

Interpretation and Use of Laboratory Culture Results and the Characteristics of Various Mastitis Pathogens

Using Your Results

Culture results can provide you with valuable decision-making information. It is recommended that you and your veterinarian review all culture results and decide what mastitis management is appropriate for the cows in your herd. By knowing which mastitis pathogens are infecting the high SCC cows in your herd, you can target management decisions for greatest impact. Generally reduction and/or preventing new infections will depend on appropriate milking procedures, cow (dry and milking) comfort and housing, heifer rearing and appropriate dry cow management. Identifying infections early will allow you to make management changes that will have the greatest impact and result in fewer new infections.

Management options commonly fall into the following categories:

- **Treatment**
Identifying the causative organism for mastitis will help you and your veterinarian make informed decisions regarding possible treatment and prevention options. Therapy during lactation is more appropriate for some organisms than others. In some cases, antibiotic therapy is of little benefit but supportive therapy (fluids, anti-inflammatory drugs, etc) will be more important. Your veterinarian will help you with these decisions as well as help you design treatment protocols appropriate for your dairy. In the long run, this will help you save money and be more profitable.
- **Dry Cow Therapy**
Comparing linear SCC scores at dry off with those at freshening will help you assess the new infection rate during the dry cow period. If you know which organisms are most prevalent at freshening you will be able to determine the most appropriate dry cow therapy (the one which will work the best on your dairy). This will help you assess the efficacy of your dry cow therapy program and the environment of your dry cows.
- **Milking Order**
Identifying those cows infected with contagious mastitis pathogens (*Staphylococcus aureus* and *Mycoplasma*) and milking them last, or with a separate unit, will decrease the spread of infection to uninfected cows during the milking process. Identify and treat all *Streptococcus agalactiae* cows or place them in your low value pen.
- **Culling**
The economic benefit of culling or keeping a cow needs to be frequently evaluated. Cows with chronically elevated SCC with known *Staphylococcus aureus* infections should be especially considered. All cows with clinical cases of *Mycoplasma mastitis* should be culled immediately.
- **Vaccination**
Effective core antigen vaccines are available for use in the prevention and control of Coliform mastitis. Significant improvements have been made in *Staph aureus* vaccines. However, there is no *Staph aureus* vaccine available today that will prevent new infections, only reduce the severity of existing infections. Vaccine use in your mastitis should be discussed with your herd veterinarian.

GENERAL MASTITIS CONTROL PRINCIPALS WHICH APPLY TO ALL DAIRIES

- 1) Milk clean dry cows.
- 2) The teat ends MUST be targeted for cleaning in the pre-milking routine. (If when checking the adequacy of pre-milking cow prep you can scrub teat ends with a cotton swab and get manure or dirt off, they are not being adequately cleaned.)
- 3) Bedding must be well managed:
 - Organic Bedding (wood sawdust, shavings, straw, etc) – bedding in the back 1/3 of the stall must be completely removed and replaced with fresh clean bedding daily. Do not move the bedding from the front of the stall to the back of the stall under the udder.
 - Inorganic Bedding (sand) - groom the stall for cow comfort keeping the sand level with the curb. Do not groom more than 2” down if using a mechanical grooming device. Replace the dirty sand in the rear of the stalls every week with fresh clean sand.
- 4) Make sure pre and post-teat dip is applied to the ENTIRE teat surface.
- 5) Do not over crowd. Preferably one cow per stall and no more than 1.2 cows per stall. In loose housing loafing areas each animal should have 100 sq. ft. per cow.
- 6) Scrape alleys at each milking.
- 7) Make sure your animals have adequate levels of Vitamin E and selenium in their diets to help maintain healthy immune system function.
- 8) Wear gloves when milking cows.
- 9) Base all your treatment decisions on culture and sensitivity results in consultation with your veterinarian.

