Management and prevention of *Salmonella* Dublin

As most dairy farms and veal farms in Canada do not have *Salmonella* Dublin (S. Dublin), efforts should be made to prevent the entry of the bacteria onto farms. As outlined below, practicing a high level of biosecurity is critical to prevent an infected animal or a visitor with S. Dublin on their boots or clothing onto the farm. When farms are infected with S. Dublin, it is possible to eliminate the disease by cleaning and disinfecting and using specific biosecurity practices.

Preventing the introduction of *Salmonella* Dublin

Dairy farm prevention

The major pathway for S. Dublin to enter a farm is through the purchase of a carrier animal. This has been consistently found to be the most significant risk factor where farms that purchased more animals had a much greater risk of their herd becoming positive for S. Dublin[2,4]. A carrier is a cow that appears healthy but is shedding S. Dublin in her manure and milk. In fact, these carrier animals can shed up to 10^8 cells of S. Dublin per gram of feces or milk, meaning that a single gram can infect a calf that is between zero to six months of age and produce clinical signs[1].

Therefore, for dairy farms, maintaining a truly closed herd by not purchasing animals is a critical factor to preventing its spread. If animals need to be purchased, ensuring that the animals come from a farm that has a negative bulk tank milk test and a negative blood test is best practice. This testing can also be used to identify other infectious diseases like Johne's disease and leukosis that can also have a serious impact on-farm.

Beyond purchased animals, any movement of cattle off and onto the farm, such as those that leave for shows, is also a risk factor. These animals could contract an infectious disease, including S. Dublin. Therefore, quarantining newly arrived animals and receiving a negative blood test result before allowing them to enter the rest of the herd can prevent spread.

Another factor that has been associated with an infection of a dairy herd is the number of neighbouring farms that are positive[2]. As S. Dublin is shed in manure, it can also be transmitted by people, boots and coveralls, and equipment entering the farm. Specifically, visitors, including other dairy farmers, nutritionists, drovers or cattle buyers, AI technicians, and veterinarians, could be carrying manure on their boots or clothing and come into contact with cattle, leading to an infection. In fact, poor biosecurity in professional visitors (i.e., dirty boots, coveralls, equipment) was associated with dairy herds having an outbreak of disease[3]. In addition, one study found that it is possible to isolate *Salmonella* from contaminated rubber boots for 48 hours after rinsing with water[6]. Producers should ensure visitors coming onto their farms are wearing clean and disinfected boots and coveralls containing no manure or provide them with designated boots and coveralls.

Veal farm prevention

Keeping a closed herd is not possible for veal farms, and introduction of S. Dublin into the herd primarily comes from buying a carrier calf. Veal producers should buy from as few sources as possible or source calves from farms that are negative for S. Dublin. Although it can be difficult to determine positivity in young calves, using bulk tank testing may be useful as a screening tool for determining the status of the source dairy farms. In addition, as S. Dublin is likely still at a low prevalence in dairy herds, it may also be prudent to discuss S. Dublin with source farms producers are buying from to highlight the challenges that can occur due to this bacterium.

Similar to dairy herds, ensuring farms have a high-level of biosecurity for visitors is also critical. Visitors, including other dairy or veal farmers, nutritionists, drovers or cattle buyers, and veterinarians, could be carrying manure on their boots or clothing and come into contact with cattle, leading to an infection. Ideally, ensuring visitors are wearing clean and disinfected boots and coveralls, or keeping designated boots and coveralls for them, is best practice.

Other major herd-level risk factors for Salmonella Dublin

Other risk factors that have been identified to be present in farms that become affected with S. Dublin include[5]:

- Group maternity pens
- Group housing of calves
- Increased herd size
- Increased surface water on farm
- Increased stocking density
- Poor general hygiene of environment and equipment

What can producers do if *Salmonella* Dublin is detected on their farm?

