Animal & Plant Health Agency

Animal and Plant Health Agency
Access to Information Team
Weybourne Building
Ground Floor
Woodham Lane
New Haw
Addlestone
Surrey
KT15 3NB

T 01932 341111
F 01932 357608

www.gov.uk/apha

[redacted]
{By Email}

Our Ref: ATIC0815

17 March 2016

Dear [redacted]

PROVISION OF REQUESTED INFORMATION

Thank you for your request for information about Mycoplasma disease, which we received on 29 February 2016. Your request has been handled under the Freedom of Information Act 2000.

The information you requested and our response is detailed below:

"I am writing to request information under the Freedom of Information Act about the extent of mycoplasma diseases affecting UK cattle herds.

To this end, I have listed six questions which I would be grateful if you could provide responses to by email.

The questions are:-

1. How many confirmed cases of Mycoplasma have been recorded in the UK since 2006? Of these, how many were: a) a single strain of mycoplasma b) multiple infections of mycoplasma (if possible, please provide a detailed breakdown of the different confirmed types of mycoplasma infection).

   Please see our response to your request at Appendix 1, with additional information and comments.

2. How many cattle have been slaughtered due to Mycoplasma diseases since 2006?

   APHA do not hold this information. Government has not directed the culling of any cattle due to Mycoplasmosis. Farmers may have culled cattle privately and may or may not have known at the time that a mycoplasma was part of the problem.

3. How much screening of UK cattle herds is being done to determine Mycoplasma infections in UK herds?

   See Table 1 in Appendix 1 for serological testing. See Table 3 in Appendix 1for antigen detection. Mycoplasma diseases will be considered on any cases submitted to APHA for diagnosis (numbers not available) where Mycoplasma is potential differential diagnosis. Details of a testing carried out on suspect Mycoplasma cases is detailed in Table 3.

4. What measures does Defra take to test imported cattle for Mycoplasma diseases?

   Imported cattle are certified as coming from countries or regions free from contagious bovine pleuropneumonia (CBPP), so no official testing is carried out. At present the risk is negligible because the whole of the EU is free. If that changes then import testing could be instated. APHA does not test imported cattle for non-notifiable mycoplasmas that are considered to be largely endemic diseases. This is a decision for the farmer on the advice of their private vet.

5. What training are government vets being given to help them identify mycoplasma in UK cattle herds?

   APHA Veterinary Investigation Officers are trained to work to protocols which direct them to investigate mycoplasmal disease when it is a potential diagnosis.

   In addition there is training via teaching at the British Cattle Veterinary Association (BCVA) Congress; and raised awareness through attendance at BCVA. The Cattle Health and Welfare Group (CHAWG) information note for vets and farmers is also published in 2014.

   Please also see attached at Appendix 2 a guide for veterinary practitioners on Mycoplasma bovis in BRD.

6. What efforts have Defra made to create awareness of Mycoplasma diseases in the UK livestock industry (Please provide any supporting evidence)."

   Defra and APHA vets have spoken at a number of meetings attended by private veterinary surgeons. In addition to these activities, the following publications have been produced:

- CHAWG information note for vets and farmers published 2014 http://beefandlamb.ahdb.org.uk/wp/wp-content/uploads/2015/01/Mycoplasma-Bovis-Briefing-Dec-2014.pdf

- Technical consultancy for Zoetis: Business solutions: A guide for Veterinary Practitioners on *Mycoplasma bovis* in BRD.
- Book: Robin Nicholas, Roger Ayling, Laura McAuliffe **(2008).** Mycoplasma Diseases of Ruminants. CAB International ISBN-13:9780851990125
- Discontools review *Mycoplasma bovis*: http://www.discontools.eu/Diseases/Detail/82

Publications (that include APHA staff as authors)

- Ayling, R. D., Gosney, F., Hlusek, M. (2015). Mycoplasma diagnostics, some results, and what we still don't know about *Mycoplasma bovis* disease. Cattle Practice. 23: 2, 248-251
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- Ayling, R. D., Godinho, K., Nicholas, R. A. J. (2007). Comparative studies on the in vitro antimicrobial sensitivities of Mycoplasma mycoides subsp. mycoides small colony type and Mycoplasma bovis. Proceedings of the FAO-AU/IBAR-IAEA Consultative Group Meeting on CBPP in Africa, FAO, Rome pp51-61.
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Recent meeting abstracts

- Ayling, R. (2015). Insights into cattle mycoplasmoses in England and Wales. Cattle Association Veterinary Ireland Abstracts –October 2015.

I attach an Annex which explains the copyright that applies to the information being released to you and contact details should you be unhappy with the service you have received.

If you have any queries about this letter, please contact the Access to Information Team at the email address below or postal address at the top of this letter.

Yours sincerely

ACCESS TO INFORMATION TEAM
Email: enquiries@apha.gsi.gov.uk

Annex

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If you are unhappy with the result of your request for information you may request an internal review within 40 working days of the date of this letter.

If you wish to request an internal review, please contact: The Access to Information Team at enquiries@apha.gsi.gov.uk or at the postal address at the top of this letter, who will arrange for an internal review of your case.

If you are not content with the outcome of the internal review, you have the right to apply directly to the Information Commissioner for a decision. Please note that generally the Information Commissioner cannot make a decision unless you have first exhausted APHA's own complaints procedure. The Information Commissioner can be contacted at:

Information Commissioner's Office
Wycliffe House
Water Lane
Wilmslow
Cheshire
SK9 5AF

Appendix 1

The Veterinary Investigation Diagnosis Analysis (VIDA) data is available at: https://www.gov.uk/government/statistics/veterinary-investigation-diagnosis-analysis-vida-report-2014

Please note Mycoplasma bovis is not a notifiable disease.

Comment: many of the clinical signs seen in cattle that may be associated with Mycoplasma infections are often multi-factorial. Therefore the detection of a mycoplasma species may not be the concluding diagnosis of the cause of a disease.

