



REVIEW ARTICLE

A Review of Obstetric and Gynaecological Challenges in Cattle Reproduction

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ABSTRACT

Reproductive efficiency is the foundation of profitable cattle production but is often affected by a broad array of obstetric and gynecological disorders. These complications include dystocia (affecting 10–20% of dairy herds globally), retained fetal membranes, uterine infections (prevalence of 15–40%), and ovarian dysfunction, drastically compromise both fertility and economic viability. Reproductive disorders have a multifactorial etiology, characterized by complex interactions among nutrition and endocrine regulation, infectious agents, and management practices. Obstetric disorders mostly happen during parturition and are likely to cause instant complications to both dam and calf, but gynaecological disorders are likely to interfere with cyclicity and conception. The rise of diagnostic measures, such as ultrasonography and molecular-based assessment tools, contributed to early identification and treatment. This review briefly describes the pathophysiology, risk factors, diagnosis, and management of major reproductive disorders in cattle. It focuses on evidence-based approaches to enhance reproductive health, with a focus on integrated herd management and emerging reproductive technologies. Furthermore, this review emphasizes the integration of modern diagnostic tools, such as transrectal ultrasonography and molecular diagnostics, to enhance early detection and targeted interventions.

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INTRODUCTION

Reproductive efficiency is among the most crucial factors for productivity and economic feasibility in cattle production systems (Souza *et al.*, 2022). In dairy and beef production, optimal reproductive performance ensures a regular calving interval, consistent milk production, and effective genetic progress (Moorey *et al.*, 2022). Nevertheless, reproductive disorders continue to be a significant issue on a global scale that translates to a significant loss of economic and herd efficiency (Medeiros *et al.*, 2022). These diseases cover a wide spectrum of pathological states of the reproductive tract and processes, such as obstetric complications related to parturition and gynaecological disorders inhibiting the

ability to enter the estrous cycle and fertility (Bendarska-Czerwińska *et al.*, 2023).

Obstetric disorders are usually in the late gestation period, parturition, or immediately after childbirth (Vogel *et al.*, 2024). Dystocia is one of these and is a major challenge, especially in heifers because of feto-maternal disproportion and abnormal fetal positioning (Tsaousioti *et al.*, 2023). The problems associated with dystocia are trauma to the reproductive tract, nerve damage, undelivered fetal membranes, and risk of uterine infections (Kissler and Hurt, 2023). Another typical postpartum disorder is retained fetal membranes, which is an inability to expel the placenta at the standard time (Amin *et al.*, 2023). The condition predisposes cows to metritis and retards uterine involution, thus affecting

subsequent fertility (Kasimanickam *et al.*, 2025). Less frequent but life-threatening and an emergency, uterine prolapse needs urgent veterinary care (Wilcox *et al.*, 2025). Abortion and stillbirth also cause reproductive losses, which are usually caused by infectious, nutritional, or environmental causes (Maes *et al.*, 2023).

Gynecological disorders, on the other hand, do not occur during the peri-parturient period and are significant causes of infertility. Metritis and endometritis are common infections of the uterus that are especially common in dairy cattle and are severely linked to inadequate hygiene, dystocia, and retained placenta (Umer *et al.*, 2022). These infections disrupt the uterine environment, impair embryo implantation, and reduce conception rates (Muter *et al.*, 2023). Other causes of reproductive failure are ovarian disorders such as cystic ovarian disease and ovarian inactivity (Stuenkel and Gompel, 2023). These diseases can usually be attributed to hormonal disturbances and metabolic stress, especially in the early lactation phase when cows are in negative energy balance (Mekuriaw, 2023).

Repeat breeding syndrome is a complication and multifactorial issue that is typified by failure to conceive despite normal estrous cycles and recurrent insemination (Pérez-Marín and Quintela, 2023). Some of the causes of this condition are subclinical infections of the uterus, poor oocyte quality, inappropriate timing of insemination, and semen quality (Mansour, 2023). Anestrus, which refers to the lack of observable estrus, is yet another reproductive issue, particularly in high-producing dairy cows (Endo, 2022). It can be caused by physiological processes such as postpartum healing or pathological events such as nutritional deficiencies and endocrine diseases (Wu and Jin, 2025).

Reproductive disorders in cattle have a multifactorial etiology, influenced by genetic, nutritional, environmental, and infectious factors (Arero, 2022). Nutrition will be crucial, especially around the transition period, which is the several weeks before and after calving (Tufarelli *et al.*, 2024). Early lactation-induced negative energy balance mobilizes body reserves and induces metabolic stress, which negatively impacts ovarian function and immune competence (Mekuriaw, 2023). Lack of such vital minerals as calcium, phosphorus, and selenium is another factor that puts people at a greater risk of reproductive disorders (Razzaque and Wimalawansa, 2025). As an example, uterine prolapse and retained fetal membranes are closely associated with hypocalcemia, and selenium deficiency affects the immune system and placental separation.

Another significant cause of reproductive failure is infectious diseases. Causative agents of abortion in cattle are well-known bacteria like *Brucella abortus* and *Leptospira* species (Aymée *et al.*, 2024). Viral infections, such as bovine viral diarrhea virus and bovine herpesvirus 1, are involved in embryonic loss, abortion, and congenital abnormalities (Yıldız and Babaoglu, 2022). Protozoal infections like *Neospora caninum* have also become a significant cause of abortion in the world (Nayeri *et al.*, 2022). These pathogens not only impact individual animals, but they can also be transmitted among herds, resulting in huge losses in reproduction (Peña-Mosca *et al.*, 2025).

Additional environmental and management factors impact reproductive performance (Vadez *et al.*, 2024). Stressors such as heat have been shown to disrupt hormonal balance, reduce feed intake, and impair oocyte quality, thereby lowering fertility (Khan *et al.*, 2023). Poor housing and hygiene conditions, as well as inappropriate handling during calving, may increase the number of obstetric complications and uterine infections (Perrot *et al.*, 2024). Proper nutritional practices, breeding, and regular health checks are therefore necessary in reproductive health practices (Ara *et al.*, 2022).

The increased reproductive disorders can be detected and treated because of improvements in veterinary diagnostics and reproductive technologies (Acharya *et al.*, 2024). Ultrasonography can be used to determine ovarian structures, uterine health, and early pregnancy diagnosis (Bean *et al.*, 2022). Molecular diagnostic methods enable rapid detection of infectious agents, and hormonal tests help assess the state of the endocrine system (Schmitz *et al.*, 2022). Reproductive efficiency and genetic enhancement have also been increased with the use of assisted reproductive technologies like artificial insemination, embryo transfer, and in vitro fertilization (Mueller and Van Eenennaam, 2022).

