Keys to Disease Prevention & Economic Impacts if Left Unchecked

Biosecurity can sometimes seem like an abstract concept, but in practice it is one of your best defenses against introduction and/or spread of infectious diseases that can have a tremendous impact on animal health and the financial success of your operation.

So what diseases are Canadian dairy producers worried about? The following page provides the answer to this question from over 1,000 dairy producers that responded to the National Dairy Study[1].

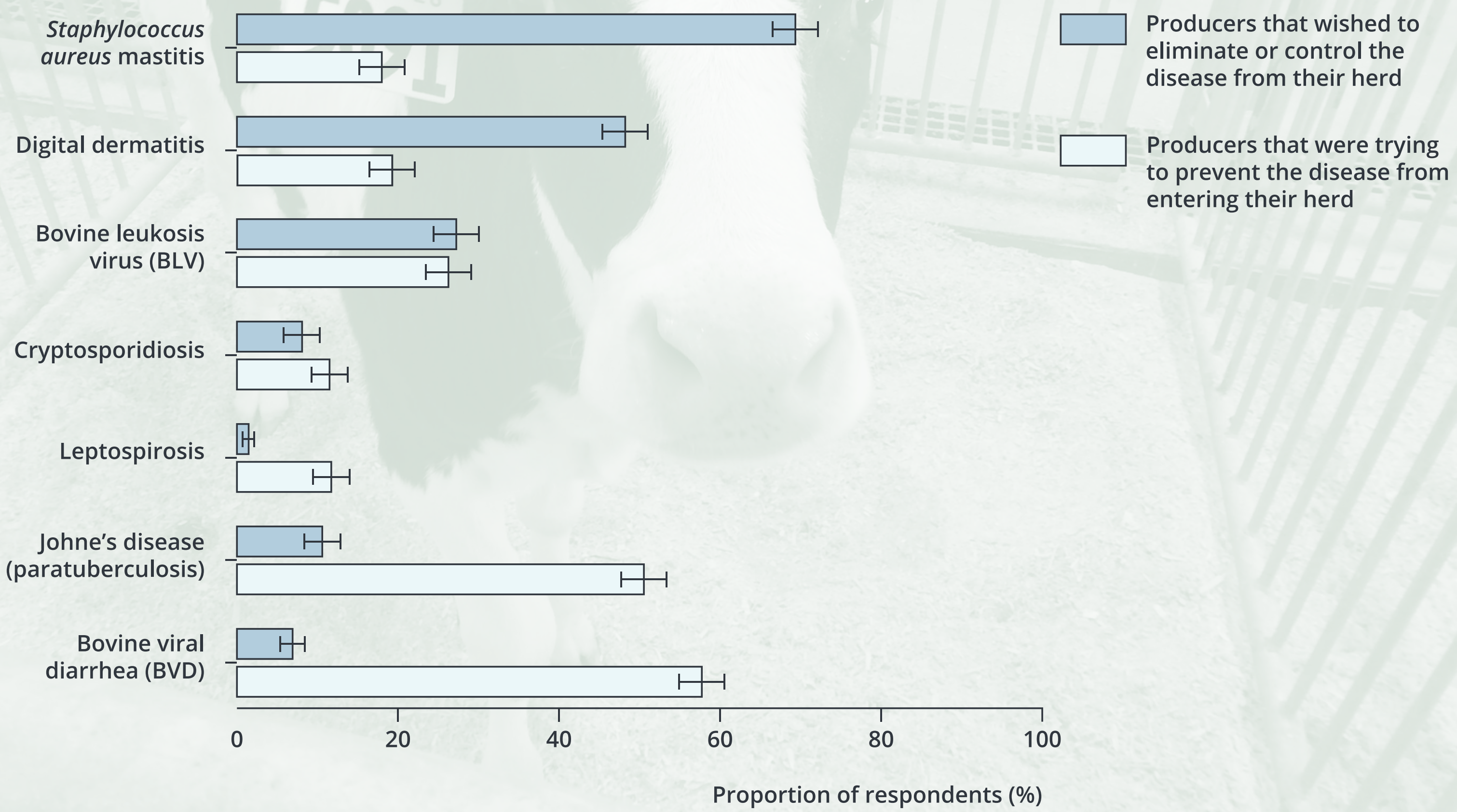
This resource is meant to provide producers with answers to the following questions for each key disease:

- What's the impact?
- What does it cost you?
- Where does it come from?
- How can you prevent and/or control it?
- What's the take home message?

Please use these resources as a guide for understanding disease on your farm. Work with your herd veterinarian to develop a tailored plan to address diseases of concern for your herd.

What Diseases are Canadian Dairy Producers Worried About?

Let's start with what diseases Canadian dairy producers view as a priority to prevent, eliminate, or control on their farms. The figure below presents the answers from over 1,000 dairy producers that responded to the National Dairy Study[1]:



The remainder of this document explores the diseases of high priority with significant financial impact to Canadian dairy farms. Specifically, the following diseases are highlighted:

Staphylococcus aureus Mastitis

***Staphylococcus aureus* is an important bacteria responsible for causing contagious mastitis in dairy cows.**

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What's the Impact?

