



VACCINE AND INFECTIOUS DISEASE ORGANIZATION

[VIDO.ORG](http://VIDO.ORG)



# Barriers & Opportunities in Controlling Johne's Disease

Antonio (Tony) Facciuolo, Ph.D.  
Principal Scientist

# Brief Introduction

- Principal Scientist

Vaccine & Infectious Disease Organization (VIDO)

- Adjunct Professor

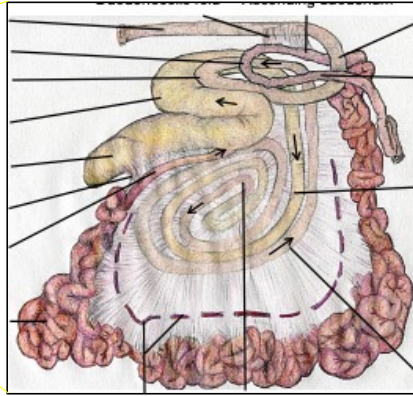
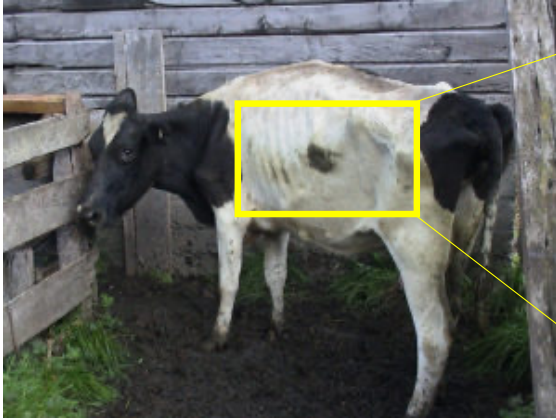
Dept. of Veterinary Microbiology (WCVM)

- Expertise & Interests:

- Bovine immunology
- Infectious diseases and vaccine development in cattle
- Johne's Disease



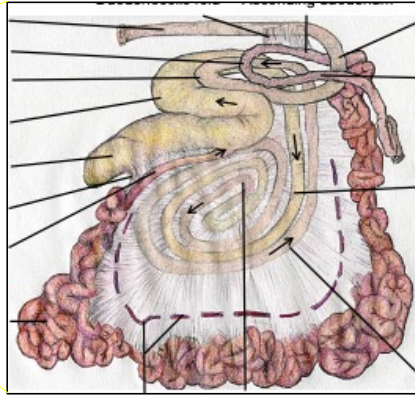
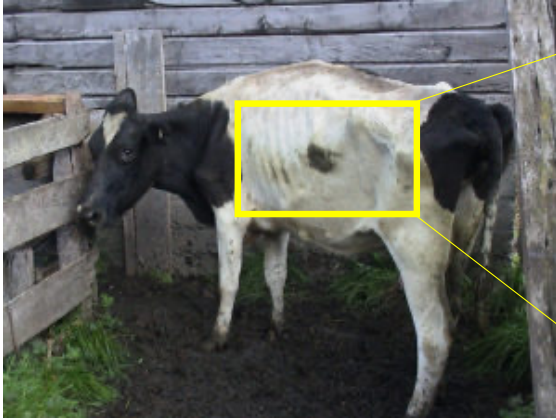
# Johne's Disease: bacterial infection



## What is Johne's Disease?

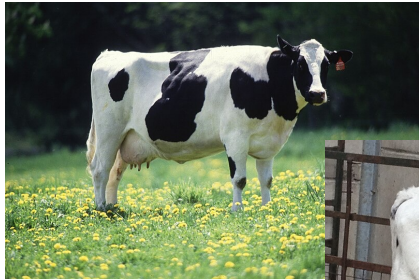
- Intestinal bacterial infection
- Lifelong infection
- Contagious

