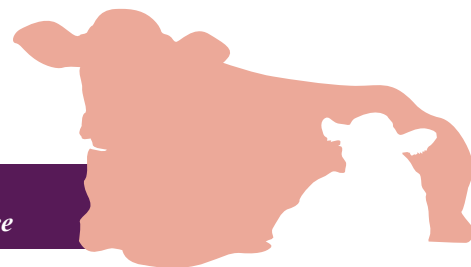


# MANAGING ENDOMETRITIS IN THE DAIRY HERD



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When it comes to managing a dairy herd, infections and inflammation of the cow's uterus can have negative implications for animal welfare, milk production, and rebreeding capacity. Maintaining uterine health is essential for proper ovarian function and the creation of a uterine environment that is favorable for successful pregnancy. Unfortunately, dairy cows can be predisposed to uterine infection during the periparturient period due to a wide variety of cow and environmental factors (Table 1).



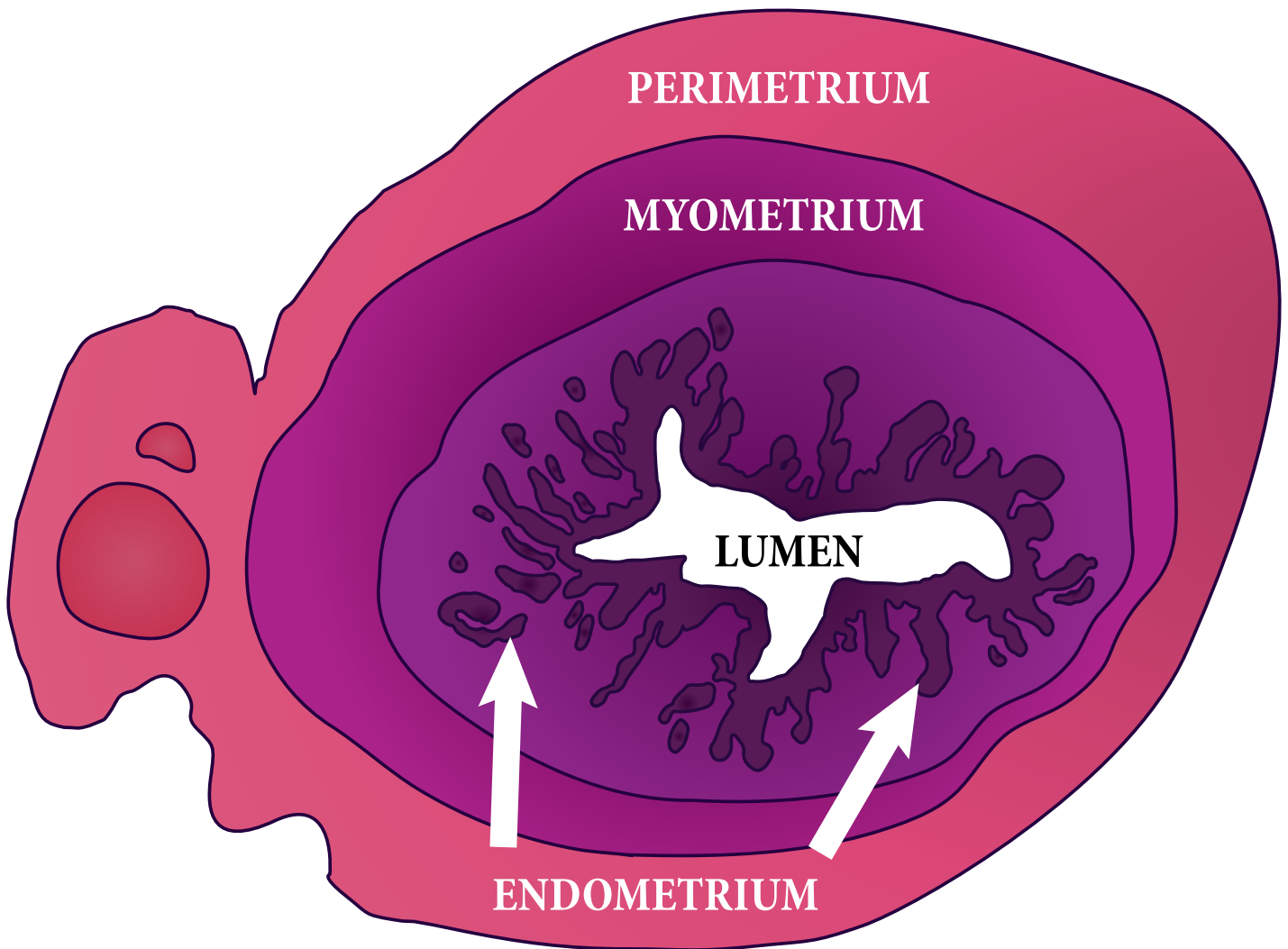
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**Table 1. Risk Factors for Increasing Rates of Endometritis in the Dairy Herd**

