Johne's Disease in Cattle

Adapted from the New York State Cattle Health Assurance Program

What Is Johne's Disease?

Johne's disease is a chronic, incurable bacterial infection that primarily affects the lower small intestine of ruminants, although the pathology and symptoms vary among species.

Infection most commonly occurs when young animals ingest the bacteria *Mycobacterium avium paratuberculosis (Map)*. After infection, the bacteria grow slowly inside the animal's intestinal cells. Over time, the animal's immune cells multiply in response to the bacteria's presence, eventually leading to thickening of the intestine, impaired ability to absorb nutrients, and clinical signs of Johne's disease in some animals.

Univ. of WI, School of Veterinary Medicine

Vermont Department of Agriculture, Food and Markets
Animal Health Section

Clinical signs of Johne's disease are delayed because of a two- to six-year or more incubation period. Signs of late-stage infection include weight loss, intermittent or sudden unresponsive diarrhea, but a normal appetite. Some animals are unthrifty or develop "bottle jaw"– fluid under the jaw caused by protein loss. Late stage animals continue to deteriorate and can die in a few days or a few months.

Johne's is a growing concern on farms across the country. According to the Dairy '96 Study conducted by the National Animal Health Monitoring System (NAHMS)[1], Johne's disease was present in at least 22 percent of U.S. dairies (only herds with 10 percent or more cows infected could be detected positive) and 3.4 percent of cows in the study. Forty percent of larger herds (>300 cows) tested positive, compared to 20 percent of smaller herds (<50 cows).

Only 7 percent of herds and 0.4 percent of cows in cow-calf operations tested positive, according to a Beef '97 NAHMS[1] study. This lower rate may be a result of extensive management on pasture and lower cull rates.

What Is the Economic Impact of Johne's Disease?

If many individuals in a herd become infected, control is difficult, and costly animal losses can be a drain on profits. Johne's disease in a herd is associated with some or all of the following costs:

- Premature culling resulting in increased replacement costs, increased cull rate, and loss of valuable animals and genetics
- Milk production may be decreased by 5 to 25 percent in the last lactation
- Decreased salvage value at slaughter owing to poor condition at culling
- Lost marketing and show opportunities
- Ineffective treatments and required drug withholding times
- Cost of testing and added management to prevent spread

A herd-level economic analysis of 934 herds in the Dairy '96 NAHMS study[2] estimated that in herds where at least 10 percent of culled cows had clinical signs of Johne's disease, the average annual adjusted loss was $245 per cow in the herd. The average annual adjusted loss across all the positive herds in the study was $100 per cow and the extrapolated loss to the national dairy industry was $200 million.

Does Johne's Disease Have Public Health Importance?

Some medical researchers suggest that *Map* may play a role in Crohn's disease, a chronic inflammatory intestinal disease in humans. Results of studies have been contradictory, and uncertainty about the public health risk of *Map* persists. Nonetheless, the concern has encouraged the dairy and beef industries and the government to direct more attention toward controlling Johne's disease and evaluating the safety of milk and beef products.

How Does Johne's Disease Occur?

Herds are almost always initially infected by the addition of inapparently infected animals. In the herd, calves are most susceptible to infection. Resistance develops with age, although youngstock and even mature cattle can be infected if they receive high doses of or consistent exposure to the bacteria. Health, immune function, genetic resistance, nutrition, and strain of *Map* may also play a role in Johne's disease, but little is known about these potential factors.

***Map* can infect an animal in three major ways:**

1. **Ingestion of manure in the calving environment that is from infected animals** or from the cow's legs, udder or teats.
2. **Ingestion of colostrum or milk from a cow that is in the later stages of *Map* infection.** Feeding pooled colostrum or milk exposes more calves to this risk.
3. **Infection of the fetuses by *Map* organisms that cross via the bloodstream from the affected dam.** This risk is less common but increases if the cow is in later stages of infection.

As infection progresses , the risk of transmission increases. Infected animals first shed *Map* in manure (stage II). Some may eventually disseminate it (stage III) to colostrum, milk, and the fetus and finally develop clinical disease (stage IV), shedding extremely large numbers of *Map.* In heavy shedders and clinical cows at slaughter, *Map* has been cultured from colostrum and milk samples from up to 35 percent of these cows and from 20 to 40 percent of their fetuses.[3] Recovery of *Map* was much lower from samples from subclinically infected cows: 9 percent of colostrum samples, 3 percent of milk samples, and 9 percent of fetal tissue samples.