Mastitis Bulk Tank Culture Report Interpretation

Type of bacteria	Usual infection source	Major means of spread	Mastitis control measures
Strep agalactiae	Infected udders of other Cows in herd	Cow-to-cow by contaminated udder wash rag, teat cups, etc.	Use separate towels to wash / dry; Teat dipping; dry cow treatment; Eradication in special cases.
Staph aureus	Infected udders of other cows, contaminated bedding from milk of infected cows.	Cow-to-cow by contaminated udder wash rag, milkers hands, contaminated milking equipment, and improperly functioning equipment	Use separate towels to wash / dry; teat dipping; dry cow treatment; milk infected cows last, cull chronically infected cows.
Mycoplasma	Infected udder of other cows, often from infected purchased cows.	Cow-to-cow by hands of milkers, equipment, and common towels. Aerosol transmission from animals with respiratory signs may also occur.	Careful purchasing of cattle using bulk tank and cow culturing. Use separate towels to wash / dry; teat dipping; dry cow treatment; milk infected cows last, cull any positive clinical case.
Non-ag Streps	Environment of cow	Environment of the cow by: wet, dirty lots, contaminated bedding, milking wet cows, poor cow prep, milking machine air slips.	Improve stall and lot sanitation; milk clean dry cows, avoid air leaks and liner slips, change bedding frequently. Keep cows standing after milking.
Coliforms	Environment of cow	Environment of the cow by: wet, dirty lots, contaminated bedding, milking wet cows, poor cow prep, milking machine air slips. Hot humid weather.	Improve stall and lot sanitation; milk clean dry cows, avoid air leaks and liner slips, change bedding frequently. Keep cows standing after milking.
Staph species	Environment of cow	Poor teat dip coverage, poor cow prep, old bedding	Consistent teat dipping, adequate cow prep, and more frequent bedding change.

Contagious Mastitis Pathogens

Streptococcus agalactiae (Strep. ag)

Streptococcus agalactiae (*Strep. ag*) is a contagious (spreads from cow to cow) mastitis pathogen that may be common on some dairies especially on expansion dairies. Most cows infected with *Strep. ag* will not exhibit signs of clinical mastitis but (10-15%) will have decreased milk production and high somatic cell counts. In small herds even one cow infected with *Strep. ag* can raise the bulk tank cell count.

These bacteria multiply only in the udder but can survive for short periods on skin, common udder washcloths and milking machine parts. These infections are spread from an infected animal to herd mates on hands, inflations, common towels, and other items used during the milking process. Purchased animals are frequently the source of bringing *Strep. ag* into the clean herd. Use of contaminated milking equipment at fairs or auctions will also spread these infections. Because cows exhibit no clinical signs when infected, *Strep. ag* can spread rapidly throughout the herd and is usually identified on bulk tank cultures, high bulk tank somatic cell counts or when *Strep. ag* is isolated from individual cows with mastitis.

Management

- Culture milk from all cows in the herd.
- Treat all cows that culture positive for *Strep. ag* at the same time in all four quarters with an approved intramammary treatment. Penicillin is usually effective.
- Milk all infected cows last until subsequent cultures are negative.
- Milk purchased animals separately and culture milk samples before mixing these animals with the remainder of the herd.
- Cull the cows that do not respond to therapy.
- Once *Strep. ag* has been eliminated from the herd, monthly bulk tank cultures should be done for at least 6 months to ensure that the herd is free of this disease.

Staphylococcus aureus (Staph. aureus or Staph. A)

Staphylococcus aureus is the organism responsible for causing one of the most common types of contagious mastitis in dairy cattle. It is a major source of expense and lost revenues on many dairies. *Staph. aureus* infections are considered contagious. The primary means of spread is from an infected udder to an uninfected cow. Thus infected cows are a common source for new infections. However, these bacteria may also be found on the teat skin of most cows and in the environment. Most commonly, *Staph aureus* mastitis exists as a very chronic, subclinical infection. Mastitis caused by *Staph aureus* damages the milk producing tissues that can decrease milk production up to 45% per quarter. These bacteria damage the udder tissue producing areas of walled off infections that do not respond to antibiotic therapy. In addition to milk production losses, elevated somatic cell counts are seen and may be accompanied by recurrent episodes of clinical mastitis.