Despite these developments, there are still challenges in the translation of scientific knowledge into practical solutions, especially in resource-constrained environments (Ioachimescu and Shaker, 2025). The effective management of reproductive disorders is often hindered by limited access to veterinary services, farmer ignorance, and economic constraints (Kitessa *et al.*, 2023). Hence, it is necessary to have comprehensive solutions that integrate both scientific and practical management solutions (Bibri *et al.*, 2023). There is a significant lack of literature documenting the complex interplay between the pathogenesis of such reproductive diseases in individual cases, as well as the rapidly changing clinical diagnostics landscape in bovine medicine. Thus, this review is a novel extensive synthesis of the underlying mechanisms, epidemiological risk factors and evidence-based management strategies for both obstetric and gynaecological problems. Special focus is on the use of modern diagnostic tools, like transrectal ultrasonography and molecular assays which help to improve precision in herd reproductive management.

Overview of Bovine Reproductive Physiology: A very well-coordinated endocrine system that is regulated by the hypothalamic pituitary-gonadal axis controls the reproductive physiology of cattle (Huang *et al.*, 2022). The hypothalamus secretes gonadotropin-releasing hormone, which causes the anterior pituitary to release follicle-stimulating hormone and luteinizing hormone. These hormones control follicular growth, ovulation, and the formation of corpus luteum (Longo *et al.*, 2025) (Fig. 1). The estrous cycle lasts an average of 21 days and is characterized by waves of follicular growth (Abulaiti *et al.*, 2022). The follicular waves are usually two or three per cycle, with a single dominant follicle selected to ovulate (López-Gatius *et al.*, 2022). Estrus is about 12-18 hours, and during this time, the cow is open to mating.

Ovulation occurs approximately 24 to 30 hours following estrus (De Rensis *et al.*, 2024).

The progesterone secreted by the corpus luteum is essential in sustaining pregnancy by inhibiting uterine contractions and sustaining endometrial activities (Bullelli *et al.*, 2022). If fertilization fails, the release of prostaglandin F₂ alpha by the uterus causes luteolysis, resulting in decreased progesterone and a new cycle. Interferon tau is a mediator of maternal recognition of pregnancy in cattle, inhibiting luteolysis and maintaining progesterone production (Bai *et al.*, 2022). The gestation period is approximately 280 days and is characterized by great physiological changes that ensure the fetus grows (Melaku, 2022).

Endocrine signals in the fetus, especially cortisol, induce parturition and trigger a cascade of hormonal reactions, including an upsurge in estrogen and prostaglandin production (Bhaumik *et al.*, 2023). The changes cause cervical dilation, uterine contractions, and expulsion of the fetus and placenta (Kissler and Hurt, 2023). Sabotage of these processes may lead to reproductive disorders (Saldanha *et al.*, 2023). To illustrate, poor luteal activity may result in premature embryonic death, and hormonal disorders may result in anestrus or cystic ovarian disease (Channo *et al.*, 2022). Disrupted GnRH pulsatility resulting from negative energy balance directly impedes the preovulatory LH surge, leading to anovulation and anestrus.

Obstetric Disorders in Cattle: Cattle obstetric disorders include complications in late gestation, parturition, and early postpartum (Arero, 2022). These diseases are of great clinical significance because they directly affect the survival of both the dam and the calf and the animal's subsequent reproductive performance (Alemu *et al.*, 2025). The most prevalent obstetric conditions are dystocia, uterine prolapse, retained fetal membranes, abortion, and stillbirth (Mekonnen and Belay, 2023). Poor nutritional status, metabolic imbalances, infectious diseases, and poor management in the calving are often common etiological factors of these conditions (Kang *et al.*, 2025). Obstetric

complications are particularly prevalent in heifers due to anatomical and physiological constraints, such as a smaller pelvis and incomplete physical maturity (Tsaousiotti *et al.*, 2024). Epidemiologically, the incidence of dystocia is significantly skewed, affecting approximately 10-15% of primiparous heifers compared to only 3-5% of multiparous cows, largely due to feto-maternal disproportion. Moreover, problems of poor sire selection that result in higher birth weight may worsen calving (Fig. 2) (Poczynek *et al.*, 2023).

Obstetric disorders have long-lasting effects that go beyond immediate clinical complications (Vogel *et al.*, 2024). They are often linked to delayed involution of the uterus and a higher incidence of uterine infections, and lower conception rates in the later breeding cycles (Tobolski *et al.*, 2025). Early diagnosis and prompt treatment are thus critical to reduce negative consequences (Lustberg *et al.*, 2023). The preventive strategies that focus on maintaining proper nutrition, genetic selection, and enhanced calving management are important for reducing the occurrence of these disorders (Kang *et al.*, 2025).

Dystocia: Dystocia refers to challenging or protracted parturition that involves human intervention and is one of the greatest obstetric issues in cattle (Tsaousiotti *et al.*, 2024). It is typically divided into maternal and fetal causes, but in most cases, the two factors can be combined (Megli and Coyne, 2022). Causes of maternal origin encompass insufficient size of the pelvis, uterine inertia, incomplete cervical dilation, and birth canal defects (Cruz-Medel *et al.*, 2024). Fetal causes are large size of fetus, abnormal presentation, position, or posture, and congenital defects (Sadlecki and Walentowicz-Sadlecka, 2023). The condition occurs because the fetus is larger than the maternal pelvis, usually due to genetic factors such as selection of a sire with a high growth rate (Wathes, 2022). Unusual fetal positions, e.g., breech or transverse positions, make delivery more complicated and necessitate expert obstetrical maneuvers (Fiorentini *et al.*, 2023).

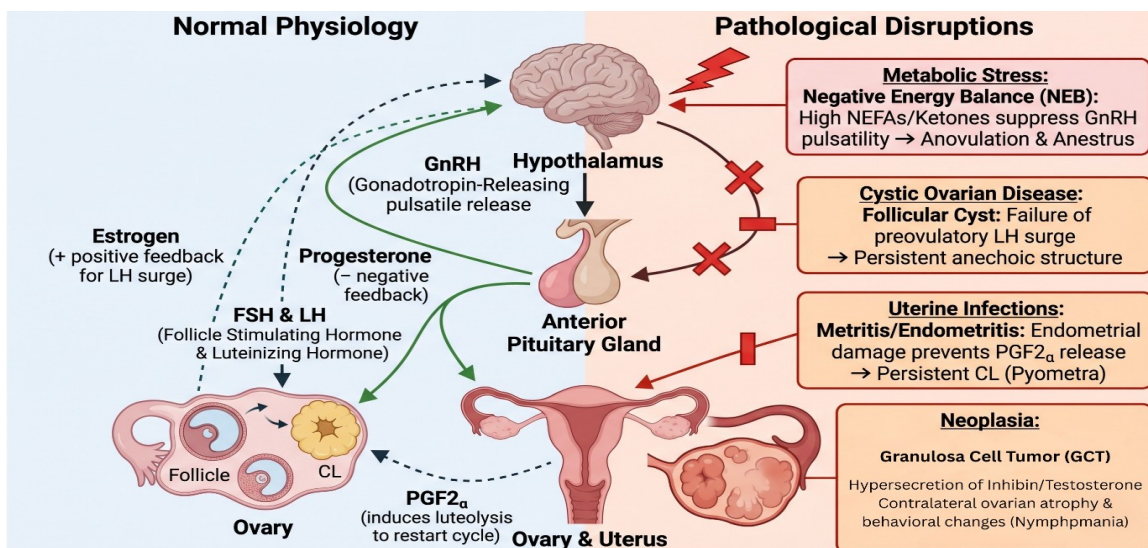


Fig. 1: Schematic representation of the bovine Hypothalamic-Pituitary-Gonadal (HPG) axis and key points of pathological disruption.