When the first diagnosis of S. Dublin occurs, it is important to have a conversation with staff and other family members to highlight the potential zoonotic nature of this bacteria. Avoiding consumption of raw, unpasteurized milk, ensuring proper hand hygiene, and wearing gloves when handling cattle is imperative. It may also be prudent to inform suppliers and cattle buyers, as they should practice additional biosecurity measures to prevent the spread of the bacteria to other farms.

The main sources of S. Dublin on farms are carrier animals that shed the bacteria in their manure and milk, especially at calving time, and calves that are clinically affected with S. Dublin and shedding large amounts of the bacteria in their feces. Therefore, when S. Dublin is diagnosed, effort should be placed minimizing contact of these animals with those that are susceptible to infection. Those that are particularly susceptible include[5]:

- Calves that are up to three months of age
- Immunosuppressed animals
- Animals in their first 14 days of lactation

As control practices will vary depending on the herd, working through a risk assessment form can be helpful to pinpoint which areas on the farm are the highest priority to address. A spreadsheet completed by Nielsen and Nielsen[7] is a useful tool (see spreadsheet here) to work through with the herd veterinarian.

In general, to best control this disease on-farm, focusing on stopping the transmission to and between young calves, but also lowering the levels of the bacteria in the environment, is critical. This can be accomplished by evaluating management of the calving pen and youngstock as well as having excellent cleaning and disinfection protocols. In addition, avoiding the purchase of additional infected animals is also important to lower the amount of the bacteria in the environment.

Calving pen management

The time of calving can be both a risk factor for infection of adult cattle and newborn calves. It is also at the time of calving that carriers will shed the greatest numbers of S. Dublin. Hence, one of the most important control points for S. Dublin is the calving pen. Specific practices that will help to reduce spread include[8]:

- Not using the calving pen as a recovery pen for sick animals
- Providing a clean, well-bedded calving area
    - Specific recommendations are to clean the calving pen at least twice a month and add bedding at least once a week or when the calving area has visible manure
- Ensuring that the majority of calvings (greater than 90 per cent) occur in the designated calving area
- Removing calves immediately after birth
- Use of individual rather than group maternity pens
    - If this is not possible and group maternity pens are used, having a maximum of four cows at one time has been found to reduce transmission

Youngstock management

Excellent management of youngstock is critical. Specifically, having clean, high-quality colostrum delivered to calves quickly after birth and feeding a high plane of nutrition (eight to 12 litres of milk per day) is key to building immunity not only against S. Dublin but also for many other diseases.

Beyond colostrum and nutrition, specific management practices to have in place for S. Dublin including:

- Isolating sick calves
    - Calves that are acutely affected with S. Dublin can shed the bacteria in high levels in their manure. Isolating sick calves so they do not have physical contact with other calves can reduce the levels of the bacteria in the environment of susceptible calves
    - When managing the sick calves, using different feeding equipment and even boots and coveralls can reduce the spread
- Having specific boots and coveralls for managing the calves
- Manage calves and heifers in groups at an appropriate stocking density
    - Ideally 35 square feet per calf preweaning will minimize exposure to fecal material

Cleaning and disinfection

Housing, feeding equipment, and other surfaces that come into frequent contact with manure are critical control points that, when cleaned and disinfected, will reduce transmission of this bacteria. It is important to clean and disinfect as S. Dublin has a tendency to persist in dairy and veal herds due to the environmental survival of the bacteria. Specifically, it is able to survive for months in cattle manure and soil, and for years in dried feces. It is also able to multiply in the environment under warm and moist conditions[1]. Therefore, cleaning all of the surfaces that calves may come in contact with is important to eliminate the spread of this pathogen. Specifically, the calving area, livestock trailers, calf pens, and feeding equipment should be the main targets for cleaning and disinfection.