Staphylococcus aureus are primarily spread from an infected cow to non-infected cow during the milking process. These bacteria are spread by contaminated milking equipment, milkers' hands, common towels etc. used during milking process. *Staphylococcus aureus* can colonize lesions on the teat ends and/or gain entrance to the gland through the teat canal. Teat injuries, teat chapping and frozen teats can also increase the risk and spread of *Staph aureus* within a herd. Calves that can cross-suckle can also spread this disease.

Staphylococcus aureus commonly produce chronic infections that persist from one lactation to another despite dry cow therapy. New infections in young animals may respond to antibiotic therapy but often these animals are infected for life.

Management

- Good pre and post teat dipping is critical. Make sure every teat is consistently covered with dip.
- Milk known *Staph aureus* cows last, or with a separate unit, for as long as they are in the herd.
- If possible, segregate them to their own group or area of the barn.
- During cold weather use teat dips containing sufficient levels of emollients to avoid chapping.
- If it is economically feasible consider culling chronically infected cows.
- Culture milk samples before purchasing any replacement animals and before mixing these animals with the remainder of the herd.

Mycoplasma species

Mycoplasma spp. are contagious organisms that may be found in infected udders, respiratory tracts, and urogenital tracts of apparently healthy animals. This disease is frequently brought onto a farm through the purchase of infected milking cows or heifers. *Mycoplasma* species are transmitted cow to cow at milking time on hands of milkers, equipment, and common towels. Aerosol transmission from animals with respiratory signs may also occur.

Mycoplasma infected cows tend to shed high numbers of organisms at calving time. This is a good time to check animals to determine if they are infected. Many mycoplasma infections are subclinical and the infected cow has a low SCC. Cows that pose the risk to the herd are those in the hospital pen because of clinical mastitis. Mastitis due to Mycoplasma does not respond to therapy. Milk from Mycoplasma species infected cows may vary from thick appearing milk to a watery, sandy consistency. One or all four quarters may be affected.

Management

- Culture all herd replacements, including heifers.
- When buying animals, multiple bulk tank cultures from the herd of origin is recommended.
- Culture all animals with clinical mastitis and all fresh cows and those with long term high SCC.
- House youngstock and lactating animals separately. Cull all cows that are known to be Mycoplasma positive with clinical mastitis.
- Segregate and milk separately all animals that are known to be Mycoplasma positive.
- Teats should pre-dipped with an approved product and dried with individual use towels.
- Dip all teats with an approved product immediately after milking. Ensure the entire teat surface is covered.
- Practice good fly control on the dairy.

Environmental Mastitis Pathogens

Streptococcus and Enterococcus species (non-ag. streps)

Streptococcus and *Enterococcus* species (non-agalactiae streps) include *Streptococcus uberis* and *Streptococcus dysgalactiae* as well as many other species of streptococci as well as enterococci. These organisms come primarily from the environment. Major sources of these bacteria are bedding material, manure, mud and infected cows. Infections with “environmental streps” frequently occur during the dry period especially during the first 2 weeks following dry off and during the first 2-3 weeks prior to calving.

These bacteria may cause either a clinical mastitis with abnormal milk, swelling of the gland, and fever or a subclinical mastitis with no apparent signs. Individual cow somatic cell counts are frequently elevated. Frequently, most of the infections caused by *Strep* species are eliminated by the cow's immune system or by antibiotic therapy. However, some environmental Strep. infections (18%) will become chronic and refractory or poorly responsive to treatment.

Culture cows with clinical mastitis or those that have chronically elevated somatic cell counts. Individual cow cultures of high SCC cows in addition to and antibiotic susceptibility testing of bacteria will help your veterinarian design a treatment protocol appropriate for your dairy.

