

Student Report

Management of a Salmonella Outbreak on a Dairy Farm

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Summary

A 200 cow dairy in Northeast Ohio experienced an outbreak of *Salmonella typhimurium* during the spring of 1994. In addition to human health implications, Salmonella outbreaks negatively impact herd health and productivity. As the United States Department of Agriculture institutes changes in the current inspection system to focus on microbial contamination of food, a greater emphasis will be placed on controlling the disease agent on the farm. This challenges both veterinarians and farmers to work as a team to institute management changes that will result in lowering the number of pathogenic organisms associated with foods of animal origin prior to their entry into the food chain. This paper reviews this Salmonella outbreak, offers management suggestions to control the disease agent, and describes how the problem was resolved on this farm.

Farm Management

This Northeastern Ohio dairy consists of approximately 200 cows and approximately 200 heifers. Calves are housed in calf hutches until they are approximately two months of age at which time they are moved to the heifer rearing site which is a dry lot housing system. The heifers receive a ration consisting of corn silage and hay. Spring and well water fill troughs for the heifers. The heifers are housed at this site until two weeks prior to freshening at which time they are grouped with the milking cows as their transition period. Cows are housed in confinement in the freestall barn. The dry cows are also housed at this facility; however, they are grouped separately from the lactating cows.

Teaser bulls are purchased from an outside source; however, their only contact with the cows is during heat detection (hand "mating"). Otherwise, only internal additions are made in the herd.

Cows are fed a one group partial mixed ration with corn silage, haylage, corn, and mineral concentrate as components. Computer feeders are present for additional

grain supplementation. Cows are fed on raised concrete slabs serving as bunks. Feedstuffs are stored in metal bins. A bird and possibly rodent problem exist on the farm, as is common on virtually all farms in the area.

This farm has adequate manure disposal procedures. Freestalls are scraped twice daily with a tractor. The manure is stored in a lagoon pond. Water is eventually drawn off the lagoon for use as irrigation water of fields and pastures. Runoff does not seem to be a problem, nor does stagnant water in the area surrounding the manure storage. Water is obtained from a well, and cows drink from troughs.

The vaccination program is designed for protection against PI3, IBR, BRSV, BVDV, and *Leptospira* serovars. Vaccination with the combination modified live and killed vaccine CattleMaster 9 (Pfizer) begins during calving and continues throughout their life in the herd. Cows receive yearly boosters. No significant health problems had been identified in the three months prior to the outbreak of Salmonella. Herd production levels are above the state average.

Disease Outbreak History

A two-year-old Holstein heifer was moved from the off-farm heifer rearing site to the population of adult milking cows two weeks prior to her expected date of parturition. After her introduction to the milking herd, she developed a watery, persistent diarrhea with both fibrinous flecks and mucosal casts and became systemically ill. She initially had a temperature of 106°F, was approximately 10% dehydrated, and had a precipitous drop in milk production. *Salmonella* spp. was suspected based on clinical signs. These signs lasted for approximately two weeks. During her period of clinical illness, she was treated with spectinomycin, hypertonic saline, and flunixin meglumine.

Three days after this heifer exhibited clinical signs, other adult cows in the milking group began developing similar signs. Cows continued to break with clinical disease for the next 20 days. A case was defined as a cow

exhibiting clinical signs similar to that of the two-year-old heifer. Ultimately, 60 of the 200 cows in the milking herd developed disease (Morbidity = 30%) and 20 cows died (Mortality = 10%, Case Fatality = 33%).

Because of the zoonotic potential associated with *Salmonella* spp, workers were advised to wash their hands thoroughly and change their clothes after handling the clinically ill cows. They were also advised against drinking raw milk. Despite these warnings, two individuals developed signs consistent with Salmonellosis. One case was later confirmed via fecal culture. It was discovered that the individual failed to wash his hands prior to eating.