Staph. aureus is a very common[1-4] pathogen on Canadian dairy farms, and one that farmers must prioritize to effectively control.

Infection with this bacterium leads to significant consequences for infected cows, including[5-8]:

- **Reduced milk production**
- **Increased number of cases of clinical mastitis**
- **Elevated somatic cell count (SCC)**
- **Increased risk of culling**

What Does it Cost You?

Studies from Europe provide us with an idea of possible costs on a typical Canadian dairy farm. When solely evaluating milk production for each 305 day lactation, Finnish researchers reported costs of $490 per cow infected with *Staphylococcus aureus* mastitis[9]. Estimates from Norway and Switzerland suggest between 6[10]-22%[11] of cows are infected within a herd. **This could cause financial losses between $3,000-10,750 per year for the average Canadian dairy herd (assuming 100 milking cows).** *All costs shown in Canadian dollars.*

Prevention is Key

Infection of the udder of cows with *Staphylococcus aureus* is very difficult to eliminate[6]. Cows with mastitis caused by these bacteria respond poorly to treatment which allows the bacteria to persist within the infected quarter. It adheres to tissue within the quarter and causes infection, as well as causing significant tissue damage within the quarter, leading to long-lasting effects.

Biosecurity Between Farms

The main source of infection for *Staphylococcus aureus* is the skin of infected cows, so ensuring infected cows do not enter your farm is imperative. Maintaining a closed herd (no additions or animals returning from outside your herd) should be a goal of every biosecurity program.

If cows must be brought into the herd (due to lack of replacements, expansion, or genetic improvement), the best way to prevent entry of this pathogen is to consider the following purchasing strategy for cows[12]:

1. **Purchase from herds with a consistent bulk tank SCC of < 200,000 cells/mL OR only purchase pregnant heifers**
2. **Ensure that each cow entering has a SCC of < 200,000 cells/mL over their entire lactation**
   - **To have greater certainty, use a cut off of < 100,000 cells/mL over their entire lactation**
3. **Culture quarter milk of cows as soon as possible following arrival, and consider animals as potentially infected (i.e. segregate and milk last) until results are available**

Biosecurity Within Farms

Within a herd, most *Staphylococcus aureus* infections are predominantly spread during milking time, but it is important to consider changes in milking practices as well as housing. The figure below presents risk factors (practices associated with a higher risk of infection with *Staphylococcus aureus*) and protective factors (practices associated with a lower level of *Staphylococcus aureus*) identified in studies conducted in Canada:

Staphylococcus aureus Mastitis

MILKING

- Wearing gloves[3]
- Pre- and post-milking teat disinfection[3]
- Flushing the milking cluster with cold water/ sanitizing solution between an infected and uninfected cow[13]
- Routine milking equipment maintenance by an independent technician (at least once per year)[4]
- *Milking liners need replacement according to product guidelines*
- Not fore-stripping cows prior to milking[2]
- Poor milking equipment maintenance

HOUSING

- Longer stalls[3]
- Sand bedding[3]
- Bedding depth > 2 cm[3]
- Stall bases with rubber mats or mattresses[2,4]
- Insufficient bedding material

MANAGEMENT

- Blanket dry cow therapy[2,4]
- Flagging cows known to have chronic mastitis[2]
- Scheduled milk testing to identify prevalence, severity, and source of mastitis
- Identification and treatment of clinical mastitis cases[3]
- Segregation or culling of chronically infected cows[6]
- No culling protocol for cows that have multiple cases of clinical mastitis[3]
- Overstocking[3]

PROTECTIVE FACTORS (blue boxes)

RISK FACTORS (pink boxes)

Although all of these factors cannot be changed immediately, there are several recommendations surrounding milking time that can have an impact on preventing the spread of mastitis to new cows. Specifically, identifying infected cows and either milking last, segregating to another group of chronically infected cows, or flushing the milking cluster with cold water/sanitizing solution between an infected and uninfected cow[13] can lead to a reduction in within-herd transmission. To reduce the risk of mastitis caused by this pathogen, a combination of these practices at milking time, changes in housing to ensure clean and dry lying areas, and identifying and culling cows with *Staphylococcus aureus* mastitis can be used.

Take Home Messages

Staphylococcus aureus mastitis is a major udder pathogen that can have significant economic impacts. To prevent these impacts, farms should strive to prevent the entry and spread of this mastitis-causing pathogen. For farms with this pathogen, a high priority should be placed on preventing transmission at milking time and identifying and culling infected cows.

Work with your veterinarian to develop a plan specific to your farm to eliminate or prevent entry of *Staphylococcus aureus* mastitis.

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Digital Dermatitis

Digital dermatitis is an infectious bacterial disease that affects the feet of cows.

What's the Impact?

Digital dermatitis is the most common foot lesion in dairy cows[1-2] and one that must be actively controlled on most Canadian dairy farms.

Lesions of digital dermatitis are often painful, and are responsible for causing lameness and infections that have been associated with[3-5]:

- **Decreased milk production**
- **Poor fertility**
- **Hoof conformation changes**
- **Increased culling rate**
- **Impaired animal welfare**

What Does it Cost You?