Dystocia pathophysiology is characterized by a long labor, which may lead to insufficient blood flow to the uterus and fetal hypoxia (Kissler and Hurt, 2023). Otherwise, it can result in fetal death and a higher risk of stillbirth (Vlachou *et al.*, 2024). The prolonged dystocia also leads to trauma to the reproductive tract that predisposes the cow to postpartum complications like retained fetal membranes, metritis, and low fertility (Smail *et al.*, 2025). Dystocia treatment varies depending on the type and severity (Lanci *et al.*, 2022). The primary examination includes assessment of fetal viability, presentation, and cervical dilation (Abdullah *et al.*, 2022). Malpresentation is usually corrected using obstetrical methods that include controlled traction and manipulation (Singh *et al.*, 2025). Where vaginal delivery is not possible, the surgical intervention, caesarean section, is recommended (Larsson *et al.*, 2022).

Prevention is imperative in mitigating the levels of dystocia (Smail *et al.*, 2025). These involve proper sire selection to prevent excessive birth weights, proper nutrition during gestation to allow proper growth of the fetus without over-conditioning and close observation of animals during the peri-parturient period (Muro *et al.*, 2023). Early identification and immediate action are key to reducing complications and improving outcomes for both the dam and the calf (Robi *et al.*, 2024).

Uterine Prolapse: Uterine prolapse is a serious postpartum disorder in which the uterus is totally everted through the vulva, typically over a few hours after calving (Peter and King, 2021). It is a real veterinary emergency since there is a probability of hemorrhage, shock, and contamination (Bonanno, 2022). The condition is most prevalent following challenging parturition, retention of fetal membranes, or excessive traction during delivery (Lupu *et al.*, 2023). Uterine prolapse is closely linked to decreased uterine tone and increased intra-abdominal pressure (Tan *et al.*, 2022). One of the most relevant predisposing factors is hypocalcemia because calcium is very important in smooth muscle contraction (DeBot *et al.*, 2022). Low calcium concentration weakens myometrial contractility, enabling the uterus to prolapse and invert because of the straining of the abdominal muscles (Zangeneh and Hantoushzadeh, 2023). Other causative factors are overdistension of the uterus, excessive recumbency, and poor body condition.

The prolapsed uterus is clinically manifested by a huge, edematous mass that sticks out of the vulva, which, in most cases, is covered with fetal membranes and debris (Chauhan *et al.*, 2025). The exposed tissue is very prone to trauma, laceration, and infection. When the large uterine blood vessels burst, a life-threatening hemorrhage can occur (Faria *et al.*, 2022). The following treatment needs urgent intervention in a strictly hygienic environment. Epidural anesthesia is usually used to minimize straining (Sharawi *et al.*, 2023). The prolapsed uterus is then cleansed, disinfected, and lubricated, then manually positioned carefully (Akambaram and Gupta, 2024). After replacement, oxytocin is given to induce uterine contractions and involution (Julikas *et al.*, 2024). In certain situations, vulvar sutures can help prevent recurrence (Hafermann *et al.*, 2024). Prevention measures emphasize proper mineral supplementation, especially

calcium, proper parturition management, and timely correction of dystocia and metabolic disorders (Raees *et al.*, 2023).

Retained fetal membranes (RFM): Retained fetal membranes are the inability to expel the placenta within 12 to 24 hours after birth (Amin and Hussein, 2022). It is prevalent in high-producing dairy cows and has been linked to both reproductive and economic impacts (Arero, 2022). The mechanism by which the fetal cotyledons and maternal caruncles normally separate is a complex process that involves enzymatic degradation, immune-mediated mechanisms, and uterine contractions (Megli and Coyne, 2022). Disruption of these processes can result in retention of the placenta (Burton and Jauniaux, 2023). Nutritional deficiency, especially of selenium and vitamin E, weakens the immune system and decreases the efficacy of placental detachment (Dahlen *et al.*, 2022). Metabolic imbalances like hypocalcemia and ketosis also impair uterine contractility and the chance of retention. Another key predisposing condition is infectious conditions and dystocia (Tiwari *et al.*, 2025).

Retained fetal membranes in cows are characterized by a lack of appetite, low milk production, and a bad odor vaginal discharge (Arero, 2022). Having retained tissues provides a favorable environment for bacterial growth, leading to subsequent uterine infections such as metritis and endometritis (Baigazanov *et al.*, 2022; Thulasiraman *et al.*, 2024). These complications slow the involution of the uterus and negatively contribute to future fertility (Ćwiertnia *et al.*, 2022). The treatment of retained fetal membranes has changed over time (Amin and Hussein, 2022). Rather, the treatment focuses on supportive care, including keeping the body clean, monitoring for systemic illness, and administering antibiotics as needed (Ronghe *et al.*, 2023). Prostaglandins can be utilized to induce uterine contractions and expulsion. Prevention strategies include proper nutritional management during the transition period, appropriate supplementation with trace minerals, and reduced calving stress (Hussain *et al.*, 2024).

Abortion and Stillbirth: In cattle, among the key causes of reproductive losses are abortion and stillbirth, which have huge economic consequences (Andrade and Simões, 2024). Abortion can be described as the pregnancy that is lost before it can be considered viable, which is normally before 260 gestation days, whereas stillbirth is the termination of a dead fetus at or around its term (Maes *et al.*, 2023). The reasons behind abortion are varied, and they can be broadly classified as infectious and non-infectious factors (Mee, 2023). Among the most significant causes are infectious agents, which include bacterial, viral, and protozoal pathogens (Akoolo *et al.*, 2022). Such organisms can enter the placenta or fetus, causing fetal death and expulsion (Maes *et al.*, 2023). The period of gestation at which abortion takes place tends to give hints as to the cause (Donley and Lens, 2022). The pathogens involved in abortifacient disease can be divided into those that tend to occur in the first, second and third trimesters, with *Tritrichomonas fetus*, *Campylobacter fetus* and *Brucella abortus* predisposing to abortions in the first trimester and *Neospora caninum* and *Leptospira*

species predisposing to abortions in the second and third trimesters, respectively. Non-infectious causes include malnutrition, ingestion of poisonous plants or mycotoxins, genetic defects, and other environmental stressors (Awuchi *et al.*, 2022). Examples of such include heat stress, which has been found to cause embryonic mortality and abortion because of hormonal imbalance and malfunction of the uterus (Khan *et al.*, 2023).