Fecal cultures were performed on four cows exhibiting clinical signs at the Ohio Department of Agriculture Animal Disease Diagnostic Laboratory, Reynoldsburg, Ohio. All were positive for *Salmonella typhimurium*. This agent was also cultured from a fecal sample of one ill farm worker.

Risk Factor Identification

In order to implement managerial changes which will aid in the control of Salmonellosis on a dairy farm, the risk factors associated with transmission of the agent must be identified for that farm. This in itself presents a unique problem with species of *Salmonella*. There is much information regarding the pathogenesis and risk factors associated with *Salmonella* which remains unclear. Information which had previously been considered to be true is now under greater scrutiny.¹ This makes control of *Salmonella* on the farm difficult.

Specific risk factors have not been identified as associated with *Salmonella* infection *per se*; however, management factors that reduce the feco-oral transmission of disease agents are clearly a significant step to take while managing this disease agent. Excellent hygienic practices on the farm are definitely beneficial, but the degree of environmental contamination plays a significant role in agent transmission.

A possible approach to the problem is to define the degree of environmental contamination on the farm. To do this, fecal cultures could be performed on a representative sample of each management group of the herd to identify the number of animals that are shedding *Salmonella*. A positive fecal culture only indicates that the animal is shedding the agent at the time; it is not synonymous with infection since some herd members may serve as passive carriers ("living fomites") only.² Fecal culture will also provide the potential to establish the serotype(s) of *Salmonella* present in the herd. This may aid in the ability to predict severity or clinical course. It is possible that more than one serovar will be isolated.

There is debate in the scientific community regarding the specificity of fecal cultures in the diagnosis of

Salmonella spp. Some researchers report that a series of fecal cultures must be performed in order to rule out the agent's presence. This appears to be of greater importance in the equine rather than the bovine animal.³ Many veterinarians involved with bovine fecal culturing seem to have little difficulty in obtaining the agent on a single culture.

In order to obtain a representative sample of the herd, samples must be collected from each management group – calves, heifers, dry cows, and milking cows. Determining sample size is a function of both the number of animals in the group as well as the prevalence of the agent in the group. Although cost is a definite limiting factor for this suggestion, the best option for this size herd may be a whole herd fecal culture followed by a second whole herd culture one month later. Any animal with two concurrent positive cultures should be recultured the following month. If positive again, consider her to be a chronic shedder. If she is negative, a fourth culture may be justified. A positive result will still identify her as a chronic shedder.⁴

Once percentages of fecal shedders are determined for each group, it is necessary to evaluate management factors within the group that may be associated with exposure. Examples would include immune status, nutritional status, environmental stresses, or physiologic stresses. Because all milking cows are housed and managed together on this farm, further investigation may be required for this group. Focusing on lactational or gestation stage or production level may indicate further risks for specific animals.

Once chronic shedders have been identified, decisions regarding management of these animals is necessary. Ideally, one would like to suggest elimination of shedders from the herd. If the percentage of chronic shedders facilitates culling, it is clearly the best option to reduce environmental contamination on the farm. Unfortunately, this is not always a feasible option.

Another diagnostic option would be herd serology. This test for the detection of exposure to *Salmonella* is not as well established scientifically as fecal culture; however, it is a more cost-effective option than whole herd fecal cultures. Once again, the test merely indicates exposure, not infection. Paired sera allows identification of animals with persistently elevated titers. Some researchers believe a persistently elevated titer indicates chronic exposure due to persistent shedding of the agent.⁵ These animals may require follow up with a third serological test or with fecal culture. Those animals identified as persistent shedders may be a justified cull.

Regardless of the problems associated with the interpretation of these tests, at least the degree of environmental contamination resulting from fecal shedding will be determined. This knowledge will guide subsequent managerial changes.

