Controlling reproduction losses in ruminant herds—impact and diagnostic solutions of four major abortive diseases.

- Chlamydiosis
- Neosporosis
- Q Fever
- Toxoplasmosis

Abortifacient infectious diseases level a massive impact on herd productivity in every region of the world. Some of these diseases can travel undetected in herds and result in unforeseen abortion outbreaks; some can cause fetal or newborn deaths and induce infertility; and some can result in a persistent or recurring infection in herds with long-term poor reproductive performance. The total reproductive losses resulting from these diseases are a primary threat to the long-term economic vitality of herds. In addition, many of these diseases are a threat to human public health, both emphasizing the need to control transmission and complicating the procedures required to do so. This brochure explores four major ruminant infectious diseases affecting herd reproduction—Chlamydiosis, Neosporosis, Q Fever, and Toxoplasmosis—and discusses the latest diagnostic tools to control each.
Chlamydia Classification: This diagram demonstrates the differences between the new and old classification of the order Chlamydiales, showing the new species classification Chlamydophila abortus

Chlamydiosis

*Chlamydophila abortus*, formerly known as *Chlamydia psittaci* immunotype 1, is the causative agent of ovine chlamydiosis (enzootic abortion). The disease primarily affects sheep and goats and less commonly, cattle and deer. *C. abortus* causes considerable reproductive losses worldwide, particularly in areas where herds are kept closely congregated during lambing season.

Vast amounts of bacteria are shed at the time of abortion or birth in the placenta and in uterine discharges. This contagious time period can extend from more than two weeks prior to abortion/birth to more than two weeks following. Initial *C. abortus* infection occurs after a susceptible animal is exposed to infected parturition material, and symptoms are often inapparent. In nonpregnant or late-gestational ewes, the infection can remain latent until the next conception. Chlamydial placentitis begins around 90 days into gestation, at a moment coinciding with a period of significant fetal growth, resulting in a diffuse inflammatory response and placental tissue necrosis. Abortion occurs late-term, with no other outward symptoms.

Chlamydiosis in small ruminants is also a zoonosis, posing a particular risk for pregnant women, with documented cases of human placentitis and abortion. Any source of potential infection must be handled with biosafety precautions. Human infection response may vary from subclinical through acute influenza-like symptoms.

Direct diagnosis of an infection relies on a sympathetic history and the presence of a necrotic placenta containing a large quantity of the agent. Indirect serological testing is faster and more accessible, and antibodies can be detected in serum in the last month of gestation and following an abortion or a suspicious birth for up to 3 months.

IDEXX Laboratories offers the IDEXX Chlamydiosis Total Ab Test, an indirect enzyme-linked immunoassay (ELISA) for the detection of antibodies against *C. abortus* in serum and plasma of ruminants. The test contains two plates (strips), offers results in just 2.5 hours, and is adapted to automation technologies.

**Indirect serological testing is faster and more accessible, and antibodies can be detected in serum in the last month of gestation and following an abortion or a suspicious birth for up to 3 months.**

**IDEXX Chlamydiosis Total Ab Test performance on 81 caprine samples**

<table>
<thead>
<tr>
<th>Number of Samples</th>
<th>IDEXX Chlamydiosis Total Ab Test</th>
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<tbody>
<tr>
<td>Three naturally infected herds</td>
<td>20</td>
</tr>
<tr>
<td>One experimentally infected herd</td>
<td>19</td>
</tr>
<tr>
<td>Two confirmed negative herds</td>
<td>42</td>
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</tbody>
</table>

The table shows the high specificity and sensitivity of the IDEXX Chlamydiosis Total Ab Test for 81 goat samples across 6 herds from France.
Neosporosis

*Neospora caninum* is a protozoal parasite that causes neosporosis, a major source of infectious abortion in cattle. This apicomplexan species is morphologically similar to *Toxoplasma gondii*, with dogs serving as the definitive host. Intermediate hosts susceptible to infection include cattle, sheep, goats, dogs, horses, and deer.

The primary clinical features are abortion and newborn illness or death. Seropositive cattle will continue to have elevated abortion rates in future pregnancies and an overall decreased milk production. Primary transmission is through congenital infections, the spread of *N. caninum* oocysts in dog feces, and vertically from cow to calf. Offspring exposed in utero can be born healthy, yet be chronically infected. If bred, these offspring may initiate seropositive pedigrees, significantly affecting reproduction and milk production rates of the herd.

Direct diagnosis of neosporosis is possible through a histological examination or by testing aborted fetal tissue for *N. caninum* organisms using either an immunofluorescence assay (IFA) or a polymerase chain reaction (PCR) test. Indirect diagnosis can be performed on cows using an indirect IFA or an ELISA.