Prior to using any type of disinfectant, remove all visible debris from the equipment or housing surface. This may be considered the most important step in decontamination of animal environments as even the best disinfectants will be minimally effective when feces or bedding material is present[9]. Cleaning the surface area will not only get rid of the physical barrier that could limit the contact of the disinfectant with the bacteria but also removes the majority of the bacteria so fewer need to be killed by the disinfectant. When cleaning, high-pressure washing should not be used due to the potential cross-contamination of the environment and aerosolization of contaminated material which could lead to animal and human infection.

For a complete cleaning and disinfection protocol, the University of Wisconsin-Madison has developed one specifically for *Salmonella* (see protocol here). In brief, the following steps that need to be taken to kill *Salmonella*:

1. Remove all bedding material or visible debris
2. Soak with water
3. Apply an alkaline foaming detergent and let soak for 10 min
4. Rinse with water
5. Apply an acid foaming detergent and let soak for 10 min
6. Rinse with water
7. Allow the area to dry
8. Apply a disinfectant
    a. Using oxidizing agents (i.e., accelerated hydrogen peroxide, chlorine dioxide), will kill S. Dublin

Vermin control might be another important consideration when cleaning the environment as mice have been found to be potential reservoirs for the bacteria. Ensure that bait traps are set to control vermin.

What about test and culling carriers?

Salmonella Dublin infections at the herd level often cannot be stopped solely by culling active carriers. In addition, test and culling strategies might not be the most cost-effective approach as within-herd transmission can be prevented without culling potential carriers[7]. However, once the transmission to calves is under control, it may be reasonable to begin culling carriers that have repeated positive blood tests to eliminate them as a reservoir for S. Dublin.

Continued purchase of animals from positive farms, however, is consistently identified as a significant risk factor for unsuccessful control of S. Dublin within a herd[8]. So, ensuring that, if animals need to be purchased, the cattle are not carriers is critical to preventing reinfection or further spread of the bacteria.

Developing a plan of action

After identifying the main areas to focus on, a plan of action will help to ensure that everything suggested can be attained and make follow-up a priority. The plan should contain:

1. A clear outline of what actions are to be taken
2. The person that is responsible for completing each action
3. Proposed date of completion for each action
4. Plans for when follow-up on the actions should be taken

This plan of action will help ensure that everyone is accountable. It is important to note that the infection of S. Dublin will not go away quickly and can take up to three years from initiation of control measures until positive herds achieve eradication of the bacteria[7].

Take home messages

Salmonella Dublin is rising in prevalence across North America. The biggest way to prevent it from coming on-farm is to avoid the purchase of animals, as they could be carriers that are shedding the bacteria but appear totally healthy. For veal farms, however, this is not a practical strategy and instead a focus should be placed on sourcing calves from unaffected farms. If a farm becomes infected, it is best to try to immediately minimize contact of susceptible animals with S. Dublin. The main areas of focus should be managing the calving area and youngstock as well as having cleaning and disinfection protocols in place. Avoiding the purchase of additional animals will also prevent potential reinfection. Producers should work with their veterinarian to help determine how to best prevent or manage S. Dublin on their farm.

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For more information:

References available upon request.

This fact sheet does not replace medical advice. Producers are encouraged to discuss preventative measures to limit the risk of S. Dublin occurring on their farm with their veterinarian, and work with them to accurately assess and diagnose any sick animals, especially if S. Dublin is suspected. New resources on S. Dublin will be made available for veterinarians to access in the Vet Portal on calfcare.ca.

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Veal Farmers of Ontario
449 Laird Road, Unit 12, Guelph, Ontario N1G 4W1
Tel: 519-824-2942
Fax: 519-824-2534
E-mail: info@vealfarmers.ca

Find us online:

www.vealfarmers.ca
www.calfcare.ca

Find us on social:

Twitter: @OntarioVeal
@CalfCareCorner
Facebook: @CalfCareCorner
@Finishing grain-fed veal in Ontario
@Marketing of male dairy calves in Ontario
YouTube: Calf Care Corner
OntarioVeal

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