Cleaning and Disinfection

Proper sanitation in the animal housing facilities is always a critical step in ensuring the well-being of a dairy herd. This practice becomes even more important when faced with an outbreak of a feco-orally transmitted agent. The recommended cleaning procedure for Salmonella control is scraping followed by a high pressure spray. This is to be immediately followed by disinfection with either phenols, chlorine solutions, iodides, or quaternary ammonium products.² Selection of a disinfectant may be limited by cost, the amount of remaining organic material, and the construction of the facility. These limitations may prohibit daily cleaning and disinfection of facilities. In this case, thorough cleaning and disinfection may be most beneficial at the onset or early in the course of an outbreak. Periodic repetition may be required.

Removal of manure from areas where animals are housed is necessary to aid in the control of Salmonella. The alleys of the free stall barn will likely need to be cleaned of manure numerous times during the day. Base the frequency of cleaning on visual appraisal. The method currently used on each farm location should be evaluated for its effectiveness and efficiency. Appropriate adjustment should then be instituted.

In addition to manure management, waterers and feedbunks should be a focus of attention. Regular cleaning is essential to limit ingestion of contaminated feed or water.

Cleaning and disinfection practices have their greatest potential to directly reduce contamination of the human food supply when properly utilized in the milking parlor. Salmonella is introduced into the milk via infection of the mammary gland or through fecal contamination of the milk. Clearly, ensuring that clean cows enter the parlor, proper teat cleaning and predipping procedures are introduced, sanitary milking technique is followed, and appropriate equipment cleaning occurs are significant steps in decreasing the incidence of milk contamination.

Feed and Water Sources

Feed and water commonly serve as sources of Salmonella on the farm. It is essential that the farm workers identify this as a potential source for the animals. A simple suggestion may be to provide some type of covering for the feedstuffs which are presently stored in metal bins. This may limit spread of the agent via birds and rodents. Also, appropriate measures to control pests may need to be initiated. It is suggested that feedstuffs of questionable origin or appearance be cultured.

It may be advisable to obtain well water samples for Salmonella culture. The information obtained may

prompt reconsideration of the potential for runoff or ground water contamination.

Obtaining samples from the waterers and feedbunks and submitting them for culture can allow assessment of the effectiveness of sanitation practices. Comparing samples from various locations on the farm may allow identification of management practices that may result in contamination.

Observation of feeding techniques may also identify practices on the farm that require adjustment to limit exposure to the cows. Examples include using the same equipment to scrape the barn and feed or infrequent cleaning of bunks. Discussing these issues with the farmer and offering specific instructions for improvement, based on farm practices, may reduce transmission to animals.

Manure Disposal

Monitor the area for runoff from the ponds. Producers should also be reminded to refrain from spreading manure on pasture fields that may be utilized for heifers on forage. Additionally, water from lagoons should not be used to flush barns during an outbreak. This practice could be a potential source of contamination.

Herd Health Preventive Measures

Aside from sanitary practices, this is likely the area that will yield the most noticeable results. It may also be the area of farm management over which the veterinarian has the greatest influence.

Fecal shedding of Salmonella has been associated with periods of stress such as periparturient period, transportation of animals and concurrent diseases.⁶ Stressing the herd may precipitate an increase in fecal shedding which may potentially lead to an outbreak of clinical cases. A conscious effort on the part of the producer and the veterinarian to reduce stresses placed on his/her herd will likely reduce the incidence of disease. Cow comfort and nutrition are two areas of utmost concern.

The idea of transportation resulting in shedding is a major concern regarding preharvest food safety control measures. In this example, shipment of heifers to the farm during their transition period likely affected the immune status of these animals. This may have served to precipitate the outbreak on this farm. It is advisable to limit the time animals are held prior to and during transport.

Another important area of focus is enabling cows to develop the highest level of immunity possible. Vaccination protocols, adequate nutrition, and facility design all play important roles.

