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Why is Participation in Johne's Disease Testing Programs so Low, and is it Important to Increase Johne's Surveillance in the Dairy Industry?

The Utah State Paratuberculosis (Johne's Disease) Control Program is part of the US nationwide Voluntary Bovine Johne's Disease Control Program. Nearly every state in the US has a similar Johne's Disease (JD) control program, and they are seeing the same trends as we have in Utah: **dairy veterinarians and producers are participating in JD testing at levels that have progressed from low to extremely low**.

Funding through the USDA APHIS (Animal and Plant Health Inspection Service) makes possible these **existing financial incentives to help encourage dairy veterinarians and producers to participate in JD testing**:

- $250 per annual herd risk assessment to the herd veterinarian, paid for each risk assessment whether initial or annual re-assessment
- $250 per year to dairy producer to remain in the JD control program
- $4 sample collection fee per sample to the collecting veterinarian
- $250 reimbursement for on-line training to veterinarians (Utah veterinarians must re-certify every 2 years) (*Dr. Bruce King, Assistant State Veterinarian, will also re-certify Utah veterinarians*)

However, at present, these are some numbers regarding testing for JD in Utah, which currently has 285 dairy herds with 88,000 lactating dairy cows:

- 11 dairy herds tested cattle for JD from July-Dec 2006
- 4 dairy herds tested cattle for JD from Jan-April 2007
- 297 cows (0.3% of lactating cows in Utah) were tested for JD from Jan-April 2007
- 8 dairy veterinarians from among an estimated 30 dairy veterinarians in Utah are certified, and most of them that must recertify this year have not yet done so

Part of the reason why testing for JD is low is probably some negative dogmas/truisms that have developed regarding JD testing:

"Producers do not demand JD testing because it is not financially important"

"Many dairy herds are closed, and probably do not have the disease. We have never seen a cow that looked like a clinically infected cow in the herd"

"All of the tests for JD are poor, especially with low sensitivity, so testing does not make sense"

"Management practices are so important to control of the disease, that if they are in good shape, testing is not necessary and may even waste money"

"It is very difficult to eradicate JD completely from a herd, so using management practices to maintain it at a low level makes more sense than testing"

I will attempt to address each of these points later in this article, but first I would like to include the following article by Dr. Warren Hess, from Utah Dept. of Ag. and Food:

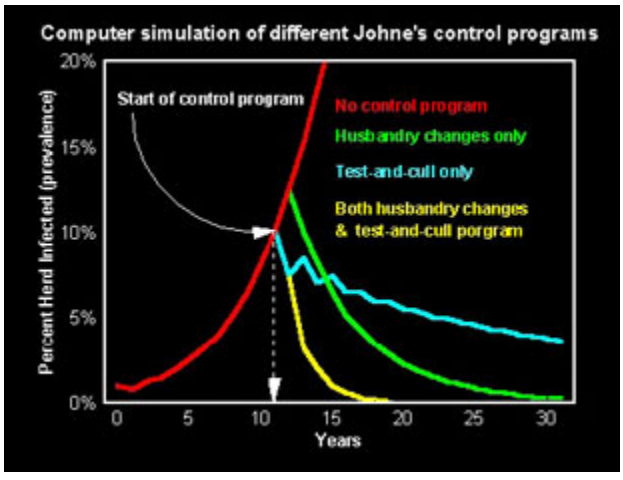
A Veterinarian's Guide to Discussing Johne's Disease with Herd Owners and/or Managers

By Warren J. Hess, DVM
Field Veterinarian
Utah Department of Agriculture and Food

Mycobacterium avium species *paratuberculosis* (MAP or Johne's disease) is an acid fast organism that causes mainly gastro-intestinal symptoms in cattle. The incubation period can be quite variable (months to

years). By the time outward clinical signs are evident (chronic diarrhea and weight loss) not only has the owner already lost a significant amount of unrecoverable revenue (i.e. lost milk production), but he/she has also had the infective organism shed on the premises for months if not years. MAP organisms can survive in the environment for weeks to months and perhaps even years. By far, the most susceptible age of cattle is newborn calves. As a general rule, the older the animal gets, the more resistant it is to infection with Johne's Disease. MAP infection has in the past, and continues to have today, the potential to completely decimate herds.