Stillbirth is often related to dystocia and long labor, which leads to fetal hypoxia (Obeagu and Obeagu, 2024). Other causes include placental insufficiency, infections, and congenital defects (Wang *et al.*, 2022a). Poor supervision during calving would also lead to an increase in the risk of stillbirth because of a delay in intervention (Probo *et al.*, 2022). Abortion and stillbirth diagnosis requires an extensive investigation, which includes examining the fetus, placenta, and dam, and laboratory tests to determine the infectious agent (Tsakiridis *et al.*, 2022). The control measures are concentrated on vaccination, biosecurity, and good herd management practices (Ciuderis-Aponte *et al.*, 2022).

Metabolic and Nutritional Influences: Nutritional and metabolic factors are key drivers of reproductive disorders in cattle (Sammad *et al.*, 2022). It is especially important during the transition period, which includes the weeks before and after calving (Tufarelli *et al.*, 2024). Cows during this period are normally affected by negative energy balance as they require more energy to produce milk and less feed (Mekuriaw, 2023). The negative energy balance causes mobilization of the body fat reserves, which causes high levels of non-esterified fatty acids and ketone bodies (Martens, 2023). Such metabolic transformations disrupt ovarian function, slow ovulation, and reduce pregnancy rates (Zhang *et al.*, 2023). Also, they weaken immune activity, making them prone to infections like metritis and mastitis (Mukhamadieva *et al.*, 2022; Zainettinova, 2023).

Reproductive disorders are also highly related to mineral imbalances (Kapper *et al.*, 2024). Hypocalcemia

decreases uterine contractility, which predisposes cows to dystocia, retained fetal membranes, and uterine prolapse (Arechiga-Flores *et al.*, 2022). The lack of phosphorus may disrupt energy metabolism and reproductive performance, and the lack of trace elements (selenium and zinc) may influence immune function and tissue integrity (Chen *et al.*, 2023). There is a correlation between the occurrence of retained placenta and uterine infections and vitamin deficiencies, especially vitamin E (Rahim *et al.*, 2023). Balanced rations and adequate nutritional supplementation are also paramount for preserving reproductive health (Ding *et al.*, 2024).

Gynaecological Disorders in Cattle: Gynaecological disorders in cattle include pathological conditions of the reproductive tract, which are not directly related to the peri-parturient period (LeBlanc, 2023). The disorders mainly affect the uterus, ovaries, and endocrine regulation, resulting in reduced fertility and reproductive efficiency (Bendarska-Czerwińska *et al.*, 2023). Gynecological disorders are not linked to parturition as in the case of obstetric disorders, but exhibit as irregular estrous cycles, inability to conceive, or extended calving intervals (Ali *et al.*, 2023). The usual gynecological ailments are uterine infections, ovarian dysfunction, repeat breeding syndrome, and anestrus (Hajam *et al.*, 2026). These disorders are often interconnected and can be a result of a complex of infectious, hormonal, nutritional, and management-related factors (Adroa Afíya, 2024). Indicatively, normal ovulation and repeat breeding can result when postpartum uterine infections impair normal ovarian operations (Fig. 3) (LeBlanc, 2023). Gynecological disorders significantly affect herd productivity (Ojeda-Rojas *et al.*, 2025). Affected animals tend to demand many inseminations, extended treatment, and more veterinary attention, all of which are lost revenues (Quelhas *et al.*, 2023). Early diagnosis and appropriate intervention are therefore necessary to reestablish reproductive function and improve fertility outcomes (Sánchez-Garrido *et al.*, 2022).

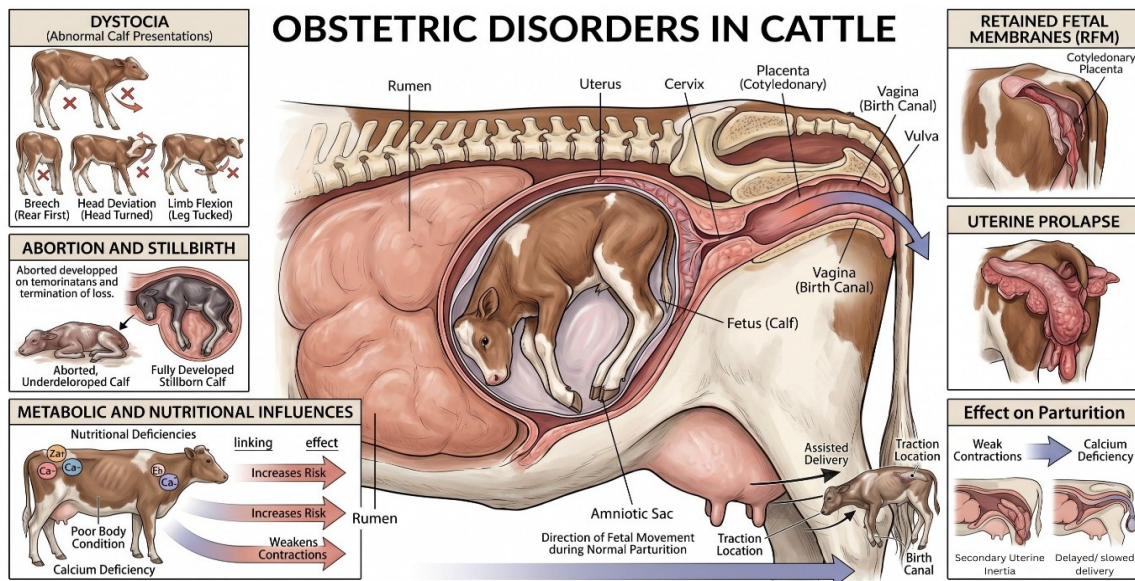


Fig. 2: Obstetric disorders in cattle.

Uterine Infections: Among the most common reproductive diseases in cattle are uterine infections, which are a major cause of infertility, especially in dairy cattle (Dobos *et al.*, 2022). These infections are commonly categorized as metritis, endometritis, and pyometra, based on severity and duration (Pascottini *et al.*, 2023). Metritis develops during the first week of the postpartum period and is characterized by inflammation of the entire uterine wall, accompanied by general symptoms, fever, loss of appetite, and low milk production (Garzon *et al.*, 2022). The disorder is commonly linked to dystocia, retained fetal membranes, and inadequate hygiene at calving. Popular bacterial pathogens are *Escherichia coli* and *Trueperella pyogenes* (Nechifor *et al.*, 2024).

