IBR IN CATTLE: FROM PATHOGENESIS TO REPRODUCTIVE EFFECTS AND ERADICATION PROGRAMMES IN EUROPE

Infectious bovine rhinotracheitis (IBR) is a familiar presence in many of our cattle herds. It is widely recognised as a key component of the bovine respiratory disease complex, and its impact can vary between farms. However, beyond respiratory disease, what are the effects of infection on fertility? And how are other countries addressing IBR? In this article, Dr Maria Guelbenzu DVM PhD MRCVS, Animal Health Ireland IBR Programme Manager, explores those questions, starting with a review of the epidemiology and pathogenesis of the disease

IBR is a highly infectious disease of domestic and wild ruminants caused by bovine alphaherpesvirus 1 (BoHV-1). Several types have been described, with subtypes 1.1 and 1.2a associated with respiratory disease (IBR) and abortion, and 1.2b having been isolated from infectious pustular vulvovaginitis (IPV) and infectious balanoposthitis (IBP)[1]. However, the clinical presentation is influenced by the route of infection, with either subtype being able to establish infection in either the respiratory or the reproductive tracts[2].

Pathogenesis

Following primary infection, affected animals excrete large quantities of virus, a key feature underpinning the high transmissibility of this disease. Spread of BoHV-1 occurs predominantly through close contact between animals. The virus may also be shed from the reproductive tract, including in semen, resulting in venereal transmission. While aerosol transmission typically takes place over short distances, it has been documented at distances of up to 4.4m[3].

BoHV-1 demonstrates moderate resistance in the environment, meaning indirect transmission is also possible. Spread within or between herds can occur via the movement of infected animals, or sharing contaminated facilities, equipment, or personnel[4].

The incubation period typically ranges from four to seven days. Clinical presentation can vary widely, from subclinical to very severe[5,6]. This variation is influenced by multiple factors including the viral strain, infectious dose, immune status of the animal, and the presence of concurrent infections.

Clinical signs associated with infection by BoHV-1 primarily involve the upper respiratory tract. Typical findings include nasal discharge, hyperaemia of the muzzle, conjunctivitis, pyrexia, and inappetence, and in severe cases may result in mortality. Infections can also be associated with reduced milk production and a variety of negative reproductive outcomes, the nature and severity of which depend on the stage of the reproductive cycle at the time of exposure.

In some herds, infection may remain largely subclinical; however, even in the absence of respiratory disease, it may still be associated with a reduction in milk yield and negative reproductive outcomes[6].

In common with human herpesviruses such as those responsible for chickenpox or cold sores, the virus is not totally eliminated after infection, with recovered animals becoming lifelong carriers. Following primary infection with BoHV-1, animals develop an immune response that limits clinical disease but does not eliminate the virus. Instead, the virus establishes lifelong latency in the trigeminal ganglion or the pharyngeal tonsils[7]. During this time, latently infected animals do not shed virus. However, periods of stress, such as transport, calving, and mixing stock, may trigger viral reactivation (Figure 1). When this occurs, the virus begins to replicate again and can be re-excreted, typically via nasal

Figures 1: Spread of IBR group of calves following reactivation and shedding of virus from carrier to naïve (susceptible) animals. Graphic courtesy of Animal Health Ireland.

and ocular secretions[8]. This re-excretion can result in new infection of susceptible animals, which in turn will also become latent carriers[9].

In rare instances, animals may undergo infection without developing detectable antibodies and, therefore, cannot be identified using standard serological tests. These are typically young calves receiving maternally derived antibodies against BoHV-1. Although protected from disease, they may also be infected and result in latency without developing an antibody response. These animals are referred to as seronegative latent carriers.

Reproductive impact

Infection with BoHV-1 can lead to a range of adverse reproductive outcomes, influenced by both the stage of the reproductive cycle at exposure and the route of infection. These outcomes may include failure to conceive, early embryonic loss, and abortion.

