Veterinary Laboratories Agency

Tuberculin Usage

Report for 1st January 2005 to 30th June 2009

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20 May 2010

Executive Summary

This report compares tuberculins (avian and bovine) produced by VLA Weybridge with tuberculins produced by Lelystad in the identification of cattle infected with Mycobacterium bovis. The performances of the single intradermal comparative cervical tuberculin test (SICCT - the skin test) with the different pairs of tuberculins were compared using VetNet surveillance data for the 54 months from 1st January 2005 to 30th of June 2009. During this period there were 26,363,877 skin tests conducted on cattle during 438,986 testing events in 79,004 herds in GB. Tuberculin type was recorded for 98% of herd tests, of which 54% were conducted using Lelystad tuberculin.

The classic test characteristics of sensitivity and specificity cannot be compared using surveillance data because only cattle that are positive to the skin test are slaughtered and we have no information on disease prevalence in animals that are not slaughtered. In the report we have attempted to control for differences in disease prevalence and factors that could affect test performance by including adjustments for Animal Health Office, test type (reason for performing the test), test result, testing interval, month of test, herd size and tuberculin batch, as well as clustering within herds.

The main results were as follows:

- The relation between skin test response and probability of confirmation of M. bovis infection in slaughtered cattle (by observation of macroscopic lesions or culture) differed between tuberculins ($p<0.001$). Slightly more cattle slaughtered for bovine tuberculosis control purposes were confirmed as infected with M. bovis when tested with Lelystad tuberculins compared to Weybridge tuberculins (adjusted percent confirmed 35.4% versus 31.8%, $p<0.001$)
- During herd tests, the rates of reactors disclosed were higher with the Weybridge tuberculins, both overall (adjusted rate 265 vs 231 per 10^5 animals tested, $p<0.001$) and for routine herd tests only (18.1 vs 12.3, $p=0.020$).
- The overall breakdown disclosure rate over the 42 month comparison period was higher for herds tested with Weybridge tuberculins than for those tested with Lelystad (3.4 versus 2.9 adjusted breakdowns per 100 herd years at risk, $p<0.001$). The confirmed breakdown incidence also differed by a smaller amount (1.7 vs 1.6 adjusted confirmed breakdowns per 100 herd years at risk, $p=0.017$)

As observed in the previous report (for the period January 2005 through March 2007), a positive skin test performed with Lelystad tuberculins was more predictive for an animal to have bovine tuberculosis confirmed by culture compared to a skin test with Weybridge tuberculins. The higher positive predictive value of Lelystad tuberculins could indicate either that the SICCT using Lelystad tuberculins is more specific and/or that the SICCT using Weybridge tuberculins is more sensitive.

Again, as observed in the previous report, the reactor disclosure rate was higher using Weybridge tuberculins and, in this analysis, it was 50% higher using Weybridge tuberculin compared to Leylstad in routine herd tests. However, although the differences between tuberculins in the overall and confirmed breakdown incidence rates were statistically significant, the magnitude of the differences was less than 0.5%. We attempted to control for possible confounders such as region, parish testing interval, herd size and production type, but more definitive conclusions regarding the effect of the tuberculins on skin test performance could only be reached through an experimental study comparing the tuberculins in naturally infected cattle.

Acknowledgements
We thank Richard Clifton-Hadley and Tony Goodchild at the VLA for their helpful comments on earlier drafts of this report.

1.0 Introduction

The objective of this series of surveillance reports is to monitor and compare tuberculins produced by VLA Weybridge (avian and bovine) with tuberculins produced by the Central Institute for Animal Disease Control, Lelystad, Netherlands in the detection of cattle infected with Mycobacterium bovis in Great Britain using the single intradermal comparative cervical tuberculin test (SICTT).

Weybridge tuberculins were in use in GB throughout the reporting period, whereas the Lelystad tuberculins were only introduced in October 2005. From that point, both tuberculin pairs were used on an alternate (stock rotation) basis until the production of tuberculins at VLA Weybridge eventually ceased and stocks gradually ran out in the autumn of 2009. Since then, only tuberculins from Lelystad have been used in the bovine TB testing programme in GB.