Endometritis is a more local infection, and it occurs in the uterine lining, typically occurring after the first week after delivery (Katila and Ferreira-Dias, 2022). It is marked by dysfunctional uterine discharge in the absence of systemic disease (Várhidi *et al.*, 2024). The diagnosis and treatment are usually standardized, with clinical endometritis being classified using a grading system. This grading system is based on the character of the vaginal discharge, from Grade 1 containing clear mucus with flecks of pus, to Grade 3 with >50% purulent or sanguinolent exudate. Endometritis disrupts embryo implantation and can be a major reason for repeat breeding (Xie *et al.*, 2024). Pyometra is a chronic disease that is defined by the presence of purulent material in the uterus under the condition of having an active corpus luteum (Xavier *et al.*, 2023). The cervix is closed and does not drain, and affected cows do not show estrus (López-Gatius, 2022). It is diagnosed by clinical examination, uterine discharge examination, and ultrasonography (Krzemińska *et al.*, 2024). Therapy is performed with the use of antibiotics, prostaglandins to induce luteolysis, and supportive management (Kasimanickam *et al.*, 2025).

Ovarian Disorders: Development of abnormal follicles and ovulation are the main causes of ovarian disorders, which are major causes of reproductive inefficiency in cattle (Xu *et al.*, 2023). Cystic ovarian disease and ovarian inactivity are the most typical ovarian diseases (Alomran *et al.*, 2023). Cystic ovarian disease is a condition characterized by the formation of persistent fluid-filled structures on the ovary that do not ovulate (Channo *et al.*, 2022). These cysts can be follicular or luteal and are associated with hormonal imbalances, particularly in luteinizing hormone production (Xu *et al.*, 2023). There is a need for a diagnostic differentiation between follicular cyst (thin-walled, anechoic, and in association with low progesterone) and luteal cyst (thicker-walled, echogenic patches, and high progesterone). The treatment protocols should be adjusted: follicular cysts usually respond to administration of GnRH or hCG (70-80%), luteal cysts should be treated with PGF₂α to promote luteolysis. The affected cows may have abnormal estrus cycles, nymphomania, or anestrus (Endo, 2022).

Ovarian inactivity, also known as ovarian quiescence, is defined as the lack of follicular development and ovulation (Kim and You, 2022). This condition is usually associated with negative energy balance, malnutrition, and systemic disease (Massironi *et al.*, 2023). Early lactation

is a sensitive period in high-producing dairy cows (Cattaneo *et al.*, 2023). Ovarian disorders are diagnosed by rectal palpation and ultrasonography, which enable proper evaluation of ovarian anatomy (Thaker *et al.*, 2023). Hormonal therapy (giving gonadotropin-releasing hormone and prostaglandins and correcting nutritional status) is the treatment (Barrea *et al.*, 2025). Fertility is highly affected by neoplastic conditions. Granulosa cell tumors (GCTs) are the most common ovarian tumors in cattle, and they produce excessive amounts of inhibin and testosterone, resulting clinically in either prolonged anestrus, nymphomania or virilism. Diagnosis is based on multi-cystic 'honeycomb' on one ovary and on the other ovary atrophy, which are visible through ultrasonography.

Repeat Breeding Syndrome: Repeat breeding syndrome is a complex reproductive disorder characterized by the inability to conceive after 3 or more consecutive inseminations, despite normal estrous cycles and the absence of apparent defects (Pérez-Marín and Quintela, 2023). It is a multidimensional ailment that is characterized by a mixture of physiological, pathological, and management-related aspects (Möbus *et al.*, 2024). Subclinical uterine infection is one of the major causes of repeat breeding as it changes the uterine environment and compromises the survival of the embryo (Pascottini *et al.*, 2023). It can also be caused by other factors, such as poor-quality oocytes, hormonal imbalances, and improper timing of insemination (Ramya *et al.*, 2023). The quality of sperm and the method of handling them are also important in conception success (Bhat *et al.*, 2024).

Nutritional deficiencies, especially during the transition period, may negatively affect reproductive performance, including follicular development and oocyte competence (Gonnella *et al.*, 2022). Conception rates are also known to be reduced by environmental stress (particularly heat stress) (Ullah *et al.*, 2022). Repeat-breeding syndrome requires a holistic approach that includes proper heat identification, the optimal timing of insemination, semen quality assessment, and treatment of underlying infections (Pérez-Marín and Quintela, 2023). It is common to use hormonal synchronization protocols to enhance conception rates (Haile *et al.*, 2023).

Anestrus: Anestrus is the term used to describe the lack of observable estrus behavior and is a typical reproductive issue in cattle, especially in high-producing dairy herds (Nishi *et al.*, 2022). It can be either physiological or pathological based on its cause (Schuster *et al.*, 2023). Physiological anestrus occurs during prepuberty, pregnancy, and early postpartum recovery (Koysombat *et al.*, 2025). Pathological anestrus, on the other hand, is caused by nutritional deficiencies, hormonal imbalances, ovarian inactivity, and systemic diseases (Nishi *et al.*, 2022). Negative energy balance is a close associate of postpartum anestrus that retards the re-emergence of ovarian activity (Mekuriaw, 2023). Inadequate body condition and poor nutrition exacerbate this condition (Morales *et al.*, 2023). Further hormonal anomalies in gonadotropin-releasing hormone and luteinizing hormone also lead to the non-development of follicles and to non-ovulation (Sigal *et al.*, 2024). Diagnosis: reproductive history, clinical examination, and ultrasonography to

evaluate ovarian activity (Di Michele *et al.*, 2025). The approach to treatment aims to correct underlying health problems, improve nutritional status, and provide hormonal therapies to induce estrus (Evans *et al.*, 2022).

Congenital and acquired abnormalities: Abnormalities of the reproductive tract in cattle, both congenital and acquired, may be of great consequence to fertility (Wathes, 2022). Congenital defects develop during embryonic development and comprise freemartinism, segmental aplasia of the reproductive tract, and hermaphroditism (Marc and Otavã, 2025). Among cervical anomalies, the occurrence of uterus didelphys (double cervix) poses distinct challenges for artificial insemination and parturition. Furthermore, the first global case of a triple cervix in a heifer was meticulously documented by Mimoune *et al.* (2016), highlighting rare but critical anatomical malformations that obstruct normal reproductive function. Freemartinism is a typical syndrome of female calves born co-twin to a male and is marked by infertility caused by abnormal development of the reproductive organs (Beech and Novick, 2023). The condition results from blood mixing between the twins in the womb, leading to hormonal effects that prevent normal female development (Kolatorova *et al.*, 2022). They are acquired abnormalities that comprise adhesions, fibrosis, tumors, and traumatic injuries of the reproductive tract (Guler and Roovers, 2022). Such conditions can be caused by infection, surgery, or trauma, in which parturition occurs. Diagnosis can be complicated by the need to use advanced imaging and clinical assessment (Hussain *et al.*, 2022). The management relies on the nature and severity of the abnormality, and some are irreversible (Singhal, 2023).