Although they are not major causes of infection, bull semen, embryo transfer, and wildlife are other proposed routes that should not be overlooked.

When Does Clinical Johne's Disease Develop?

Clinical disease in cattle typically does not occur until maturity. Calves infected at a young age with a high dose of organisms, however, may develop clinical disease at less than two years old. The total number of clinical cases and the occurrence in two-year-olds, sometimes even younger animals, will grow as infection in the herd becomes more extensive.

Animals exposed at an older age (18 to 24 months or older), or to a very small dose at a younger age, are less likely to develop clinical disease. If they do develop it, it will occur later in life. Onset of clinical disease is often associated with stressful conditions such as calving, dry period, extreme temperature or environmental stress, feed changes, nutritional imbalances, relocation, or concurrent diseases.

How Is Johne's Disease Detected in Cattle?

Fecal culture can detect shedding of *Map* in 30 to 40 percent of infected animals and is the most accurate diagnostic test in live cattle. Its disadvantage is higher cost and may require several weeks or months for results.

Serology tests, such as the ELISA, measure the concentration of antibodies to *Map* and are less accurate but faster and less expensive. They identify cattle with elevated antibody (stages III and IV) and are best used to screen herds or groups for presence of infection. ELISA tests can produce false positives from cross-reaction with other organisms, so culture of positives to confirm shedding of *Map* is recommended. The AGID is a less sensitive but highly accurate serum test and a good test to confirm clinical cases.

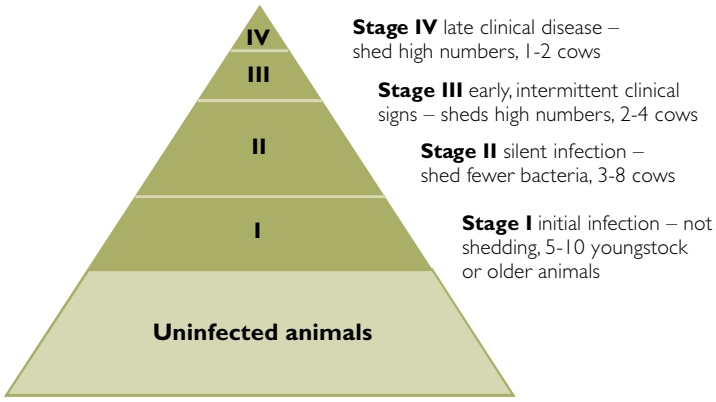
DNA probe tests detect unique genetic segments of *Map* and are under development for feces, milk, or blood. They may offer quick, accurate, diagnosis in the future.

The most accurate post-mortem diagnosis in cattle is histopathology and culture of the lower small intestine (distal ileum) and associated lymph nodes.

In general, Johne's disease tests fail to detect more than 50 percent of animals infected with *MAP* and serologic tests can be expected to give some (1-3%) false positive results. Nevertheless, Johne's tests are good tools and can be an important part of Johne's disease control when used in conjunction with good management practices. An appropriate herd management plan should be developed in consultation with the herd veterinarian and a diagnostic laboratory approved for Johne's tests by NVSL.[4]

What Are the Stages of Johne's Disease Infection ?

Stage I: Early, silent, subclinical, nondetectable infection. This stage is typical in youngstock less than two years of age and animals exposed to a low dose of *Map* or at an older age. This infection cannot be detected with fecal culture or serologic tests (ELISA). It progresses slowly, over months or years, to stage II. Some animals may resolve this early infection or simply never progress to the next stage.



Stage II: Subclinical shedders. Typically this stage occurs in older youngstock and mature cattle in which infection has progressed. Animals appear healthy but shed intermittently so that *Map* may or may not be detected on fecal culture. Fewer than 10 percent have enough antibody to be positive by an ELISA blood test. Risk of transmitting infection is less than at stages III and IV, but a high proportion of infected animals in a herd are in stage II, so they are a hidden source of infection.