When infection happens at the time of service, it can negatively affect fertility. Infection at this stage has been associated with chronic necrotising endometritis and oophoritis, often accompanied by a shortened oestrus cycle[10]. When infection occurs later in the oestrus cycle, reduced conception rates may be observed.

Exposure during pregnancy can result in abortion, stillbirth, or the birth of weak calves that die shortly after birth. Abortions linked to BoHV-1 infection are most commonly detected during the last trimester of pregnancy, with the interval between infection and expulsion of the foetus reported to range from 15 to 64 days[11].

Following venereal infection, viral replication occurs within the local mucosa of both sexes, leading to oedema and hyperaemia of the genital mucosa. Initial pustules typically develop within 48 hours and generally resolve within eight to 11 days later. Reduced conception rates can result, largely due to a transient reluctance to mate. Following infection in bulls, infectious virus can be intermittently detected in semen for up to six weeks. Latency is subsequently established in the distal sacral ganglia, and reactivation of the virus can result in renewed shedding, with infectious virus again detectable in semen. In terms of herd fertility, the impact of infection, with BoHV-1 will depend on the strain involved, the route of infection and the degree of herd immunity[12].

Bulls going into AI centres

As mentioned above, carrier bulls may shed virus intermittently in their semen, which can then be transmitted at insemination. For this reason, animals that have antibodies to IBR (even if as a result of vaccination) are legally prohibited from entering semen collection centres.

EU legislation as well as World Organisation for Animal Health (WOAH) standards **(https://www.woah.org/en/what-we-do/standards/codes-and-manuals/terrestrial-code-online-access/)** cover the collection

Country	Beginning	End	Time from Comp to Free (Years)	IBR Free	Vaccination
Austria	1987 Vol, 1990 Comp	1999	9	Yes - EU	No
Czech Rep	2005	2020	15	Yes - EU	No
Denmark	1984	1992	8	Yes - EU	No
Finland	1978	1994	16	Yes - EU	No
Germany	1997	2017	20	Yes - EU	Marker*
Norway	NA	1994	-	Yes - EU	No
Sweden	1994	1998	4	Yes - EU	No
Switzerland	1983	1988	5	Yes - EU	No
Italy (regions)	1990s	2017	-	Yes - EU	Bolzano - No; Trento - Marker
UK (Jersey)	NA	2017	-	Yes - EU	
Belgium	1991 first Vol, 2012 Comp	Ongoing	-	No – ApPr (2014)	Marker
France (except Corsica)	1996 Vol, 2006 Comp	Ongoing	-	No – ApPr (2020)	Marker
Luxembourg	2017	Ongoing	-	No – ApPr (2017)	
Slovakia	1996 Vol, 2006 Comp	Ongoing	-	No – ApPr (regions) (2023)	Marker
Hungary (region)	2002	Ongoing	-	No	Marker
The Netherlands	1998, 2018 Comp for dairy	Ongoing	-	No	Marker

*During eradication, now vaccination is banned.

Table 1: Control programmes in selected European countries.

Guide to abbreviations. Vol: voluntary programme; Comp: compulsory programme; Yes – EU: free from IBR and recognised by EU; No: Not free and no EU approved programme for the control and eradication of IBR; No – ApPr: Not free but with an EU approved programme for the control and eradication of IBR; NA: not available.

and processing of semen and embryos for international trade. Bulls entering semen-collection centres approved for intracommunity trade in EU Member States (MSs) must meet quarantine and subsequent monitoring requirements (negative for all antibodies, therefore not vaccinated), with semen and embryos imported from third countries subject to similar requirements as described in EU Regulation 2020/686 **(https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32020R0686)**. Article 20 of this regulation requires that prior to admission to quarantine, bulls come from an establishment that was free from IBR and have never been kept previously in any establishment of a lower health status.