As can be seen in the following graph, within 10 years of MAP being introduced into a dairy herd, infection rates increase exponentially. With no control program in place, infection prevalence can exceed 50% of the herd within 20 years. After infection prevalence exceeds 10% in a herd, most herd managers/owners realize that they have a significant problem. Our goal as herd consulting veterinarians is to help the manager "see" that prevention is much more desirable than management only after the disease is present, or only after the prevalence is high within the herd. In fact, as the following graph depicts, managing a herd after it reaches a 10% infection prevalence of Johne's Disease can take 5-10 years to approach a 1-2% infection level, and it may never be possible to completely rid the organism from the herd. It also tells us that husbandry changes alone are far more effective than test and cull methods alone. Test and cull WITHOUT husbandry changes is often a waste of everyone's time and money. By far, the most effective husbandry changes involve protecting the newborn calf from the MAP organism. This is the main reason for the Risk Assessment/Management Plan that is to be completed annually on each farm participating in the Utah State Paratuberculosis (Johne's Disease) Control Program, part of the US nationwide Voluntary Bovine Johne's Disease Control Program.



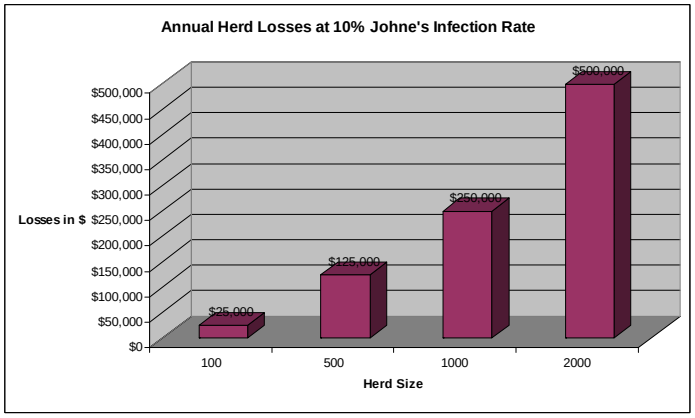
This graph depicts a computer simulation of different methods for control of Johne's disease. It is based on a herd of 100 milking dairy cattle where one cow was infected with *M. paratuberculosis* at the start of the simulation (year 0), and a control program was started when the prevalence of infection in the herd reached 10% (year 11).

The model illustrates:

1. **After the prevalence of *M. paratuberculosis* infection in a herd has reached approximately 7%, the infection spreads quickly.**
2. Different methods of control decrease the prevalence of infection at different rates.
3. **The fastest method of infection control results when animal husbandry changes are made AND a test-and-cull program is instituted.**

Disclaimer: *This is only a mathematical model based on probability statistics and epidemiology. It is not designed to predict results in individual herds; successful control of Johne's disease may be accomplished much faster or slower depending on many conditions specific to each farm or herd. Models of this type are most useful to demonstrate concepts and relationships for teaching purposes.*

Unfortunately, herd owners/managers best recognize actual money lost/gained and not unrealized money lost/gained. If they never thought it was possible, they tend not to miss it. Our job then, is to make sure that the owner/manager fully understands the unrealized gains/losses that their herd might experience. The following graph shows the potential loss (or gain) that a herd with a 10% prevalence of MAP infection might experience.



Most of the losses in a dairy herd come from lost milk production potential. Each infected cow has the potential of losing 1,000 – 6,000 lbs of milk in its

current lactation. Total lifetime milk production can be decreased by as much as 28% in an infected animal.

A herd that has a high potential for acquiring MAP infection (or that already has it) likely is also at risk for (or already dealing with) many other husbandry related diseases such as mastitis, scours, LDA's, lameness, respiratory disease etc. The losses/gains that we have been discussing do not take into account additional money related to these other diseases.