# Johne's Disease: bacterial infection



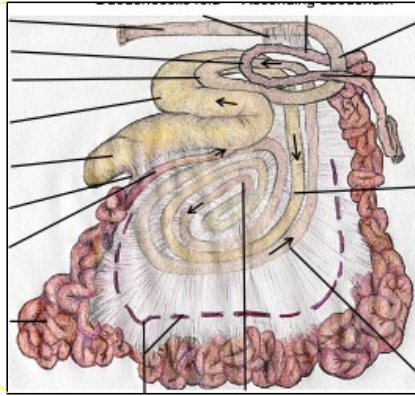
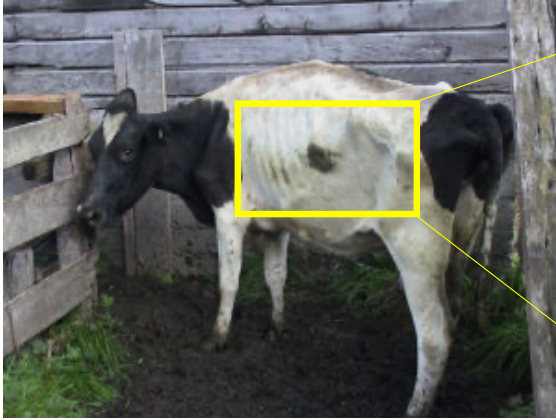
## What is Johne's Disease?

- Intestinal bacterial infection
- Lifelong infection
- Contagious
- Prolonged incubation period (i.e., asymptomatic)
- Sporadic fecal shedding of the bacteria





# Johne's Disease: production-limiting



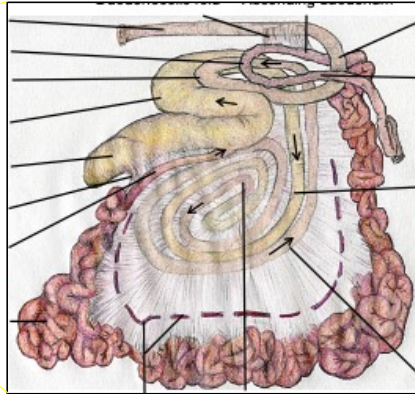
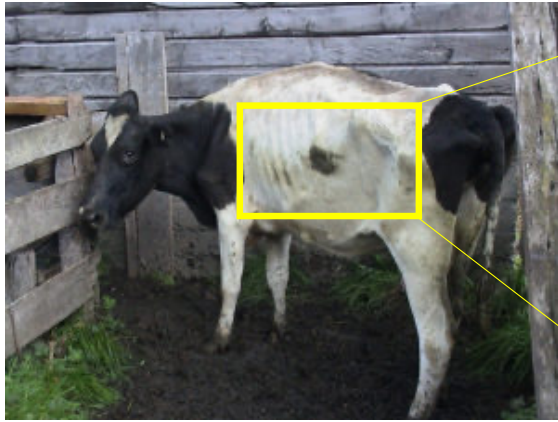
## What is Johne's Disease?

Production-limiting disease

- ↓ bodyweight
- ↓ wean weight of calves
- ↓ milk production
- ↓ heifer sales
- ↑ culling (loss of valuable genetics)



# Johne's Disease: production-limiting



## What is Johne's Disease?

Production-limiting disease

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## Clinical Stage of Disease

- Inflammation of the intestines
- Diarrhea
- Progressive weight loss

# Johne's Disease: a promiscuous pathogen



## What animals are affected by Johne's disease?

- All ruminants
- Monogastric species (humans, rabbits, raccoon, opossum, coyote, red fox, weasel, mouse, badger...)



# Johne's Disease: Prevalence

How prevalent is Johne's disease in Canada?



