

# **On-Farm Management Systems to control Johne's Disease**

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**November 2001**

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# Acknowledgements

I would like to thank the following people for their assistance in providing information to enable me to complete this report.

Wendy Law - NZMP Edgecumbe Library

Stephen Hopkinson - South Taranaki Animal Health Services

David Hayes - Animal Health Manager, Livestock Improvement

Lindsay Burton - Principal Veterinarian (Animal Health & Welfare), Livestock Improvement

I would also like to thank Clare Bayly (Public Relations Manager, Livestock Improvement) and Kathryn Wade (Personal Assistant, Livestock Improvement) for their help in compiling this report.

# Introduction

The report:

1. Gathers available research statistics and findings on the identification and treatment of Johne's Disease (JD) in the New Zealand dairy cow population.
2. Makes recommendations on its control through a variety of management systems.

## Background

Johne's Disease is an infectious bacterial disease that primarily affects the intestinal tract of bovine and other ruminant animals.

It is caused by a mycobacterium named *Mycobacterium avium* subspecies *paratuberculosis*. The microbe is only able to multiply inside an animal's intestinal tract. However, the development of clinical disease does not occur instantly and, in some instances, the organism is known to survive for more than a year in the intestinal tract. The microbe is also resistant to heat, cold and drying and can survive for considerable periods in the environment.

The main source of infection is directly from infected animals. Johne's Disease is as much a herd problem in New Zealand as it is a problem for individual animals.

There are some recent, but unconfirmed, reports of culturing the microbe, or detecting its genetic components in humans with Crohns disease.

Johne's Disease is an animal health problem which affects ruminant animals the world over. It therefore has implications for trade of dairy products as consumers become concerned and informed of animal health issues. It is therefore desirable that livestock industries take a proactive stance in increasing industry awareness and management measures to control the disease.

One of the most difficult factors in the control of Johne's Disease is the slow progressive nature of the disease. Physical evidence of the disease may not be evident for several years after initial infection. When signs do appear they are intermittent bouts of diarrhoea progressing to chronic diarrhoea with weight loss, despite apparent good appetite. Clinical signs in infected cattle commonly show up within a few weeks of a stressful event such as a calving. This is why it is commonly known as a "Stress Disease".

In the sub clinical stages, cattle are more susceptible to other infectious diseases. They may suffer from inefficient utilisation of nutrients causing a drop off in production even though the animals appear to look well. In a trial in the United States production losses of up to 15% were recorded between clinical and sub clinical groups of cows<sup>1</sup>.

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<sup>1</sup> Elizabeth Brett 1998 JD. An economic evaluation of control options for the NZ livestock industries.

# Common Sources of Infection

## 1. **The most common source of infection is faeces or manure**

Except under unusual circumstances infection takes place during the first few months of life of the animal. Animals become more resistant with age, though resistance is never complete. If given a sufficiently large dose of the bacteria, adults can become infected. Nevertheless, under good animal husbandry conditions exposure to such large doses rarely occurs.

The majority of infections in young animals are acquired by ingestion of the bacteria. This happens accidentally when they consume manure containing the bacterium. Sucking on manure contaminated teats, licking contaminated bars in the pens where they are being raised in a location where they have access to manure from the adult herd are ways young animals ingest this microbe.

Johne's Disease typically enters a herd when infected, but healthy-looking animals, are introduced. As the disease progresses, the frequency and number of bacteria being excreted increases meaning that an animal in the early and late clinical stages of the disease can excrete billions of Johne's microbes per day. The infection thus spreads to calves and herd mates without the owner's knowledge.

## 2. **Another source of infection is milk from infected dams**

The likelihood of Johne's Disease bacteria being excreted in milk of infected females increases as the disease progresses. Studies suggest that 36% of cows in the early and late clinical stages of the disease could have Johne's microbes in their colostrum and milk. In beef herds, where calves remain with their mothers longer than their dairy counterparts and nurse daily, the chance for transmission of the infection through colostrum and milk is high. These bacteria may be excreted directly through the mother's milk.

### 3. **In-utero exposure as a source of infection for calves**

It is possible for a foetus to become infected in-utero if its mother is in the late stages of disease. Studies have shown that 8% to 50% of foetuses were infected in-utero when their mothers were in the early to late clinical stages of the disease. Infected foetuses can abort, or they could be born live and grow to become infected adults.