Comparisons between the two tuberculins have been made using the following parameters:

1. Size of skin test response
2. Probability of M. bovis infection confirmation in reactors, inconclusive reactors and direct contacts slaughtered
3. Probability of M. bovis confirmation by culture in reactors
4. Rate of reactors and inconclusive reactors disclosed per 100,000 animals tested
5. The incidence of herd breakdowns

Emphasis in the main body to the report has been placed on the results from analyses controlling for factors, recorded on VetNet, that may be associated with the performance of the tuberculin test and the prevalence of bovine tuberculosis (bTB). These factors include month of test (seeking to adjust for seasonal factors), Animal Health Office (AHO), region (East, North, West, Wales or Scotland), herd size, test type, interval between testing (annual, bi-annual, 3 or 4 yearly) herd type (beef, dairy or other), test result (reactor, inconclusive reactor or direct contact) and tuberculin batch.

2.0 Source of data

The analyses in this report are based on VetNet TB surveillance data downloaded on 1st July 2009.

2.1 Herd level data

All holdings in GB that had one of more SICCTs conducted with either Weybridge or Lelystad tuberculin between 1st January 2005 and 30th June 2009 are included.

2.2 Animal level data

All animals that had a SICCT conducted with either Weybridge or Lelystad tuberculin between 1st January 2005 ±30th June 2009 and which were subsequently slaughtered are included. Hence animals identified as having visible lesions through slaughterhouse surveillance that did not have a skin test and those diagnosed as infected with M. bovis using the ancillary interferon gamma blood test were omitted.

2.3 Definition of confirmed bovine tuberculosis (bTB)

Bovine tuberculosis (bTB) is defined as ¡confirmed ¶within surveillance data if macroscopic lesions typical of infection with M. bovis were observed in the reactor animal during post mortem examination and/or M. bovis was cultured from a tissue sample from the animal. Lack of laboratory confirmation in a skin test reactor does not imply freedom from infection.

3.0 Data

3.1 Herd level data

The data extracted for the comparative analyses contained the results from 438,986 herd tests between 1st January 2005 and 30th June 2009. This included 26,363,877 SICCTs conducted on individual animals within a total of 79,004 different herds. Over 50% of the herds had one or more animals tested on 2 or more occasions (median 2, inter-quartile range (IQR) 1 to 4). The median number of animals tested on each test occasion was 16 (IQR 3-76). The type of tuberculin was either missing or ambiguous for 1.9% of herd tests after the introduction of Lelystad in October 2005. From this date onwards forty percent of the herd tests were conducted using Weybridge tuberculins.

3.2 Animal level data

Between 1st January 2005 and 30th June 2009, 131,425 animals were slaughtered because they were identified as reactors, inconclusive reactors or direct contacts during the SICCT surveillance program. Lesion status was available for 127,573 (97.1%) of these animals and culture status for 66,398 (50.5%). After the introduction of Lelystad tuberculins, the type of tuberculin was either missing or ambiguous for 2.1% of records. Overall either lesion or culture status was available with tuberculin type for 125,524 animals (95.5%). Forty-five percent of the animals had been tested with Weybridge tuberculins prior to slaughter from October 2005.

3.3 Data quality

The analyses are based on surveillance data entered into VetNet. These data are subject to update and more recent data are likely to be less complete than historical data. Data cleaning was conducted to remove implausible values but it is not possible to validate the data at source.