No Canadian research has evaluated the economic impact, but a research team from the United States reported that each case of digital dermatitis is estimated to cost $49 for milk loss, $58 for decreased fertility, and $79 for treatment costs[6]. Together, each case costs $186 per infected cow, per year. **This means the disease could cost between $2,790-4,092 per year for the average infected Canadian dairy herd (assuming 100 milking cows).** *All prices shown in Canadian dollars.*

Where Does it Come From?

Digital dermatitis is a highly infectious disease that is capable of spreading throughout a herd. With respect to the cause, there remains much that is unknown; however, the science points towards treponemes, a type of bacteria. It is suspected that transmission mainly occurs from animal to animal[15]. A significant amount of work needs to be completed in this area to gain a better understanding of disease transmission, however, undetected and untreated animals are thought to be a continuous source of the pathogen that causes digital dermatitis.

Biosecurity Between Farms

It is imperative to prevent digital dermatitis from entering farms that are not infected. Maintaining a closed herd is the best recommended practice to prevent entry of this disease, as nearly all Canadian farms have digital dermatitis present. It is important to consider how a new, healthy introduction, or a first lactation animal entering a lactating herd with digital dermatitis can help to perpetuate the cycle of infection.

Other sources can also lead to infection. Contaminated hoof trimming equipment, such as hoof knives[15] may be responsible for the transfer of bacteria between animals and between farms. The bacteria that cause digital dermatitis are able to survive for several hours on hoof knives. Specific disinfectants, such as sodium hypochlorite or Virkon™, are necessary to kill the bacteria[16]. Set the expectation that your hoof trimmer and veterinarian use only cleaned and disinfected equipment on your cattle to prevent the spread of digital dermatitis.

Ensure that your hoof trimmer and veterinarian use only cleaned and disinfected equipment on your cattle.

Biosecurity Within Farms

There have been many specific risk factors (factors that are associated with a higher level of digital dermatitis) and protective factors (factors associated with a lower level of digital dermatitis) that have been identified:

Digital Dermatitis

HOUSING

- Slatted flooring[13]
- Solid grooved flooring[8,9]
- High moisture level in the environment[10,11]

MANAGEMENT

- Cows with a high immune response[14]
- Whole herd trims[2]
- Routine foot baths with copper sulfate[17,18,19]
- Having cows with dirty legs[7]
- Introduction of new animals into the herd[9,10,12]
- Improper disinfection of hoof trimming equipment[9]
- Inadequate removal of manure from standing areas

PROTECTIVE FACTORS

RISK FACTORS

The main takeaway from this figure is that maintaining a clean, dry environment with minimal manure contamination, minimizing introduction of new animals, and disinfecting hoof trimming equipment are keys to reducing the impact of digital dermatitis. As is the case with most infectious diseases — hygiene is of the utmost importance! Keeping cows' feet free of manure (even a rinse with water when they are leaving the parlour) can help.

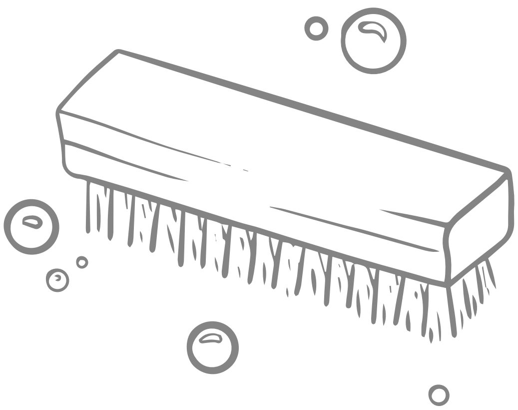
Control Strategies

Footbaths

Footbaths are effective in controlling digital dermatitis, with copper sulfate being effective in reducing its prevalence[17-19]. A 5% copper sulfate footbath used at least 4 times per week is an evidence-based protocol that might best reduce digital dermatitis lesions[20]. To maximize the effectiveness of footbaths, it is important that each foot is submerged into the bath — it's all about contact time! It suggests that footbaths should be at least 3.0 m long to get ample submersion of the cows' feet[21].

Identify & Treat Early

Another key prevention strategy is to identify and treat cases of digital dermatitis, especially in heifers that could serve as a reservoir of digital dermatitis[15]. Work with your veterinarian to first set objectives and then identify an identification and treatment strategy for your farm.



Take Home Messages

Digital dermatitis is an extremely common disease on Canadian dairy farms and represents an area of substantial economic loss. On farms that do not have digital dermatitis, maintaining a closed herd (where NO animals have been in contact with animals from another herd at any point, whether through purchase/ introduction, shows, etc.) and ensuring that hoof trimming equipment is cleaned and disinfected prior to use and/or entry into your barn may prevent infection of your herd. Farms that have digital dermatitis can help to control the disease through maintaining a clean, dry environment, establishing a regular footbathing routine using an evidence-based protocol, and identifying and treating new cases of digital dermatitis as soon as possible.

Work with your veterinarian and hoof trimmer to create a strategy to tackle digital dermatitis on your farm.