We should make sure that the dairy producers we consult for receive the biggest bang for their buck. The most effective husbandry measures are separation (ASAP) of the newborn calf from its mother. Individual calving stalls and appropriate cleaning/disinfection are also musts. Feeding un-pooled colostrum from ONE SINGLE test negative cow to ONE SINGLE calf is a method to decrease spread of MAP. The use of milk replacer or the use of pasteurized milk fed to calves is another way of decreasing the likelihood of calves becoming infected with MAP. If owners/managers are not willing to make these essential changes, testing and culling will not likely be of great help to them in decreasing the prevalence of MAP in the herd.

Environmental sampling can be a very cost-effective method of determining if a farm has MAP on its premise. Several swabs are taken from cow housing areas of the farm, including alleyways (the most common single environment where MAP has been detected), manure storage, calving, sick cow and fresh cow areas, and submitted for organism detection (culture or PCR). This should be repeated several times over the course of several months. If MAP is detected, the next area of emphasis should be in testing cows that colostrum is to be collected from. Only test-negative cows should have colostrum collected and fed to calves. Testing should <u>never</u> be done unless the farm knows IN ADVANCE how it is going to respond to a positive test. Waiting until the results come back and THEN deciding what to do generally results in poor decisions being made and again a waste of time, money and resources. It is part of the herd veterinarian's job to urge that those decisions be made before testing is begun.

If a herd owner/manager desires to verify and/or certify the Johne's Disease status of their herd, individual testing of animals then becomes warranted. Testing should generally be reserved for those cows in their second lactation or older. Several studies have shown that there is not much difference in the accuracy (sensitivity and specificity) of ELISA and PCR tests (at least the ones that we use here in Utah). Pooled PCR tests of fecal samples can be cost-effective in herds that are at low risk for infection or that are known to have a low prevalence of MAP. **ELISA testing of individual cows (serum or milk ELISA have recently been shown to have the same sensitivity as fecal PCR when testing individual cows) is more economical for herds that have a higher risk of infection or that have a known prevalence of infection**. Fecal cultures should be used to verify ELISA or PCR-positive animals before culling is considered.

(Dr. Hess's article ends here)

I would like to return to some of the points often cited as reasons why JD testing is not done very often:

"Producers do not demand JD testing because it is not financially important"

As mentioned above, each infected cow has the potential of losing 1,000 – 6,000 lbs of milk per lactation. It has been found in previous studies that cows with JD begin losing milk production early in their second lactation, and the **average milk loss from JD during the second lactation was more than 1,500 pounds per lactation**. Among JD-positive cows in **third or greater lactation, the mean milk loss was approximately 3,000 pounds per lactation**. It can be controversial to suggest a milk price/cwt when calculating financial loss, because since the end of the M-W (Minnesota-Wisconsin) milk pricing system in 1993, milk prices have fallen and risen more rapidly over the years than previously. However, **with current projections of Class III milk price between $18.50 and $19.00/cwt, it certainly may be reasonable to suggest a milk price of at least $15.00/cwt for some time into the future**, but individuals can always **substitute their own current mailbox price at any time**. If we use a milk price of $15.00/cwt, the above figures suggest average losses of **$225.00 to $450.00 per lactation per infected cow**, making JD one of the most expensive diseases in the dairy industry.

Of course another essential part of this issue is the prevalence within infected herds; how many cattle are usually infected within a herd that has at least one cow with JD? It has recently been estimated that **of the dairy herds infected with JD, most have 5- 10% of the cows infected (the most specific estimates are usually 7-9%).** If we suppose that the a herd has 7% of the cows infected with JD, together with above figures, this suggests herd-wide losses of (0.07 x $225 to $450) = $15.75 – $31.50 per cow per year, or **$4725.00 - $9450.00 per 300 cows per year**; **$15,750.00 - $31,500 per 1,000 cows per year**. This is an expensive disease within the **average infected herd**. Those numbers are based strictly on milk loss alone. Another recent study

actually estimated JD costs at $50 per cow per year across the herd, accounting for other factors in addition to milk loss, including reproductive, carcass value, and premature culling losses.