70% dairy herds

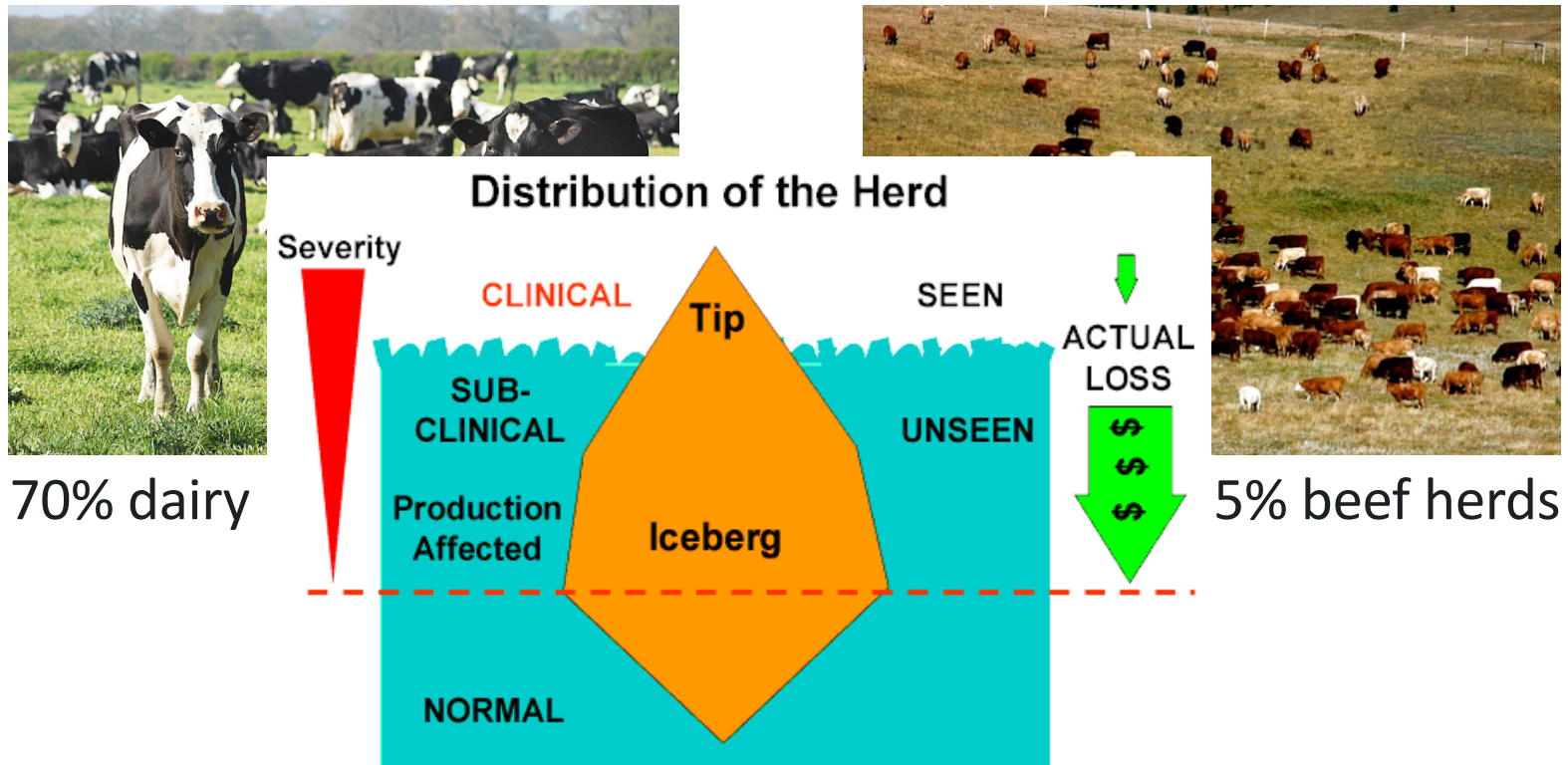


5% beef herds



# Johne's Disease: Prevalence

How prevalent is Johne's disease in Canada?