Infectious Causes of Reproductive Disorders: They are a leading cause of reproductive failure in cattle caused by infectious diseases and cause huge economic losses around the world (Kappes *et al.*, 2023). The diseases may impact fertility, cause embryonic death, abortion, and stillbirths (Maes *et al.*, 2023). These causative agents are bacteria, viruses, and protozoa, each with its own mechanisms of pathogenesis and transmission. One of the most significant causes of reproductive disorders is bacterial infections (Guiton and Drevet, 2023). The well-known pathogen is *Brucella abortus*, which causes late-term abortions and infertility (Zavattieri *et al.*, 2023). In tropical and subtropical areas, *Leptospira* species are the cause of abortion, stillbirth, and weak calves (Orjuela *et al.*, 2022). *Campylobacter* and *Trichostrongylus axei* are venereal infections transmitted during natural mating, causing early embryonic death and reinfection of the womb (Dur-e-Najaf *et al.*, 2023).

Reproductive losses are also caused by viral infections (Rezaei and Moghoofei, 2024). The causative agent of infectious bovine rhinotracheitis is bovine herpesvirus 1, which is linked to abortion and infertility (Engdawork and Aklilu, 2024). Another significant pathogen is the bovine viral diarrhoea virus that results in a broad spectrum of reproductive issues, including premature embryonic mortality, abortion, and fetal malformation (Laghari *et al.*, 2025). Protozoal infections, especially *Neospora caninum*, are known to be significant

causes of abortion in cattle (Fayisa, 2023). The infection may be vertical between the dam and the fetus or horizontal if contaminated feed is ingested (Megli and Coyne, 2022). Management of infectious diseases is pegged on a mixture of vaccination, biosecurity, and herd management practices (Marzouk and Alajaji, 2025). To prevent the spread of infection, it is necessary to regularly screen, isolate infected animals, and maintain proper sanitation (Jimenez *et al.*, 2023).

Risk factors affecting reproductive health: The causes of reproductive disorders in dairy cows are a complex interplay of risk factors, such as nutrition, management practices, genetics, and environmental conditions (Silva Neto *et al.*, 2024). One of the greatest factors leading to reproductive inefficiency is poor nutritional conditions, especially in the transition period (Pascottini *et al.*, 2022). Factors contributing to reproductive disorders include poor heat detection, improper timing of insemination, and poor hygiene during calving (Castro-Montoya *et al.*, 2022). Genetic predisposition is also a factor, with some breeds and bloodlines being more prone to certain conditions (Anderson *et al.*, 2022). Environmental stresses, particularly heat stress, adversely affect reproductive performance through hormonal imbalances, reduced feed intake, and compromised oocyte quality (Skliarov *et al.*, 2022). To maximize reproductive health, these risk factors need to be addressed by improving management and environmental control (Olorunsogo *et al.*, 2024). The risk factors occur in a hierarchy. Primary risks (such as 'severe negative energy balance') directly predispose the animal to secondary risks (such as 'retained placenta' and 'metritis' that follow). In addition, interaction effects are important, such as when heat stress and the lack of calving hygiene occur in combination, the risk of developing puerperal metritis is greatly increased from either risk factor alone.

Diagnostic approaches: Both proper and quick diagnosis of reproductive problems in cattle is paramount to be effectively treat, improve fertility, and manage herds at the herd level (Džermeikaitė *et al.*, 2023). A thorough diagnostic methodology incorporates clinical, imaging, laboratory, and more and more, sophisticated molecular methods (Schmitz *et al.*, 2022). The diagnostic method varies depending on the type of disorder, the stage of the reproductive cycle, and the resources one has (Giudice *et al.*, 2023). The initial step in diagnosing reproductive disorders is clinical examination (Pascoal *et al.*, 2022). An accurate reproductive history, including calving history, estrous history, insemination dates, and past reproductive problems, provides useful pre-historic information (Smits *et al.*, 2022). Physical examination includes general health assessment, body condition scoring, and evaluation of systemic signs such as fever or decreased appetite, which may indicate underlying infections or metabolic disorders (Table 1) (Kamel *et al.*, 2024).

The use of ultrasonography has become an inseparable part of modern bovine reproduction diagnosis (Fontes and Oosthuizen, 2022). Ultrasonography can also be used to differentiate between types of uterine infections and to evaluate treatment response, making it a useful technique in the diagnostic and follow-up process (Wang

et al., 2022b). Laboratory diagnostic methods are very important for diagnosing infectious and metabolic factors in reproductive diseases (Birhanu, 2023). Hormone assays are fundamental to assessing ovarian function, and progesterone measurement is commonly used to establish luteal function and pregnancy (Greene *et al.*, 2025). In a few situations, the estrogen and luteinizing hormone may also be evaluated (Demir *et al.*, 2022).

The use of molecular diagnostic methods has greatly contributed to the detection of infectious agents that are related to reproductive failure (Schmitz *et al.*, 2022). Assays through polymerase chain reaction can be easily and rapidly identified with high sensitivity to identify bacterial, viral, and protozoal pathogens, even where traditional culture techniques are not clear (Oon *et al.*, 2023). The methods are specifically applicable in the diagnosis of diseases like bovine viral diarrhea, infectious

bovine rhinotracheitis, and neosporosis (Dima and Abdisa, 2022). Another useful diagnostic tool is serological testing, particularly in the herd-level surveillance of infectious diseases (Haselbeck *et al.*, 2022). The presence of antibodies against specific pathogens can be detected to inform exposure assessment and the development of vaccination and control measures (Pantaleo *et al.*, 2022). Nonetheless, the interpretation of serological results should take into account the history of vaccination and the risk of latent infections (Jerre *et al.*, 2022). Though not widely used in field settings, endometrial biopsy offers comprehensive data on the health of the uterus and histopathological alterations (Vitale *et al.*, 2023). It is especially useful when other diagnostic methods cannot identify the underlying cause of chronic infertility or recurrent breeding (Pérez-Marín and Quintela, 2023).