4.0 Statistical analysis

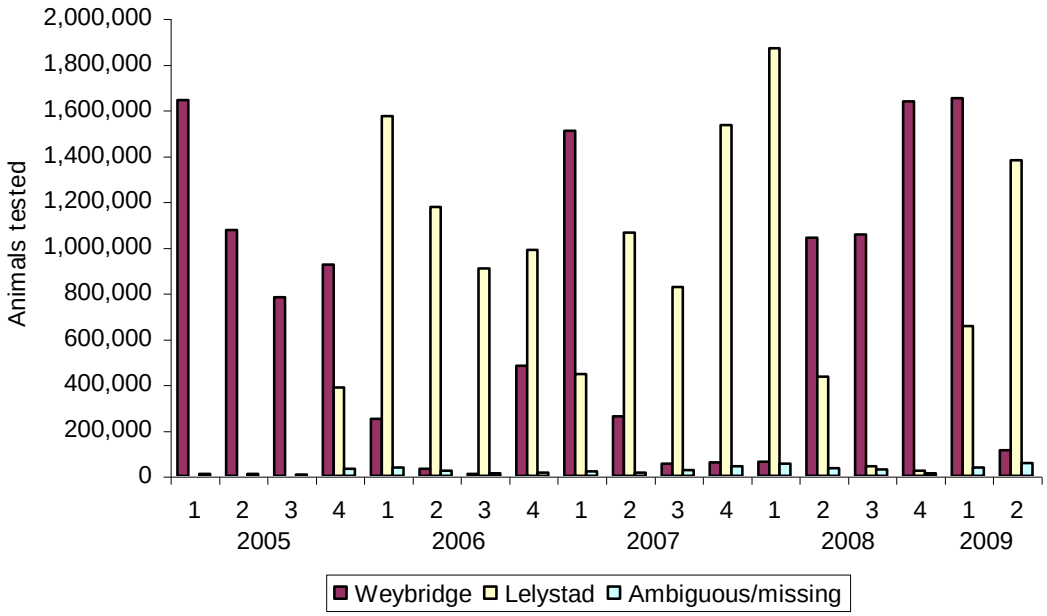
Univariate and bivariate analyses were conducted initially to calculate incidence statistics and to compare the distribution of tuberculins between factors related to disease prevalence that could also be related to performance of the test (confounding factors and effect modifiers). Tables in the Appendix show unadjusted data by tuberculin type including herd breakdown incidence rates (table A1, page 16), rates of reactors and inconclusive reactors disclosed (tables A2 and A3, page 16), confirmation of bTB in animals slaughtered as part of bTB control (table A4, page 17) and bTB confirmation by skin test response (table A5, page 17). The distribution of tuberculin type by possible confounders including region, test interval, season, test type (reason for carrying out a skin test) and herd production type are shown in tables A6-A10 respectively (pages 18-20).

A range of regression models that sought to control for confounders were utilized for the main results (pages 7-12). Although each batch of tuberculin has to meet Veterinary Medicines Directorate (European Pharmacopoeia) licensing criteria before release, we also examined for possible differences that might be related to differences in production and handling of each batch. P-values of <0.05 were interpreted as statistically significant. Standard errors used to calculate probability values and confidence intervals were adjusted for intra-herd correlation as necessary. All analyses were conducted using STATA version 10.1.

5.0 Tuberculin usage over the comparison period

Figure 1 shows the quarterly number of tests conducted with Weybridge and Lelystad tuberculins between 1st January 2005 and 30th June 2009. Lelystad tuberculins were introduced in October 2005 and there was relatively little overlap in testing with Weybridge and Lelystad tuberculins by time period of use. In order to facilitate adjustment for seasonal factors that might influence bTB prevalence, the period over which the performance of the two tuberculins was compared was extended backwards to the beginning of 2005 to include the preceding summer season when skin testing took place with Weybridge tuberculin only.

Figure 1. Number of skin tests conducted by tuberculin type by year and quarter



6.1. Size of skin test response s

Skin test responses to Weybridge and Lelystad bovine and avian tuberculins were compared in animals slaughtered as reactors, inconclusive reactors or direct contacts. The mean response to Lelystad bovine tuberculin was slightly larger than with Weybridge (see table 1), but the difference was not statistically significant. There was no difference in the mean size of the avian response.

Table 1. Adjusted mean size of skin test response to Weybridge and Lelystad tuberculins ***

	Weybridge		Lelystad		P value
	Mean [mm]	95%CI	Mean [mm]	95% CI	for difference
Avian	2.82	2.75-2.88	2.82	2.75-2.89	0.971
Bovine	9.59	9.43-9.75	9.75	9.56-9.94	0.268
Bovine-avian difference	8.26	8.04-8.48	8.53	8.27-8.80	0.150

***From separate linear regression models fitted to the logarithm of the avian response+1, the logarithm of the bovine response+1 and the difference in the bovine and avian response. All models controlled for AHO, test type, herd type, test result, testing interval, month of test, herd size and clustering of animals by herd.

The possible effect of tuberculin batch on the size of the skin test response was examined in separate models for Weybridge and Lelystad tuberculins. No significant differences were observed (see Table 2).