Bovine respiratory disease (BRD) develops as a result of complex interactions between environmental factors, host factors, and pathogens. Environmental factors (eg, weaning, transport, commingling, crowding, inclement weather, dust, and inadequate ventilation) serve as stressors that adversely affect the immune and nonimmune defense mechanisms of the host. In addition, certain environmental factors (eg, crowding and inadequate ventilation) can enhance the transmission of infectious agents among animals. Many infectious agents have been associated with BRD, these include viruses: Bovine Respiratory Syncytial Virus (BRSV), ParaInfluenza 3 (PI3), Adenovirus, Bovine Viral Diarrhea Virus (BVDV), and Infectious Bovine Rhinotracheitis (IBR) and bacteria: *Pasteurella multocida*, *Mannheimia haemolytica*, *Histophilus somni*, *Mycoplasma bovis* and some other *Mycoplasma* species.

Mastitis may also be a clinical sign of infection with *Mycoplasma bovis* but more commonly caused by other bacterial pathogens including: *Pseudomonas* species; *Staphylococcus* species; *Streptococcus* species; *Brucella* species; *Corynebacterium* species; *Escherichia coli*; *Klebsiella* species*; Enterobacter* species; *Pasteurella* species, *Trueperella pyogenes; Proteus* species; and other *Mycoplasma* species.

Diagnosis of Mycoplasma at APHA. Note: samples may have been tested by non-APHA labs but we have no data on this.

Serology for *Mycoplasma bovis*: This shows previous exposure to *Mycoplasma bovis.* Samples are submitted from suspect cases usually showing clinical signs of BRD, so this data is biased to clinical cases and cannot be extrapolated to the whole cattle population.

Ref: Ayling, R. D., Gosney, F., Hlusek, M. (2015) Mycoplasma diagnostics, some results, and what we still don't know about *Mycoplasma bovis* disease. Cattle Practice. 23: 2, 248-251.

Appendix 1

Table 1: APHA *Mycoplasma bovis* serological testing results from England and Wales from 2005 to 2014 updated to include 2015.

Individual samples				Submissions		
Year	**Number of Samples**	**Number of positive samples**	**Percentage positive**	**Number of Submissions**	**Positives**	**Percentage**
2005	1462	296	20	394	102	26
2006	1270	367	29	334	132	40
2007	963	216	22	231	67	29
2008	834	312	37	220	86	39
2009	1094	294	27	290	84	29
2010	972	346	36	261	107	41
2011	1151	445	39	240	103	43
2012	1227	372	30	282	110	39
2013	1083	443	41	289	142	49
2014	1246	665	53	334	203	61
2015	1019	571	56	350	197	56
Total	**12321**	**4327**	**Ave 35**	**3225**	**1333**	**Ave 41**

Mycoplasma Detection at APHA; The following *Mycoplasma* and related species are able to be diagnosed on appropriate samples submitted to APHA for Mycoplasma diagnosis

Ref: Ayling, R. (2015) Insights into cattle mycoplasmoses in England and Wales.
Cattle Association Veterinary Ireland Abstracts –October 2015.

Appendix 1

Table 2: Mycoplasma and related species that commonly occur in cattle and associated clinical signs/disease.

***Mycoplasma* species** Previous nomenclature in brackets.	**Clinical signs / disease**
Mycoplasma alkalescens	Associated with cases of otitis, mastitis and respiratory disease often in association with *M. bovis*. Detected in lung, joint fluid, milk, foetal stomach contents, eyes, vaginal swabs and thoracic fluid.
Mycoplasma arginini	Detected in many host species, generally thought to be a commensal, but increasing evidence of pathogenicity especially when combined with other infections.
Mycoplasma bovigenitalium	Mainly reproductive tract with reduced fertility, endometritis (whites), granular vulvitis, semen with reduced motility, but also isolated from pneumonic, arthritic and mastitic cattle and aborted fetuses.
Mycoplasma bovirhinis	Found in the upper and lower respiratory tracts of both healthy and diseased cattle and buffaloes all over the world. It is not believed to be a primary pathogen but may exacerbate existing disease.
Mycoplasma bovis	Pneumonia, mastitis, arthritis, otitis, meningitis, infertility, abortion and keratoconjunctivitis.
Mycoplasma bovoculi	Eye infections, keratoconjunctivitis.
Mycoplasma californicum	Can cause mastitis, has been isolated from respiratory tract.
Mycoplasma canadense	Can cause mastitis, has been isolated from respiratory tract.
Mycoplasma canis	Reported in pneumonic calves, normally isolated from dogs.
Mycoplasma dispar	Frequent isolate from the lungs and nasal cavities of both healthy and pneumonic dairy and fattening calves.
Mycoplasma leachii (bovine group 7)	**Not in the UK.** Mastitis, polyarthritis and abortion.
Mycoplasma mycoides subsp. *mycoides* (small colony)	**Not in the UK.** Causes contagious bovine pleuropneumonia, a notifiable disease. Pneumonia in older animals, but arthritis observed in calves.
Mycoplasma vercundum	Not thought to be a pathogen, isolated from respiratory tract.

Appendix 1

Mycoplasma haemobos (*Eperythrozoon haemobos*)	A haemoplasma, carried in the blood. Reduced appetite, decreased milk yield, anaemia and udder and limb oedema. Often a co-infecting organism. Currently not culturable in the laboratory.
Mycoplasma wenyonii (*Eperythrozoon wenyonii*)	A haemoplasma, carried in the blood. Reduced appetite, decreased milk yield, anaemia and udder and limb oedema. Often a co-infecting organism. Currently not culturable in the laboratory.
Ureaplasma diversum	Role in bovine reproductive failure. Clinical signs include granular vulvitis, endometritis, salpingitis, abortion, infertility in the female and seminovesiculitis.
Other *Mycoplasma* species have been detected in cattle, but these are rare occurrences and include: *Mycoplasma fermentans*, *Mycoplasma capricolum* subsp. *capricolum* and *Mycoplasma mycoides* subsp. *capri*.	