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Bovine Leukosis Virus

Bovine leukosis, caused by bovine leukemia virus (BLV), is a production-limiting disease commonly found in Canadian dairy herds.

What's the Impact?

BLV is a common disease in the Canadian dairy industry that infected herds must actively control and uninfected herds must work diligently to prevent[1-3]. Clinical signs of disease (e.g. weight loss, inability to stand, enlarged lymph nodes, tumors) are not often displayed by infected animals, while clinical signs of malignant lymphosarcoma (cancer) develop in < 5% of infected animals[3]. Despite the low prevalence of clinical signs, cows that have been infected with the virus have significant consequences, including[4,5]:

- **Reduced immune function**
- **Reduced lifetime milk production and cow longevity**
- **Carcass condemnation at slaughter**
- **Lower reproductive efficiency**

What Does it Cost You?

This disease is a major "silent" threat to the health and productivity of dairy cows because clinical disease often goes undetected. American and Canadian researchers have reported that costs range from $412[6]-635[7] per infected cow. **This means the disease could cost between $12,000-19,000 per year for the average infected Canadian dairy herd (assuming 100 milking cows).** *All costs listed in Canadian dollars.*

Where Does it Come From?

The source of BLV is other infected cattle. These animals serve as a source of transmission between cattle and other farms. The virus is predominantly spread through the transfer of blood from an infected to susceptible animal. Biosecurity is crucial in order to control between- and within-herd transmission. Several countries have officially eradicated BLV using either specific management interventions, test and segregation, and/or test and slaughter protocol; it is possible with stringent biosecurity protocols and robust testing to eliminate this costly disease!

As infection with this virus is permanent and untreatable, every effort must be made to prevent these animals from entering the herd!

Biosecurity Between Farms

The leukemia virus relies on the introduction of persistently infected cows that do not show obvious clinical signs to allow for transfer between herds. This is why maintaining a closed herd, or purchasing from low-risk herds, or tested animals, is critical to control. If purchasing is required, it is highly recommended to test all newly introduced cattle prior to arrival to the farm using a blood test; herds that do not test purchased animals have higher levels of BLV on their farm[1]. As infection with this virus is permanent and untreatable, newly arrived cattle that are infected serve as a continuous source for spreading the virus. Every effort must be made to prevent these animals from entering the herd!

Biosecurity Within Farms

As highlighted below there are many risk factors (factors associated with a higher level of leukosis) and protective factors (factors associated with lower levels of leukosis) that have been identified.

Bovine Leukosis Virus

MANAGEMENT

Protective factors	Risk factors
Changing gloves between cows during pregnancy exams[1]	Purchasing animals with unknown infection status[1]
Using artificial insemination[8]	Lack of fly control[8]
Feeding heat treated colostrum or colostrum replacers[5]	Gouge dehorning[8]
Disinfection of blood-contaminated equipment (ear taggers, dehorning irons) between animals[5]	Reusing needles[8]
Segregation and culling of cows that test positive for leukosis[5]	Breeding with a bull[8]

PROTECTIVE FACTORS

RISK FACTORS

Control Strategies

Based on these risk factors, there are a variety of control strategies that could be put into place including[7]:

1. **Improving management practices to reduce spread of disease**
2. **Identifying and removing positive animals from the herd**
3. **Rather than culling, keep infected animals in a separate pen, away from the herd**

Management

Each of the following strategies have been identified as factors associated with a reduction in leukosis and could be implemented with relative ease, but must be done consistently in order to be effective by everyone working with animals on your farm:

- Fly control
- Disinfection of equipment between animals
- Use of cautery dehorner
- Single use needles
- Single use examination sleeves for AI and pregnancy diagnosis
- Use of frozen or pasteurized colostrum or colostrum replacer

The Costs and the Benefits:

When implementing all these management strategies, it was estimated to cost approximately $32-85 (depending on whether a colostrum replacer was fed) per cow, per year[7], but it was estimated that the within-herd level of leukosis would fall by 25%! Despite the cost associated with prevention and management strategies, it led to an additional increase in profit per animal of $79-132 per year[7] by preventing reproductive inefficiencies and production losses, highlighting the success of using these strategies. If your herd has a high level of leukosis, this may be the best strategy to consider initially.

Test & Cull

This strategy focuses on identification and resulting culling of positive animals.

The Costs and the Benefits:

One research study used this approach but chose not to cull all positive animals and instead culled 10% of positives (to ensure the herd size remained constant), but culled in combination with the application of all management strategies mentioned above. They estimated this would cost $35 per cow per year, but yield an increased profit of $159 per year[7].

Test & Segregate

The segregation of positive animals in a separate pen has been demonstrated as an effective way to prevent new infections within a herd.

The Costs and the Benefits:

When combined with the implementation of all above mentioned management strategies (#1), researchers estimated a cost of $46 per cow per year. This strategy led to a profit of $159 per cow per year and had the highest rate of reduction in the number of cows infected with leukosis in the barn[7].

Take Home Messages

Bovine leukosis is a common and costly infection on dairy farms in Canada. Similar to other infectious diseases, the best option to prevent this virus from coming onto your farm is to refrain from purchasing and introducing potentially infected animals. The disease can be eradicated using a combination of management strategies and test and cull/segregate options.

