

TB TESTING FOR CATTLE IN NZ

FACTSHEET TB03

OVERVIEW OF THE NEW ZEALAND'S CATTLE TESTING PROGRAMME

In New Zealand, a small range of diagnostic tests are used to detect and eradicate tuberculosis infection from our cattle herds. All tests are based on measuring an animal's immune response to *tuberculin*, which is a standardised protein extract derived from killed TB bacteria (*Mycobacterium bovis*). In general, this response is measurably different between infected and non-infected animals.

Tuberculin tests can be applied directly to an animal with an injected skin test, or can be carried out in a laboratory using a blood sample taken from the animal.

The testing programme operates broadly as follows:

SURVEILLANCE TESTING

In any one year, a large proportion of the national cattle population (4.41 million animals in 2014/15) is skin tested for TB. Tests are allocated to herds in an area-based disease surveillance programme which largely reflects the risk of infection from contact with infected possums. In higher-risk areas, testing is more frequent and is applied across a wider age-range of livestock.

In a small number of cases where the risk of infection is considered to be high, skin-test positive cattle are sent directly to slaughter. However, most skin-test positive animals are tested again (as explained below).

SERIAL TESTING

Most cattle that test positive to a skin test are tested again using an *ancillary serial blood test*. Animals which are positive to the ancillary test are sent to slaughter as reactors. After slaughter they are carefully inspected and tissue samples taken for further laboratory analysis. This may or may not lead to diagnosis of TB infection. If TB is diagnosed, the herd is classified 'Infected'.

TESTING IN INFECTED HERDS

Once a herd is classified as infected, skin and blood tests can be used in various combinations in order to detect (and then slaughter) all likely TB cases. Even those animals which have tested negative to a skin test can be tested again, using an *ancillary parallel blood test*.

Cattle from infected herds must be negative to both a skin test and a blood test before they are allowed to be moved to another herd, and they must be tested again after movement.

PRE-MOVEMENT TESTING

Areas of highest TB risk are classified as *Movement Control Areas*. In these areas, all cattle must be negative to a skin TB-test before they are allowed to be moved from one herd to another.

FALSE TEST RESULTS

To understand the accuracy of TB tests, it is first important to understand the underlying problem of false test results.

Most infected cattle respond positively to tuberculin tests. However some truly infected cattle don't respond to the test and produce a *false-negative* test result. This tends to occur when the animal's immune system isn't functioning properly due to some form of health stress (including seriously advanced TB).

False-negative animals pose an obvious disease control problem in that, left undetected, they can go on to infect their herd mates, or another herd if moved. A proportion of such animals may respond to a different diagnostic test if applied around the same time, or to the same test if applied at a later date, especially if any health stress factors have been alleviated.

The reverse situation is that some non-infected animals may respond with a *false-positive* test result. This mostly occurs if they have been exposed to bacteria that "look" immunologically very similar to *M. bovis*. The extent of this problem varies over time and between regions, with higher false-positive test rates in various valleys on the West Coast and in Golden Bay, and in a few herds near thermal areas in Waikato and Bay of Plenty.

While false-positive cattle in themselves don't compromise the effectiveness of the control programme, they often still need to be slaughtered, which can be regarded as a wasteful cost (including compensation costs payable to farmers).

The hard reality is that there is always a trade-off between false-negative and false-positive test results. Tests can be adjusted for bias either way but not both ways at once. If tests are adjusted to minimise false-negative results (so as to minimise the risk of leaving infection behind on the farm) this would mean more false-positive results and more wasteful slaughter of healthy animals. Conversely, setting the testing programme towards reducing the wasteful slaughter of healthy animals would lead to greater risk of leaving undetected disease behind.

A smart testing programme manages these trade-offs by employing a range of tests in various combinations and sequences, while balancing disease risk against waste and cost.

MEASURING TEST ACCURACY

Measures of the accuracy of TB tests must take into account the likelihood of a test producing both false positive and false negative result. This requires a measure of two numbers, to describe *test sensitivity* and *test specificity*, as follows:

Test sensitivity

This is the ability of a TB test to give a correct positive result for animals that truly have TB. Thus if 100 known TB-infected animals were TB tested, and the test correctly identified 85 of them as infected, then its sensitivity would be 85%.