It is unknown how in-utero infection affects diagnostic tests on those animals that survive to adulthood. Risk for infection of the foetus is low from dams in the sub-clinical stages of the disease.

### 4. **Standing water**

Ponds and water troughs contaminated with infected faeces may be a source of Johne's Disease. Other possible, but less likely wet sources, are pastures contaminated with lagoon water from heavily infected herds.

# Prevention and Control of Johne's Disease in Dairy Cattle

Johne's disease is an intracellular intestinal infection caused by the acid-fast bacterium, *Mycobacterium avium* subspecies *paratuberculosis*. The infection eventually causes weight loss (despite good appetite), drop in milk production, diarrhoea (sudden onset or intermittent) and death. Some cows may develop "bottle jaw" due to a low protein oedema, or appear unthrifty overall. Clinical signs of the disease occur more commonly during the end stages of the infection, typically at three to six years of age or older.

Usually the infection is chronic and mostly sub clinical in nature. Only 1-5% of infected cows in a herd may show signs of the disease each year while the rest appear healthy. Thus, Johne's Disease should be regarded as a herd problem. A cow with clinical Johne's Disease represents the "tip of the iceberg" of infected animals in the herd.

Johne's Disease can be prevented, controlled and even eliminated from infected herds by applying critical management points that are based on an understanding of the epidemiology and pathogenesis of the disease.

Prevention or control of Johne's Disease takes commitment and time. Half-hearted attempts to prevent or control the disease will generally fail. Once the pathogen is brought into the herd the infection can spread through the herd for a few years before clinical cases are noticed. A typical herd control programme may take five years or longer. A shorter period is possible but may be more expensive. Prevention is in all ways cheaper than control.

## Prevention

The basics of prevention are straightforward. Prevent introduction of the microbe by closing the herd to infected replacement or herd-addition animals and guard against entry of equipment, feed and water contaminated with manure.

Current diagnostic tests for Johne's Disease are marginally adequate tools for use in disease prevention at the herd level. However, they have low accuracy in detecting the early stages

of infection, even in mature animals. Negative test results from immature animals (< 24 months of age) for Johne's Disease may be of limited value.

Confidence that an animal or herd is not infected requires repeated tests with negative results, taken over time.

## **Control**

1. *Prevent infection by closing the herd to animals with an unknown JD infection status*
  - a) Acquire from a test-negative herd owner:
    - owner has individual cow/calf data
    - practices critical management points
  - b) Pre-test mature cow additions:
    - only when acquired from outside sources of unknown Johne's Disease infection status
    - test them again two or three times at 6-12 month intervals
  
2. *Secure replacements and additions from herds that are at low risk for Johne's Disease.*
  - a) Acquire from a herd with negative Johne's Disease history:
    - owner and veterinarian document monitoring and the herd has had no Johne's Disease for past five years.
  - b) Acquire from a herd with low Johne's Disease prevalence:
    - tested positive for Johne's Disease but history and test results indicate low prevalence.
  - c) Acquire from a herd that tests negative on a sub-sample of the herd:-
    - negative test results from 30 randomly chosen cows, > 4 years old, likely indicate that, < 10% of the cows are infected.

Control of Johne's Disease would require regionally co-ordinated efforts by animal health authorities, vets and farmers. It must be based on sound policies underpinned by knowledge of the behaviour of Johne's Disease in individual animals and the patterns of spread and persistence of the organism in animal populations. However, this knowledge is incomplete and requires regular reassessment as new information becomes available.

Infection of animals may cause clinical disease, but this is not necessarily essential to the organism. To survive, the organism needs to colonise, replicate and be shed so the rate of recruitment of new bacteria is equal to or greater than the rate of loss of bacteria from the population. Central to efforts to detect and control Johne's Disease is acceptance that the presence of obvious clinical disease is not required for spread of the organism in animal populations.

The main route of transmission is faecal-oral, either from contaminated teats during suckling, or pasture and soil, water or contaminated surfaces. Observation and experimental evidence, particularly from cattle, suggests that young animals are more susceptible to infection than older animals.<sup>2</sup>

### **Tests for Detection of Infected Individuals and Population**

The critical issues for detection and control of Johne's Disease relate to the prolonged incubation period and the fact that non-lethal tests generally must be used. This removes the opportunity to assess an animal's classification by the most sensitive method, culture of intestinal tissues, except by biopsy. Unfortunately transmission of infection to other animals is possible prior to ante mortem tests becoming accurate - long before clinical signs develop.