Work with your veterinarian to develop objectives and a strategy to achieve them to reduce the risk and potential impact on your farm caused by BLV!

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Johne's Disease

Johne's disease (JD) is an infection of the intestinal tract caused by the bacterium *Mycobacterium avium* spp. *paratuberculosis* (MAP).

What's the Impact?

Johne's disease is an infectious disease found on many dairy farms that is particularly challenging to control[1-2].

Similar to BLV infection, infection with MAP will only produce clinical signs of disease (diarrhea, rapid weight loss, low milk production, and death) in 10-15% of infected cows[3]. The greatest impact of disease is seen in those that are subclinically affected (infected animals that do not show signs), which results in[4,5]:

- **Reduced milk production**
- **Increased mastitis risk**
- **Reduced slaughter value**
- **Premature culling**

What Does it Cost You?

The effects of JD result in significant economic losses to the dairy industry, with Canadian researchers estimating a loss of $416 per infected cow, per year[6,7]. **With an estimated 10% of cows infected within a positive herd, JD could cost approximately $4,200[7] per year for the average Canadian dairy farm (assuming 100 milking cows).** *All costs listed in Canadian dollars.*

Where Does it Come From?

Biosecurity is absolutely crucial in order to control between- and within-herd transmission of these pathogens. The primary route of transmission for MAP is through feces, where animals consume the feces of infected animals. Other modes of transmission include ingestion of milk or colostrum from infected cows, and transplacental transmission. Newborn calves (within 24 hours of life) are most susceptible[8] but calves less than 6 months of age also have significant risk.

Biosecurity Between Farms

The most likely source of MAP introduction into a previously uninfected herd is through the purchase and introduction of infected cattle. This occurs when cattle have not been tested, or are assumed to be healthy because they are not showing signs of the disease. The best way to prevent entry is to maintain a closed herd. If you must buy animals in, consider purchasing cattle from herds with a known disease-negative status or test cows prior to introducing them.

Some other sources of transmission include manure movement between farms, provision of contaminated colostrum or milk for calf feeding, and sharing of pastures or water sources between herds. These sources are low-risk when compared to the purchase of infected animals[8].

If you must buy animals in, consider purchasing cattle from herds with a known disease-negative status or test cows prior to introducing them.

Biosecurity Within Farms

As highlighted below there are many risk factors (factors associated with a higher level of JD) and protective factors (factors associated with lower levels of JD) that have been identified. The majority of the risk factors identified relate back to the fecal oral cycle and manure management.

Johne's Disease

HOUSING

- Manure build-up in calving area
- Routine use of calving pen for sick and lame cows

MANAGEMENT

- Smaller herd size
- Calves fed colostrum from known negative dam
- Use of pasteurized colostrum or colostrum replacer
- Purchase of cattle within the past 5 years
- Youngstock exposed to the feces of adult cattle
- Poor dry cow cleanliness
- Length of time calves spend in calving area

PROTECTIVE FACTORS[9,10]

RISK FACTORS[9,10]

Control Strategies

The major challenge with MAP is breaking the continual cycle of disease. This can be accomplished through[11]:

1. **Protecting youngstock from manure of adult cows, as well as feed and water contaminated with manure**
2. **Reduce the number of infected animals in the herd that may be shedding bacteria**

Management

Specific management practices that could be implemented to reduce transmission to youngstock include[11]:

- Clean and disinfect calving pens after use
- Calve cows in clean, dry, dedicated maternity areas
- Removing calf from maternity pen quickly following birth
- Collect colostrum from clean udders (prepare udders as if for normal milking)
- Provide calves with colostrum from known negative animals
- Use pasteurized milk or milk replacer during pre-weaning period
- Raise calves separated from adult herd for first year of life (separate calf and/or heifer facilities)
- Prevention of shared access of feed/water between adults and youngstock
- Not spreading manure on youngstock grazing land

The Costs and the Benefits:

If all of the above strategies were implemented, it would cost an average Canadian herd $1,200 in the first year and a recurring cost of $660 in subsequent years to maintain. This may seem steep, but it is estimated that a profit of $2,278 per year would be achieved with the control of JD[7]. Many farmers already have these strategies implemented and are well on their way to reducing the impacts of JD; implementing a few more of the strategies listed above could have a significant effect on your bottom line!

What About Testing & Culling?

Reducing the number of infective animals within the herd is also a beneficial strategy to reduce JD. Testing all animals and culling those that are positive has been a suggested strategy; however, this needs to be combined with the management strategies highlighted above to have the greatest impact[6]. In fact, within several years of program implementation, the level of MAP-positive cows in the herd could be expected to decrease approximately by 50%[12].

Take Home Messages

As highlighted above, JD is both a costly and common disease on Canadian dairy farms. To control the spread, infected animals should be prevented from entering non-infected herds. Within an infected herd, additional effort should be made to prevent fecal contamination from adult animals to prevent transmission to young calves.

You and your veterinarian can develop a strategy involving the above mentioned strategies to help reduce the impact of JD on your farm.