Appendix 1

Mycoplasma antigen detection

The complete requested data is not readily available at this time and forms part of a publication that is in preparation. However, approximate numbers and percentage species isolated are given; and recent data describing mixed infections as presented at conferences is given below.

No of Mycoplasmas detected 2006 to 2015	*M. bovis*	*M. alkalescens*	*M. arginini*	*M. bovirhinis*	*M. bovoculi* **	*M. bovigenitalium*	*M. canis*	*M. canadense*	*M. dispar*	*Acholeplasma granularum*	*Ureaplasma diversum*	*Candidatus M. hemobos* ***	*M. wenyonii* ***
2356	30.3%	18.0%	6.3%	22.6%	0.2%	0.2%	5.0%	2.1%	8.3%	0.1%	1.8%	0.6%	4.6%

Note numbers and % are not confirmed.

** from eye swabs

*** usually only detected from blood samples, so very specific testing.

Appendix 1

From the testing of respiratory cattle samples from England and Wales over a 30 month period (October 2012 to March 2015) 204 *M. bovis* were detected of which 126 (61.8%) of samples had just *M. bovis* detected. 63 (30.9%) of the samples had two, 12 (5.9%) had three, and 3 (1.5%) had four mycoplasma species detected. The most commonly detected mycoplasmas in these mixed infections in descending order were: *M. alkalescens*, *M. arginini*, *M. dispar*, *M. bovirhinis*, *Ureaplasma diversum*, *M. canis* and *M. canadense*.

Cattle – *Mycoplasma bovis* diagnosed (APHA)

October 2012 - March 2015

M. bovis				126
M. bovis	*M. alkalescens*			23
M. bovis	*M. alkalescens*	*M. bovirhinis*		2
M. bovis	*M. alkalescens*	*M. canis*		1
M. bovis	*M. alkalescens*	*M. canis*	*M. bovirhinis*	1
M. bovis	*M. arginini*			18
M. bovis	*M. dispar*	*M. bovirhinis*		2
M. bovis	*M. bovirhinis*			6
M. bovis	*M. canis*			3
M. bovis	*M. canadense*	*M. dispar*	*U. diversum*	2
M. bovis	*M. dispar*			8
M. bovis	*U. diversum*			4
M. bovis	*M. alkalescens*	*U. diversum*		2
M. bovis	*M. alkalescens*	*M. arginini*		2
M. bovis	*M. alkalescens*	*M. dispar*		2
M. bovis	*M. canadense*			1
M. bovis	*M. dispar*	*M. bovirhinis*		1
Total *M. bovis*				**204**

2 infections	63
3 infections	12
4 infections	3
No of mixed infections	78

Animal & Plant Health Agency

Services

APPENDIX 2

Business solutions

A GUIDE FOR VETERINARY PRACTITIONERS on *Mycoplasma bovis* in BRD

Technical consultancy provided by:
the Mycoplasma Group AHVLA

For further information please contact Zoetis UK Ltd, Walton Oaks, Dorking Road, Walton on the Hill, Tadworth, Surrey, KT20 7NS. Technical Services and Customer Support 0845 3008034
Use medicines responsibly (www.noah.co.uk/responsible) Date of preparation: September 2013. AH572/13

zoetis

zoetis

Introduction

The purpose of this practitioners guide to *Mycoplasma bovis* is to discuss the relevance of this complex organism in modern cattle practice in the EU.

Mycoplasma bovis is involved in a number of clinical diseases, including respiratory disease, mastitis, arthritis and otitis media/interna. In this guide, we focus on the role of *Mycoplasma bovis* in Bovine Respiratory Disease (BRD).
We hope that the information provided will help you and your clients minimise the impact of *Mycoplasma bovis* on the UK cattle population.

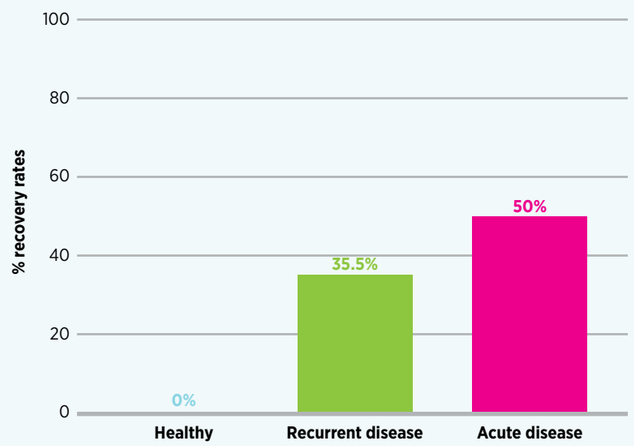
Background

Mycoplasma bovis belongs to the mollicute (meaning 'soft skin') class of bacteria, which has a complex plasma membrane in place of the typical bacterial cell wall. Mycoplasmas tend to inhabit mucous membranes, including those of the respiratory, urogenital and mammary glands.

The role of *Mycoplasma bovis* as a primary respiratory pathogen is complex. *Mycoplasma bovis* is frequently isolated from the upper respiratory tract (URT), trachea and lower respiratory tract (LRT) of calves with acute or recurrent BRD, so clinical disease is often present in the herd. At the same time, other studies confirm *Mycoplasma bovis* as the predominant pathogen in numerous outbreaks of respiratory disease, and this alongside experimental confirmation of its ability to cause pneumonia in calves, verifies its role as an important respiratory pathogen.

In essence, like other pathogens involved in BRD, it is capable of causing disease as a sole pathogen, as well as acting as a primary or secondary agent in multiple-pathogen infections.