Management

- Minimizing exposure to the bacteria is essential for the prevention of environmental mastitis caused by non-ag. streps.
- Adequate amounts of clean, dry bedding should be provided in all stalls. Well-managed inorganic bedding (sand) is associated with fewer pathogens than organic bedding (straw, shavings, sawdust, etc.). Wet or soiled bedding should be removed at each milking. The back one-third of every stall should be bedded daily when using organic bedding material.

Streptococcus uberis

Streptococcus uberis is a commonly found non-ag streptococcus or environmental streptococcus. It is frequently cultured from the bovine udder. Cows become infected from environmental sources between milking when teat ends come in direct contact with surfaces contaminated with manure or dirty bedding material. Cows frequently become infected with *Strep. uberis*, like other environmental organisms, during the early dry period and during the 2 weeks prior to calving.

These bacteria may cause either clinical mastitis with abnormal milk, swelling of the gland, and fever or sub clinical mastitis with no apparent signs except that individual cow somatic cell counts may be elevated SCC >400,000 or linear score of ≥ 4 . Cow to cow transmission can occur but is relatively rare.

Management

- Minimize exposure to dirty environmental conditions.
- Provide adequate amounts of clean, dry bedding material in all stalls. Inorganic bedding (sand) is associated with fewer pathogens than organic bedding (straw, shavings, sawdust, and paper pulp).
- Wet or soiled bedding should be removed at every milking. Alleys, walkways, and holding areas should be scraped free manure on at each milking.

Streptococcus dysgalactiae

Streptococcus dysgalactiae is considered a non-ag streptococcus or an environmental strep. *Streptococcus dysgalactiae* unlike the other non-ag streps (*Streptococcus uberis* and *Enterococcus*) may occasionally spread contagiously from cow to cow through milking units, common udder washcloths or multi use towels. Cows become infected between milking when teat ends come in direct contact with manure, soiled bedding, etc. or at milking time when poor udder preparation occurs prior to milking unit attachment.

These bacteria may cause either clinical mastitis with abnormal milk, swelling of the gland, and fever or subclinical mastitis with no apparent clinical signs. Individual cow somatic cell counts usually elevated in these animals. Most of the infections caused by *Streptococcus dysgalactiae* are eliminated by the cow's immune system or by intramammary antibiotic treatment. Approximately 18-20% of the cows will become chronic infections.

It is recommended that cows with clinical mastitis or those that have chronically elevated somatic cell counts (greater than 4 linear score on two consecutive tests) be cultured and antibiotic susceptibility be performed. This will help provide information that will allow you and your veterinarian to design the most effective treatment protocols for your dairy.

Management

- Minimize exposure to dirty environmental conditions.
- Be sure adequate amounts of clean, dry bedding material should be provided in all stalls.

Escherichia coli

E. coli is a Gram negative bacterium (coliform) that is commonly found in bedding, manure, water, and soil. Mammary gland infections with *E. coli* can cause life-threatening illness. Most of these infections occur during the first two weeks prior to calving through the first 60 days of lactation. Infection occurs when the teat end contacts contaminated material between milking.

Most *E. coli* infections are of short duration. Approximately 50% last less than 10 days. However some may become chronic lasting more than 100 days. Ten percent of the cows may have a sudden onset of fever, markedly decreased milk production, loss of appetite and dehydration. Often these cows will go down and be unable to rise. Milk from the affected quarter may have large clots or be watery or bloody. Supportive therapy with anti-inflammatory drugs and fluids is may be required for these cases. Antibiotic therapy is often of little benefit unless the organism has spread to the animal's circulatory system. Most often the cow's immune system will effectively kill the bacteria. The clinical signs are due to toxins produced and released by the bacteria. Immunization with J5 vaccine can reduce the incidence and severity of clinical cases if administered at the appropriately.