All cows that have aborted should be screened by serological assay, and confirmed by a direct assay on fetal tissue or by performing a histopathology analysis. If any cow is positive, the entire herd should be screened for *N. caninum* antibodies.

Current ELISA technology expedites and automates the process of herd screening, without compromising quality. IDEXX Neospora Ab Test, offers rapid detection of antibodies against *N. caninum* in samples of bovine, ovine, and caprine serum and plasma. A recent trial of the IDEXX Neospora Ab Test demonstrated nearly 100% specificity and over 96% sensitivity in determining the serological status of ruminants from several regions across Europe.

**Sensitivity:** The IDEXX Neospora Ab Test detected 96.6% of bovine infections in 89 positive samples from Germany, France, and Hungary.

**Specificity:** The IDEXX Neospora Ab Test demonstrated excellent specificity in 964 negative cattle, goat and sheep samples from different regions of Europe.

**Life cycle of Neospora caninum**

Ingestion of infected tissue (e.g., fetus, placenta) may cause dogs to shed *Neospora caninum* oocysts in their feces. These oocysts are very resistant and may survive up to weeks and/or months in the environment.

*N. caninum* infection in cows may cause abortion, stillbirth, weak calves and a decrease in milk production.

If these infected cattle are used for breeding purposes, vertical transmission of the infection from cow to calf may occur in breeding herd operations, chronically infected pedigrees could result from this cycle.
Q Fever

Q Fever affects cattle, sheep, goats, domestic pets, and various wild animals, and is among the most hazardous to humans of cattle-borne diseases, with human epidemics and laboratory infections being common. *Coxiella burnetii*—the small, intracellular bacterium that causes Q Fever—was formerly classified in the Rickettsiaceae family. However, phylogenetic investigation has shown *C. burnetii* to be distant from the Rickettsia genus, and it has since been reclassified into the Coxiiellaceae family in the order of Legionellales. *C. burnetii* is distinguished from rickettsiae in that this pleomorphic bacterium produces a small, dense, highly resistant sporelike form significant to its infectious and hardy characteristics.

Parallel comparison of IDEXX Q Fever Ab Test and CF Test on 81 caprine samples.

<table>
<thead>
<tr>
<th></th>
<th>IDEXX Q Fever Ab Test</th>
<th>CF</th>
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</thead>
<tbody>
<tr>
<td>(Infected herd. Total of 16 animals):</td>
<td>16/16 100%</td>
<td>15/16 93%</td>
</tr>
<tr>
<td>(Experimentally infected herd. Total of 21 animals):</td>
<td>21/21 100%</td>
<td>21/21 100%</td>
</tr>
<tr>
<td>(3 negative herds. Total of 44 animals):</td>
<td>44/44 100%</td>
<td>44/44 100%</td>
</tr>
<tr>
<td>Overall correlation between both methods:</td>
<td>c = [(36+44)/81]*100 = 98%</td>
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The IDEXX Q Fever Ab Test correlates very well with the complement fixation test in a trial of 81 samples from six goat herds.\(^1\)

<table>
<thead>
<tr>
<th></th>
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<tbody>
<tr>
<td>CF +</td>
<td>36</td>
<td>0</td>
</tr>
<tr>
<td>CF –</td>
<td>1</td>
<td>44</td>
</tr>
<tr>
<td></td>
<td>37</td>
<td>44</td>
</tr>
</tbody>
</table>

\(^1\) *C. burnetii* aerosolizes on particles easily, is resistant to heat, drying, and many disinfectants, and requires only a few organisms to induce disease in susceptible animals. Infection may result from inhaling airborne contaminant, contact with infected animals and their reproductive tissues, and through vertical and sexual transmission. *C. burnetii* is excreted in massive amounts in lochia, placentas and other birthing matter, as well as in milk, urine, feces, and possibly blood. Ticks may also transmit the bacteria. As a result of its durability, ease of transmission, and risk to humans, *C. burnetii* is listed as an OIE Containment Group 3 pathogen and is considered a potential bioterrorism threat.

Monitoring, biosafety protocols, and prevention techniques are critical to protecting herds and humans from *C. burnetii* exposure.

In ruminants and other animals, Q Fever often has few outward symptoms until late-term abortions occur without warning, either sporadically or as part of a rare epidemic outbreak. *C. burnetii* infections persist for years, and may be lifelong. Additional symptoms may include the birth of dead or weak offspring, retained placenta, metritis, and infertility.

All late abortions in ruminants should be investigated for Q Fever, with care to protect human and other animal health. The IDEXX Q Fever Ab Test has shown great suitability to assess this.