Recovery rate of *Mycoplasma bovis* from lung lavage fluids



Data such as this from a Belgian study examining isolation rates of *Mycoplasma bovis* from the LRT of both healthy and diseased veal calves indicate that *Mycoplasma bovis* is an important pathogen, and not just a commensal of the bovine respiratory tract. (Thomas A. *et al.* (2002) Veterinary Record 151(16): 472-6)

Epidemiology

Mycoplasma bovis is well adapted to causing chronic, asymptomatic infections, and therefore the role of 'carrier' animals is an important part of the *Mycoplasma bovis* story. Animals may remain infected for many years, shedding bacteria intermittently.

Initial infection of an animal or herd comes from exposure to *Mycoplasma bovis* through a variety of routes, the main sources being respiratory secretions and infected milk. Chronically infected cows are capable of shedding large numbers of bacteria in their milk.

In infected herds, calves become infected when they are very young, either through contact with contaminated vaginal mucus during parturition or in the maternity pen, being fed milk from chronically infected cows or through close contact with individuals shedding *Mycoplasma bovis* in respiratory secretions. Calves then go on to shed *Mycoplasma bovis* in large numbers during the first 2 months of life.

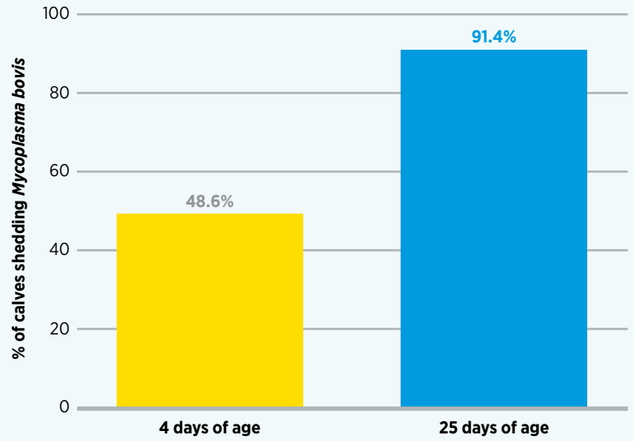
In many infected herds, the role of contaminated milk is crucial. Small numbers of infected cows can potentially contaminate large volumes of milk. Calves fed contaminated milk are much more likely to be colonised by *Mycoplasma bovis*.

Large numbers of *Mycoplasma bovis* can be isolated from the air of sheds housing infected animals. In calf barns, poor air circulation will significantly increase the bacterial load of the environment, and therefore the rate of transmission of the mycoplasma. Studies have demonstrated very rapid spread of infection within calf populations via this route.

In terms of cow-to-cow spread in milking herds, the role of fomite transmission is important, so it is plausible that a similar role may be important in terms of BRD. The bacterium is able to survive for prolonged periods of time, with survival rates being improved by lower ambient temperatures. Transmission of bacteria from calf to calf via infected feeding equipment, pen divisions and bedding could all play a role in spreading the bacteria and subsequent clinical disease, although the role of direct transfer remains more important.

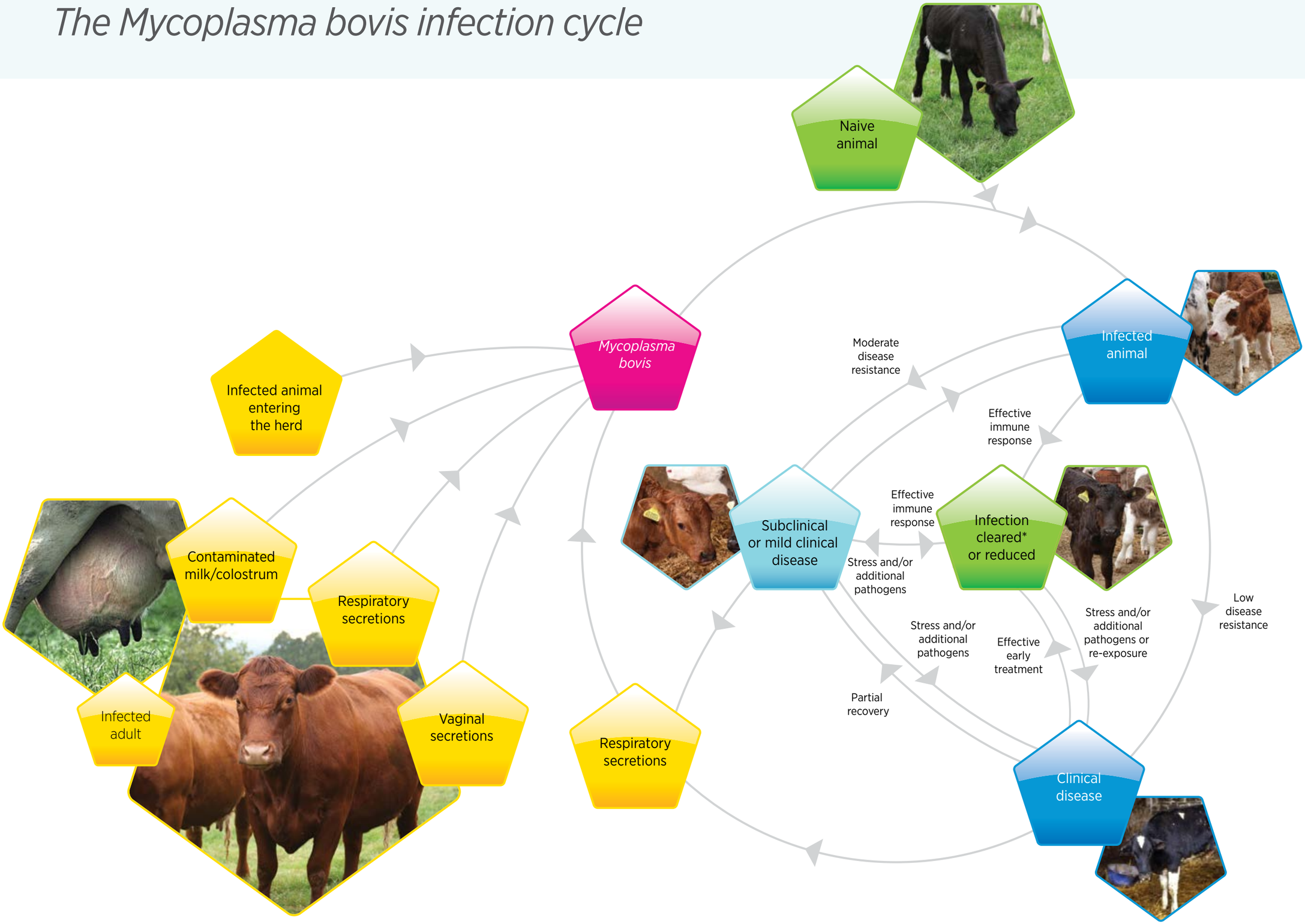
In diseased herds, the prevalence of colonisation of the URT can be very high, with reports of 100% of animals being infected. Given the routes of transmission of the bacteria, it is not surprising that herds which experience high rates of *Mycoplasma bovis*-associated disease tend to have a higher prevalence of infection, and that once a herd is infected, eradication of *Mycoplasma bovis* is extremely hard due to the continual cycle of infection, shedding and transmission.