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Cryptosporidium parvum

Cryptosporidium parvum **is an intestinal parasite that commonly causes calfhood diarrhea on dairy farms.**

What's the Impact?

Recent research suggests that *C. parvum* is a common issue on many dairy farms[1-3].

An infection with *C. parvum* can often lead to diarrhea and changes in the intestine leading to reduced levels of nutrient absorption. More broadly, if a calf develops diarrhea, it can result in the following consequences[4,5,6]:

- **Reduced growth up to 3 months of age**
- **Increased risk of dying prior to weaning**
- **Increased age at first calving**
- **Reduced first lactation milk production**

C. parvum is also zoonotic meaning that you could get this pathogen from your calves. Ensure that after working with calves, your hands are cleaned to make sure you do not get infected.

What Does it Cost You?

Canadian researchers estimate that each case of diarrhea will cost $155[7], based on labour and treatment costs as well as the cost of calf losses from diarrhea. **With 23% of calves on the average dairy farm having diarrhea[4], an estimated cost of $1,782 per year would result on the average Canadian dairy farm[7] (assuming 100 milking cows).** *All costs listed in Canadian dollars.*

Similar to MAP, transmission of *C. parvum* relies on the ingestion of feces from a shedding animal. Those shedding *C. parvum* can range from calves with diarrhea to adult cows that shed the parasite but show no clinical signs of disease.

Biosecurity Between Farms

Unlike many of the other pathogens discussed previously, there has been little research into the transmission of *C. parvum* from farm to farm; however, it can be assumed that maintaining a closed herd will aid in preventing the occurrence of the disease. An additional measure is to ensure that visitors coming to your farm wear clean boots and clothing, and bring equipment that is not contaminated with manure, as *C. parvum* can survive very well in that environment and only a small dose can lead to an infection. In addition, ensuring that visitors do not interact with calves can also reduce the risk of disease transmission.

Ensure that visitors coming to your farm wear clean boots and clothing, and bring equipment that is not contaminated with manure.

Biosecurity Within Farms

There have been many specific risk factors (factors that are associated with a higher level of *C. parvum*) and protective factors (factors associated with a lower level of *C. parvum*) that have been identified:

Cryptosporidium parvum

HOUSING

- Concrete flooring in calf housing area
- Use of multi-cow maternity facilities (exposure to the manure of multiple animals)

MANAGEMENT

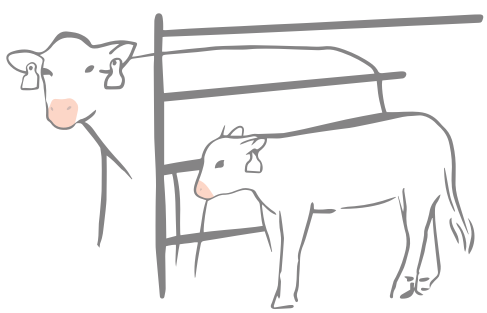
- Use of soap or detergent when washing calf feeding utensils
- Cleaning of calf housing areas
- Increased frequency of cleaning
- Contact between pre-weaned calves
- Longer time spent in maternity area (prolonged exposure to the manure of adult animals)

PROTECTIVE FACTORS[8,10]

RISK FACTORS[2,8,9]

Control Strategies: Management

As this disease has the largest impact on calves, management strategies should target calves that are less than 21 days old, as these animals are reservoirs for infection. Based on the factors identified above, there are several biosecurity recommendations that could be made:



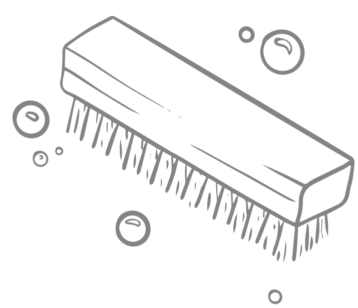
1. Minimize contact young calves have with older calves/heifers and adult feces

- When managing calves, it is recommended to work from the youngest age groups to the older calves, as these groups are more likely to shed pathogens that can be spread to young calves through gloves, clothing, equipment, etc.

2. Clean and disinfect calf housing area and feeding utensils between calves

- *C. parvum* is difficult to kill; frequent cleaning and contact with a disinfectant is required to reduce the number of infective parasites that can be ingested by calves
- There is also evidence that providing a period of rest in the calf pen between groups will reduce the amount of *C. parvum*[11] in the environment

Providing increased volumes of milk to ensure proper nutrition, excellent colostrum management practices and protocols, and frequent addition of clean/dry bedding can also help prevent infection, reduce risk, or increase calves' capacity to fight infection[10].



Take Home Messages

C. parvum is commonly identified on dairy farms and can lead to diarrhea as well as a reduction in long-term growth. Maintaining excellent biosecurity, through cleaning and disinfection, working from youngest to oldest calves, and minimizing contact that visitors have with calves is a way to control this disease on your farm.

Work with your veterinarian to develop effective protocols and determine the best way to prevent *C. parvum* on your farm.

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Salmonella Dublin

***Salmonella* Dublin is an emerging multidrug-resistant bacterium (there are few antibiotics available that can kill it) that can cause a wide variety of symptoms in infected cattle.**

What's the Impact?