Management

- The most effective management measure is to keep cows clean and dry, particularly in the dry cow and pre-fresh areas.
- Avoid overcrowding of pens and bedded packs. There should be one cow per free stall and 100 sq. ft. per cow in loafing areas.
- If organic bedding is being used, preferably use large particulate material. Avoid dusty fine particulate bedding.
- Implement a core antigen coliform mastitis vaccination program the dry period and early lactation.
- Prevent access to muddy corrals and pastures and areas of standing water.
- For cases of severe, acute mastitis discuss treatment protocols with your veterinarian.

Klebsiella species

Klebsiella species are Gram negative bacteria (coliform) that are commonly found in organic bedding, manure, and soil. Many of these infections are associated with the use of green sawdust or recycled manure bedding. Rates of new infections are higher in the summer than in other seasons. Most of these infections occur during the first two weeks prior to calving through the first two months of lactation. Infection occurs when the teat end contacts contaminated material between milking.

Klebsiella infections are typically very difficult to treat, and the infected animals, or individual quarters, usually have to be culled. Some cows may have a sudden onset of fever, markedly decreased milk production, loss of appetite and dehydration. Often these cows will go down and be unable to rise. Milk from the affected quarter may have large clots or be watery or bloody. Supportive therapy with anti-inflammatory drugs and fluids is may be required for these cases. Antibiotic therapy is often of little benefit unless the infection is systemic. The cow's immune system will effectively kill the bacteria; most clinical signs are due to toxins produced by the bacteria. Immunization with J5 vaccine can reduce the incidence and severity of clinical cases.

Management

- The most effective management measure is to keep cows clean and dry, particularly in during the dry cow and pre-fresh areas.
- Avoid the use of green sawdust, wet wood, or recycled manure bedding.

- Avoid overcrowding of pens and prevent access to muddy pens and pastures and areas of standing water. Each cow in loafing areas should have 100 sq. ft. and in stall barns, there should be one stall per cow.
- Consider the use of immunization with a J5 vaccine during the dry period and early lactation.

Enterobacter and Citrobacter

Enterobacter and *Citrobacter* are Gram negative bacteria that are found in bedding, manure and soil. Like other Gram negative bacteria, they may cause a life threatening acute mastitis. Exposure to these organisms occurs between milking when teat ends contact contaminated surfaces, especially bedding material.

Most infections are of short duration. However, some may become chronic lasting more than 100 days. Cows may have a sudden onset of fever, markedly decreased milk production, loss of appetite and dehydration. Often these cows will go down and be unable to rise. Milk from the affected quarter may have large clots or be watery or bloody. Supportive therapy with anti-inflammatory drugs and fluids is usually required for these cases. Antibiotic therapy is often of little benefit. The cow's immune system will effectively kill the bacteria. The clinical signs are due to toxins produced by the bacteria. Immunization with J5 vaccine can reduce the incidence and severity of clinical cases.

Management

- The most effective management measure is to keep cows clean and dry, particularly in the dry cow and pre fresh areas.
- Effective bedding management is important in limiting the incidence of the disease.

Coagulase-negative Staphylococcus species (Staph species)

Coagulase-negative *Staph* (CNS or *Staph* species) can be normal inhabitants of bovine skin or can be found in the environment in bedding and manure. They frequently gain access to the udder between milking and are normally not contagious. *Staph* species is one of the most common organisms cultured from dairy cows (10 to 20% of quarters is common). *Staph* species infections are usually associated with sub clinical mastitis resulting in moderate increases in somatic cell counts.

If a herd is experiencing a high incidence of *Staph* species infections, post milking teat dip products and their application should be re-evaluated. *Staph* species can be quite resistant to antibiotic therapy. However, most infections will resolve without treatment, given enough time. Persistent infection will likely clear during the dry period.

Management

- Minimize exposure to dirty environmental conditions. Adequate amounts of clean, dry bedding should be provided in all stalls. Inorganic bedding (sand) is associated with fewer pathogens than organic bedding (straw, shavings, sawdust, and paper pulp). Wet or soiled bedding must be removed daily. Alleys, walkways, and holding areas should be scraped free of manure on a regular basis. Ponds.