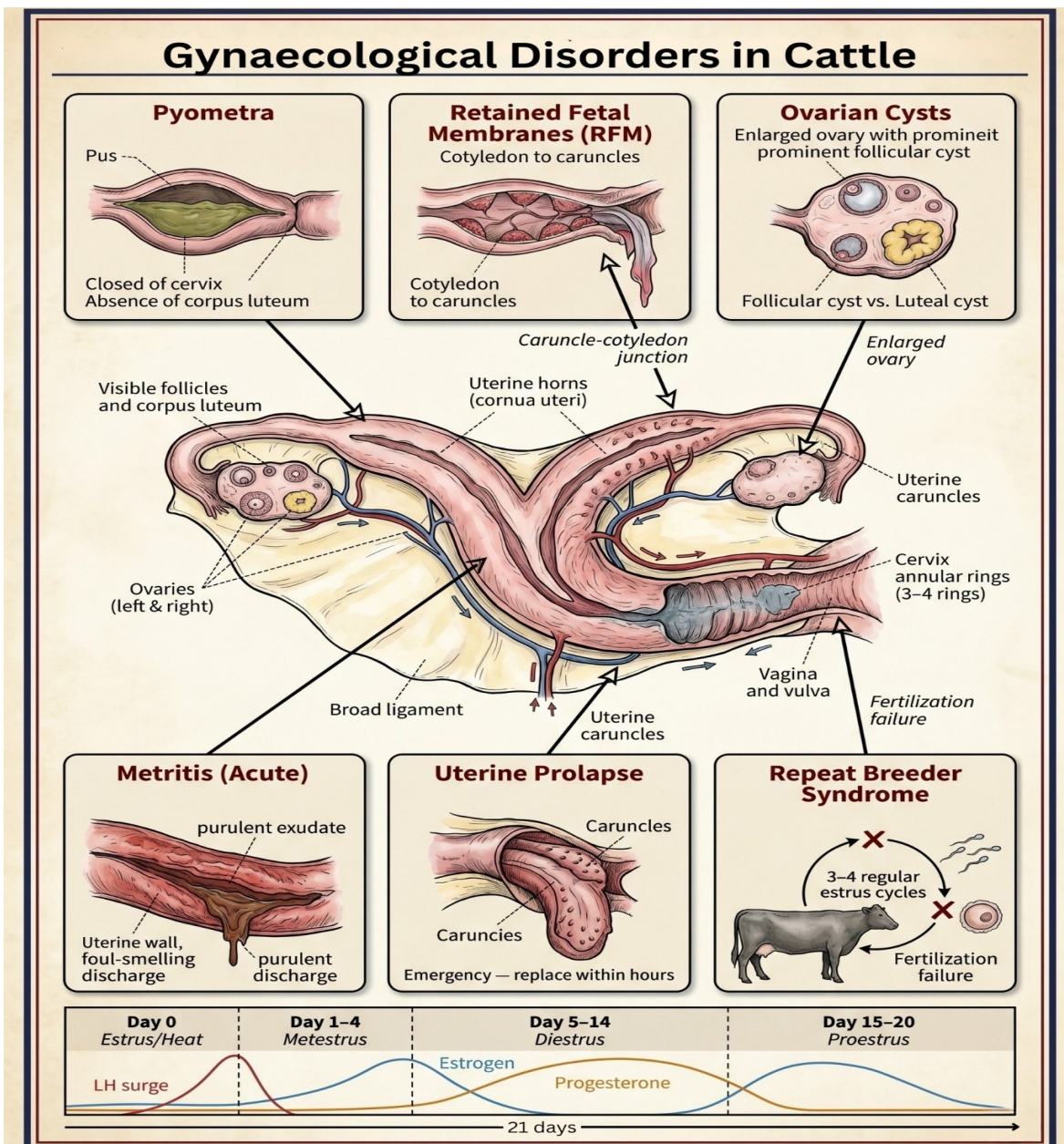


Fig. 3: Gynaecological disorders in cattle.

New diagnostic methods use biomarkers to enable early detection of reproductive disorders (Nandi *et al.*, 2025). The use of acute phase proteins, metabolic indicators, and reproductive hormones as possible predictors of disease risk and as indicators of reproductive status is under investigation (Soliman *et al.*, 2024). Moreover, advanced livestock technologies, including activity monitors, rumination sensors, and automated estrus detection systems, are being progressively utilized to enhance reproductive management (Das *et al.*, 2023).

A combination of modern technologies and the traditional clinical approach to diagnosis offers the most effective and precise evaluation of reproductive health in cattle (Džermeikaitė *et al.*, 2023). The most important element in applying an effective treatment strategy to enhance reproductive efficiency at both individual and herd levels is early detection and accurate diagnosis (da Costa Freitas and Barbosa, 2025).

Treatment and Management Strategies: Treatment and management of reproductive disorders in cattle should be an integrated and holistic approach that encompasses the

causal factors of the condition and clinical presentation of the condition (Storoni *et al.*, 2026). Good management not only enhances the health of individual animals but also the increased productivity and profitability of the herd (Nguyen *et al.*, 2023). The management of most reproductive disorders is based on medical treatment (Khairullin *et al.*, 2024). Antibiotics are commonly used to treat uterine infections such as metritis and endometritis, and the selection of the drug depends on the suspected or known causative agents (Umer *et al.*, 2022). Hormonal treatments are very important in controlling reproductive functions (Li *et al.*, 2024). Prostaglandins are usually prescribed to cause luteolysis and treat problems like pyometra, and gonadotropin-releasing hormone is prescribed to cause ovulation and to treat ovarian cysts (Krekeler and Hollinshead, 2023). When anestrus occurs, hormonal treatments are used to restore normal estrous cycles (Endo, 2022). Economic evaluations indicate that proactive management of treatment efficacy is financially advantageous, since the costs of additional days open are often lower than the losses incurred from extended calving intervals.

Table 1: Comprehensive Diagnostic Approaches for Reproductive Disorders in Cattle