### **Control and Eradication of Paratuberculosis**

The spread of Johne's Disease from farm to farm is usually due to trading of livestock but lateral spread of faeces across boundary fences also occurs. Achieving regional surveillance requires monitoring of past movements of livestock from infected farms; this is known as a trace-forward investigation. If infection is confirmed by examination of the intruded livestock, it is then necessary to determine whether the infection has been transmitted to the exposed stock. Apart from considerations such as likely amount of shedding by the introduced animals (which can be assessed by both faecal culture and histological examination) the amount and duration of contact with exposed stock and the age of the exposed stock at the time, a critical consideration is the time elapsed since the most recent contact with infected stock. It is generally necessary to wait several years to determine whether transmission has occurred.

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<sup>2</sup> Hagan WA. Age as a factor in susceptibility to Johne's Disease. Cornell Vet 1938; 28:34-40

## **Conclusion**

Detection and control of paratuberculosis is complex. Great appreciation of the mechanisms of persistence and spread of Johne's Disease in animal population and the ranges of clinicopathological outcomes possible after introduction of the infection is required.

An understanding of the variable performance of tests at different stages of the disease will lead to more effective detection and control strategies and better understanding of such programmes in the livestock industries.

## Economic Analysis

In commercial herds, the economic impact of Johne's Disease will tend to be confined to herd productivity losses. The economic analysis<sup>3</sup> was limited to estimates of the current known effects of clinical Johne's Disease to the pastoral livestock industries at the farm gate, with some estimate of the possible costs associated with sub-clinical Johne's Disease in dairy cattle.

(Sub clinical disease refers to the period when the animal is infected with the bacterium but cows do not display the visible signs of infection. Clinical disease refers to the period when the animal shows the visible signs of disease, i.e., scouring, weight loss).

There is speculation within the dairy industry about the potential for Johne's Disease to have a negative influence on trade barriers for exports of New Zealand dairy produce to some markets.

The disease is known to affect around 12% of dairy herds but thought to affect upwards of 60% of New Zealand herds. However, most infected herds experience only low levels of clinical disease of less than two clinical cases per year. At known infection levels, Johne's Disease is estimated to cost the dairy industry \$3.8 million but this could be as high as \$18.9 million if non- official estimates are used.

### **Test and Cull Programme**

A test and cull programme would involve regular testing of all breeding stock and the subsequent culling of all infected animals. The commonly used test in cattle (ELISA test) will only detect 25% of all sub-clinically infected animals.

For a dairy producer whose main concern is maximising milk production, isolated calf rearing is the most economic option for a herd with one or more clinical cases per year.

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<sup>3</sup> Elizabeth Brett 1998 JD. An economic evaluation of control options for the NZ livestock industries.

## **A Blanket Ban on Exports**

A blanket ban on products from countries with Johne's Disease would seem highly unlikely as Johne's Disease is endemic in many countries and regions including the United States and European Community. The World Trade Organisation agreement on non-tariff barriers restricts the use of disease as a trade barrier if it is also present in the importing country.

Improved market access to information about the disease could raise public awareness and thereby help to minimise the spread of Johne's Disease through the livestock industries and help to minimise its cost to the pastoral industries. The objective of market assurance programmes, which classify herd according to their disease status, is to increase the quality and quantity of information about stock for sale.

One such programme, The Australian National JD Market Assurance Programme (NJDMAP), has been introduced in Australia to limit the spread of Johne's Disease in the cattle industries. Herds in the programme are repeatedly tested and classified with a specified number of clean tests indicating freedom from the disease.

The key to controlling the disease is to have a range of disease control options available to livestock producers. The level of infection in individual herds determines whether any control is required, and which option provides the most appropriate form of disease control.

The effect on milk productivity may increase as the infection progresses. Buergelt and Duncan (1978) observed a 16% and 8% decrease in milk production in cattle with clinical and sub-clinical Johne's Disease, respectively. Studies by Benedictus et al (1987) showed that in Netherland herds, cows experienced milk loss in the two lactations prior to either the emergence of clinical signs or the detection of the sub-clinical infection.