Table 2. Test results for differences between batches in skin test response to avian or bovine tuberculin

	Weybridge		Lelystad	
	Avian	Bovine	Avian	Bovine
P value	0.880	0.088	0.915	0.638

Both models controlled for AHO, test type, herd type, test result, testing interval, month of test, herd size and clustering of animals by herd.

6.2 Proportion of reactors, inconcl usive reactors and direct contacts confirmed infected by visible lesion or culture

Given the difference observed in the bovine skin test reactions, we examined whether the association between confirmation of infection with M. bovis by visible lesion or culture in slaughtered animals and the skin test response (bovine - avian difference) differed between tuberculins. This was investigated in a logistic regression model controlling for AHO, testing interval, test type, month of test, herd type, herd size and clustering within herds that incorporated an interaction term between tuberculin type and skin test response. The interaction was highly significant ($p<0.001$), implying that the relation between confirmation and skin test response size differed between tuberculins.

Further analysis of the individual animal results showed that reactors and inconclusive reactors slaughtered according to bTB control criteria were more likely to be confirmed as infected with M. bovis if they had been detected using Lelystad tuberculin rather than Weybridge (see table 3). The magnitude of the difference in confirmation was greatest in animals slaughtered as reactors.

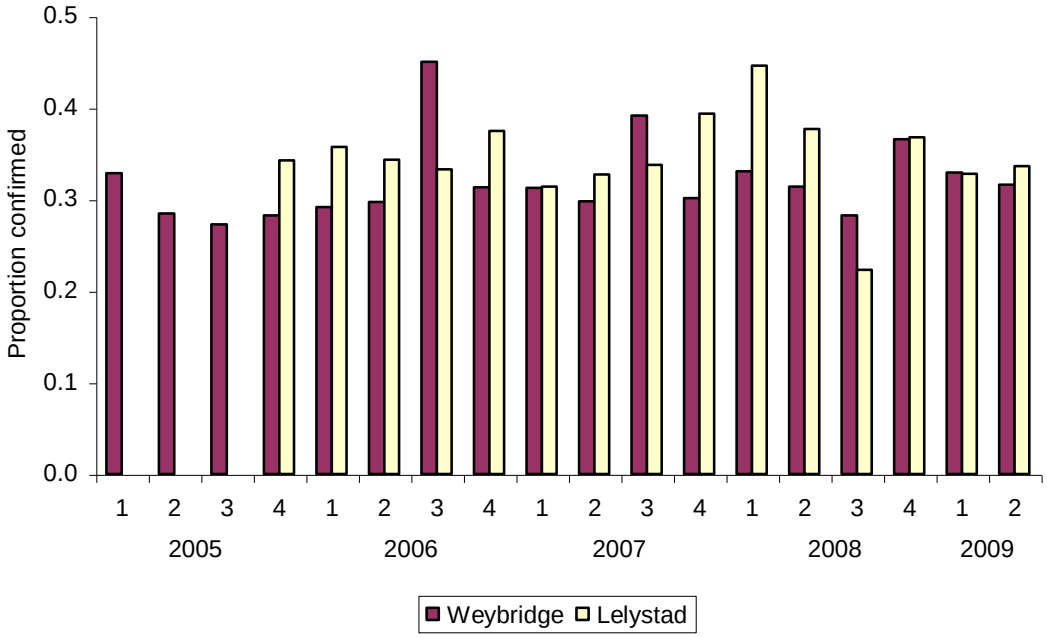
Table 3. Percentage of animals tested and slaughtered with bTB confirmed by visible lesion and/or culture

	Weybridge		Lelystad		p value for
	% conf.	95%CI	% conf.	95%CI	difference
All	31.8	30.4-33.2	35.4	33.8-37.0	<0.001
Reactors	35.3	33.8-36.8	39.2	37.6-40.8	<0.001
Inconclusive reactors	5.3	4.3-6.6	6.6	5.0-8.6	0.337
Direct contacts	12.1	10.3-14.0	12.2	10.0-14.8	0.958

From generalized linear models adjusting for AHO, test type, test result (in model for all), parish testing interval, herd type, month of test, herd size and clustering of animals by herd.