Mycoplasma bovis spreads rapidly within a group of calves



Mycoplasma bovis is capable of rapid spread within a group of calves. In this study, the number of dairy-bred calves shedding *Mycoplasma bovis* almost doubled between 4 and 25 days of age. (Stipkovits L. *et al*. (2001) Veterinary Record 148(13): 399-402)

The Mycoplasma bovis infection cycle



* note - there is limited information available regarding whether or not an effective immune response can clear infection

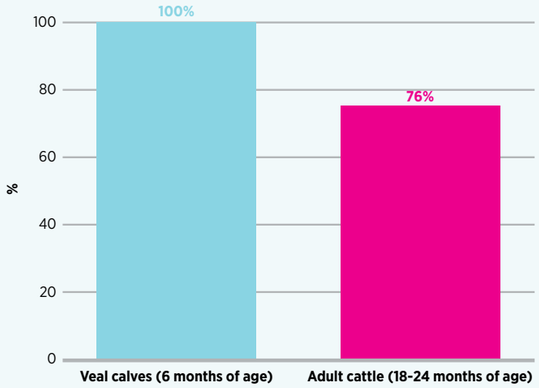
Prevalence

When we talk about prevalence, it is important to make the distinction between exposure to *Mycoplasma bovis* and its role as a key causal agent of BRD.

Based on exposure studies (seroprevalence), there is no doubt that *Mycoplasma bovis* is a highly prevalent bacteria. Recent studies identify high rates of infection and exposure in many EU countries, although prevalence does vary from region to region and between production systems. Very high rates of exposure are seen in those systems which rely on the mixing of animals from multiple sources, coupled with husbandry systems that encourage transmission from carrier animals (high-stress levels, overcrowding and poor air quality).

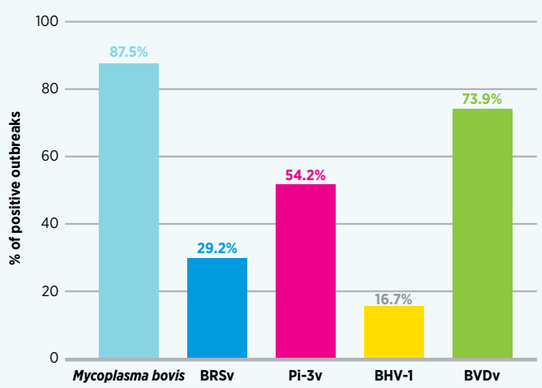
In terms of the prevalence of *Mycoplasma bovis* as a key pathogen in BRD outbreaks, the evidence is growing. Newer, more sensitive diagnostic techniques have added much to the understanding of the significance of *Mycoplasma bovis* as a BRD pathogen. The wider adoption of PCR techniques for pathogen identification in BRD samples will continue to increase the awareness of *Mycoplasma bovis* as a key pathogen.

Seroprevalence (%) to *Mycoplasma bovis* at slaughter



Results of an Italian study demonstrating the seroprevalence of antibodies to *Mycoplasma bovis* at slaughter (Radaelli E. *et al*. (2008) Research in Veterinary Science, 85(2): 282-290)

Percentage of sero-positive outbreaks by pathogen in veal calves with BRD



A study conducted on Belgian veal units in which calves tested serologically positive for *Mycoplasma bovis* in 87.5% of BRD outbreaks. (Pardon B. *et al*. (2011) Veterinary Record 169(11): 278)

Immunity

The understanding of the immune response to *Mycoplasma bovis* is an area of active research, and is currently not fully understood.

As with all respiratory infections, non-specific defence mechanisms are vital. These can be compromised by various factors including air circulation, stress and the presence of other primary pathogens, such as viruses.

Specific responses are an important component of the immune response to infection with *Mycoplasma bovis*. Indeed, the presence of *Mycoplasma bovis* stimulates a strong immune response and the recruitment of macrophages, neutrophils and lymphocytes to the LRT contributing to the development of clinical disease. Specific immunity to *Mycoplasma bovis* infection comprises a local humoral response, with phagocytosis by alveolar macrophages following opsonization with *Mycoplasma bovis*-specific antibody. The role of a maternally derived antibody, in terms of effective opsonization and enhanced clearance of *Mycoplasma bovis,* is unclear. Interestingly, the adaptive immune response (which indicates infection rather than protection) appears to be relatively ineffective at resolvin infection, resulting in chronic infections and the development of the 'carrier' status in a large number of individuals. Some researchers believe that *Mycoplasma bovis* may evade the immune system through the production of biofilms. Further work will no doubt elucidate exactly how *Mycoplasma bovis* is able to modulate the immune response.