The use of J5 vaccines to aid in the control of Salmonella outbreaks is common. Six commercially avail-

able vaccines are labeled for vaccination against *Salmonella typhimurium*, and in some cases, *S. dublin*.⁷ Of these, Endovac Bovi (Immvac, INC) or J Vac J5 (Sanofi) are most likely to be of benefit. This is because common core antigens exist among gram negative bacteria. These are not serotype specific and allow for protection against more than one serotype of Salmonella. Research has shown that the use of J5 vaccine is likely to result in positive economic returns for virtually all farms when considering mastitis control.⁸ Although this vaccine is unlikely to be the magic bullet that solves the Salmonella problem, it may offer some protection against clinical disease. Incorporating this vaccine into the vaccination protocol could potentially reward the producer in mastitis control, calf health, and Salmonella control while being cost effective. If, on herd culture, only one serovar is isolated, an autogenous vaccine may also be of benefit to the farm.

Herd Monitoring

Many of the suggestions made previously also play a role in herd monitoring. These would include: fecal culturing or serology to identify environmental contamination and/or chronic shedders, culturing of feed and water sources, observation of feeding and cleaning procedures, and identification of risk factors that exist for animals in specific management situations.

Other monitoring includes recording occurrences of clinical cases as well as their treatments and diagnostic results. Herd production parameters from DHI or other sources will not necessarily show lowered production if Salmonella is present, especially if subclinical carriers are within the herd. However, these are generally used as a means of herd evaluation in other situations.⁹

In a number of recent studies concerning establishing the incidence of Salmonella on dairy farms, researchers reported utilizing both bulk tank milk filter cultures¹⁰ and Moore swabs¹¹ to aid in the identification of Salmonella on a farm. The use of bulk tank milk filter cultures would be valuable in determining the risk to those who consume raw milk from the bulk tank or possibly those who consume improperly pasteurized milk. It may also enable identification of unsanitary practices in the milking parlor.

Moore swabs (Difco Laboratories; Detroit, MI), in the opinion of one group of researchers, were felt to "provide the greatest likelihood of identifying Salmonellae on a dairy". Moore swabs are sample collection swabs originally used to sample rivers and estuaries. They have been utilized to detect Salmonella contamination of raw milk in bulk tanks. Pacer *et al* placed Moore swabs in "flowing fecal matter" or "trolled" them in the lagoons

of California dairies to identify Salmonella on the premises.¹¹ Strategic use of this technique or obtaining other culture samples from various drains in the facility may serve to evaluate the effectiveness of existing management practices.

Personnel Management

It is important to stress to workers their role in disease transmission. Instituting a boot washing protocol on the farm may be of benefit. Once again, use phenolic, chlorine solutions, iodides, or quaternary ammonium products as previously mentioned. Ideally, boots should be scrubbed and disinfected as a worker moves from group to group. If this meets resistance, at least ensure that workers wash their boots as they leave the group identified as clinically ill or with the highest level of infection. Hands should also ideally be washed at this time.

Another consideration is to implement a "restriction of movement" policy if enough workers are available to allow for the farm to function in this manner. By limiting the flow of employees through highly contaminated areas, it may be easier to confine the agent to one area. If this is not feasible, consider developing a path of movement which allows the heaviest contaminated areas to be traversed last.

Human Health

It is necessary to educate farm workers and farm family members about the zoonotic potential of Salmonella. Proper hand washing should be discussed as well as the need to change clothes after working with the affected cows. Additionally, consumption of raw milk by family members should be discouraged. For legal purposes, it would also be advisable to document that the human health risks associated with this agent were discussed with those individuals at risk.

Farm Implementation and Current Status

In an attempt to control the spread of *Salmonella typhimurium* and limit the severity of clinical signs, all animals in the herd were vaccinated with Endovac Bovi (Immvac, INC). Additionally, farm workers were educated about the feco-oral route of transmission of the agent. Emphasis was placed on preventing feed and water contamination. Also a "restriction of movement" policy was instituted. Workers were either limited to work in one barn or were to move into the milking cows after work in other barns had been completed.

Within six months after the last clinical signs of the described outbreak were noted, the use of Endovac Bovi (Immvac, INC) was limited to cows at dry off and

heifers prior to freshening. This was incorporated into the vaccination protocol for the farm.

