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Detecting and managing leukosis easier than you think

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Bovine leukosis is a persistent and incurable disease affecting the health, productivity and profitability of dairies. It is caused by the bovine leukemia virus (BLV), which primarily infects lymphocytes, the immune cells responsible for antibody production and viral disease combat. Blood containing infected lymphocytes is the primary transmission route, and less than a single droplet is sufficient for infecting another cow.

The disease progresses slowly, so most infected cows will appear healthy for a long time. However, their productivity and lifespan are reduced, and their weakened immune system make them more vulnerable to other diseases. Only a small number (less than 5 per cent) will develop visible symptoms, such as tumors (lymphomas).

A cow infected with BLV generates, on average, \$635 less per year than an uninfected cow. Around 90 per cent of Canadian dairy herds have at least one infected cow, and in many herds, more than 40 per cent of cows are infected.

Given the widespread presence of BLV in Canada and its significant impact, it is crucial to implement screening and control measures. The goal is to gradually reduce the presence of this disease in Canadian herds, an ambitious but necessary project for the prosperity of the dairy industry. Along with biosecurity measures, a key step is identifying high-risk infected cows most likely to spread BLV to others. These high-risk animals can then be isolated or culled to

protect the rest of the herd and improve overall herd health and productivity.

The chair in biosecurity of dairy production at the Université de Montréal's Faculté de médecine vétérinaire and Lactanet have partnered on a project to validate different test options and strategies.

It is important to understand that screening tests are not perfect. They can sometimes misclassify cows, for example. This is partly due to the dynamic nature of diseases, meaning that a disease develops over time. They do not always follow a predictable pattern in every animal. Every individual is unique, and cows do not always follow the textbooks. That is why we run projects to validate and optimize tests.

In addition, as test methods evolve, we also revalidate and adjust them to ensure they remain accurate and reliable.

The main objective of this project was to validate an individual cow-level milk enzyme-linked immunosorbent assay (ELISA) test, which can be easily conducted on milk samples collected during routine dairy herd improvement (DHI) testing. This makes it a very convenient tool for determining the leukosis status of cows.

The ELISA detects antibodies against the BLV, indicating whether a cow has been exposed to the virus. As the disease cannot be cured and there is no commercially available BLV vaccine, a cow with a positive ELISA test is considered to be infected.

Briefly, DHI milk samples were obtained from 637 cows across eight

dairy herds in Quebec, with some herds having 10 per cent or fewer cows affected by leukosis, while in other herds, more than 30 per cent of cows had the disease.

The research question was: "How good is the milk ELISA test at correctly identifying cows with bovine leukosis and cows without bovine leukosis?"

The ELISA showed a high sensitivity (92 per cent), making it particularly good at identifying as positive BLV-infected cows. Moreover, the test's sensitivity was increased to 99 per cent in older cows (whom typically are more advanced in disease progression). The test also showed very good specificity (98 per cent), thus indicating that most truly healthy cows are actually classified as negative by the test. These characteristics makes the ELISA an excellent option for screening purposes.

Other questions that arises are: If all cows are screened with the ELISA test for bovine leukosis, how confident can we be that a positive cow is truly infected? Or that a negative cow is truly healthy.

To answer this, we used measures that are called predictive values, which estimate the confidence we can have in a positive or negative result (Figure 1).

As we can see from Figure 1, it is easier to trust that a cow testing positive truly has bovine leukosis when the disease is highly present in the herd.

For instance, in a herd where 30 per cent or more of the cows have leukosis, we can be between 95- and 99-per-cent certain that a cow with a positive test result is truly infected (i.e. the positive



predictive value [PPV]).

However, in a herd where only 10 per cent of the cows are infected, a cow with a positive test result has an 85-per-cent probability of truly being infected. Thus, 15 per cent of cows testing positive in such a herd would be false-positive results. This could be problematic if the test is used for culling decisions. In this situation, performing a second test to confirm the initial positive result before making a definitive culling decision may be advisable.

The opposite is observed regarding cows with a negative milk ELISA test result. When leukosis is relatively uncommon in a herd (e.g., 10 per cent of cows are infected), we can be almost certain that a cow with a negative test result is truly healthy. But, in herds where the disease is extremely common (i.e., 70 per cent or more of cows infected), the test can lead to many false-negative results. This may be less problematic, though, if the plan is to retest the herd annually, for instance. These cows wrongfully diagnosed as healthy may then be captured in the next sampling.

As a follow-up to this project, Lactanet now offers leukosis screening using individual milk samples (both DHI and non-DHI "hand-strips") with the validated milk-ELISA test. Taking things one step further, and to promote an integrated screening approach, Lactanet leukosis reports have been redesigned to transform the product into more than just a regular health test.

The Lactanet Leukosis milk-ELISA test is a screening tool designed to detect the disease and to monitor its progression in herds. The reports incorporate milk recording and health test data to assess the impact of the disease on the productivity and health of cows that test positive. This facilitates decision-making by identifying the most affected cows, considering their overall performance rather than just a single test result.

Figure 1. Probability (%) of being infected with BLV depending on the proportion of infected cows in the herd