# Johne's Disease: "who infects whom?"

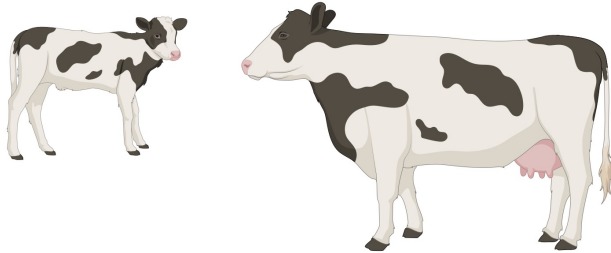
Calf to calf



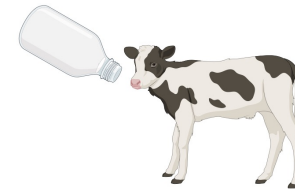
Fecal-oral



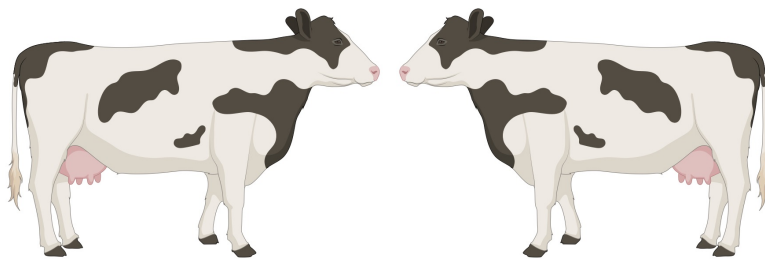
Cow to calf



Colostrum  
or milk



Cow to cow



# Johne's Disease: RISK FACTORS

## HIGH RISK

**Contact of calves with adult cow feces** Dore et al., 2011; Nunney et al., 2023

**Buyer beware! Purchasing an infected animal** Wolf et al., 2016

### Calf-to-calf transmission

- Youngstock shed! Wolf et al., 2016
- The higher the prevalence, the earlier the onset of shedding Weber et al., 2010

**Fecal-oral (exposure to feces)** Benedictus et al., 2018, Nunney et al., 2023

**Unknown exposures** Nunney et al., 2023

**In utero** Whittington & Windsor, 2009, Nunney et al., 2023

**Cleanliness of animals, pens, feeders** Wolf et al., 2016

## LOW RISK

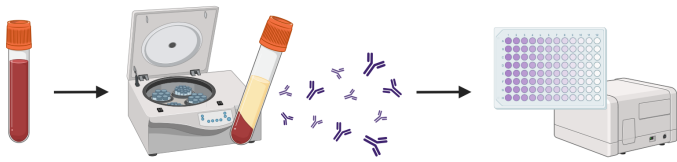
Dams that are test-positive (feces, blood) present low risk factor for having progeny that shed Eisenberg et al., 2015

**Bulk milk** Whittington & Windsor, 2009

**Colostrum from dam** Whittington & Windsor, 2009, Nunney et al., 2023



# Johne's Disease: Testing & Surveillance



## Blood test (antibody ELISA)

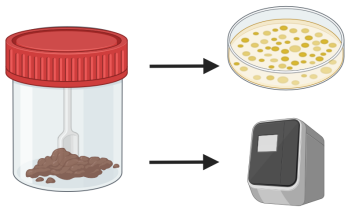
- Tells us if the animal's immune system responded to MAP infection
- Cheap test - \$5/sample
- Does **NOT** tell us: currently infected, exposed and cleared infection, or shedding
- **Not reliable for early detection**

# Johne's Disease: Testing & Surveillance



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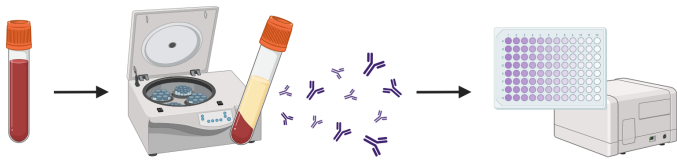
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## Fecal test - two types: PCR to detect bacterial DNA, or culture to detect live bacteria