Herds that aim to send bulls to AI centres are recommended to have eradication programmes in place, if not already IBR-free. It is important that potential AI sires are not included in vaccination programmes and where these are in place, careful planning to prevent accidental exposure to vaccine virus, especially when using live vaccines, is required.

IBR eradication programmes in Europe

EU-approved programmes

Within the European Union, IBR is recognised as a Category C+D+E disease under the EU Animal Health Law (AHL). This classification means that eradication programmes are optional for MSs, but measures are required to regulate intracommunity cattle trade.

The first countries to achieve national IBR-freedom were Denmark, Finland, Norway, and Sweden, all of which are now officially recognised as IBR-free under the AHL framework. Since then, Austria, Germany, Switzerland, and the Czech Republic, as well as several regions of Italy, have also achieved free status (see Figure 2 and Table 1). In total, 14 countries or regions currently benefit from additional EU guarantees for cattle trade through recognised IBR-free status or an approved programme.

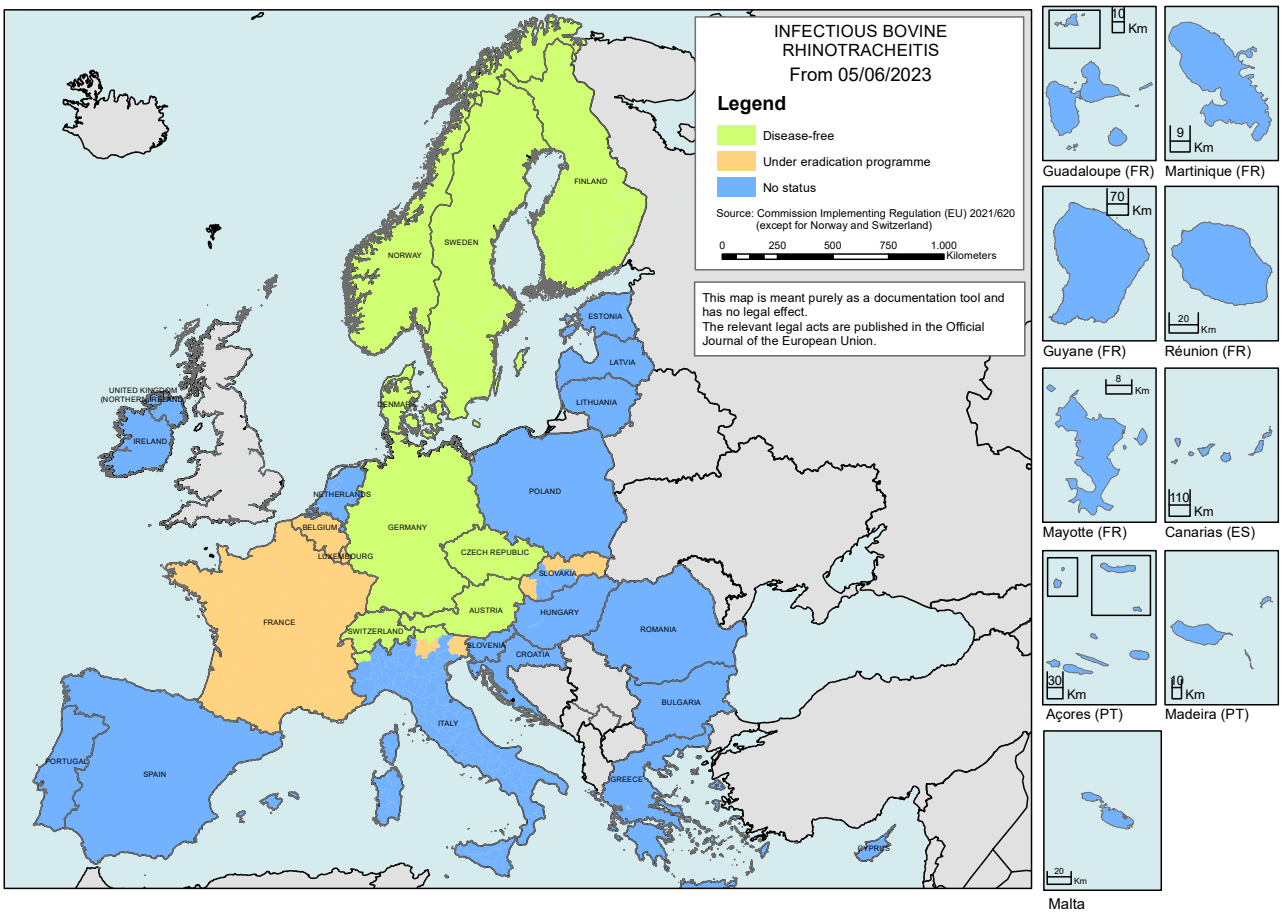
Most of these countries/regions achieved freedom through programmes based on the identification and removal of seropositive animals without the use of vaccination. However, this approach is only feasible where the prevalence of BoHV-1 infection is already very low. These countries typically initiated control programmes relatively early (Table 1), often in contexts of lower cattle density, and were able to secure the necessary industry and policy support to implement eradication strategies.