S. Dublin is an emerging disease of concern for the Canadian cattle industries. An infection of *Salmonella* Dublin can have many different symptoms and commonly affects calves that are 1 week of age to 1 month of age. Common symptoms include sudden onset of pneumonia that is not responsive to treatment, sudden spikes in death rate, and septicemia. No matter the symptom, it is often the case that a high number of calves die when the bacteria is first introduced to the farm.

Salmonella Dublin is also a serious threat to human health. It can infect people and cause illness and death especially in those with compromised immune systems. The main sources of contamination for humans is through consumption of raw milk or unpasteurized cheese, contaminated beef products, or direct contact with feces from infected animals[1].

What Does it Cost You?

Unlike many of the other pathogens highlighted above, the cost of having a herd infected with *Salmonella* Dublin is not well known. On some farms in an initial outbreak, as many as 50% of calves can die or have to be euthanized as a result of *Salmonella* Dublin. Ongoing mortality after an initial outbreak will also be higher, with Danish farms infected with *Salmonella* Dublin having a higher risk of calf mortality compared to negative herds. After initial infection, positive herds also had reduced milk production from 7 to 15 months after herd infection in this Danish study[2].

In addition, some of the surviving animals may become carriers of this pathogen, especially if infected between 1 year of age and calving or at the time of calving[3]. These carriers then serve as a source of *Salmonella* Dublin which is shed in manure and milk leading to new infections of young calves.

Danish researchers estimated that *Salmonella* Dublin infection would cost $77 per lactating cow (or $7,100 on the average Canadian dairy farm (assuming 100 milking cows) in the first year of infection. In subsequent years, it was estimated to cost $13 per lactation cow, per year, or $1,200 per year on the average Canadian dairy farm (assuming 100 milking cows)[2]. *All costs listed in Canadian dollars.*

Biosecurity Between Farms

As most farms in Canada do not have *Salmonella* Dublin on their farms, it is imperative to prevent the entry of this bacteria. Practicing excellent biosecurity is extremely important. The most significant biosecurity practice is to eliminate or reduce the purchase of infected cattle. Infected "carrier" cattle are the main risk to a herd that doesn't have *Salmonella* Dublin. These carriers are animals that likely got infected and shed the bacteria in their feces and milk but do not show any other symptoms of illness. Cattle should not be bought to prevent the entry of this pathogen, or cows should only be bought from farms that are known not to have *Salmonella* Dublin.

Other biosecurity considerations include ensuring that visitors to the farm wear clean coveralls and boots that are not contaminated with feces, as manure can act as a reservoir for *Salmonella* Dublin[4].

Ensure that visitors to the farm wear clean coveralls and boots that are not contaminated with feces, as manure can act as a reservoir for *Salmonella* Dublin[4].

Biosecurity Within Farms

There have been many specific risk factors (factors that are associated with a higher level of *Salmonella* Dublin) and protective factors (factors associated with a lower level of *Salmonella* Dublin) that have been identified:

***Salmonella* Dublin**

HOUSING

- Individual rather than group maternity pens
- Increased stocking density

MANAGEMENT

- Increased frequency of cleaning of environment, equipment, and feeding utensils
- Trade of cattle, or direct contact with other cattle off the farm
- Return of cattle after off-farm activity
- Neighbouring farms being positive
- Professional visitors not required to wear protective clothing

PROTECTIVE FACTORS[5]

RISK FACTORS[5]

Control Strategies: Management

Although control of *Salmonella* Dublin on infected herds can be challenging, it is possible to eradicate this bacteria from your farm through the implementation of specific biosecurity practices:

1. Calving pen management.

This is one of the most important areas to address as carrier animals will shed *Salmonella* Dublin in the greatest numbers around calving. Ideally, the calf should be removed from positive cows as soon as possible to prevent the calf from being contaminated with their feces. Minimizing the number of other cows in the calving pen will also reduce the burden of the bacteria in the pen. Ensuring that ample bedding is present to cover manure, disinfecting regularly, and avoiding the use of the calving pen as a sick pen are measures that can reduce spread[6]

2. Youngstock management.

Ensuring that adult cow feces does not come into contact with youngstock is another important principle in preventing the transmission of this bacteria. Ensuring that when managing calves, clothing, and boots are free of manure as well as equipment and feeding utensils is essential. Avoiding feeding waste milk to calves is another consideration as feeding waste milk has been identified as a risk factor

3. Avoid purchase or introduction of infected animals.

Testing measures for *Salmonella* Dublin are not well developed, hence, preventing the purchase of animals can help prevent introduction of carriers

What About Testing and Culling Carriers?

The culling of carrier animals may not be necessary to achieve control if proper biosecurity measures are in place on the farm. This is mainly due to the difficulty involved in identifying carrier cows. Work with your veterinarian to create strategies to control this disease on your farm.

Take Home Messages

Salmonella Dublin can be an extremely costly disease and have a significant impact on the welfare of your dairy herd. As many herds in Canada are not currently infected, a focus should be placed on reducing the purchase of potentially infected carrier animals.

If *Salmonella* Dublin is present on your farm, establishing excellent biosecurity protocols with the help of your veterinarian, especially in the calving pen and in the rearing of youngstock will help to control this bacteria.