"Many dairy herds are closed, and probably do not have the disease. We have never seen a cow that looked like a clinically infected cow in the herd"

I have visited many dairy herds where there is a history of, or I have actually seen, at least one cow that appears to be a classical case of JD. Very thin, but bright and alert, and with good appetite despite chronic weight loss. There may or may not be a history of intermittent diarrhea. However, many times for various reasons there is a rationale of why this cow cannot be a JD case, and no testing has been done. Also, even in herds with considerable prevalence of JD, many cows do not progress to classical signs of JD before they are culled or die for other apparent reasons. I have seen two herds that were decimated and went out of business from JD, and at any given time there were relatively few cows with classical clinical signs.

Also, consider the decline in percentage of closed dairy herds. Several recent studies have found that the **single factor most associated with preventing introduction of JD into a negative herd is maintaining a closed herd**, which seems logical. In the mid-1990's it was estimated that 56% of dairy herds had been closed to outside animals for at least one year. In 2000, it was estimated at 44%. I have been unable to find a current reference on estimated percentage of US dairy herds currently closed; I suspect it is a decided minority. However, dairy veterinarians are not always aware whether clients with a long-time closed herd may have recently begun to purchase animals. More and more dairy farms are buying at least some animals from dispersal sales or livestock dealers as other producers leave the dairy industry. Dairy veterinarians should not assume that herds they think of as closed have remained completely closed unless they ask about this periodically.

Unless a dairy herd has been completely closed to outside animals since the last previous testing of at least a good portion of the herd found no JD, it is difficult to impossible to say whether the herd is free of JD.

Another important question today is what percentage of US dairy herds have at least one cow infected with JD? **It has recently been estimated that up to 80% of US dairy herds are infected**. We must acknowledge that this number is not precisely known, because of the low level of current testing for JD. It is almost certain that the prevalence of infected herds has decidedly increased from the early 1990's when it was estimated that 25-50% of herds were infected.

Most of our dairy producers are ignoring, or largely ignoring an important and costly disease in their herds.

"All of the tests for JD are poor, especially with low sensitivity, so testing does not make sense"

One of the most common criticisms of JD testing, given as a reason for not testing, is this one, and it is not without some foundation. Sensitivity of JD tests (ability to detect truly infected animals with one test) is usually reported as 25-35% for serum or milk ELISA, 25-35% for PCR of feces, and 55-65% for culture of feces. However, different JD ELISA tests used throughout the world have had sensitivity reported between 10-77%. A new type of ELISA for JD that includes test antigen preparation with sonication called the **SELISA has been reported to have sensitivity and specificity of 95%**. The authors stated that it is "appears superior to the commercial ELISAs routinely used for the diagnosis of JD". If there is further development and eventual adoption of this test, and it indeed performs with high sensitivity and specificity, it will become one of the best diagnostic tests we have for any disease in livestock. In addition, several studies have shown that **sensitivity of fecal culture in cows shedding moderate to high levels of MAP in feces is greater than 80%**. Sensitivity of the other tests is also higher when applied only to strongly infected (usually defined as heavy fecal shedders of MAP) cows.

It would be ideal to have more sensitive tests for JD. However, the best ELISA and fecal culture sensitivities reported for detecting JD are superior to those of SCC and CMT for detecting truly infected cows with mastitis on one single test. The tests we have can indeed be very valuable and useful. I think there are some compelling reasons why we should do more JD testing, in far more dairy herds than are currently testing, but I will address them further below after considering some other important factors.

"Management practices are so important to control of the disease, that if they are in good shape, testing is not necessary and may even waste money"

Management practices are indeed important. This is especially true of environmental management of manure, and cleanliness around baby calves. However, we must consider at least two other very important factors about JD: transmission to calves in utero, and what is the goal

of a JD control program in most commercial dairy herds? **Specifically, are we trying to eradicate JD, or keep the level below the "tipping point" above which it is likely to spread to much higher levels in the herd?**

There has been surprisingly little study of transmission of JD in utero. It has been found that 75% of JD-positive cows have uterine fluid containing MAP, and 26% of calves born from positive cows are infected with JD in utero. This suggests that there is nothing we can do from the time calves are born to uninfect one-fourth of the animals with JD in our herds, because they were born with it. **All the management practices we can think of cannot prevent JD in 1-3%, one-fourth of the total of 5-10%, of the cows with JD that live in most of our herds, if they are born with it.**