Risk Factor	Possible Issue	Potential Control Points
Retained placenta (RP)	Provides a way for bacteria to enter the reproductive tract	Expel placenta in 24 hours Maintain clean fresh and transition cow housing
Improper transition cow nutrition	Increased number of retained placentas	Monitor nutrient intakes in transition cow rations (work with nutritionist) Focus on intake of selenium, vitamin A, vitamin E, calcium, and protein levels in the dry cow ration as they have all been linked with RP incidence Minimize milk fever in fresh cows
Assisted calving	Trauma to the reproductive tract	Only assist when needed Use the least amount of force necessary Always wear gloves and use copious amounts of lubricant
Stillbirth	Traumatic calving	Observe close-up cows frequently
Male calf	Increased dystocia	Use sexed semen
Sires low in calving ease and high in stillbirths	Increased dystocia	If data/PTAs are available, select sires based (in part) on calving ease and low percent stillbirths
Primiparous dam	Increased dystocia	Minimize stress in the pre-fresh and fresh cows areas Maintain adequate bedding and feeding space per cow Provide a well balanced ration with correct proportion of vitamins and minerals
Over or under-conditioned at calving	Increased risk of dystocia and metabolic disorders in the fresh pen	Manage nutrition pre-calving for an ideal calving body condition score (BCS) of 3.25-3.50
Twins	Increased dystocia	Identify prior to parturition to prepare for additional observation and care
Unsanitary environment	Increases bacterial exposure (number and kind)	Maintain a clean pre-fresh and fresh cow environment
Compromised immunological response	Suppressed immune system after calving may allow bacterial populations to thrive	Minimize stress in the pre-fresh and fresh cows areas Maintain adequate bedding and feeding space per cow Provide a well balanced ration with correct proportion of vitamins and minerals.
Vulval angle (<70° to horizontal)	Increased exposure of the reproductive tract to bacteria from rectum	Select cows based on rump angle

Although all production species can suffer from disruptions to uterine health after parturition, the prevalence of endometritis is notably greater in dairy breeds when compared to other breeds of cattle. Additionally, the prevalence is numerically greater in intensive confinement systems when compared with grazing based systems.

During the fresh-cow period there are two broad categories of uterine infections that can impact a modern dairy herd: metritis and endometritis. It is important to note that these two terms should not be used interchangeably, as they denote two different conditions. The easiest way to differentiate between the two conditions is the timeframe for each. Metritis is an inflammation of the uterus that occurs within the first 21 days in milk (DIM), while endometritis is an inflammation of the uterus that occurs when a cow is greater than 21 DIM. Additional differences lie in the etiology or cause of each disease. Endometritis impacts the lining of the uterus (endometrium) and glandular layers (mucosal), whereas metritis is more invasive and additionally involves the deeper muscular (myometrium) layer of the uterus (Figure 1). Endometritis can be clinical, often referred to as purulent vaginal discharge, but usually presents subclinically (no outward or systemic signs of illness). Metritis, on the other hand, can be subclinical but presents more often clinically. These clinical manifestations include discharge that may or may not be purulent (containing pus) and with an elevated body temperature (>103 degrees F).