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Bovine Viral Diarrhea Virus

Bovine viral diarrhea virus (BVDV) is a production limiting pathogen of cattle in Canada. This virus exists in most cattle producing countries worldwide.

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What's the Impact?

BVDV is an important and prevalent pathogen in the Canadian dairy industry.

Infection with BVDV leads to substantial negative impacts including[1,2,3]:

- **Reduced milk yield**
- **Respiratory disorders**
- **Congenital defects**
- **Early embryonic death**
- **Decreased growth**
- **Extended calving intervals**
- **Reduced first service conception**
- **Increased mortality and morbidity due to suppression of the immune system**

The impact of BVDV, however, depends on the time and duration of the infection, which strain of BVDV the animals are infected with, how prevalent the disease is, and other infections that are occurring in the herd.

What Does it Cost You?

The effects of BVDV result in significant economic losses to the dairy industry. Canadian researchers have estimated losses of $47 per infected cow, per year[6,7]. **BVDV could cost approximately $4,842[6] per year for the average Canadian dairy farm (assuming 100 milking cows).** *All costs listed in Canadian dollars.*

Biosecurity Between Farms

The way BVDV is introduced onto your farm is through the entry of a persistently infected animal. A persistently infected (**PI**) animal will be continuously infected with BVDV and will shed large amounts of the virus throughout its entire lifetime. Therefore, to prevent BVDV from coming onto your farm, ensure that PI animals do not come onto your farm through testing all incoming cattle onto your farm. In addition, pregnant animals, which are not PI animals, could also be carrying a PI fetus. Hence, purchasing non-pregnant animals, or not purchasing any cattle into your herd will reduce the risk to your farm, as the purchase of heifers or cows is a significant risk factor for disease entry[8].

To prevent BVDV from coming onto your farm, ensure that PI animals do not come onto your farm through testing all incoming cattle onto your farm.

Biosecurity Within Farms

As highlighted below there are many risk factors (factors associated with a higher level of BVDV) and protective factors (factors associated with lower levels of BVDV) that have been identified:

Bovine Viral Diarrhea Virus

HOUSING

- Purchase of cattle within the past 5 years (risk factor)

MANAGEMENT

- Vaccination against BVDV (protective factor)
- Performing diagnostic tests for BVDV at the time of purchase (protective factor)
- Purchase only from BVDV-negative herds (protective factor)

PROTECTIVE FACTORS[8]

RISK FACTORS[8,9]

Control Strategies

It has been well documented that BVDV can be eliminated from herds; what's more, some countries around the world have been able to completely eradicate the virus through:

1. **The use of vaccination programs**
2. **Elimination of PI animals from the herd**

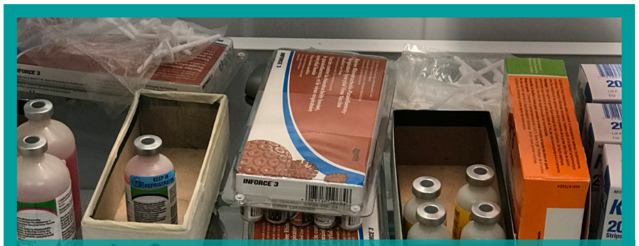
Vaccination

Vaccination is an effective and relatively inexpensive option to control BVDV. Vaccination can help to prevent new infections from occurring, reduce the presence of the virus in the environment, and increase herd immunity where there are fewer susceptible animals in the herd that could be infected with PI cattle. A systematic vaccine schedule that is implemented regularly and follows a defined protocol will create an environment with a high number of immune animals meaning a single infected animal with BVDV will not be able to meet and infect enough remaining susceptible or non-immune animals to maintain or even spread the infection[10] (this is effective herd immunity). Work with your veterinarian to develop a vaccination program tailored to your farm to control BVDV.

Test & Cull

As PI animals are the largest source for transmission of BVDV, it is important to find and eliminate these animals from the herd. In most herds, the number of PIs is low so it is an economical strategy to cull positive animals[11]. Once the PI animals are removed, it is still important to continue to monitor for new PIs, specifically, newborn calves should be tested for a period to ensure that the production of a PI did not occur during pregnancy. In addition, it is important to ensure that no new PI animals are brought into the herd. Hence, not purchasing new animals or when animals are required, purchasing animals that are negative for BVDV and testing calves from purchased pregnant animals will help to prevent the recurrence of BVDV on your herd.

For more specific information on testing strategies, work with your veterinarian and other advisors.



Vaccination is an effective option to control BVDV. Work with your veterinarian to develop a vaccination program tailored to your farm to control BVDV.

Take Home Messages

BVDV is a common viral pathogen affecting the Canadian dairy industry. Infected herds experience significant consequences including reduced milk production and reproductive performance. To control this pathogen, it is important to prevent persistently infected animals from infected susceptible animals in your herd. Having a proper vaccination strategy, purchasing animals are negative for BVDV, and if PIs are present in your herd, identifying and eliminating them can help to reduce the impact of BVDV.

Work with your veterinarian to develop an effective protocol to keep BVDV off your farm!

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