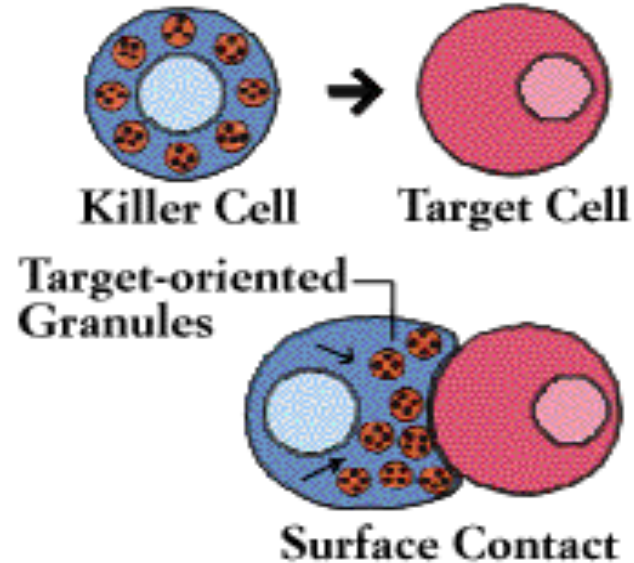
Killer Cells

- Cells that “kill” other infected cells .
- Primary defense against viruses, cancer, abnormal cells.
- Referred to as “Cell Mediated Immunity”
CMI
- Difficult to measure



Killer Cells = Cell Mediated Immunity

- “CMI” involves the production of “killer” CD 8 cells (T Lymphocytes).
- “CMI” immunity critical for clearing certain viral infections.



“Specific” Immune Defenses

- **Humoral** (antibodies) or **Cell Mediated** (killer cells)
- **Passively** acquired (temporary)
 - **Colostrum** (first milk)
 - Transfusion of serum or whole blood with immune components
- **Actively** acquired
 - Exposure to disease (measles, mumps)
 - **Vaccinations**

Specific Immune Responses

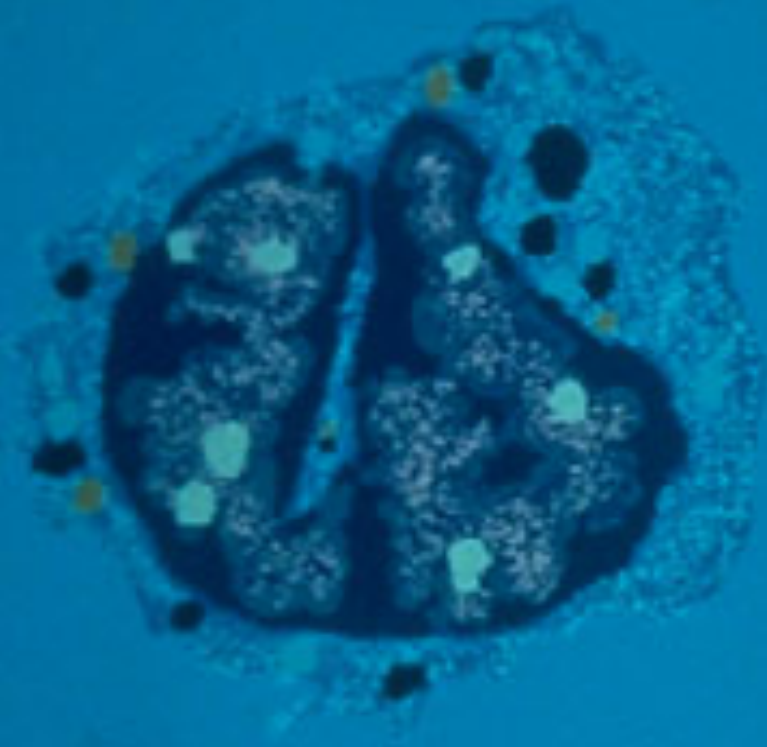
- Antibody (“Humoral Immunity”)
- Killer Cells (Cell Mediated Immunity “CMI”)
- Memory (T & B cells)
 - very important
 - many immune responses are short lived (days to weeks)
 - allows body to “rest”, but can be rapidly deployed when needed.