The article by Dr. Hess includes an interesting graph. It suggests that as soon as the prevalence of JD in a herd has reached approximately 7%, the rate of new infections increases. After the prevalence reaches approximately 10%, the infection rate can increase dramatically. **According to the data available, we have many herds living "on the edge" of JD increasing dramatically in the herd.** I think the two goals of JD testing in most dairy herds should be to determine for sure whether they are infected with JD, and to maintain a relatively low level of the disease (the first goal might be less than 5% of the herd) consistently, rather than to attempt to eradicate it. There is no evidence to support the concept that we can even achieve the low level in most herds with management practices alone. In fact, in the only study of over 700 dairy herds to evaluate Risk Assessment alone and its relationship to prevalence of JD over time, it was **not found to be associated with reducing JD over time, including when Risk Assessment suggested improved management against the disease**. In another study, the separation of calves either within 12 or 24 hr after birth from dams and housing of the calves away from adult cows was not found protective against JD. (That study also found that **feeding antibiotic discard milk to calves was significantly associated with more JD** in the calves). *Just as we cannot control JD only by testing, we apparently cannot control it only by management practices*. Over the last 20 years, estimates of herd and within-herd infection prevalence with JD have been increasing, not decreasing or remaining steady.

"It is very difficult to eradicate JD completely from a herd, so using management practices to maintain it at a low level makes more sense than testing"

The first part of this statement is very true. A disease that is incurable, has a long and variable incubation period, often affects less than 10% of the population, and for which diagnostic tests have relatively low sensitivity is not at all easy to eradicate. However, as we have seen, the steady increase in prevalence and the studies to date suggest we cannot truly contain JD by management practices alone. Our industry is "losing" this battle.

Some Specific Johne's Disease Suggestions for the Utah Dairy Industry to Consider

As stated earlier, I suggest that the two main goals for most dairy producers should be to find out whether their herd is infected, and to maintain low levels of JD in their herds if they are among the majority that are already infected. A good initial goal is probably less than 5% of the herd, given what we know about spread of the disease.

If we suppose that a serum or milk ELISA has sensitivity of 30%, and we test 100 cows of which 7 are infected with JD, the probability that we will detect the presence of at least one cow as positive is 83%. If, as might be typical in Utah, we test 300 cows of which 21 (7%) are infected, the probability of detecting JD is 99.6%. **Therefore we can very effectively screen our dairy herds for presence of JD with current tests**.

Of course, the challenge remains, how to more effectively **find the individual cows infected**. Cows that shed more MAP organisms have higher individual sensitivity with all tests for JD. It is a common recommendation today to screen with ELISA and confirm positive results with fecal culture. For the highest shedders, ELISA sensitivity has been reported as greater than 80%, and fecal culture sensitivity as greater than 85%. If this were true, and there was no relationship such that positives on one test were more likely to be detected on the other, we would detect (.80 x .85) = 68% of the high MAP shedding cows in the test population (usually cows > 2 years old) at that time. I would suggest that of the ELISA-positive cows, fecal confirmation could be higher than 85%. At any rate, with periodic testing, we should be able to detect the highest MAP shedders in herds. My suggestion from past experience would be to cull all of these cows, and try to minimize keeping them around for another calf, milking them down to a low level of production, etc. **However, exactly what strategy will be used for dealing with these cows needs to be decided by each producer and their veterinarian**. They certainly would all be strong cull candidates, especially before having another calf that might be infected in utero with JD.

If this is done, it seems very likely that we could keep more of our infected herds at a prevalence of JD below 5%, relatively safely below levels where it is likely to dramatically increase according to the information we have. (Eradication is not considered in this strategy).

I urge all dairy veterinarians in Utah to become certified or re-certified to participate in the Utah State Johne's Disease Control Program. Also, because the herd health veterinarian is the major trusted advisor to nearly all dairy producers, please ask them to reconsider testing for JD in their herds, to reverse the trend that many herds are coming closer to the level of danger of major spread of infection within their herds. I am aware that this may be a controversial subject, certainly with some differing opinions. As always, I welcome feedback and discussion from our readers.

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Extension Veterinarian