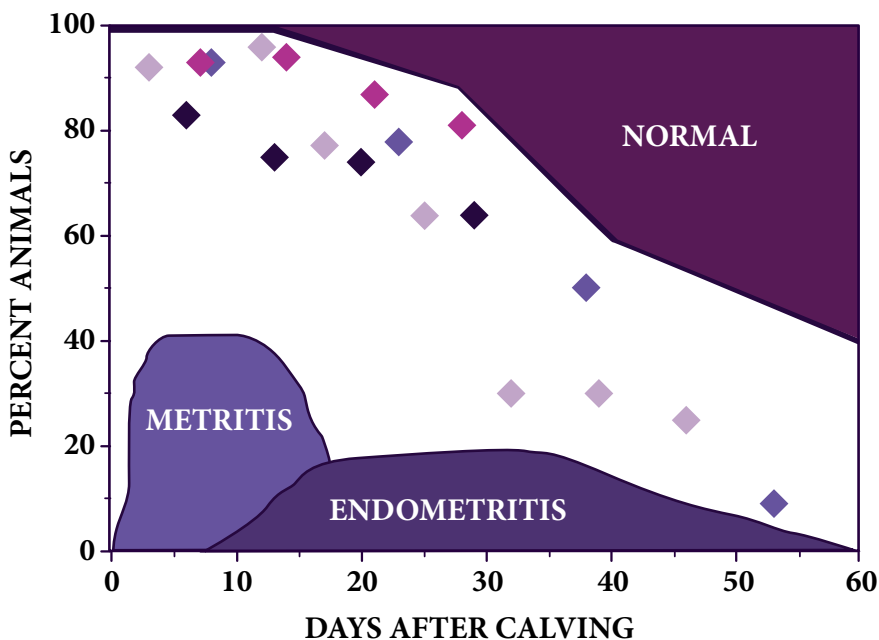


**Figure 1.** A basic diagram of a mammalian uterus. The lumen is the interior cavity of the uterus that would house the fetus and fetal membranes during gestation. The endometrium is the innermost section of uterine tissue with a glandular layer responsible for secretions needed before, during, and after conception. The deeper, muscular layer referred to as the myometrium can contract or relax to aid in the process of initiation (contract) and maintenance (relax) of pregnancy as well as contractions necessary for labor.

The longer window of time from parturition to infection (>21 days) indicates the chronic nature of endometritis. By breaking down the word “endometritis,” you can better understand what this disease actually is. The “endometrium” is the inner lining of the uterus, which is comprised of the mucosa and submucosa. These mucosal portions of the uterus contain glands responsible for secreting important substances into the lumen of the uterus to enhance both sperm viability and embryonic development. The word then ends with the suffix “-itis,” which is used in pathological terms to describe the inflammation of an organ. Therefore, very simply put, endometritis is the inflammation of the inner mucosal lining of the uterus as a result of a bacterial infection. This chronic infection is due to the body’s inability to naturally clear bacteria from the uterus (Figure 2). Based on work done by numerous research groups as presented by Sheldon and coworkers (2008), it is apparent that most cows are immunologically capable of clearing bacteria; however, up to 40% of cows will maintain bacterial infection three weeks after calving.

## The Body’s Natural Defenses

The blunt reality is that keeping the uterus free of bacteria during the periparturient period is an impossible task. During the parturition process, all of the cow’s physical defenses against infection (the vulva and cervix) are relaxed, allowing for bacterial invasion. Most dairy cows experience some kind of bacterial contamination of the uterus shortly after calving. However, through immunological responses and natural uterine cleaning many cows are able to clear unwelcome bacteria. This is followed by the normal passing of the lochia, which is made up of any remaining fetal fluid, blood from the umbilical vessels, and the caruncular (maternal) portion of the placenta by 14-21 days postpartum. The lochia can often be observed as a bright reddish-brown discharge on the tail and should not be confused with discharge that could be the result of metritis, as this is the normal course of uterine involution. This remodeling of the uterine endometrium allows for the clearing of any bacterial contamination and is usually completed around 40-50 DIM and is the basis for the recommended 45-60 day voluntary wait period.