Stage III: Intermittent, early clinical signs, heavy shedders. These animals may either appear healthy or have diarrhea or weight loss. They are likely to be detected through fecal culture and ELISA. *Map* is found in high numbers in manure and at lower levels in some animals (10–35 percent) in colostrum, milk, and the fetus. These animals are a high risk for transmitting infection.

Stage IV: Clinical Johne's disease, heavy shedders. Cattle in advanced infection classically have diarrhea, lose weight, and milk production and continue to eat. Signs often coincide with stress events. Occasionally, animals appear to recover but relapse after a subsequent stress event. Stage IV animals shed billions of *Map* in their manure, and circulating organisms are likely to be present in colostrum, milk, and the fetus. These animals are hazardous to the rest of the herd. They are "heavy shedders" on fecal culture, many are positive on serologic tests, and they are an enormous source of infection and premise contamination. This terminal stage may last a few days to months if animals are not culled. Moreover, carcasses may not pass inspection.

"The Johne's Iceberg"

In a herd where Johne's is established, every cow in stage IV represents several cattle in earlier stages. The distribution of infected animals in infected herds resembles an iceberg (Figure 1). Thus the clinical case (stage IV) of Johne's disease in a home-raised animal represents only the "tip of the iceberg" of infection in the herd. The number will vary depending on the degree and spread of infection in the herd, but 5 to 20 other animals may be infected for each clinical case. A single fecal culture test in a herd detects only 30 to 40 percent of infected animals, and 20 to 30 percent of these individuals will be in stages III and IV, shedding high ($>10^6$ colonies/gram feces) numbers of *Map*. The remaining 70 to 80percent will be in late stage II, shedding lower ($<10^3$) numbers of *Map*.

The iceberg illustrates the how Johne's disease is a hidden herd problem, which if ignored can fuel an increasing rate of new infection in each generation. Diagnosing and preventing Johne's before multiple clinical cases occur is the most effective way to prevent a widespread and costly infection.

What Should I Do about Controlling Johne's Disease on My Farm?

The best approach to Johne's disease is to have a plan and make it part of the routine. Learning more and discussing the prevention points with a veterinarian is a good place to start.

There are three key elements to prevention and control of Johne's disease:

► **Do Not Introduce Infected Animals into the Herd**

Johne's is usually introduced to a herd by addition of inapparently infected carrier animals. Risk of introduction can be reduced by knowing the source, requesting a history of health status and management programs for specific diseases, buying from lower-risk sources, initially isolating animals – particularly from youngstock – and instituting prevention practices.

► **Institute Preventive Risk Management Practices**

Routine management practices that prevent the most susceptible animals – *those less than 12 months and preferably up to 24 months* – from ingesting *Map* in manure, colostrum, milk, feed, and water are the most critical element in control of Johne's disease.

► **Identify Infectious Animals**

Spread of *Map* infection can be dramatically reduced by identifying and "removing" the most infectious animals by culling, segregating, or managing them differently. Recognizing and testing suspect animals should be a standard policy. Herd testing added to effective management programs can help in breaking the cycle.

The relative importance of various control and prevention measures will be different for each farm situation. In infected herds, control programs must focus on hygiene and husbandry. The top priority for uninfected herds is prohibiting entry by an infected animal. In both cases, an appropriate testing strategy can make the plan more effective.

Producers must also make a long-term commitment to Johne's control; thus herd plans must fit their current and future goals and resources. The important risks must be identified and then managed by realistic, routine procedures. From the start, plans should involve the employees who will be responsible for carrying them out.

Critical Management Points for Johne's Herd Plans to Reduce New Infections

The following principles can be adapted to dairy and beef operations.

Manage Manure ("All Manure Is Guilty")

- Prevent exposure of newborns to *Map* at calving by ensuring calves are born in a clean, dry area that is used *only*

for calving. Put cow-calf pairs on clean pasture.
- Provide youngstock with clean feed and water that is not contaminated with manure, especially from older animals.
- Raise youngstock in separate facilities or segregated from mature cattle and their manure.

Manage the Risk in Colostrum and Milk
- Feed colostrum from healthy cows, preferably ones that test as low risk. Minimize pooling: feed one cow's milk to one calf to reduce risk further.
- Use milk replacer, milk from healthy, low-risk cows (preferably those that test as low risk) or pasteurized whole milk. Minimize pooling.