Miscellaneous Mastitis Pathogens

Pseudomonas species

Pseudomonas species are environmental bacteria commonly found in water and wet bedding. Water supplies (ponds, troughs, wells, and wash hoses), contaminated teat dips and contaminated multidose bottles of medications can be sources on a dairy farm. *Pseudomonas* spp. gain access to the udder via teat end contact with contaminated material.

Pseudomonas spp. usually causes chronic infections that respond poorly to antibiotic therapy requiring the culling of cows, or individual quarters. Infection rates in dairy herds are generally less than one percent and usually involve higher producing dairy cows in early lactation. Clinical outbreaks can occur with swelling of the udder, high fevers, and abnormal milk.

Management

- If clinical outbreaks occur, water supplies on the dairy should be cultured.
- The most effective management measure is good cow preparation and to keep cows clean and dry, particularly in the dry cow and pre-fresh areas. Make sure bedding is clean and dry. Avoid access to ponds, low wet areas, and standing water.

Pasteurella species

Pasteurella spp. is a Gram-negative bacteria that may, on rare occasion, cause mastitis in individual cows. These organisms are normal inhabitants of the respiratory tract of most animals. How this disease spreads is unknown but allowing calves to suckle may be one source.

Pasteurella spp. may cause acute or chronic mastitis. Affected quarters may produce a thick, creamy, yellow secretion with a foul odor. Although when isolated, *Pasteurella* spp. appears susceptible to many antibiotics, infected cows respond poorly to intramammary or systemic antibiotics. Infected cows may require culling or the quarter may need to be dried off.

Management

- Avoid overcrowding and provided comfortable stall areas to avoid teat injuries.
- Milk cows infected with *Pasteurella* spp. last, or with a separate unit. Cull infected cows or dry-off infected quarters.

Proteus Species

Proteus species are Gram negative bacteria that are found in the cow's environment in bedding, manure, feed and water. Generally, *Proteus* species is not a common mastitis pathogen. If this organism is isolated it is generally a contaminant. However, rare infections can occur between milkings when teat ends are in direct contact with contaminated surfaces. However, it has been know to cause mastitis outbreaks. Mastitis due to *Proteus* spp. is often chronic, difficult to cure, and unresponsive to antibiotics. If *Proteus* species are isolated from a quarter sample you must consider how the sample was taken and if this was the only organism isolated. If another organism(s) was isolated it may be a contaminant and not involved in the mastitis process. However, if it is the only organism isolated it is probably the mastitis causing agent.

Management

- Maintain clean, dry, well-bedded cow areas.

Serratia species

Serratia spp. Is a Gram-negative bacteria that are commonly found in soil and water. It is generally a contaminant in the milk sample. However, *Serratia* species may cause clinical mastitis that does not respond well to lactating cow antibiotic treatment. Exposure occurs between milkings when teat ends contact contaminated surfaces. These bacteria may also cause chronic infections lasting several lactations. If *Serratia* species are isolated along with other more common mastitis causing agents it may be a contaminant. However, if it is the only agent isolated, it is probably the agent responsible for causing the mastitis in the quarter.

Management

- Maintain clean, dry, well-bedded cow areas.

Yeast

Yeast are microorganisms that are found in a variety of areas such as soil, plants, decaying organic matter, and bedding especially sunflower hulls. Other on-farm source may be contaminated multi-dose antibiotic or other medication bottles, contaminated syringes and teat cannulae. A primary means by which yeast are spread is by contaminated intramammary infusions where aseptic technique has not been followed. Spread can also be cow-to-cow but is rare. It may occur at milking time when improper procedures or faulty milking equipment is used.

Most cases of yeast mastitis are self-limiting and cows usually return to normal production. Antibiotic therapy should *NOT* be used. Yeast mastitis is not responsive to standard anti-microbial therapy.

Management

- Care during when inserting instrument or antibiotic into the udder. Be sure to disinfect scrub teat ends with alcohol prior to inserting any instrument or antibiotic tube. Use single use treatment tubes only.
- Avoid treatment with multi-dose bottles of medication.
- Change bedding from sunflower hulls to another type.