Test specificity

This is the ability of a test to give a correct negative result for animals that are truly not infected with TB. Thus if 100 truly non-TB animals were tested and one of them produced a false-positive result, then the specificity of the test is 99%.

THE TESTS

INTRADERMAL TUBERCULIN TEST (TB SKIN TEST)

The skin test is used in the TB programme as a primary screening test. To perform the test an approved technician injects 0.1 ml of tuberculin into a cleaned fold of skin at the base of the tail of a cattle beast. Three days after the injection, the tester returns and 'reads' the test on each of the animals that were injected. Any animal that has a visible or palpable swelling response at the injection site is classified as being "test-positive." The animal is then tagged with an official orange tag and its identity is recorded.

The **sensitivity** of the intradermal tuberculin test as applied under New Zealand conditions is $85\% \pm 5\%$. That means that if there are ten TB cattle in a herd, the intradermal tuberculin test would be expected to identify eight or nine of those ten animals.

The **specificity** of the skin TB test as applied under New Zealand conditions is 99.8%, which means about three cattle in every thousand tested would be expected to be false-positives.

THE GAMMA INTERFERON TEST (BLOOD TEST)

The gamma interferon test is performed on a blood sample taken from cattle. Biologically, the test measures the same response as the skin test, except it is performed on live blood cells. Although care must be taken in extracting and transporting the blood sample, the test is more reliable for being performed in a controlled laboratory situation. The gamma interferon blood test is used in the following two ways in New Zealand:

Ancillary serial blood test

This is where the blood test is performed on cattle that were positive to a previous skin test. All cattle that are positive to both the skin test and the following blood test are sent to slaughter. This combination of the two tests greatly reduces the number of false-positive animals wastefully slaughtered, and reduces compensation costs payable to farmers. However it does somewhat increase the risk of leaving infected animals behind, so it is not used in known high TB risk situations.

The sensitivity of the standard ancillary serial gamma interferon test is approximately 85% and the specificity is approximately 93%.

Ancillary parallel blood test

An ancillary parallel blood test is performed on skin test-negative cattle, normally in infected herds. Using the blood test after a negative skin test in this way improves the overall sensitivity of detecting TB in a herd. All cattle that are identified as positive to the parallel gamma interferon test are classified as TB reactors and sent for slaughter.

The combined sensitivity of the intradermal skin test and the parallel gamma interferon test is estimated at 95%. The specificity of the parallel gamma interferon test is estimated at around 90%.

TEST PROGRAMME OUTCOMES

Critics of the TB testing programme often focus on perceived limited accuracy of just one aspect of a single type of test. However as outlined above, the testing programme uses different tests in various sequences and combinations in order to strike a balance between reliably detecting disease and avoiding wasteful slaughter. The programme must also be affordable, and the relatively low cost of a skin TB test – at about one-tenth the cost of a blood test – is significant.

Rather than focusing narrowly on test accuracy, it is more useful to look at overall outcomes of the testing programme. In the 2014/15 year, 370 cattle were slaughtered as a result of positive TB tests, and 141 of these (38%) were found to have TB after slaughter. This means 229 cattle (62%) were “wrongly” slaughtered because of false positive test results.

This proportion of false-positive slaughter might seem high, but remember we also have to minimise the more important risk of false negative tests which leave infected animals behind. How do we assess this? If we were leaving a lot of infection behind in the national cattle herd, then this would show up as large numbers of cattle being found with TB at routine slaughter. However in 2014/15 there were just 24 such cases (0.001% of total cattle slaughtered).

On balance there do not seem to be any major disease control problems arising from limitations in test accuracy. If anything we are doing too much testing – it took more than 4 million tests to find those 141 cattle last year. The focus for the coming years will be on better risk assessment – including using livestock movement data now becoming available from the NAIT tracing programme – to develop a more targeted testing programme with fewer tests overall.

While cattle TB tests are not perfect, it is worth reflecting on the fact that even in human health care – with much greater resources available – TB is still notoriously difficult to diagnose. Definitive diagnosis in humans often relies on costly processes such as X-ray and surgical tissue biopsy. These methods are clearly not available for large scale use in farmed cattle.

For more information, please visit the [OSPRI](#) website, or phone OSPRI on 0800 482 463.