Only some animals progress to the clinical stage of the disease<sup>4</sup> which usually occurs between 4 to 8 years of age. The clinical stage can be induced by a number of factors, including stress when cows are moved to a different herd, an intensive production system,

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<sup>4</sup> Clinical disease refers to the period when the cow shows the visible sign of the disease, i.e., scouring, weight loss

or simply an individual animal's weak immune system. According to Doyle (1956) and Desmecht (1975), high producing cows are more likely to develop clinical signs. Clinical cases suffer significant loss of condition and severe, non-treatable diarrhoea. Certain death follows, as there is no treatment available.

Young calves are commonly infected from their mothers and bacterium can also be transferred from infected mother to offspring in utero. Around 10% of calves born to sub-clinically infected cows and about 50% of calves born to clinically ill cows are already infected with the bacterium.

### **Disease Control Options**

Effective management of Johne's Disease in infected herds can reduce the economic losses caused by the disease. Current strategies for managing infected herds aim to minimise disease spread and economic loss from clinical cases. It is not possible to eradicate Johne's Disease with certainty due to the difficulty in diagnosing infected animals in the early stages of the disease.

An economic analysis of disease control options was conducted to observe which option delivered the best returns to producers<sup>5</sup>. The two main disease control strategies studied in the report were Test/Cull and the Vaccination programme. The objective was to reduce the level of infection in the herd but not necessarily to eradicate it. These options could be operated in conjunction with the following On-Farm Management Systems.

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<sup>5</sup> Elizabeth Brett 1998 JD. An economic evaluation of control options for the NZ livestock industries.

# On-Farm Management Systems

1. **Keep calving mobs on clean pasture**

This could be quite difficult to achieve on many farms as weather conditions influence the cleanliness of the calving paddock.

2. **Take calves away from mothers immediately and feed them colostrum from cows tested to be free of Johne's Disease or use milk replacer.**

Taking calves away from their mothers and feeding them colostrum requires additional labour so the cost of this option has to be weighed against the benefits. Collecting colostrum from cows tested free from Johne's Disease is another issue as it is very difficult to test cows for 100% clearance from the disease. Colostrum milk replacer is available commercially.

3. **Keep calves in pens that are free from contamination from cows.**

This is practised on most farms today and only requires management to ensure calves are contained in facilities that are not contaminated by cows.

4. **Continue feeding calves milk from cows tested free of Johne's Disease or use milk powder.**

As mentioned before, it is difficult to test cows 100% free of Johne's Disease so the use of milk powder is an option. Alternatively, collecting milk from young cows reduces the risk of infection as young cows generally have lower levels of bacterium in their milk.

5. **Pasteurise milk to be used for calf rearing.**

Pasteurising is an expensive alternative but one which might be feasible if farmers combined in groups to share the costs.

6. **Select paddocks which are isolated (from other stock on the farm) to take calves when they are released from the calf shed, or when they are weaned.**

This option would require farmers to select paddocks for calf grazing which had not been used as holding paddocks for the herd as these paddocks would have a high level of contamination.

7. **Do not keep calves from clinical cows.**

Farmers could consider the option of not retaining calves from cows that are known to have Johne's Disease as these calves have a significant risk of carrying the disease.

8. **Refrain from grazing young calves on pasture which has been used for effluent disposal.**

It is not prudent to graze young calves on paddocks which have been used for effluent disposal as Johne's Disease bacteria is known to flourish in environments adjacent to oxidation ponds. When effluent is sprayed onto pasture, Johne's Disease bacteria has been known to survive up to 12 months.

9. **Only purchase calves from herds known to be free of Johne's Disease.**

Currently this presents difficulties as few dairy farmers (other than those with clinical cases of Johne's Disease) are aware of the infection level within their herd/s.

## Conclusion

Current research suggests it is not possible to eradicate Johne's Disease from the national dairy herd, making it essential that farmers consider control options.

However, until an industry requirement is agreed it is unlikely that farmers, generally, would adopt management practices to manage the disease if those practices imply effort and/or cost. Success of any industry initiative to encourage farmer action would, therefore, on the financial implications of inaction for the individual farmer, let alone the industry.

Any industry campaign <sup>should</sup> ~~would~~ be supported by a national Johne's Disease monitoring programme which would record levels of herd infection and which would, thereby, guide farmers to the appropriate management option.