Inadequate Colostral Immunity

- Preweaning
 - Risk of death ↑
 - Risk of sickness ↑
 - ADG ↓
- Feedlot
 - Risk of sickness ↑
 - Risk of respiratory disease ↑
 - ADG ↓

Source: Wittum, et al AJVR 56:9 1995

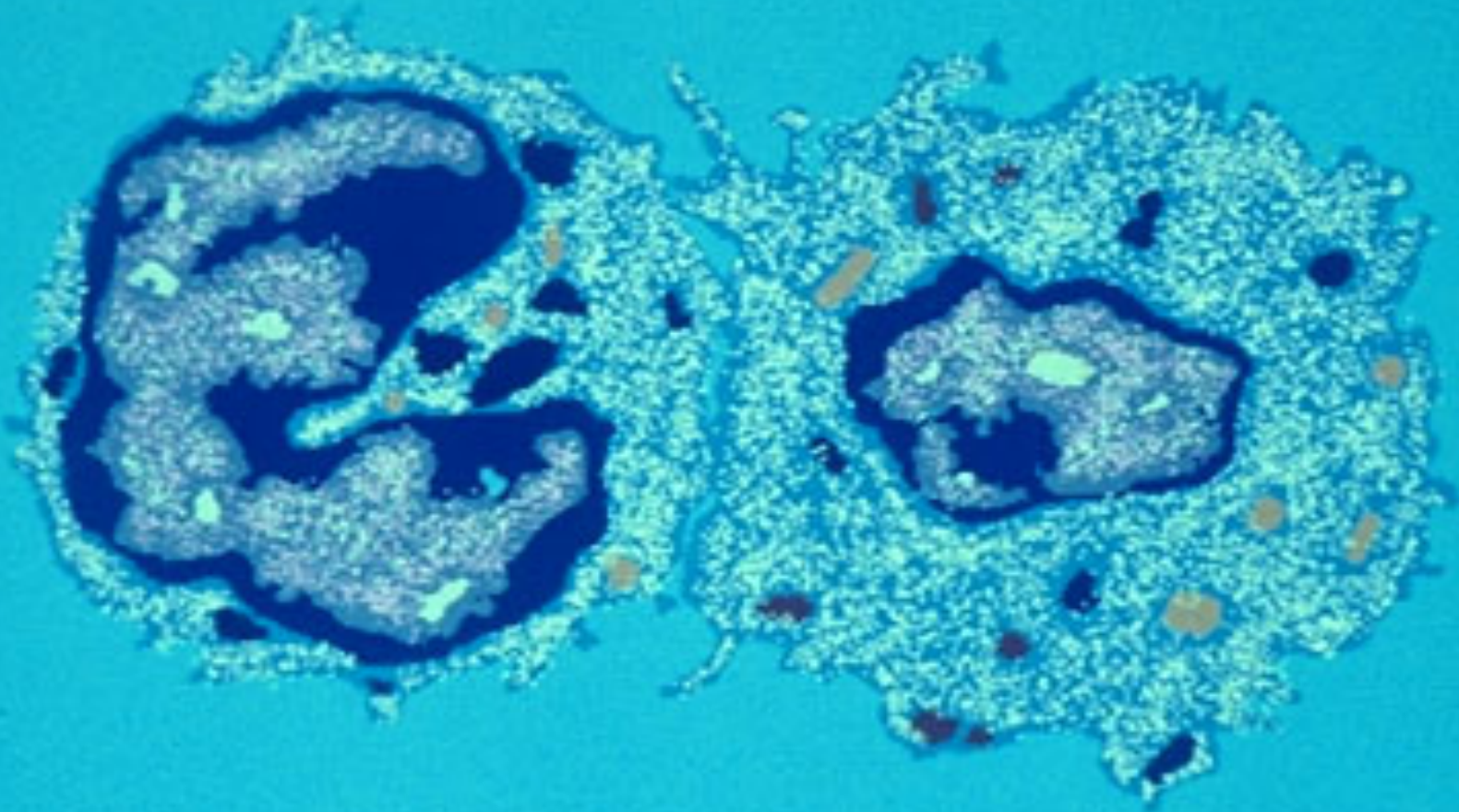
T Killer Cell



Virus Infected Cell



Infected Cell is “lysed”



MALT- Mucosal Associated Lymphoid Tissue

- protects mucous membranes from potentially harmful microbes
- prevent uptake of potentially harmful antigens
- prevent the development of potentially harmful immune responses
- contains more than 80% of the immune cells in the body!



Innate Immunity Compromised...

- Stress (DISTRESS)
- Micronutrient deficiencies (Cu, Se, Zn, others?)
- Environment
 e.g. dust
- Genetics?