Within EU-approved programmes, marker vaccines may be used to support control efforts. However, for a herd to be considered IBR-free, it must test negative and must not have used vaccination for at least two years.

Non-EU approved programmes

Outside of the framework of the EU Animal Health Law, approaches to IBR control vary considerably. The heterogeneity reflects differences in disease prevalence, cattle industry structure, and the level of government and industry support for control measures across countries and regions.

A review of control programmes for infectious diseases of cattle in Europe covering 33 countries, reported that 24 (73 per cent) had programmes in place to control or eradicate IBR[13]. Of these, 15 programmes were compulsory and most (19) were operated at a national level. Regional programmes were reported in Italy, France, Portugal, Spain, and Ukraine.



Figures 2: **EU map of Member States/regions with approved IBR programmes or IBR-free status.**

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Funding arrangements also varied, with programmes supported by private funding (43 per cent), government funding (35 per cent) or a combination of both (22 per cent). The majority of these initiatives were designed primarily to control, rather than eradicate, the disease.

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READER QUESTIONS AND ANSWERS

1. WHICH OF THE FOLLOWING STATEMENTS REGARDING THE TRANSMISSION OF BOVINE HERPESVIRUS 1 IS CORRECT?

A. Transmission occurs only via aerosol spread over long distances
B. Venereal transmission can occur via infected semen
C. The virus is highly unstable in the environment, preventing indirect spread
D. Latently infected animals continuously shed virus

2. WHICH OF THE FOLLOWING FACTORS CAN INFLUENCE THE CLINICAL PRESENTATION OF IBR?

A. Viral strain
B. Infectious dose
C. Immune status of the animal
D. Breed of the animal

3. WHICH OF THE FOLLOWING STATEMENTS REGARDING LATENCY OF BOVINE HERPESVIRUS 1 INFECTION IS CORRECT?

A. The virus is completely eliminated following recovery
B. Latency is typically established in the liver
C. Stress events may trigger reactivation and viral shedding
D. Latently infected animals always test seropositive

4. WHICH OF THE FOLLOWING REPRODUCTIVE OUTCOMES MAY BE ASSOCIATED WITH BOHV-1 INFECTION?

A. Early embryonic loss
B. Abortion in late gestation
C. Increased twinning rates
D. Reduced conception rates

5. WHICH OF THE FOLLOWING STATEMENTS REGARDING IBR CONTROL PROGRAMMES IN EUROPE IS CORRECT?

A. All EU Member States are required to implement compulsory eradication programmes
B. Marker vaccines may be used within EU-approved programmes
C. Countries with high prevalence can easily eradicate IBR without vaccination
D. Herds can be classified as IBR-free while continuing vaccination

ANSWERS: 1B; 2A,B, AND C; 3C; 4A,B, AND D; 5B.