Nocardia species

Nocardia spp. is an organism that is found in the soil, water, grass and on the teat skin. They are NOT a common cause of mastitis. Contaminated intramammary treatments, syringes or cannulae and improper pre-infusion sanitation may spread infection from cow to cow. *Nocardia* spp. can also be spread cow to cow at milking time.

Nocardia spp. may cause a sub clinical or clinical mastitis with reduced milk production. The udder may have hard nodules or feel woody on palpation. Some quarters may develop draining sores on the side of the gland. Infected cows may develop fevers. *Nocardia* spp. infections do not respond to antibiotic treatment.

Management

- Care during teat disinfection (swabbing teat ends with alcohol) and single use treatment tubes should be used.
- Keep stalls clean and dry and avoid dirt lots.
- Avoid treatment with multi-dose bottles of medication.
- Consult with your veterinarian regarding management of infected cows.

Prototheca species

Prototheca species are algae that cause mastitis in dairy cows. They have been isolated from plants, bedding material, soil, mud, ponds and standing water, manure, and water troughs. These bacteria may cause acute or chronic mastitis. Clinical signs may be apparent or the infection may remain sub clinical. Affected cows may experience decreased milk production and a watery mammary secretion with flakes and clots. Infections can come from teat end contact with contaminated surfaces during milking or be transferred cow to cow at milking time. Cows infected with *Prototheca* species generally have SCC log score of <4 after recovering from the clinical episode. *Prototheca* species can cause chronic intramammary infections. Quarter infections with *Prototheca* species are unresponsive to intramammary or systemic antibiotics.

Management

- Maintain clean, dry, well-bedded cow areas. Limit access to ponds, mud, and other areas with standing water.
- Milk cows infected with *Prototheca* spp. last, or with a separate unit.
- Remove infected cows from the herd.

Arcanobacterium pyogenes

Arcanobacterium pyogenes is a Gram positive bacterium that is a cause of . Sources for these bacteria include wounds, abscesses, contaminated bedding material and damaged teat ends. These organisms are frequently spread by flies or by direct teat end contact with a contaminated surface.

Once an infection is established, the prognosis is poor and loss of the quarter is expected. The severe clinical mastitis caused by *A. pyogenes* is characterized by a thick, yellow, foul smelling discharge. Some *Arcanobacterium pyogenes* infected cows spontaneously cure other infections are unresponsive to antibiotic therapy.

Management

- Maintain clean, dry, well bedded cow stalls and loafing areas.
- Stalls should be comfortable and overcrowding should be avoided to minimize teat injuries.
- Establish an effective fly control program.
- Milk *Arcanobacterium pyogenes* infected cows infected with a separate unit.
- Cull infected cows or dry off infected quarters.

Corynebacterium bovis

Corynebacterium bovis is a Gram-positive bacterium that is rarely found in infected udders and the teat canal normal animals. *Corynebacterium bovis* is spread primarily from cow to cow at milking. These bacteria can cause mild udder infections with a mild increase in somatic cell count and slight reduction in milk production. Rarely do they cause clinical mastitis. An increased incidence of these infections in a herd warrants reassessment of teat dipping procedures and application methods. Most infections are self-limiting and do not require antibiotic therapy.

Management

- Dry cow therapy will eliminate most *Corynebacterium bovis* infections.

Gram positive bacillus

Gram-positive bacilli are found in soil, water, dust, air, and manure. Since Gram positive bacilli are normally found in the environment, infection, although rare, can result from improper teat end cleaning and sanitation prior to treatment, direct teat end contact with contaminated treatment materials, etc. Mastitis caused by these organisms is infrequent. However, *some* cases may be fatal.

Management

- Use only single dose intramammary treatment tubes and clean teat ends thoroughly with 70% alcohol prior to infusion.
- Keep the bedding environment clean and dry.