Figure 2 shows the quarterly adjusted overall confirmation proportions for animals tested with each tuberculin pair.

Figure 2. The overall confirmation proportions by tuberculin type and quarter



The differences between the probabilities of confirmation between tuberculins were reduced slightly if the regression models included a term adjusting for the bovine ±avian response. However, the probability of confirmation after having been tested with Lelystad tuberculin was still significantly higher than with Weybridge (35.2% versus 31.8%, p=0.001).

There was no evidence that either the avian or bovine tuberculin batch affected the proportion of animals confirmed as infected (see table 4).

Table 4. Test results for differences in proportion of animals with bTB co nfirmed by tuberculin batch

	Weybridge		Lelystad	
	Avian	Bovine	Avian	Bovine
P value	0.989	0.729	0.522	0.343

From separate generalized linear models for Weybridge and Lelystad tuberculin incorporating terms for different bovine and avian batches and adjusting for AHO, test type, test result, parish testing interval, herd type, month of test, herd size and clustering of animals by herd.

6.3 Confirmation by culture and tuberculin type

Tissue samples were sent for culture for M. bovis in 45% of reactors with visible lesions at post mortem and 56% of reactors without visible lesions. We were therefore able to examine whether the probability of confirmation by culture differed between tuberculins. In this selected sample the confirmation by culture tended to be slightly higher in reactors with and without visible

lesions that had been disclosed with Lelystad tuberculin compared to Weybridge (see table 5).

Table 5. Percent of reactors confirmed by culture of M.bovis

	VL		NVL	
	Weybridge % culture confirmed	Lelystad % culture confirmed	Weybridge % culture confirmed	Lelystad % culture confirmed
All	93	95	4	5
Annual testing	93	95	4	5
Bi-annual testing	93	95	3	4
3-4 yearly testing	87	93	3	3

Unadjusted data

6.4 Rate of disclosure of reactors an d inconclusive reactors

The rates of reactors and inconclusive reactors disclosed overall were slightly lower in herds tested with Lelystad tuberculin and for reactors the difference was statistically significant (see table 6). The difference in the disclosure of reactors in whole herd tests was not quite significant. However in an analysis confined to routine herd tests in non-endemic areas, the reactor disclosure rate with Weybridge tuberculin was 50% greater than that with Lelystad.

Table 6. Reacto rs and inconclusive reactors per 100,000 tests

	Weybridge		Lelystad		P value
	Rate	95%CI	Rate	95%CI	for difference
Reactors	265	251-279	231	220-243	<0.001
Inconclusive reactors slaughtered	11.2	9.8-12.8	10.1	8.8-11.4	0.069
Reactors in whole herd tests*	320	288-356	273	246-303	0.065
5 H D F W R U V L Q U R X W	18.1	13.3-24.7	12.3	9.1-16.4	0.021

From generalized linear models controlling for AHO, test type, parish testing interval, herd type, month of test, herd size and clustering of animals by herd. *in herds subject to annual testing ,in herds subject to 2,3 or 4 yearly testing intervals.

In order to examine batch differences, similar models were run separately for each tuberculin source (Weybridge or Lelystad) with the addition of terms for the avian and bovine batches used in the test. There were some statistically significant effects of batch as shown in Table 7 below, particularly for Lelystad.

Table 7. Test results for batch differences in risk of reactors and inconclusive reactors dis closed

	Weybridge p values		Lelystad p values	
	Avian	Bovine	Avian	Bovine
Reactors	0.619	0.011	<0.001	<0.001
Inconclusive reactors	0.085	0.014	<0.001	<0.001

6.5 Incidence rate of bovine tuberculosis breakdowns in herds

The breakdown incident rates were estimated from the herd tuberculin test results following periods when the herds were assumed to be at risk of infection. The time at risk was defined as the period between two consecutive tests when the herd was not under restriction, that is excluding the time between a breakdown and the formal lifting of restrictions (restoration of officially TB free status by issue of a TB10 notice) 7KH SHULRG DIWHU D KHU final recorded test was not counted. For herds not under restriction at the start of the study period, 1st January 2005, the time at risk was counted from this date. As a consequence of this definition, at the start of the study period the times at risk were underestimated and the incidence rates likely to be overestimated. Therefore, the results for incidence rate are presented from 2006 onwards when the estimated rates have stabilized.

