The role of the veterinary laboratory in achieving and maintaining improved herd health

As diagnostic testing is playing a greater role in screening for and monitoring infections and diseases, the veterinary laboratory is becoming a more important service to the practising veterinarian, writes John Gilmore BVSc MSc, FarmLab Diagnostics, Roscommon

Increasingly, today, the practice of food animal medicine involves looking at the herd rather than individual animals. With diagnostic testing more widespread, the veterinary laboratory provides a useful service to the practising veterinarian in delivering effective, evidence-based herd health-related advice.

Laboratory testing for infectious and parasitic diseases involves the use of a variety of methods to determine the aetiology of many diseases and disease syndromes. The laboratory-based methods commonly used for infectious and parasitic diseases are generally broken down into direct (detecting the presence of an infectious or parasitic agent) or indirect tests using serology/antibody detection. The range of diseases, which are covered by diagnostics in the context of herd-health monitoring, are many and varied, and outside the scope of this paper.

The objective of this paper is to provide an overview of the commonly used diagnostic tests which may be applied in a herd health context.

TEST CATEGORISATION

As stated in the introduction, tests can be generally categorised as direct or indirect. Examples for various disease categories are shown in the table below. There are, of course a range of other tests for biochemical measures, but are beyond the scope of this paper which focuses on tests for infectious and parasitic disease.

ACHIEVING AND MAINTAINING HERD HEALTH

Herd health is widely talked about nowadays and is often described as if it were a 'destination' to get to. Once it has reached the holy grail of 'good herd health', the herd has arrived at a better place, it's believed. In reality, all diseases and disease processes are dynamic, and require constant work to maximise benefits in herd health. Many practitioners often wonder where to start and this may sometimes be as a result of a client request. Perhaps the client is already involved in some other monitoring programme, eg. bulk tank milk screening tests, and now wishes to take their herd's

Disease/infectious agent		Direct tests	Indirect tests
Respiratory disease	Virus		
	Infectious bovine rhinotracheitis (IBR)	Polymerase chain reaction (PCR)	Serology/BTM/IM*
	Bovine viral diarrhoea (BVD)	PCR	Serology/BTM/IM
	Respiratory syncytial virus (RSV)	PCR	Serology/BTM/IM
	Coronavirus	PCR	
	Bacteria		
	Mannheimia haemolytica	PCR/culture	Serology
	Histophilus somni	PCR/culture	Serology
	Mycoplasma bovis	PCR/culture	Serology
	Parasite		
	Dictyocaulus	Faecal Baermann tests	
	Tickborne fever	PCR	
Infertility	Virus		
	IBR	PCR	Serology/BTM/IM
	BVD	PCR	Serology/BTM/IM
	Bacteria		
	Leptospira spp	PCR/ IFAT	Serology
	Salmonella spp	PCR/culture	Serology
	Parasite		
	Neospora caninum	PCR/histopathol-ogy	Serology
Johnes disease	Mycobacterium paratuberculosis (MAP)	Faecal culture/ PCR	Serology/IM
Mastitis	Bacteria		
	Many agents eg. Staphylococcus spp, Streptococci Mycoplasma	Culture PCR	
	Fungi	Culture	
Parasitic Disease	Gutworm	Faecal analysis	Ostertagia BTM antibody
	Lungworm		
	Liver fluke		BTM antibody test
	Rumen fluke		

Table 1: Some commonly used screening methods in herd-health screening
***BTM= bulk tank milk; IM= individual milk sample.**

health to the next level. In other cases, the farmer may have experienced a severe clinical outbreak.

BTM ANTIBODY SCREENING

BTM, as a test matrix, is beneficial as it is readily accessible and relatively inexpensive to test. Pooled tests by their nature are cheaper than screening several individual animals, and therefore, lend themselves to be analysed on a more frequent basis than individual animal screening. BTM however, has many disadvantages, chief among these being that sensitivity in general, will be poorer than individual screening, and the fact that individual positive animals will not be identified.

Poll results may go up and down, BTM screening therefore, is particularly suitable for identifying trends on a farm over periods of time, and are of limited use as one-off tests. Many farmers will be familiar with this concept in relation to somatic cell count (SCC). Indeed, as part of a herd-screening programme, the vet's involvement in SCC monitoring is of huge benefit in terms of mastitis-control programmes on farms. This may involve screening of individual high-SCC animals to identify the aetiology of the elevated herd SCC. The same concept may be applied in relation to other herd level diseases. By monitoring BTM for a range of antibodies at regular intervals (see Table 2), over the course of a year, farmers and their veterinary