**Figure 2.** Each diamond represents the number of cows with bacteria isolated from the uterus from for different studies (each diamond color represents a different study). Derived from Sheldon et al., 2008.

In cows that suffer from endometritis, there are internal causes and extenuating circumstances that allow infiltrating bacteria to become persistent infections. Uterine disease is often associated with *Escherichia coli*, *Trueperella pyogenes*, *Fusobacterium necrophorum*, and species of *Prevotella*. The most prevalent bacteria documented are *E. coli* and *T. pyogenes*. The situations that allow for these and other bacteria to thrive can include stress to the cow, direct trauma to the reproductive tract, and depression in the cow’s natural immunity. Many cases of clinical endometritis are preceded by no noticeable issues with uterine health early in the post-calving period. This is likely because a cow’s first estrous cycle post-calving initiates a novel immunological event. When that postpartum cow ovulates her first follicle at approximately 14-28 days postpartum, she also creates her first corpus luteum (CL), which produces progesterone.

Progesterone acts as an immunosuppressant to protect a developing embryo from immunological attack. This phenomenon most simply means that the actions of the immune system are reduced or act with less efficiency. The theory of the CL and subsequent release of progesterone causing immunosuppression began 50 years ago when researchers diagnosed a higher prevalence of endometritis after the first estrous cycle (approximately three weeks postpartum), when progesterone increased in association with the first luteal phase. For the uterus, this ultimately means a time of increased susceptibility to pathogens already present. This also defines the difference between uterine contamination and infection. With physical defenses relaxed during calving, the uterus is almost always contaminated with bacteria post-calving. Other events then allow for these bacteria to adhere to the uterine endometrium, colonize or invade it, and then potentially release bacterial toxins, which elicit an inflammatory response.



The link between endometritis and poor reproductive performance in dairy cattle is well documented. One comprehensive study conducted by Santos and co-workers (2010) in Florida found that out of approximately 5,700 cows evaluated for postpartum health disorders, 20.8% had clinical endometritis and of these, approximately 30% were not cycling after 60 DIM. These cows experienced an approximate 25% decline in first service pregnancy rates postpartum and a 40% increase in pregnancy loss during the first 60 days of gestation when compared to healthy cows. These statistics highlight the cost of endometritis that include an increase in days open, services per pregnancy, and risk of culling. Many research publications have labeled subclinical endometritis as the most prevalent uterine disease in dairy cattle.

## Clinical (Purulent Vaginal Discharge) vs. Subclinical Endometritis

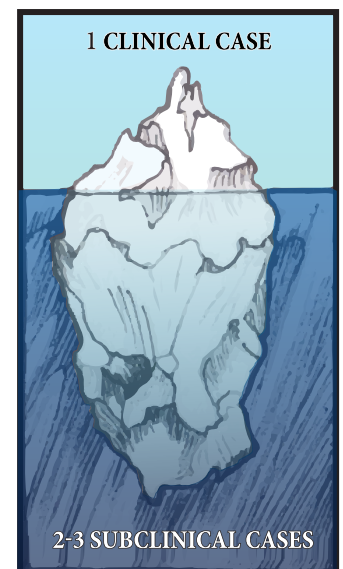
Endometritis can present as either a clinical or subclinical inflammation. Clinical cases consist of vaginal discharge that contains pus. The two most common classifications are purulent (>50% pus) and mucopurulent (50% pus and 50% mucus).

Clinical endometritis often lacks any systemic evidence of infection making elevated rectal temperature a poor signal of infection. Some producers may use a delay in uterine involution as an indicator of clinical endometritis, but this method can be unreliable. Many unrelated factors can alter the timetable of uterine involution, such as animal age, breed, or nutritional status. However, cervical diameter is a useful indicator, with a diameter greater than 7.5 cm after 20 DIM indicating clinical endometritis.

If a cow presents with a closed cervix and a fluid filled uterus, she might be suffering from a particular classification of endometritis called pyometra. This special case is diagnosed much less frequently than metritis or endometritis, as it is a closed infection without any vaginal discharge.