The efforts of the producer and the veterinarian were effective in reducing the number of clinical cases of Salmonella on this farm. Additionally, the milk production returned to higher than the state average. No other clinical cases were reported until the dairy dispersed in 1996 due to the retirement of the owners.

Conclusion

Controlling any disease in a herd takes commitment of both the farmer and the veterinarian. A Salmonella disease outbreak has no easy answers concerning control, but the importance of instituting changes has both herd and public health implications.

In summary, farm management practices are essential in limiting the contamination of our food supply. Efforts should focus on limiting the exposure of cows to Salmonella. This is best accomplished by identifying risk factors specific to that farm. General recommendations include identifying chronic shedders and eliminating them from the herd; focusing efforts on cleaning and disinfection and employing superior hygiene throughout the farm, and monitoring the herd and the environment for shedding of the agent. Additionally, the importance of maintaining adequate nutrition, health, and

vaccination while minimizing stresses on the cows should not be overlooked.

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Abstract

Use of Drama in Teaching the Human Side of Veterinary Practice

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Objective

To describe a teaching experiment in which fifth year veterinary students were given the opportunity, using dramatic scenarios, to consider ways of dealing with emotive issues relevant to veterinary practice, that demand good communication skills.

Design

Workshops were devised using dramatised scenarios of several critical incidents in practice, including euthanasia. A clinical psychologist and several veterinary practitioners participated in discussions. Both live performances and video scenarios were presented to fifth year veterinary students and were followed by group discussions. Each workshop was evaluated and modifications were made where necessary.

Results

The teaching format involving drama was well received. The combination of drama and discussion was more effective than a formal talk and discussion, provoking animated participation and maintaining audience attention. The majority of students considered that comments and advice from attending veterinarians were the most useful parts of the workshops in preparing them for veterinary practice. The large audience (up to 45 attendees) was considered to be desirable for enhancing discussion. Requests for more similar sessions were made by students.

Conclusion

Drama was found to be a satisfactory modality in teaching communication skills in preparing veterinary students for practice.

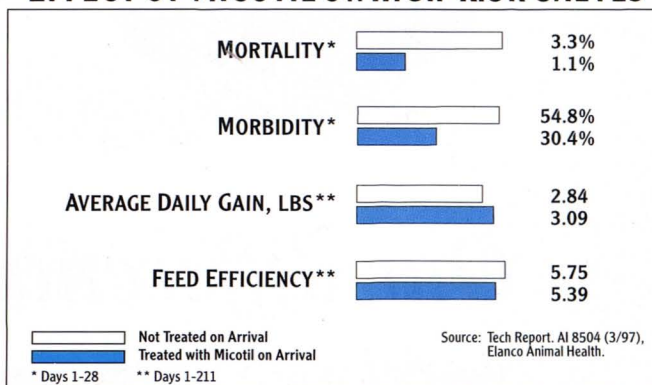


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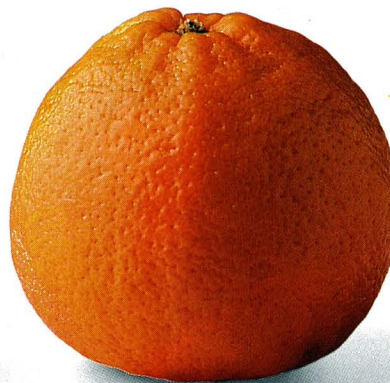
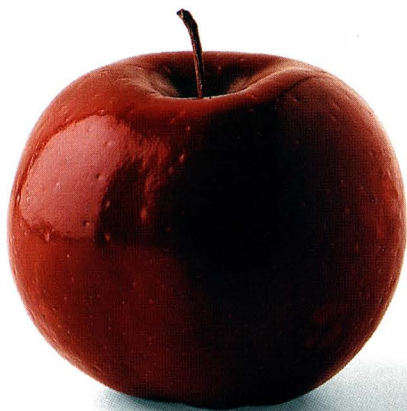
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