	Test method	Timing
Routine (proactive) screening		
BTM	IBRgB Ab Elisa	Quarterly
	Neospora Ab Elisa	Quarterly
	Salmonella Ab Elisa	Quarterly
	Ostertagia Ab Elisa	Twice during grazing season
	Fasciola Ab Elisa	Autumn
	BVD PCR	Quarterly
Individual animal tests	MAP Ab Elisa	Annually
	Neospora Ab Elisa	Twice yearly if history of disease on farm
Juvenile screening	BVD Ab	When young-stock management groups are more than six months old, (maternally derived antibody diminished) or three to four weeks after a disease outbreak
	RSV Ab	
	IBR Ab	
	Mannheimia haemolytica Ab	
	Mycoplasma Ab	
	Worm faecal egg counts	Monthly intervals during grazing season
	Rumen and liver fluke faecal testing	Autumn
Reactive tests		
Abortion	See list of tests for disease categories shown in Table 1	After every case of abortion
Respiratory disease		• Pooled nasal swabs for PCR testing from five to six animals early in disease outbreak • Paired serology or serum samples four weeks after event from animals six to 12 months
Mastitis	Milk culture and sensitivity	• Every cow with clinical mastitis • Cows showing individual SCC>200,000 or positive on CMT
Diarrhoea	Calf faecal analysis for rotavirus, coronavirus, E coli, cryptosporidia, coccidiosis	Five to six calves in any one management group early in disease outbreak
	Faecal culture	Where salmonellosis suspected
	Faecal analysis for gutworms, liver and rumen fluke	Grazing animals with diarrhoea
	MAP PCR testing	Adult animals with scour where Johne's disease suspected
Milk drop syndrome	• PCR testing for respiratory pathogens • PCR testing for tick borne fever	Early in disease outbreak if clinical signs indicate
	Paired serology for respiratory pathogens and leptospirosis	• First set of samples when syndrome occur • Second set of samples three to four weeks later
Other diseases	Farmers should be encouraged to consult with their veterinary practice when confronted with issues relating to disease or ill-thrift on farm so that a suitable testing regime may be instituted	

Table 2: Example of a health monitoring programme for a dairy herd.

practitioners can quickly become aware of any changes occurring in the disease status on the farm. Farmers should be aware of the fact that this constitutes only one element of a disease-screening process, and that there are a number of inherent limitations. As stated earlier these largely relate to test sensitivity, but also the nature of the disease process. Some diseases elicit a strong antibody response, with many animals seroconverting as the disease spreads throughout the herd. An example of this scenario may be where a persistently infected BVD animal is introduced to a group of naïve dairy cows, resulting in a strong antibody response in the bulk tank. On the other hand, Johne's disease antibody testing has poor sensitivity, even in individual animals. This, combined with the fact that the disease usually has a low herd prevalence, renders MAP-antibody testing unsuitable as a test method in BTM.

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Where BTM is being used as a tool to monitor parasitic infections, farmers should also be aware that while antibody level correlate with infection levels for Ostertagia and Fasciola in grazing cows, antibody levels may remain high for long periods post treatment, therefore it is not a useful test to monitor the effectiveness of anthelmintic or flukicide treatment.

INDIVIDUAL ANIMAL SCREENING

PROACTIVE TEST PROCEDURES

Outside of BTM testing, most other screening tests will usually be carried out on individual animal samples.
As discussed earlier the sample size selected will vary depending on the disease and test sensitivity, with diseases such as Johne's diseases requiring full herd screening of all adult animals, probably over a number of years to give an assurance of freedom. While juvenile screens of young animals for BVD or IBR may involve selection of a small number of animals (eg. five or six) from different management groups. However, these animals can only be tested when maternal antibodies have waned.
A proactive monitoring programme should also exist for parasitic diseases. In some cases this may involve use of pooled samples, such as the use of bulk -tank milk antibody testing for Ostertagia or Fasciola monitoring, but also may involve the use of routine screening of individual faecal samples, for instance monitoring faecal egg counts for gutworms in first grazing calves. Practitioners should, however, inform their clients of the limitations of parasite monitoring on faecal samples. For instance, monitoring of faecal samples in young stock will be of little use in scheduling anthelmintic lungworm doses due to delays associated with the prepatent period in the appearance of lungworm larvae in the faeces, and this is a very significant issue for cattle on Irish pastures. Similarly, the use of faecal analysis in adult cows to determine Ostertagia and Fasciola hepatica levels will often yield disappointing results due to low or intermittent shedding of parasite eggs in adult cattle.

REACTIVE TEST PROCEDURES

Individual animal screening may take place reactively as a result of a disease incident or positive results on another test, for example positive IBR results in previously negative bulk-milk samples. Monitoring of disease outbreaks constitutes an important element of maintaining improved herd health on any farm. This means that the farmer should be aware of the need to alert the veterinary practice early in any infectious disease process situation, particularly in relation to diseases such as abortion, respiratory disease, mastitis, or diarrhoea.

ABORTION

If we take bovine abortion as an example, most farmers will experience the situation where one or two cows will abort calves, and it is likely that many of these go unreported. Farmers should be made aware of the fact that while there remains a statutory responsibility to notify the occurrence of bovine abortion, it is also in their best interest to attain an aetiological diagnosis. This will involve a visit from the veterinary practitioner allowing samples to be taken to fulfil statutory brucellosis testing requirements, but also to screen for other diseases. Additional serum samples may be taken to screen for a range of diseases including Salmonella, leptospirosis, neospora, IBR, etc. Where possible the farmer should be encouraged to submit the foetus to the RVL for PM examination. Where this is not possible, samples may be taken by the practitioner. Useful samples include, placental cotyledons, foetal brain, liver, kidney and abomasal contents. The use of swabs allows safe and easy transport of this material by post. The practitioner should consult with the laboratory in relation to suitability of swabs for tissue sampling and this will be influenced by the test method being used. The development of real-time PCR test methods provides an additional tool in the detection of some possible aetiological agents such as: leptospirosis, neospora, haemophilus, chlamydia and IBR.