A potential device to aid in diagnosis of endometritis is the Metricheck by Simcro. This tool allows an examiner to collect material contained within the cranial portion of the vagina. The material can then be examined for purulence, smell, or any other indicator of an abnormal uterine environment.

Recognizing subclinical cases of endometritis can prove to be challenging. The iceberg concept typically used to describe mastitis cases is an accurate descriptor for endometritis as well. In surveying field studies, for every one case of clinical endometritis, there are often two to three subclinical cases present; therefore, the diagnosis of clinical endometritis is just the tip of the iceberg in a dairy herd.



A study by Gilbert and coworkers (2004) in New York using five different herds, found an average prevalence rate of 53% for subclinical endometritis (range of 37-74% between herds). Typically, incidences of subclinical endometritis can only truly be diagnosed by elevated polymorphonuclear neutrophils (PMN) in the uterine fluid. In previous research, I. M. Sheldon, a leading researcher in the area of uterine diseases in cattle, found that subclinical endometritis is most accurately diagnosed by demonstrating the presence of >18% neutrophils between days 21-33 post calving in uterine flush fluid or >10% neutrophils between days 34-47. More recent work from Dubuc (2011) suggests that these thresholds may be even lower with >6% by day 35 and >4% by day 56, having predictive power of reproductive outcomes. A cytobrush or uterine lavage can be used to collect this fluid for evaluation and Barlund and coworkers (2008) found these to be the most accurate methods to diagnose cows with subclinical endometritis. Additionally, some researchers have proposed using vaginoscopy (examination of the vagina using a cytoscope) or transrectal ultrasound to evaluate endometrial fluid volume and wall thickness, but to date these methods have proved unreliable. Available assessment tools are provided in Table 2.

**Table 2. Tools Used to Diagnose Endometritis**

Device Name or Technique	Tool Required	What it Identifies	Clinical or Subclinical
Metricheck		Cranial vaginal/ cervical mucus	Clinical
Cytobrush		PMNs in uterine fluid/ cell culture	Subclinical
Uterine lavage		Collection of uterine fluid for PMN evaluation/cell culture	Subclinical
Speculum/ Vaginoscope		Vaginoscopy, examination of the cervix/mucus	Subclinical
Ultrasound		Uterine wall thickening, fluid volume, and appearance	Subclinical

# The Relationship Between Endometritis and Reproduction

An overall evaluation of explicit and well-kept reproductive records may provide producers with a tool for identifying (or diagnosing) subclinical cases of endometritis. Decreased reproductive success in cows suffering from subclinical endometritis is usually the result of delayed luteolysis, producing an extended luteal phase (progesterone production). In practical terms, the cow never comes into heat or estrus and consequently fails to ovulate. The pathway behind this phenomenon can be complicated but will be simplified here.

Bacterial microbes contaminating the uterus trigger an inflammatory response. There are two hormones that play a role in inflammatory responses of the uterine endometrium, they are prostaglandin E2 (PGE2) and prostaglandin F2 $\alpha$  (PGF2 $\alpha$ ). These hormones also have nearly inverse effects on the CL and subsequent progesterone production. The hormone PGE2 is known to serve in a luteoprotective manner (prevents destruction of the CL) while, PGF2 $\alpha$  acts in a luteolytic manner (destroys the CL). During the inflammatory response as a consequence of bacterial contamination (primarily from gram negative bacteria) of the uterus, there is an increase in the production of PGE2 relative to PGF2 $\alpha$ . Concurrently, there is an increase in circulation to the uterus that occurs from vasodilation (expansion of the blood vessels). This allows bacterial toxins to enter the blood stream. These toxins then further disrupt reproduction by alteration of steroidogenesis (estrogen and progesterone). This disruption perturbs follicular growth, which ultimately reduces CL size. A reduction in CL size is directly correlated with a reduction in progesterone. This reduction in progesterone prevents the uterine endometrium from properly preparing for a developing embryo, which will inhibit successful pregnancy even if fertilization occurs.