Implications of Stress

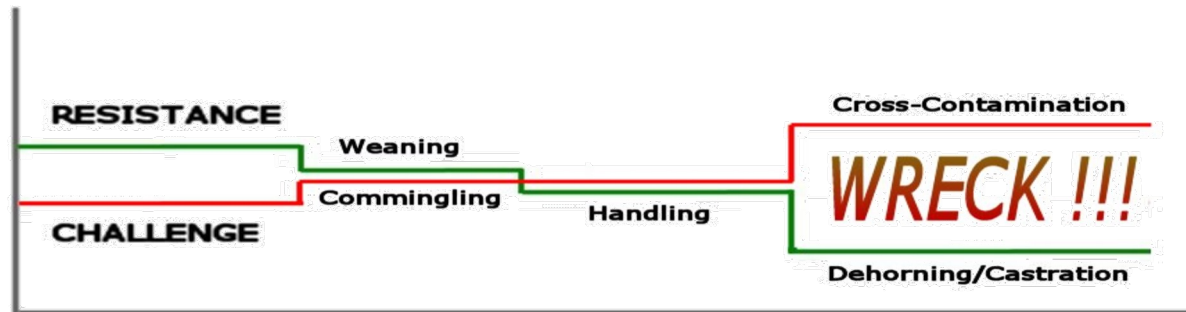
- Stress can:
 - ↓ conception rates
 - ↓ immune function
 - ↑ cortisol levels
 - ↓ weight gains
 - ↑ shrink

(Grandin, 2007)

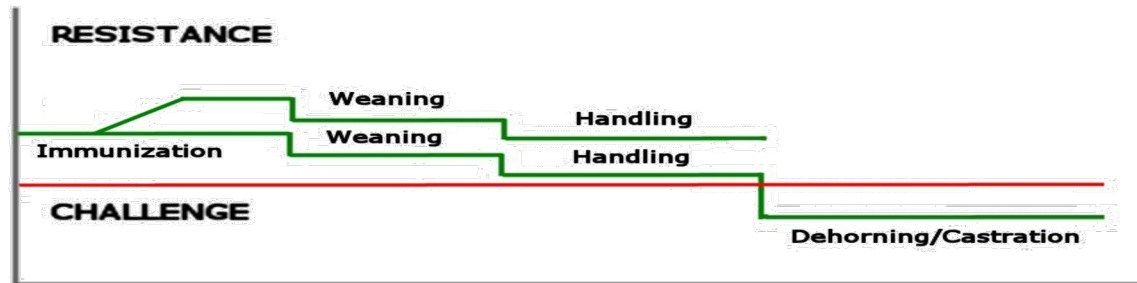


Response to Stress:

Stress plays a large part in the disease



RESISTANCE VS. CHALLENGE INTERACTION



Source: Great Plains Veterinary Educational Center

Cooperative Extension Service



Stress in Cattle Production

- “Non-fight or flight” stressors
 - Malnutrition, Dehydration, etc.
 - Heat or Cold
- “Fight or Flight” stressors
 - Handling, Isolation, Exposure to Novel Environments, Transportation, etc.
 - Predation
 - Brain perception of environment is important



Immunity

- What stressors can we control?
- Some of the psychological stressors such as loud noises, mixing, and fear
- Some of the physiological stressors such as vitamin, mineral and nutritional imbalances
- Some of the physical stressors such as hunger, thirst, injury and disease

Immunity

- **Vaccination does not equal immunization**
- Many factors influence the immune response
- Vaccines are **one** tool you can use to develop immunity in calves or adult cattle
- Vaccination must be done correctly to maximize immune response

Immunity

- Primary vaccination may only provide memory with very little antibody production so very little immunity is stimulated
- Booster vaccinations act, when memory is in place, to create a much larger immune response