Pathology

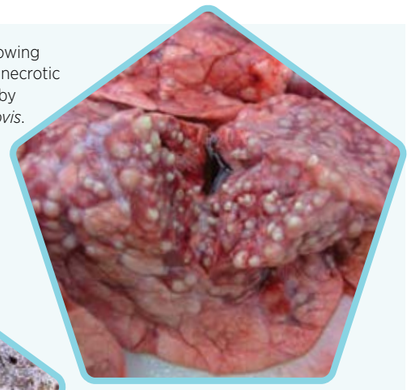
As previously discussed, *Mycoplasma bovis* is well adapted to colonisation of the URT without causing clinical disease. Clinical disease occurs where host and/or pathogen factors result in the replication and spread of bacteria to the LRT (as well as other sites, such as the middle ear).

The impact of *Mycoplasma bovis* in the LRT is significant. Naturally occurring *Mycoplasma bovis* infection leads to similar, though typically more severe, lesions to experimentally induced disease.

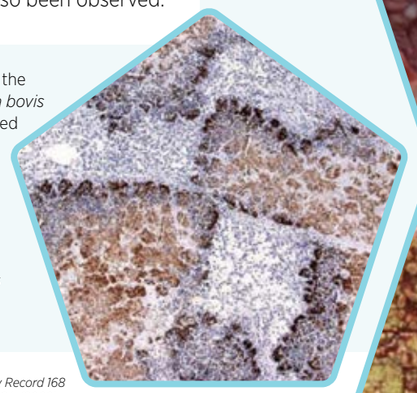
Gross appearance

The affected lung lobes are a deep red colour, with degrees of consolidation. The distribution of the lesions is mainly focused on, but not restricted to, the cranioventral portions of the lung. In many chronic cases (not uncommon in animals affected by *Mycoplasma bovis*), caseo-necrotic lesions can vary from a few millimetres to several centimetres in diameter, and are distinct from typical lung abscesses as they are not surrounded by a well-defined fibrous capsule. These changes are considered by many to be pathognomonic for *Mycoplasma bovis* infection. Additional signs include a diffuse fibrinous or chronic fibrosing pleuritis and the observation of linear yellow necrotic lesions with oedema fluid in the interlobular septae. Occasionally, lung sequestration, fibrinosuppurative tracheitis and caseous necrosis of regional lymph nodes have also been observed.

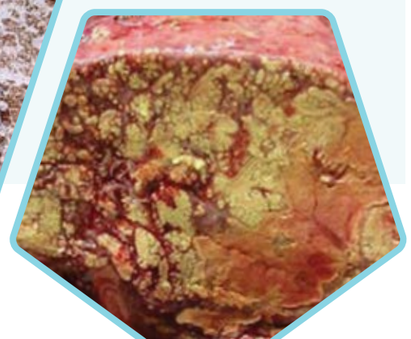
In terms of histological appearance, the mixed nature of infections can often complicate interpretation, however, typical observations would include the bronchioles being filled with dry caseous exudate accompanied by peribronchiolar lympho-histiocytic cuffing, thickening of the alveolar septa as a result of cellular infiltration and atelectasis. Various lab techniques, such as immunohistochemical (IHC) staining of bronchiolar contents and both ELISA and qPCR on pneumonic lung, are able to confirm the presence of *Mycoplasma bovis* and its importance in the development of these significant lesions.



1. Bovine lung showing foci of caseous necrotic lesions caused by *Mycoplasma bovis*.



2. Immunohistochemical staining of the bovine lung showing *Mycoplasma bovis* antigen (brown staining) associated with pneumonic lesions.



3. (Bottom right) *Mycoplasma bovis* lungs may contain numerous foci of caseous necrosis.

Images 1 and 2 from Nicholas R.A.J. (2011). Veterinary Record 168 (17): 459-462. Image 3 from Maunsell FP & Donovan GA (2009). Veterinary Clinics of North America, Food Animal Practice; 25(1):139-77

Clinical picture

BRD

The clinical picture of BRD caused by *Mycoplasma bovis* is not significantly different from that of BRD caused by other pathogens. This is no great surprise, given the multiple aetiologies of BRD. Fever, loss of appetite, nasal discharge, coughing and increased respiratory rate are all typically observed. The only potential distinguishing clinical picture of *Mycoplasma bovis* may be the tendency for chronic cases to respond poorly to many antimicrobial treatment regimens.

The *Mycoplasma bovis* disease complex also includes otitis media/interna and arthritis. If signs of these disorders appear in conjunction with BRD, it significantly increases the likelihood of *Mycoplasma bovis* involvement.

Otitis media/interna

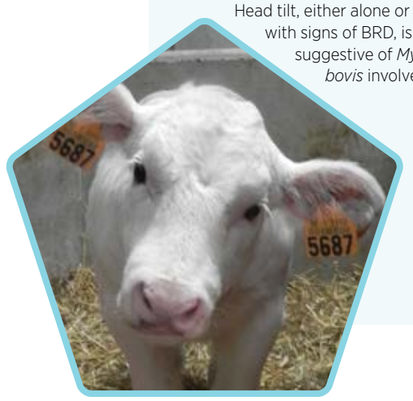
Mycoplasma bovis commonly spreads from colonisation of the URT up the Eustachian tube to the middle ear (and then on to the inner ear). Clinical signs attributable to spread to this location would be ear pain (headshaking), epiphora, ear droop progressing to head tilt, nystagmus, circling and recumbency, as infection penetrates the inner ear. In some cases, cranial nerve dysfunction may occur as a sequelae to otitis interna, with associated clinical signs. Occasionally, if accompanied by rupture of the tympanic membrane, otitis media may present with a purulent discharge from the ear canal.

Arthritis

Mycoplasma bovis commonly spreads to joints, particularly the larger rotator joints such as the shoulder, stifle, elbow, hock and carpus. Clinical signs are typical of a septic arthritis, and would often be seen in an animal with previous history of recent BRD.