Regardless of the causative agent, prolonged uterine inflammation and infection leads to decreased reproductive performance, such as increased days to first service, decreased pregnancy success, increased days open, and ultimately increased culling. A study by LeBlanc and coworkers (2002a) examined the records of 1,865 cows in 27 different herds. They found that cows with cases of endometritis experienced a 27% delay in establishing pregnancy and were 1.7 times more likely to be culled from the herd for reproductive failure. Endometritis is a possible culprit for a high number of anestrus cows in a herd and should be considered when evaluating a reproductive program.

## Prevention and Treatment

Each case of endometritis (clinical or subclinical) represents a financial cost to the producer. The potential financial impact may result from a reduction in milk yield; milk loss due to treatment; higher culling risk and associated milk losses and replacement costs; and reduced reproductive performance, with associated costs for increased days open and additional inseminations per pregnancy. The most notable and documented costs are associated with increased culling and poorer reproductive performance. In order to minimize costs associated with endometritis, producers should implement preventative and treatment regimens.

Although endometritis is generally considered a disease that happens in the transition group, there are some pre-disposing conditions that can be managed as early as the preceding lactation. The easiest factor to recognize when examining dry and pre-fresh cows is their body condition. Both over-conditioned and under-conditioned cows are at a great risk for dystocia and the other diseases associated with the fresh pen (milk fever, ketosis, etc.). All of these conditions can contribute to higher rates of endometritis in a herd, either through trauma to the reproductive tract or simply unnecessary stress during early lactation, potentially compromising the cow's ability to fight infection. Nutritional management from late lactation through the calving pen is the only way to maintain or achieve an ideal calving BCS of 3.25-3.50. One of the simplest ways to control for over-conditioned dry cows may be to move low-producing cows to a lower energy ration. Ideally, dry cows should add little to no condition during the dry period unless dried off at a BCS at 3 or below. Excessive conditioning during the dry period as a result of feeding or extended days dry should be avoided.

**Table 3. Impact of Two Different Treatment Regimens for Endometritis on Reproductive Parameters in Dairy Cows.**

Variable	No Treatment	Antibiotic IU
<i>Median Days to 1st Service</i>		
Overall	82	81
20-26 DIM	73	79
27-33 DIM	92	82
<i>1st Service Pregnancy Risk (%)</i>		
Overall	27.0	30.8
20-26 DIM	30.0	30.2
27-33 DIM	23.5	31.6
<i>Pregnant by 120 DIM (%)</i>		
Overall	<b>29.2</b>	<b>34.2</b>
20-26 DIM	37.8	33.3
27-33 DIM	20.5	35.3
<i>Median Days Open</i>		
Overall	<b>178</b>	<b>134</b>
20-26 DIM	137	134
27-33 DIM	205	133
<i>Cumulative Pregnancy Risk (%)</i>		
Overall	<b>70.8</b>	<b>73.0</b>
20-26 DIM	75.6	75.0
27-33 DIM	65.9	70.6
<i>Number of Inseminations (Pregnant Cows)</i>		
Overall	2.5	2.2
20-26 DIM	2.2	2.1
27-33 DIM	2.9	2.4
<i>Culled for Reproductive Failure (%)</i>		
Overall	6.7	3.6
20-26 DIM	4.4	5.0
27-33 DIM	9.1	2.0

Additionally, it is important to maintain a clean and sanitary calving environment. This not only includes calving areas and bedding materials, but also the equipment used for, and employees assisting in, the calving pen. Before assisting with a calving, and immediately after, all equipment such as calf chains or calf jacks should be cleaned and sanitized to prevent contamination. Ideally, these items would be made from an inorganic and easy to clean material like stainless steel. Employees should be mindful as well, washing up and wearing gloves before assisting with calving. To prevent unnecessary trauma, ample lubricant should be used when introducing any object to the reproductive tract.

Treatment for endometritis is best administered after consultation with the herd veterinarian as the specific pathogenic bacteria will vary among operations and localized expertise will likely provide the best remedy.