Vaccination

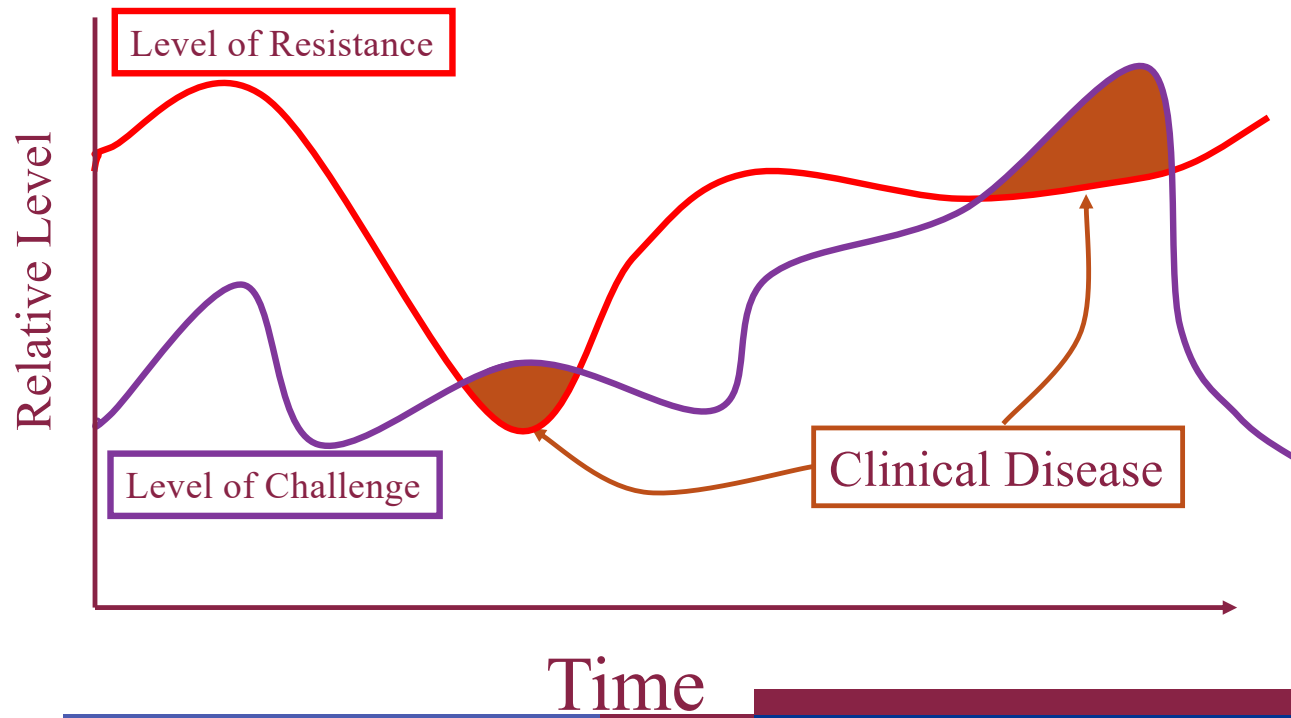
Vaccines protect populations by protecting individuals, but are limited in their ability to protect an individual in an unprotected population.