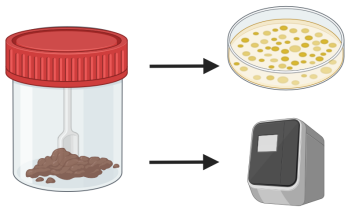
- Tells us if the animal is actively shedding
- **Limitation: Animal can be infected but not shedding at the time of sample collection!**
- **Expensive: \$30-35/sample**

# Johne's Disease: Testing & Surveillance



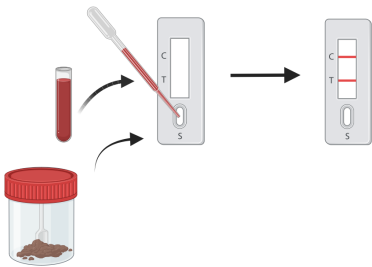
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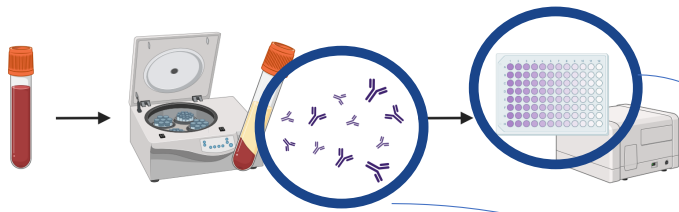


## Optimal JD Test

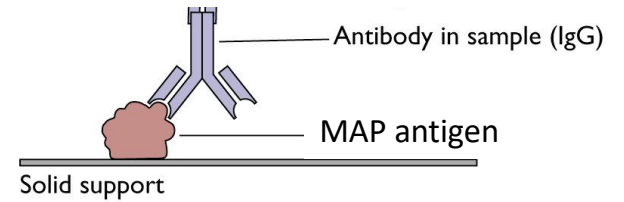
- ✓ On-farm, point-of-care test (rapid)
- ✓ Blood (antibodies) or feces (DNA)
- ✓ Cheap! To allow more frequent sampling!



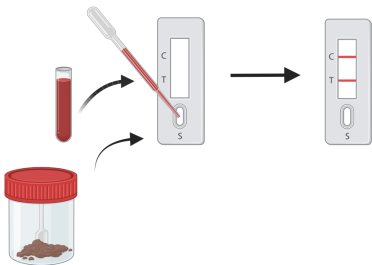
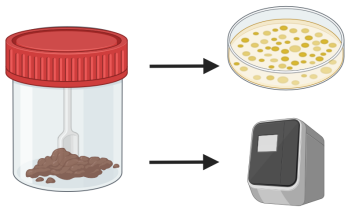
# Johne's Disease: Challenges in creating better tests



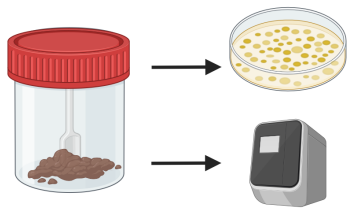
**"MAP antigen" is not reliable**



**Disease-specific antibodies are not always present in blood**

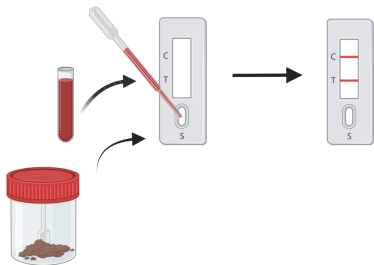


# Johne's Disease: Challenges in creating better tests

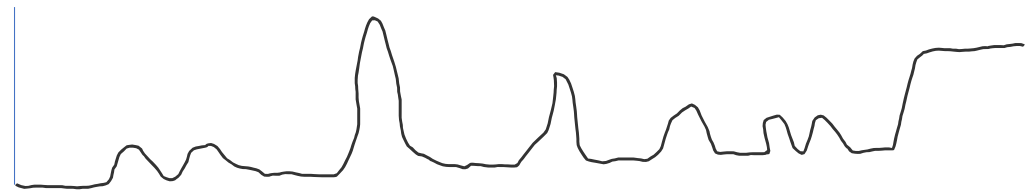


**MAP bacteria enters dormant state during recovery  
(8-16 weeks to detect growth under laboratory settings)**

**Specialized equipment significantly increases cost of the test  
Sampling too infrequent (current decisions motivated by economics)**