There has been documented success with intrauterine antimicrobial treatments and to a lesser extent with use of prostaglandin (PGF2 $\alpha$ ) treatment. The potential benefit of PGF2 $\alpha$  treatment is two-fold. First, PGF2 $\alpha$  would stimulate the contractions of the uterine myometrium. These contractions would assist in flushing bacteria from the uterus. Second, PGF2 $\alpha$  would remove the CL, thus progesterone secretion, which should reduce immunosuppressive influence. However, the efficacy of using PGF2 $\alpha$  as a preventative measure and/or treatment for endometritis is not yet established by current research (Haimerl et al., 2013).

LeBlanc and coworkers (2002) in a field trial aimed to determine whether intrauterine (IU) treatment with antibiotics or intramuscular (IM) injections of PGF2 $\alpha$  were more effective at minimizing the impact of endometritis on reproductive success. For this trial, they examined cows once between 20 and 33 DIM during which they diagnosed 16.9% (316/1,865) of cows with endometritis. Upon diagnosis, cows were either not treated, treated with 500 mg of cephapirin benzathine (IU antibiotic), or treated with 2 mL of cloprostenol (IM PGF2 $\alpha$ ). All cows were reexamined 14 days after treatment (34-47 DIM), and those that still exhibited clinical infection (pus discharge) received a follow-up treatment. Table 3 summarizes a portion of the results from this study. Only data from no treatment and cephapirin treated groups are included to spotlight the major implications of the study with the greatest impact of treatment realized through reduced days to pregnancy and higher cumulative pregnancy risk.



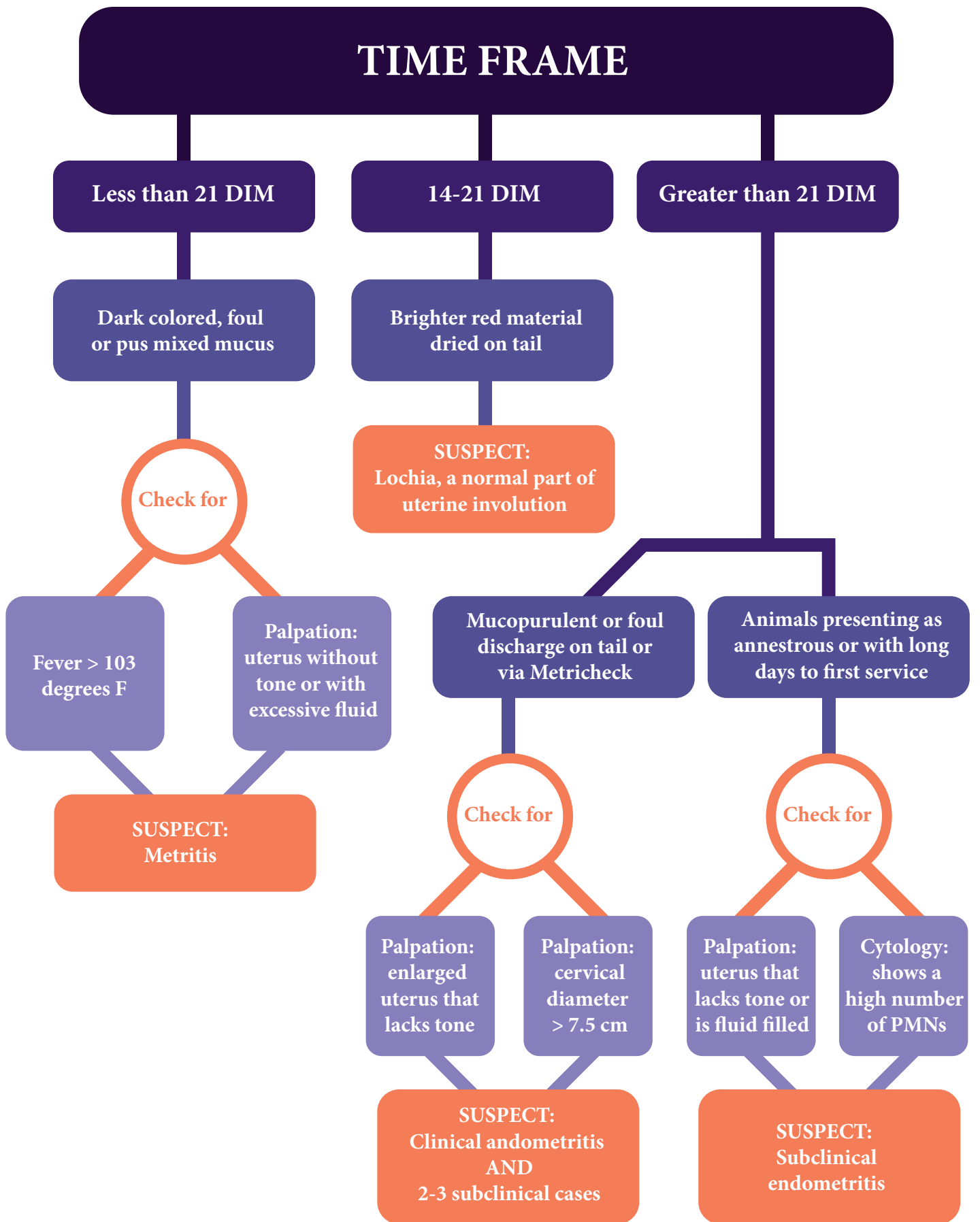
Many producers with documented clinical or perceived subclinical issues with endometritis may choose to implement a presynchronization program with PGF2 $\alpha$  injections during the voluntary wait period (VWP) before breeding by estrous detection or timed artificial insemination (TAI). The repeated PGF2 $\alpha$  injections may reduce cases of endometritis by aiding in uterine clearing and involution and acting to more frequently remove the immunosuppressive actions of progesterone. Treating the infection with intrauterine antibiotics, as reflected in numerous research findings, is the key step to increasing the number of cows clearing infections efficiently. The key is to identify infected cows early and remedy the situation quickly. This will reduce the potentially monumental impact on a cow's fertility.