Falkner

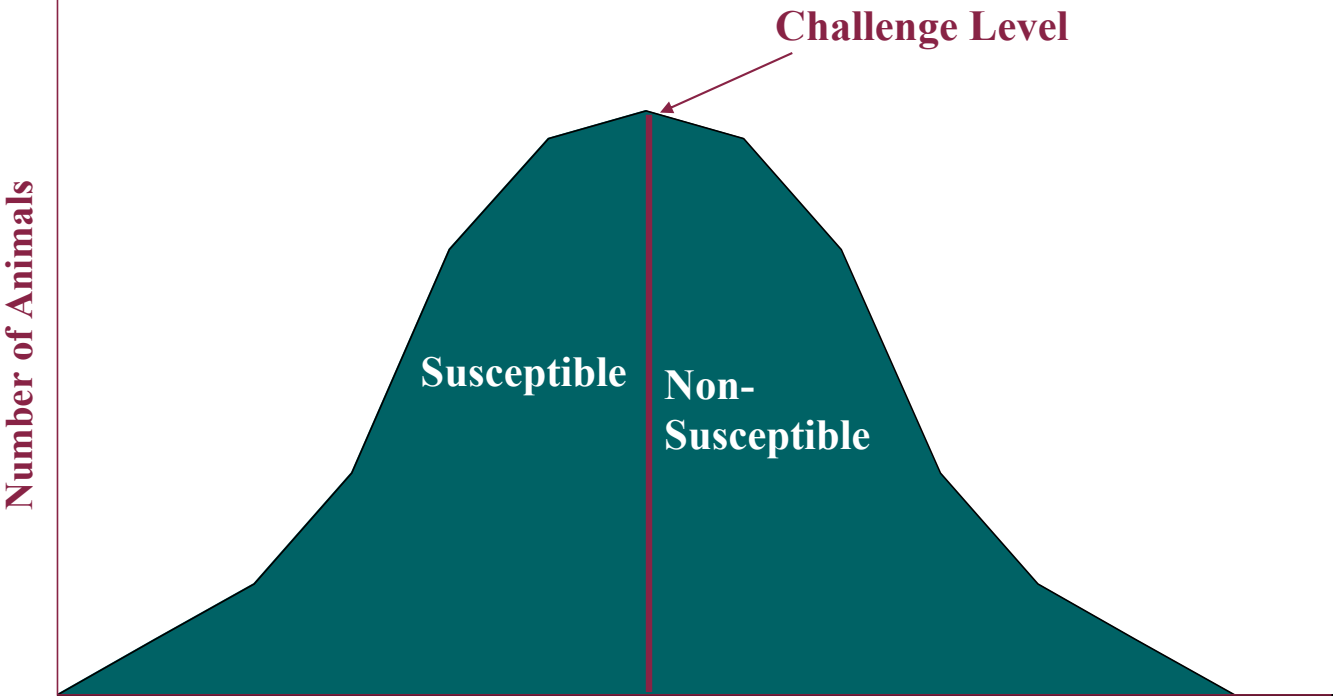
Cooperative Extension Service



Disease and Resistance

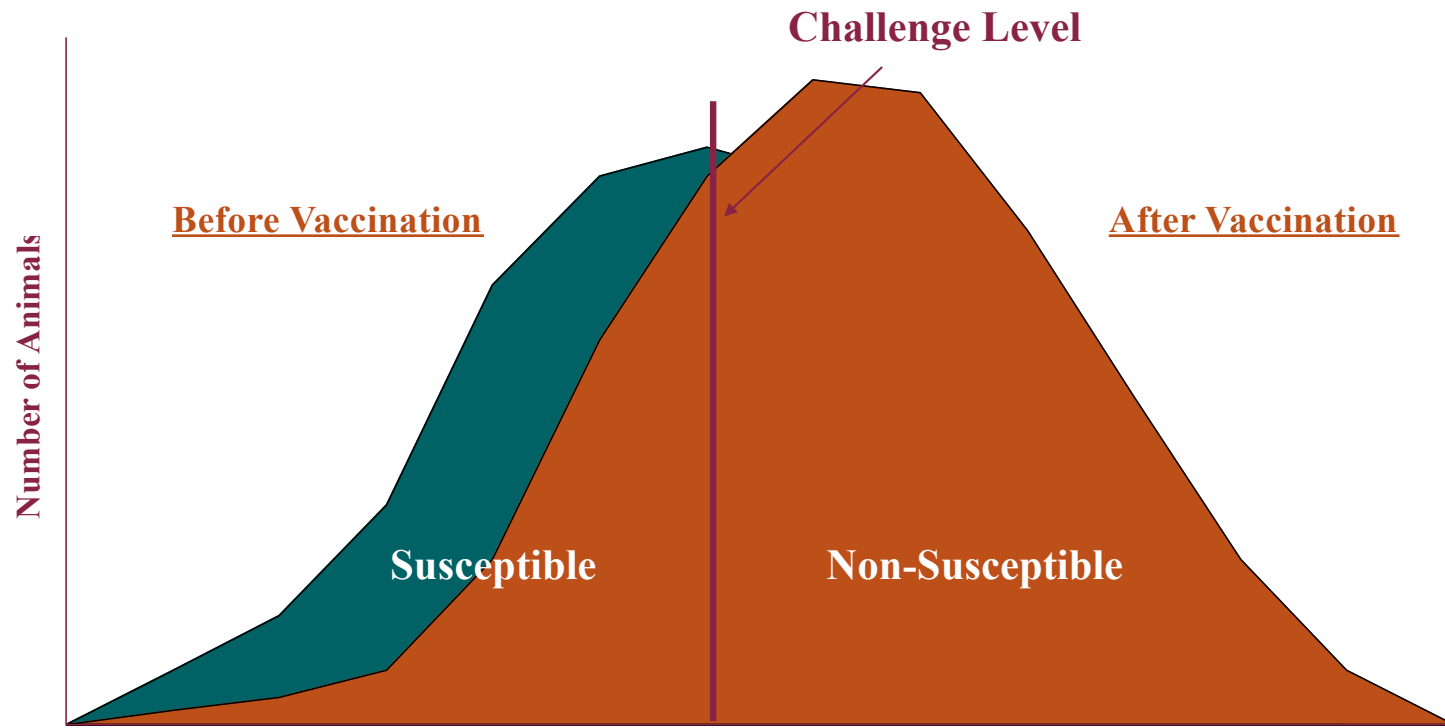


Population Dynamics 101



Relative Level of Resistance

Population Dynamics 101



Relative Level of Resistance

Herd Immunity

- Reduced probability of individual becoming infected when part of a vaccinated population
 - Chance of becoming infected in a population decreases with increasing density of individuals being vaccinated.
 - GOAL
 - Prevent transmission of pathogen within the population such that the infection will eventually be controlled or become extinct. (eg. prevent **viremia**).
- Potgieter L., Immunology of Bovine Virus Diarrhea Virus. November 1995 VCNA Vol 11 No 3 pp 501-520.

Developing Immunity in Calves

- Develop a sound vaccination/ preventative health program with your veterinarian
- If you raise your replacement heifers, start as calves at branding if possible
- If you purchase replacement heifers, try to start on a MLV program prior to breeding
- If you purchase bred replacements, look at using vaccines that are chemically altered to get some viral replication or MLV when open

Vaccination

- -Need to be specific for area and operation
- -A vaccination program is one segment of a total herd health program
- -Vaccination programs need to be designed with your specific management practices in mind
- **-Consult your local Veterinarian to design a herd health program for your operation**

Vaccination

- Nutrition, vitamin and mineral requirements must be met for the immune system to function properly. By meeting these requirements, an immune response can be enhanced
- Vaccination programs are a management tool that can prepare an immune system for exposure to disease

Vaccine Types

- MLV- modified live viral vaccine
 - Virus replicates in body
 - Better cross protection (core proteins)
 - More robust immune response (CMI)
 - Longer duration of immunity

Higher Risk- viral shedding??

post vaccinal fever

more complicated label restrictions

Vaccine Types

- Chemically Altered-(IBR, PI3) or Hybrid