The overall breakdown incidence rates and the confirmed breakdown rates were both slightly lower in herds tested with Lelystad tuberculins compared to herds tested with Weybridge tuberculins after controlling for confounders and other factors (see table 8). The difference in the confirmed breakdown incidence rates was small though statistically significant.

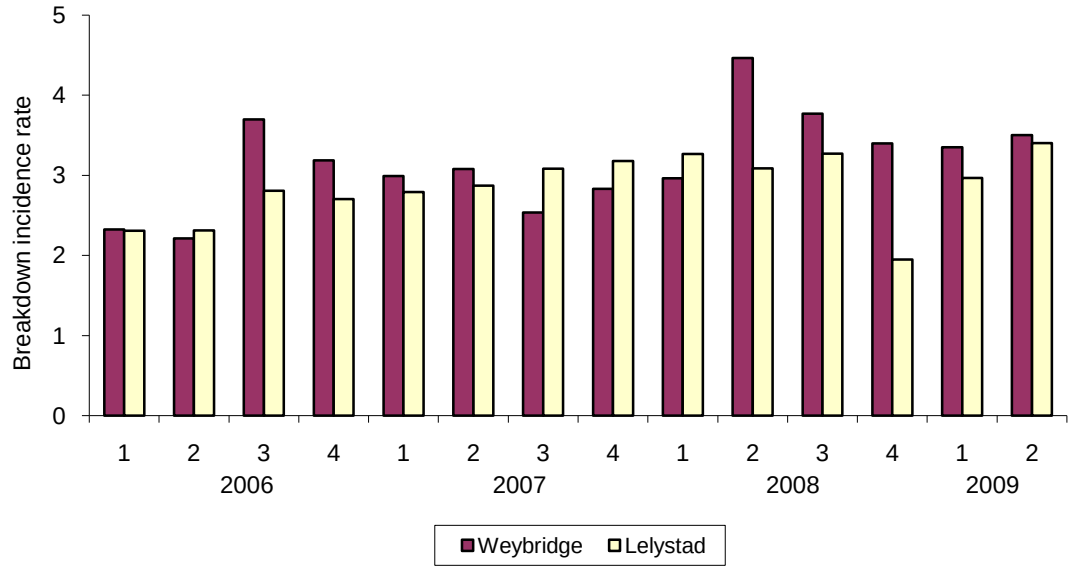
Table 8. Breakdown incidence rate per 100 herd years at risk by tuberculin type over a 42 month comparison period

	Weybridge		Lelystad		p value for
	rate	95%CI	rate	95%CI	difference
All breakdowns	3.4	3.2-3.5	2.9	2.8-3.0	<0.001
Confirmed breakdowns	1.7	1.6-1.8	1.6	1.5-1.7	0.017

From Poisson model for breakdown incidence controlling for AHO, test type, testing interval, month of test, herd size and clustering of animals by herd.

Figure 3 shows the quarterly adjusted incidence rate for all breakdowns by tuberculin type.

Figure 3. Breakdown incidence rate per 100 herd years at risk by quarter and tuberculin type



7.0 Discussion

The aim of this series of reports was to determine if the diagnostic performance of the SICCT using Lelystad and Weybridge tuberculins is similar. We cannot compare sensitivity and specificity because animals that do not react to the tuberculin test were not slaughtered and therefore we have no information on confirmation of M. bovis infection (by lesion or culture) in skin test negative animals. We can compare the positive predictive values of the tests, but comparisons of this parameter are likely to be confounded by differences in the underlying prevalence of bTB in each of the herds tested. We have attempted to adjust for differences in prevalence by controlling for factors related to prevalence and tuberculin distribution that are recorded on VetNet.

Individual skin test results are only available on animals that are slaughtered as part of bTB control (reactors, inconclusive reactors and direct contacts). So, comparisons of skin test size represent comparisons of population samples selected by the tuberculins themselves and little can be concluded from the observed differences between magnitude of the responses to Lelystad and Weybridge bovine tuberculin.