**IF AIMING TO MINIMIZE RISK OF ENDOMETRITIS,**  
*there are a few key factors to always keep in mind.*

1. Exposure of the uterine environment to bacteria during parturition is inevitable. You can minimize the contamination load by keeping clean close-up and calving pens or areas.
2. Ensure cows are calving-in within the ideal BCS (3.25-3.50). Over and under-conditioned cows are at an increased risk of dystocia and incidence of metabolic disorders in the fresh pen, increasing stress during early lactation.
3. Ensure fetal membranes have passed within 24 hours of calving. Do not manually remove. If it appears that a cow will need assistance in passing fetal membranes, consult with your veterinarian about administration of prostaglandin or oxytocin.
  - a. Uterine involution may be helped with increased oxytocin release associated with more frequent milking (4X) in early lactation.
4. Remove fetal membranes immediately after passing. This can reduce exposure to additional bacteria and minimize potential disease spread.
5. Never house fresh cows with diseased cows or those with chronic illnesses (mastitis). Remember that their immune systems are immunosuppressed. Housing them together might seem easy for the purpose of group milking, but could have major consequences on the long-term health of fresh cows.
6. Minimize stress on the fresh cow. This includes keeping a stocking density of no more than 80% if held in free-stalls or 120 square feet of bedded pack and maintaining 28-30 inches of bunk space per cow.
7. Keep cows in a clean and dry environment to minimize bacterial growth. Inorganic bedding materials such as sand are ideal; however, properly managed organic bedding materials also can be suitable. Outdoor pens should allow for adequate shading.

In closing, understanding the different types and timeframes of uterine disease can assist early identification and proper remediation efforts (Figure 3). Creating a sterile environment for calving and expecting a sterile uterus post-calving is unrealistic. Instead, minimizing stressors that may allow bacterial contamination to thrive is critical. Producers should be willing and able to assess uterine health through reproductive records and visual observations (with or without additional tools), and they should work with their veterinarian for identification and treatment of subclinical cases of endometritis if an issue is apparent. Finally, appreciate that optimum uterine health is one major piece of the puzzle to achieving reproductive success, and with proper attention and management, can improve overall herd fertility.



**Figure 3.** Schematic representing timeframes and associated factors for determining uterine health in early postpartum cows.

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