Identify and Manage Infectious Animals
- Diagnose, and take aggressive action on clinical suspects and high risk animals. Segregate and cull immediately.
- Adopt a test strategy to manage high- and low-risk animals: cull, segregate, or manage to reduce the risk of infecting replacement animals. Coordinate test results to be available for critical decisions such as drying off, calving, breeding, pasture use, culling and replacement selection.
- When adding animals, consider the potential magnitude of risk in the source.
- Develop and integrate a Johne's management plan with other farm priorities and resources; identify responsibilities; put the plan in writing; regularly evaluate its effectiveness and modify it as needed.

Cattle Health Assurance Programs

Cattle health assurance programs being developed in many states can help identify the risks for the introduction and spread of Johne's Disease on dairy farms. Working with the herd veterinarian and farm managers, Agriculture and Extension veterinarians can assist in developing and reviewing a herd plan to deal with and prevent these risks. Writing out the farm plan and assigning responsibility for the specific practices to farm personnel increases the likelihood that the preventive practices will be implemented and that progress will be made toward the farm's Johne's control goals. These programs focus on best management practices and, if testing is part of the herd plan, may offer a discount on Johne's testing performed at approved diagnostic laboratories.

What If My Herd Is at Low Risk for Having Johne's Disease?

Farms at low risk of infection should consider pursuing test negative status through a state Johne's Herd Status Program. Herd owners who may want to position themselves to market added-value animals or products can consider becoming test negative. The U.S. Voluntary Johne's Herd Status Program is based on a cost-effective, four-level serial testing scheme that incrementally raises the assurance that a herd is at low risk of infection.

Notes

1. NAHMS, Centers for Epidemiology and Animal Health, USDA, APHIS. Fort Collins, Colo.
2. Ott, S. L. et al. 1999. "Herd-Level Economic Losses Associated with Johne's Disease in U.S. Dairy Operations." *Preventive Veterinary Medicine* 40: 179–192.
3. Sweeney R. W. 1996. "Veterinary Clinics of North America." *Food Animal Practice* 12:305–12. July .
4. The National Veterinary Services Laboratory in Ames, Iowa, conducts an annual check test for diagnostic laboratories performing Johne's testing. Participating labs are listed at the USAHA web site (see below).

Additional Sources of Information about Johne's Disease

NYSCHAP Johne's Module and Resource Materials
http://nyschap.vet.cornell.edu

Vet Clinics of North America: Food Animal Practice, Paratuberculosis, Vol. 12, July 1996.

http://johnes.org/ (University of Wisconsin School of Veterinary Medicine Johnes Information Center)

www.aabp.org (American Association of Bovine Practitioners [AABP] web site): Articles on Johne's disease

www.aphis.usda.gov/vs/ceah/cahm: Studies conducted in US Dairy and Beef herds by CEAH, USDA, and APHIS-NAHMS

www.crohns.org: Paratuberculosis Awareness and Research Assoc.

www.ifst.org/mptbeda.htm: (UK Institute for Food Science and Technology): Information on *Map* in milk

www.niaid.nih.gov/dmid/crohns.htm (NIAID, NIH): "Crohn's Disease – Is There a Microbial Etiology?"

www.usaha.org (U.S. Animal Health Association): Johne's Herd Status Program and other topics

National Cattleman's Beef Association. Should you be Concerned? Producer publication. Englewood, CO 80155-3469 303-694-0305

Stabel JR. Symposium: Health and Safety on the Dairy Farm. Johne's Disease and Milk: Do Consumers Need to Worry? J Dairy Sci, 83: 1659-1663, 2000

Workbooks for dairy and beef veterinarians: Designing Johne's control programs – the USAHA Website under Prevention and Control of Johne's Disease in Dairy Herds http://www.usaha.org/njwg/jddairym.html and *Bovine Practitioner,* May 1999.

Bovine Paratuberculosis (Johne's Disease) Information Sources, John M. Gay, DVM PhD DACVPM ACE Field Disease Investigation Unit, http://www.vetmed.wsu.edu/courses-jmgay/paratuberculosis.htm

Vermont Department of Agriculture, Food and Markets
Animal Health Section
116 State Street
Montpelier, VT 05620
Phone: 802-828-2421