RESPIRATORY DISEASE

Early investigation of respiratory disease outbreaks may facilitate effective intervention measures, such as intranasal vaccination in the face of an IBR outbreak. Nasal swabs may be taken from a number of animals which appear to be early in the disease process when levels of viral shedding will be at their highest. As well as identifying an emerging pathogen on the farm, this measure will facilitate monitoring of the effectiveness of any existing vaccination programmes. For instance the diagnosis of coronavirus as the sole agent in a respiratory type outbreak will help to dispel the fear that an existing vaccination programme for other agents is not working, and indeed may indicate that what turns out to be mild disease outbreak may in fact have been much worse should a vaccination programme against other respiratory agents not already exist on the farm.

MASTITIS AND SCC

Farmers should also be encouraged to take samples from cows with high SCC results or clinical mastitis. In all cases it is not necessary to get an immediate diagnosis, especially in the case of individual sporadic cases. Samples may, for instance, be labelled and frozen, in which case they are readily available for analysis should a more significant mastitis problem emerge on the farm. In the context of antimicrobial resistance there is, however, an argument to be made for the culture of all mastitis cases as part of an on-farm mastitis control programme. A recent survey of veterinarians in Sweden indicated that 98% of vets carried out bacterial culture to aid in the choice of treatment protocol. This not only aids in treatment selection but also monitors the emergence of resistant strains of bacteria on the farm. Building data on the mastitis pathogens on the farm is likely to be important to justify dry-cow therapy in future, where EU legislation on antimicrobial usage is discouraging prophylactic usage.

DESIGN OF ON-FARM TESTING PROGRAMMES

On-farm testing programmes should be designed by the attending veterinary practitioner in consultation with their client. This will allow for a bespoke programme for each individual farm. The design of the programme will vary depending on several factors, including biosecurity/ vaccination policy on the farm, disease history, farm size and type of enterprise. A small suckler farm for example, which maintains a closed herd will have a different requirement than a large dairy herd that employs contract rearing of replacement heifers. The example in Table 2, is just that. It provides an example of a testing programme, which may work on particular farms, but issues such as quarantine testing, test methods, test accreditation should first be discussed by the veterinary practitioner and client.

LIMITATIONS OF DIAGNOSTIC TESTING

When testing for any disease it is important to be cognisant of the limitations of the specific test methods being used. Generally, these are measured in terms of test sensitivity (proportion of diseased animals with a positive test result) and specificity (proportion of non-diseased animals with a negative test result). Some tests are regarded as having high sensitivity, eg. IBRgB antibody Elisa tests for the detection of antibodies to infectious bovine rhinotracheitis, while other tests have quite low sensitivity, eg. MAP antibody detection for the diagnosis of Johne's disease. The specificity of a test is a measure of the likelihood that a positive test result actually means that the animal is infected with that specific disease. Examples of tests with high specificity include antigen Elisa tests, which detect a specific antigen associated with a pathogen, for example the Erns antigen Elisa for the detection of BVD virus, detects the Erns protein expressed on pestiviruses.

The suitability of the test method being used also needs to be considered. For example the use of routine faecal egg count testing on adult cows, will often yield negative results, despite the fact that the herd may be infected with a significant level of Ostertagia parasites due to the prepatent nature of the infection. In this situation, the monitoring of BTM antibodies may yield more information in terms of the economic benefit to be gained by using an anthelmintic in a group of previously untreated cows.

Practitioners should also be aware of the effect of sample size, and herd prevalence when selecting populations of animals for testing. Diseases with low prevalence or using test methods with poor sensitivity and/or specificity require larger sample sizes than others, a typical example of this situation being the need to test entire herds when carrying out Johne's disease screening tests.

CONCLUSIONS

As issues relating to herd health and their impact on animal welfare, environmental sustainability and farm profitability become increasingly more important, there is a growing awareness of the need to attain specific aetiological diagnoses in order to institute effective, evidence-based control measures on farms. Veterinary practitioners play a central role in the design and interpretation of laboratory testing programmes on farm. Before testing programmes are finalised it may also be useful for the veterinary practitioner to liaise with the veterinary laboratory to discuss issues such as test suitability.

The attending veterinary practitioner is an essential conduit in the transfer of data from the laboratory to the farmer. By having an understanding of the farm and the diseases being tested for, they play an essential role in the interpretation and implementation of laboratory results on the farm. By instituting specific-testing programmes, improvements in herd health can be achieved. Perhaps the bigger task is maintaining the improved herd health status, and that can only be achieved through veterinary practitioner involvement.

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