Other Clinical Signs

Mycoplasma bovis is a recognised cause of mastitis and has on occasions been linked with cases of infertility and abortion and infectious keratoconjunctivitis.

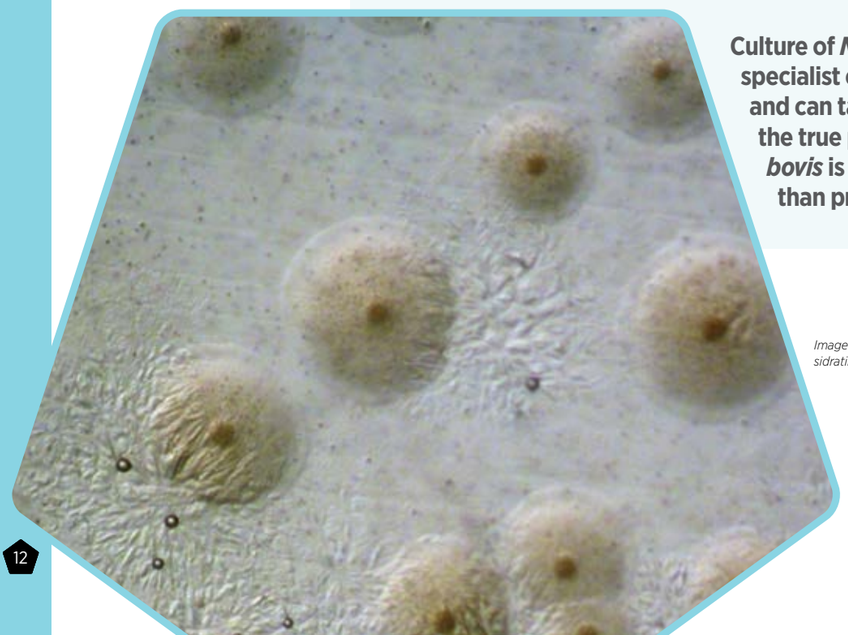


Head tilt, either alone or in combination with signs of BRD, is strongly suggestive of *Mycoplasma bovis* involvement

Diagnosis

BRD with poor response to treatment, accompanied by either arthritis or otitis media/interna, would strongly support a diagnosis of *Mycoplasma bovis*. In additon, some of the gross and histopathological changes described above would be considered strongly suggestive, if not pathognomonic, for *Mycoplasma bovis* infection.

Serological testing by ELISA will demonstrate previous exposure of the animal to infection. Diagnosis of pathogens in lung tissue through laboratory testing has generally resulted in an underestimation of the prevalence of *Mycoplasma bovis* for a number of reasons. Culture of *Mycoplasma bovis* is not straightforward, and requires specialist expertise and equipment, and may take a prolonged period of incubation before a negative result can be established with confidence. The culture and identification of other bacterial BRD pathogens is easier, so the presence of *Mycoplasma bovis* may be missed. Confirmation of **current** *Mycoplasma bovis* involvement can only conclusively be determined through the identification of *Mycoplasma bovis* antigen in lung lesions, through the use of molecular methods such as PCR, qPCR or by IHC staining of lung sections. These tests range in their sensitivity and cost, and there is not a standardised approach within the laboratory network of the EU. Care must be taken when interpreting a negative result – one should always take into account the whole clinical picture.



Culture of *Mycoplasma bovis* requires specialist expertise and equipment, and can take up to 10 days. As a result, the true prevalence of *Mycoplasma bovis* is probably much greater than previous estimates.

Image from http://mynotes4usmle.tumblr.com/post/47687055944/sidratime-fried-egg-appearence-of-mycoplasma

Treatment

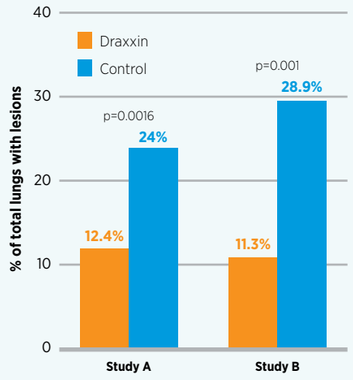
Care must be taken when selecting an appropriate antimicrobial, either for the treatment of undifferentiated BRD (where *Mycoplasma bovis* may be involved) or for outbreaks and individual cases where the involvement of *Mycoplasma bovis* has already been determined.

In vitro sensitivity profiles can be an unreliable indicator of clinical efficacy, particularly for certain classes of antimicrobial. Where possible, practitioners should utilise studies that demonstrate efficacy in the face of either a confirmed natural or experimental challenge with *Mycoplasma bovis*.

A number of studies have demonstrated the efficacy of tulathromycin as a treatment for *Mycoplasma bovis*-associated BRD. These studies have shown good clinical efficacy against both high and low MIC_{90} strains (graph 1), an extended duration of action of up to 9 days (graph 2) and superior efficacy compared to another macrolide, tildipirosin (graph 3), demonstrating tulathromycin is an ideal choice of antimicrobial for the first-line treatment of BRD that may involve *Mycoplasma bovis*.

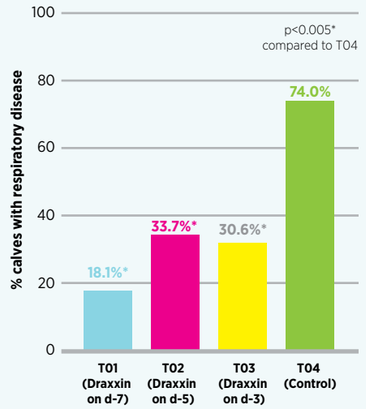
The use of metaphylaxis in the treatment of *Mycoplasma bovis* is a valuable tool. *Mycoplasma bovis*-associated BRD is capable of spreading rapidly within a population, due to the large numbers of bacteria shed from affected animals. Given the ability of *Mycoplasma bovis* to cause chronic, unresponsive clinical cases, treatment early in the disease process may be considered an important element of disease management in conditions where high morbidity is likely.