MAP shedding

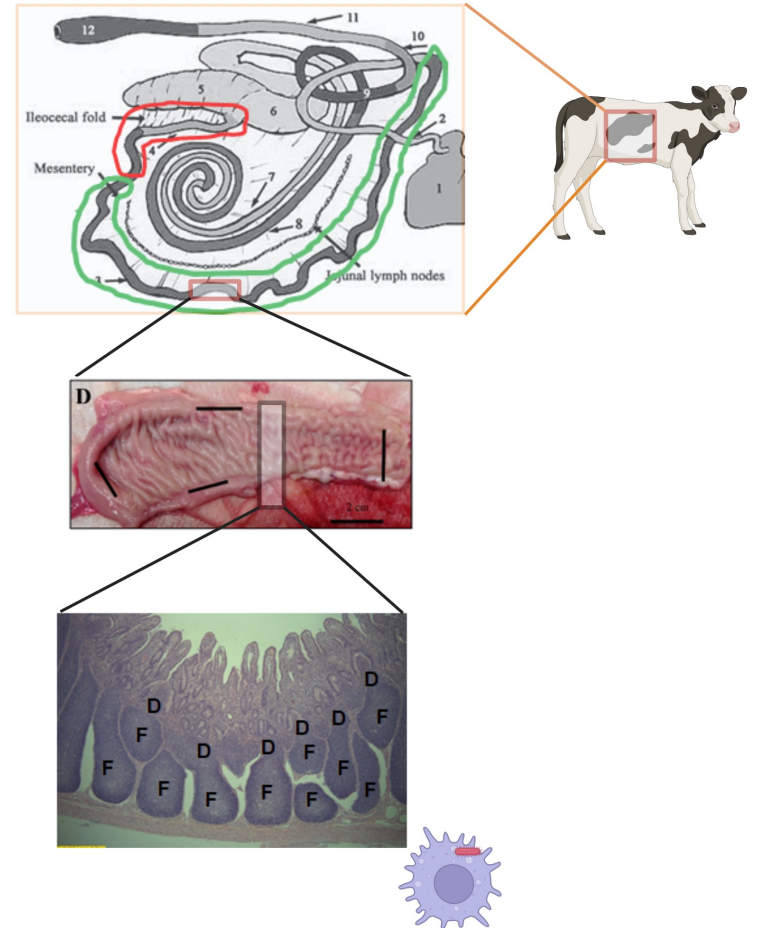


Time

# Johne's Disease: Vaccine Development

What is an effective Johne's disease vaccine?

- Prevents intestinal infection?
- Reduces or clears intestinal infection?
- **Block transmission/shedding in feces?**
- Stop or delay progressive disease?
- **Mitigate negative production-limiting traits of MAP infection?**
- All the above, would be ideal

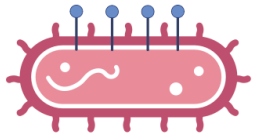




# Johne's Disease: Vaccine Development

What types of vaccines have been developed?