Pregnant women are at particular risk, for whom infection may cause placentitis, which can lead to premature birth, growth restriction, spontaneous abortion, or fetal death.

For direct diagnosis of *C. burnetii*, samples can come from the placenta, vaginal discharge, aborted fetal tissue (liver, lung or stomach), milk, colostrum, or feces. Indirect serological assays are often used for individual diagnosis and herd screening, including IFA, CFT, and ELISA. Because of their ease of use, reliability, and scalability, ELISA test kits have become the choice tool for veterinary diagnosis and large-scale routine herd monitoring. The IDEXX Q Fever Ab Test, available from IDEXX Laboratories, has shown excellent specificity and high sensitivity consistently competitive with the complement fixation test.

Monitoring, biosafety protocols and prevention techniques are critical to protecting herds and humans from *C. burnetii* exposure. All late abortions in ruminants should be investigated for Q Fever, with care to protect human and other animal health. If seropositive animals are found: 1) ensure all milk is properly pasteurized; 2) disinfect animal facilities regularly, especially parturition areas, with a 10% bleach solution; 3) keep pregnant animals in separate pens; 4) always quickly remove all birthing matter, including aborted fetuses and dispose of properly to prevent contact with domestic animals or wildlife; and 5) keep manure from infected herds away from gardens and populated areas. To reduce risk of herd exposure to Q Fever, minimize introduction of new animals, regrouping of herds, and exposure to ticks and wildlife.\(^2\)
The intestinal coccidium *Toxoplasma gondii* is a significant cause of abortion and the birth of weak offspring among sheep and goats infected during pregnancy. The female usually has no symptoms. Early-term infections can result in fetal death and resorption, causing the appearance of infertility. Infection mid-pregnancy can produce weak or stillborn offspring, often accompanied by a mummified fetus. Late-term infections produce infected but clinically normal offspring. Future pregnancies are not impacted by a past infection.

Cats are the definitive host for the sexual phase of the *T. gondii* life cycle, and most warm-blooded animals, including humans, can serve as intermediate hosts for the asexual phase. Cats may become infected by eating intermediate hosts such as rodents. *T. gondii* oocysts are shed in cat feces for several days after infection; these oocysts release infectious spores into the environment for one to five days. Sporulated oocysts are highly resistant and may remain infective in the environment for a year or more. The most likely sources of human and animal infection is through consuming raw or undercooked meat containing live *T. gondii* tissue cysts, or from exposure to oocysts in cat feces.

Direct diagnosis of *T. gondii* presence in tissue is difficult and expensive. The ELISA as an indirect serological test is well suited to diagnostics in herds and offers automated interpretation.

Toxoplasmosis is widespread in human populations, with about 30% of the population having had a past exposure. While most healthy people will experience no symptoms from an initial infection, very young, elderly, or immunosuppressed individuals may become ill. In particular, this zoonosis is a threat to pregnant women and fetal health, and in this aspect especially, represents a significant public health concern. 2

*T. gondii* should be suspected whenever late abortion occurs in ruminants, especially when tiny (2–3 mm) white necrotic spots are visible on the cotyledons, with little or no accompanying inflammation. Direct diagnosis of *T. gondii* presence in tissue is difficult and expensive. A wide variety of indirect serological tests are available, including the dye test, IFA, direct agglutination test (DAT), and ELISA. The dye test uses live tachyzoites, so may pose a laboratory risk. The ELISA is well suited to diagnostics in herds and offers automated interpretation. IDEXX Laboratories offers the IDEXX Toxotest Ab Test for testing the serum or plasma of ruminants, as part of its broad line of abortive disease diagnostic kits. The test features two plates (strips) and gives rapid, highly sensitive results, all in a format identical to other IDEXX abortive disease assay tests presented in this article.
Abortive Disease

Conclusion

Reproductive losses in a herd can be huge. Fetal resorption or undefined infertility often remain undetected. Routine monitoring of herds for exposure, controlling the introduction of potential agent carriers, appropriate biosafety procedures, and vaccination where possible are together the best security against reproductive diseases. Developing a systematic approach to disease monitoring and control by using appropriate, fast, and reliable diagnostic tests such as ELISAs can make the work easier to manage and more affordable in the long-term.

Four diseases, Chlamydia, Neospora, Q Fever and Toxotest, one protocol: IDEXX ELISA abortive disease tests offer matching formats to make testing easier.

• Rapid turnaround and reliable results
• Common incubation times
• Ready-to-use conjugates
• Read at 450 nm
• Two plate kits with strip plates for small series
• Adapted to automation

References


For more information about Abortive Disease, please contact your IDEXX representative or visit idexx.com/ruminants.