Sr. No.	Diagnostic Method	Principle	Sample Type	Target Disorder(s)	Indicators	Sensitivity / Specificity	Advantages	Limitations	Field Applicability	References
1.	Clinical Examination	Physical assessment	Whole animal	General disorders	Discharge, BCS, systemic signs	Low to moderate	Simple, low cost	Subjective	High	(Sheldon <i>et al.</i> , 2006)
2.	Rectal Palpation	Manual palpation	Reproductive tract	Pregnancy, cysts	CL, uterine size changes	Moderate	Rapid, common	Operator dependent	High	(Zangos <i>et al.</i> , 2016)
3.	Vaginal Examination	Visual inspection	Vaginal tract	Metritis, endometritis	Purulent discharge	Moderate	Direct observation	Limited depth	High	(Sheldon <i>et al.</i> , 2006)
4.	Transrectal Ultrasonography	Sound wave imaging	Uterus, ovaries	Pregnancy, cysts	Follicles, embryo, fluid	High (>90%)	Accurate	Requires skill	Moderate	(Korhonen <i>et al.</i> , 2002)
5.	Doppler Ultrasonography	Blood flow imaging	Ovaries	CL function	Vascularization	High	Functional insight	Expensive	Low	(Wang <i>et al.</i> , 2023)
6.	Uterine Cytology	Cell analysis	Uterine swab	Endometritis	PMN cells	High	Detects subclinical	Lab required	Moderate	(Sheldon <i>et al.</i> , 2006)
7.	Uterine Culture	Microbial isolation	Uterine fluid	Infection	Bacterial growth	Moderate	Identifies pathogen	Time consuming	Low	(Sgayer <i>et al.</i> , 2020)
8.	PCR	DNA detection	Blood/tissue	BVD, IBR, Neospora	Pathogen genome	Very high	Highly specific	Expensive	Low	(Herlina <i>et al.</i> , 2025)
9.	Serology (ELISA)	Antibody detection	Blood	Brucellosis, leptospirosis	Antibody titer	High	Herd screening	Past vs current unclear	High	(Bedir <i>et al.</i> , 2025)
10.	Progesterone Assay	Hormonal analysis	Milk/blood	Pregnancy	Progesterone level	High	Accurate	Lab dependent	Moderate	(Bailey <i>et al.</i> , 2014)
11.	Blood Biochemistry	Metabolic profiling	Blood	NEB, ketosis	NEFA, BHBA	High	Detects metabolic issues	Indirect	Moderate	(Banavara <i>et al.</i> , 2003)
12.	Endometrial Biopsy	Histology	Uterine tissue	Infertility	Tissue damage	Very high	Detailed	Invasive	Low	(Vitale <i>et al.</i> , 2023)
13.	Vaginal Mucus Scoring	Visual scoring	Vaginal mucus	Endometritis	Mucus consistency	Moderate	Simple	Subjective	High	(Sheldon <i>et al.</i> , 2006)
14.	Whiteside Test	Chemical reaction	Uterine fluid	Endometritis	Color change	Moderate	Cheap	Low precision	High	(Jakupov <i>et al.</i> , 2024)
15.	Infrared Thermography	Heat detection	Body surface	Inflammation	Temperature rise	Moderate	Non-invasive	Environmental effects	Moderate	(Mahan <i>et al.</i> , 2010)
16.	Activity Monitors	Behavior tracking	Movement data	Estrus	Increased activity	High	Automated	Cost	Moderate	(Prabhakar <i>et al.</i> , 2013)
17.	Pedometers	Step count	Leg sensor	Estrus	Increased steps	High	Practical	False positives	High	(Raizman and Santos, 2002)
18.	Milk Progesterone Kits	On farm test	Milk	Estrus cycle	Hormone fluctuation	Moderate to high	Quick	Less precise	High	(Nebel, 1988)
19.	Laparoscopy	Direct visualization	Abdomen	Ovarian disorders	Ovarian structures	Very high	Accurate	Invasive	Low	(Pinto <i>et al.</i> , 2023)
20.	Acute Phase Proteins	Biomarker detection	Blood	Infection	Haptoglobin	High	Early detection	Nonspecific	Moderate	(Jain <i>et al.</i> , 2011)
21.	Ultrasonographic Follicle Tracking	Serial imaging	Ovary	Follicular dynamics	Dominant follicle	High	Research accuracy	Time intensive	Low	(Coelho Neto <i>et al.</i> , 2018)
22.	Rumination Sensors	Feeding behavior	Collar sensor	Health monitoring	Reduced rumination	Moderate	Early detection	Indirect	Moderate	(Iqbal <i>et al.</i> , 2021)

In some obstetric conditions, surgery could be required; this is done when the dystocia is severe and vaginal birth cannot be done (Kissler and Hurt, 2023). Uterine prolapse should be corrected with utmost care by hand replacement under sterile circumstances (Padoa *et al.*, 2023). Such processes involve quality veterinary services and proper aftercare. Treatment and prevention critically entail nutritional management (Gabielli *et al.*, 2024). Adequate energy consumption, especially during the transition phase, helps avoid a negative energy balance and maintain normal ovarian function (Mekuriaw, 2023). Minerals and vitamins should be balanced to support the immune system and uterine health (Weyh *et al.*, 2022).

It is also important that herd-level management practices are considered (Genfors *et al.*, 2023). Consistent reproductive health checks, proper record keeping, and prompt veterinary care are vital in the early identification and treatment of conditions (Blackwell and O'Reilly, 2023). Estrus synchronization protocols and monitoring technologies are among the ways to enhance heat detection efficiency (Merkelytė *et al.*, 2025). Some preventive measures include proper hygiene during the calving process, vaccination against major infectious diseases, and biosecurity to prevent disease introduction (Ferreira *et al.*, 2024). Successful reproductive management is also dependent on farmer education and awareness (Wicaksono *et al.*, 2025).

Emerging Technologies and Future Perspectives: The development of reproductive technologies and more precise livestock farming is shifting the treatment of reproductive disorders in cattle (Džermeikaitė *et al.*, 2023). Early detection, improved monitoring, and more effective interventions are enabled by modern tools (Majebi *et al.*, 2023). The use of precision livestock farming technologies, such as activity monitors and sensors, allows monitoring the behaviour of the animals and their physiological parameters continuously (Tzanidakis *et al.*, 2023). The devices enhance the accuracy of heat-detection services and enable early detection of health-related problems (Islam *et al.*, 2023). Artificial Intelligence (AI) and Machine Learning (ML) algorithms are being used to analyze data generated from milking robots and rumination collars, to provide predictive modelling of herd fertility. In practice, the technologies are not widely adopted due to significant upfront investment requirements, the challenges of building on-farm data systems, and the complexity of software integration. Genomic selection has provided an opportunity to breed animals with better fertility and disease resistance (Bora, 2023). Assisted reproductive technologies such as embryo transfer and in vitro fertilization are being employed more widely to accelerate genetic advancement and enhance reproductive efficiency (Mikkola *et al.*, 2024). Reproductive disorders are also coming under the spotlight of molecular diagnostics and biomarker studies, which are making it possible to diagnose them more accurately and at earlier stages (Nandi *et al.*, 2025). Further study and innovation are necessary in order to solve the multifaceted problems that reproductive health in cattle holds (Džermeikaitė *et al.*, 2023).

Conclusions: Fertility, productivity, and economic sustainability in cattle production systems have been major problems in livestock production systems across the world as a result of reproductive disorders in cattle. Both gynecological and obstetric disorders lead to reproductive inefficiency because of complex and multifactorial mechanisms of nutrition, infection, hormone regulation, and management practices. These disorders require an in-depth insight into the causes and pathophysiology of the disease to prevent and control the condition. The development of diagnostic tools and treatment interventions has enhanced the effectiveness of managing reproductive disorders, although their effectiveness depends on effective implementation and integration into herd management practices. The combination of better nutrition, disease management, reproductive surveillance, and the use of new technologies is the most promising way to improve reproductive performance. Ongoing research, education, and adoption of best practices are critical to ensuring sustainable cattle production and enhancing farmers' livelihoods. In practical terms, the nutritional transition of transition cows should be managed to reduce metabolic stress, implementing only evidence-based management practices (such as avoiding the use of obsolete practices like manual removal of the placenta) and introducing precision monitoring technologies that are cost-effective to optimize timing of insemination.

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