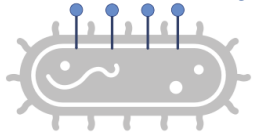
A. Modified-live (oral vaccine)



Experimental candidates developed

**Limitation: Interfere with bovine tuberculosis tests**

B. Killed vaccine (injectable)



Commercial vaccine licensed for use in Spain & Australia

**Limitation: Interfere with bovine tuberculosis tests**

C. Subunit vaccine (injectable)



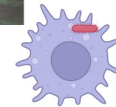
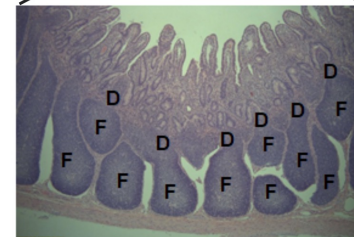
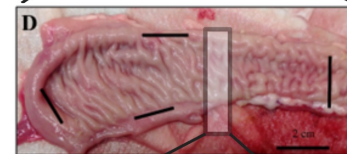
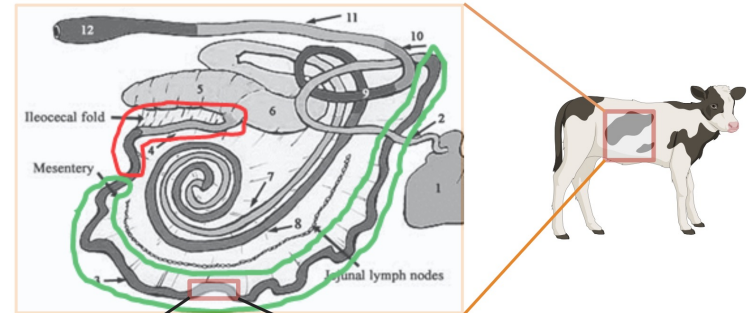
Experimental candidates developed

**Limitation: Not as potent as modified-live or killed**

# Johne's Disease: Vaccine Development

## What are the challenges?

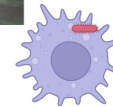
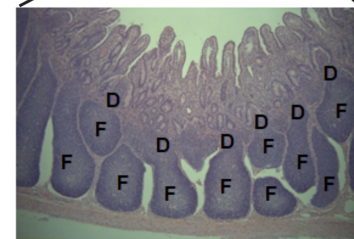
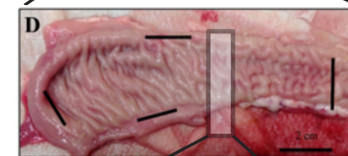
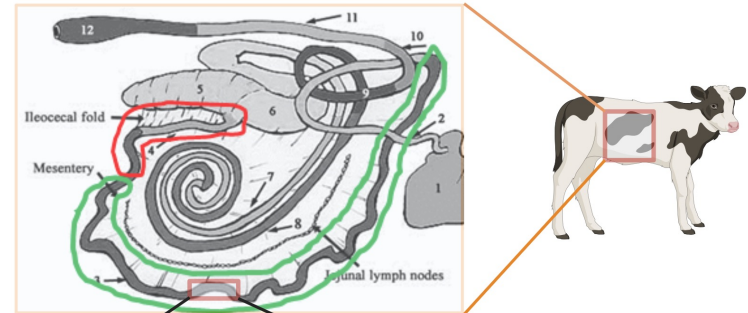
- Understand the ruminant intestinal immune system
- Determine which vaccine route best stimulates an intestinal immune response
- Identify which vaccine formulations provide protective immune responses (vaccine antigen + vaccine adjuvant)



# Johne's Disease: Vaccine Development

## What are the challenges?

- Understand the ruminant intestinal immune system
- +  
• Determine which vaccine route best stimulates an intestinal immune response
- =  
• Inform us which vaccine strategies provide protective immune responses in the intestines



# Summary

## Barriers

Diagnostic tests for early detection

- Testing costs impedes more frequent testing
- Current tests cannot reliably detect many infected animals

No available vaccine to prevent infection or block transmission/shedding



# Summary

## Barriers

Diagnostic tests for early detection

- Testing costs impedes more frequent testing
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No available vaccine to prevent infection or block transmission/shedding

## Opportunities

- ✓ Leverage the use of current diagnostic tests to identify as many positive animals as possible
- ✓ Implement management practices based on known risk factors
- ✓ Hygiene! Feces is the major vehicle of transmission
- ✓ Be vigilant when bringing in new animals

# THANK YOU



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