 - MLV- BRSV, Killed BVD
 - Limited viral replication
 - Safe for all stages of pregnancy
 - Adjuvant system- enhanced colostral immunityMore expensive, not as convenient, killed BVD

Vaccine Types

- Intranasal Vaccines for Respiratory Viruses:
- Chemically altered IBR, PI3; MLV BRSV (No BVD)
- Mucosal tissue contains more than 80% of the body's immune cells
- Immediate protection by stimulating mucosal response and interferon release at the site of infection
- Primes the immune system for a strong memory response for faster, more robust long term protection
- Both local and systemic immunity is important in controlling disease
 - For respiratory protection; however, local immunity is more important in early stages of respiratory infection!

Vaccine Types

- Killed Viral vaccine

- Highest safety factor
- Multi-dose vials, no mixing
- Two doses to start

Least immune response

No viral replication- won't trigger CMI unless previous MLV vaccine

Vaccination Goals- Calves

- At Branding- Respiratory vaccine (MLV or hybrid), Blackleg
-Strip and Ship- MLV+ Mannheimia, Blackleg

Wean on ranch- 1st trip- MLV +MH, Blackleg, Name brand dewormer (no Generics)

-2nd trip- 2- 4 wks as labeled, Booster MLV (MH), Blackleg

Replacements- pre- breeding MLV, Vibrio/Lepto

Vaccination Goals- Cows and Bulls

- Annual vaccinations for both
 - Cows- Repro vaccs- Booster Virals, Vib/ Lepto; Dewormer- no generics
 - Bulls same- may use MLV

Vaccination Goals For Ranch Calves

- Strip and ship- MLV primer, M. hemolytica vacc; 7(8)- way
- Wean on Ranch- 3 MLV resp vaccs; 1 or 2 MH; 2-3 blackleg vaccs depending on marketing program
- Pre-wean vacc 3-4wks prior to weaning then weaning booster
- If wean on ranch, strip, let sit overnight then work calves next day to let cortisol levels drop

Summary

- **Effective herd health management programs must be comprehensive and not rely too much on product solutions**
- **Annually vaccinate bulls and cows (colostrum)**
- **Preparation of replacement heifers is the key.**
- **Start preparing replacements as calves at branding**

QUESTIONS ??

- THANKS FOR LISTENING !!!!