Graph 1: Efficacy of tulathromycin against *M.bovis*



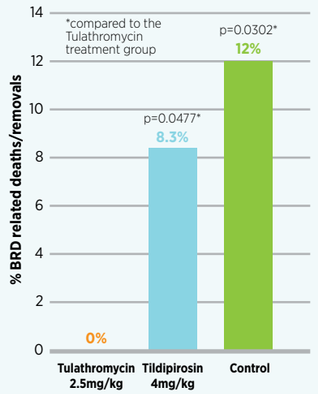
Tulathromycin is an effective treatment for BRD caused by *Mycoplasma bovis,* irrespective of the MIC_{90} of the challenge strain (Study A MIC_{90} >64 µg/ml, Study B MIC_{90} <1 µg/ml). Treatment with tulathromycin resulted in significantly better cure rates and significantly reduced lung lesions in both studies. (Godinho K.S. *et al*. (2005) Veterinary Therapeutics 6(2): 96-112)

Graph 2: Duration of activity of tulathromycin against *M.bovis*



Treatment with tulathromycin at 3, 5 and 7 days prior to challenge with *Mycoplasma bovis* daily for 3 consecutive days resulted in effective control of clinical signs of disease, proving a duration of antimicrobial action of up to 9 days. (Moyaert H. *et al.* (2012) Poster presentation at the XXVII World Buiatrics Congress, 3-8 June 2012, Lisbon, Portugal (Abstract 505, Poster 759)

Graph 3: Comparison of efficacy of tulathromycin and tildipirosin against *M.bovis*



In an *M.bovis* challenge study comparing the efficacy of two macrolide treatments (tulathromycin and tildipirosin) tulathromycin showed significantly superior efficacy. 126 calves, showing clinical signs of BRD, were allocated to one of 3 groups. Clinical signs were assessed until euthanasia and necropsy on Day 14. (Zoetis study A132R-GB-12-018)

Prevention

Common to all causes of BRD, ensuring that non-specific defence mechanisms are not compromised is perhaps the most important preventive control measure available to the cattle practitioner and producer. Attention should be paid to air quality, stress and husbandry in order to ensure effective non-specific defence against all BRD pathogens.

Specific control methods for *Mycoplasma bovis* must mainly be focused on minimising the exposure of naive animals to the bacterium. The main sources of *Mycoplasma bovis* are contaminated milk from infected cows and the respiratory secretions from infected, but not necessarily clinically affected, animals.

Minimising the risk of spread from dam to newborn calf:
On dairy units, removing the newborn calves from the cow and away from the calving accommodation as soon as possible after birth reduces the time, and therefore the risk, of transmission of infection (via respiratory and vaginal secretions) from dam to calf.

Minimising the risk from contaminated milk:
On dairy units, prevention of infection from contaminated milk can be achieved relatively simply by switching to an artificial milk replacer. If this is not considered to be economically justifiable, the risk from contaminated milk can be minimised through the careful selection of cows eligible to contribute to the calf-feeding pool (by either segregation or culling of infected animals) and implementing an effective milk pasteurisation policy. Where pasteurisation is the main control policy, frequent monitoring of pasteurisation efficacy is vital.

Minimising risk from purchased cattle:
Ideally, serological screening, quarantine and, if applicable, a treatment policy could be used to minimise the risk from incoming animals. In the absence of the ability to screen, an effective quarantine policy may still be effective by separating these animals on arrival when they are stressed and therefore more likely to be shedding higher numbers of *Mycoplasma bovis*.

Minimising the risk of animal-to-animal spread:
Mycoplasma bovis will spread from animal to animal primarily in respiratory secretions. Segregating clinically affected individuals, that are likely to be shedding high numbers of *Mycoplasma bovis*, may be effective. Ensuring excellent air circulation will reduce the bacterial load in cattle buildings. *Mycoplasma bovis* is largely susceptible to common on-farm disinfectants, so effective disinfection of equipment that is used across groups is essential. In addition all-in, all-out policies for cattle sheds, coupled with effective disinfection of the housing, is a practical solution for many.

Pasteurisation is now more common on farms, and is a practical way of minimising the risk of transmitting infection to calves. Pasteurisation of colostrum on a low-temperature, long-duration setting (60˚C for 60 mins) has been shown to not have a detrimental effect on the IgG content.

Summary

Mycoplasma bovis is like many other BRD pathogens. Alone, or in combination with other pathogens, it can cause clinical disease that has a significant impact on the cattle industry. There is currently no commercially available vaccine to protect against *Mycoplasma bovis,* so control relies on improving the overall health of cattle, minimising the exposure of naive cattle and implementing effective treatment regimes.

Mycoplasma bovis is a highly prevalent and important pathogen in many EU cattle systems. It should be considered one of the four key bacterial BRD pathogens, alongside *Mannheimia haemolytica, Pasteurella multocida* and *Histophilus somni*, and specific steps taken during BRD outbreaks to ensure effective control of this important pathogen to help improve disease outcomes.

For further information on *Mycoplasma bovis,* practitioners are recommended to read the following excellent review articles:

Caswell J.L. *et al.* (2010) *Mycoplasma bovis* in respiratory disease of feedlot cattle. Vet Clin North Am Food Anim Pract. 26(2): 365-79

Maunsell F.P. *et al.* (2009) *Mycoplasma bovis* infections in young calves. Vet Clin North Am Food Anim Pract. 25(1): 139-77

Maunsell F.P. et al (2011) ACVIM Consensus Statement - *Mycoplasma bovis* infections in cattle. J Vet Intern Med 25: 772-783

Nicholas R.A.J. (2011) Bovine mycoplasmosis: silent and deadly. Veterinary Record 168(17): 459-462