Overall, the percentage confirmation was 3.6 percent higher in animals tested with Lelystad tuberculin compared to Weybridge, implying that a skin test reaction to Lelystad tuberculin has a higher positive predictive value than a reaction to Weybridge. This could indicate that Lelystad is more specific i.e. that it is better able to exclude animals that are not infected. Another explanation is that SICCT performed using Weybridge tuberculin are more sensitive and detect more animals that are truly infected. These animals may not be confirmed as infected through post-mortem and culture because the reference tests themselves are not 100% sensitive in identifying infection.

Confirmation by culture in the samples from animals with no visible lesions was slightly higher for animals tested with Lelystad tuberculin compared to Weybridge (see table 5). However, tissue samples are sent for culture in less than 60% of reactors without visible lesions at post mortem. Furthermore the sampling strategy is non-random and proportionally fewer samples are sent from herds with large numbers of reactors. The problem with the sampling methodology limits interpretation of the results but they are not inconsistent with higher confirmation in animals disclosed as reactors with Lelystad tuberculin compared to Weybridge.

The unadjusted rates of disclosure of reactors and inconclusive reactors were higher than those described in the previous tuberculin report[1] but still showed a higher rate of reactors disclosed by Weybridge tuberculin compared to disclosure with Lelystad (table A2). However, in regression analyses controlling for confounders and clustering within herd, although disclosure rates were still lower with Lelystad, the differences in rates between the two tuberculins were much smaller.

[1] Released October 2007, for the period Jan 2005-March 2007

A difficulty with examining bTB surveillance data is the performance and results from one test may be dependent on the results from another (previous) test. Routine herd tests differ from other tests in that they are not conducted as part of the response to a breakdown and are usually performed in areas where bTB is not considered to be endemic i.e. outside areas subject to annual testing, and so should be more truly independent. When the data analysis was confined to animals tested as part of routine herd tests, the rate of disclosure for reactors was significantly lower for tests conducted with Lelystad tuberculin compared to Weybridge after adjustment for related factors (adjusted rate 18.1 versus 12.3 per 10^5 animals tested). This could indicate greater sensitivity associated with Weybridge tuberculin or lower specificity if the number of false positives represents a greater proportion of the Weybridge sample.

One simple interpretation of the differences observed is that the lower proportions of slaughtered animals confirmed infected with Weybridge tuberculin is a function of the higher disclosure rate of reactors. Under this scenario the net effect of the two tuberculins on disease transmission may be similar, that is providing that animals not confirmed infected by lesion or culture are truly uninfected and represent a false positive population.

Overall breakdown incidence rates were lower with Lelystad than Weybridge tuberculin after adjustment for confounding factors (3.4 versus 2.9 adjusted breakdowns per 100 herd years at risk) and there was a smaller though still significant difference in the incidence of confirmed breakdowns (1.7 versus 1.6 adjusted breakdowns per 100 herd years at risk). The absolute size of the differences in the incidence rates suggests that changes in distribution of the tuberculins are unlikely to have an important effect on long-term trends. However, we cannot rule out residual confounding which could conceal greater differences in SICCT performance between the tuberculins than observed.

Data has been subject to cleaning but has not been validated at source. We know for example that there is uncertainty in the outcome measure. Culture confirmation of infection with M. bovis is conducted in only about 50% of animals slaughtered as reactors, inconclusive reactors or direct contacts during routine surveillance. A detailed comparison of post-mortem findings and culture showed that in the region of 6% of animals with lesions will not have infection confirmed by culture (SE3013 final report). If the errors in data are random and unrelated to tuberculin type which seems likely for most variables, the effect will be to reduce precision of estimates and the power to detect statistically significant differences related to test sensitivity. However this is ameliorated somewhat by the very large sample sizes in most analyses.

8.0 Conclusions

The findings in the report are consistent with trends observed and described in earlier reports, but there are more statistically significant differences partly as a result of the greatly increased sample sizes. The overall incidence of breakdowns and the rate of disclosure of reactors were higher with the Weybridge tuberculin than with the Lelystad. By contrast, confirmation of infection by lesion or culture was higher in SICCT positive animals tested using Lelystad tuberculin. However, the differences were small and it is unlikely that any effects could be observed in overall trends in bTB surveillance data in the short-term.

We are unable to reach definitive conclusions since the sensitivity and specificity of the two tuberculins cannot be compared without data about the prevalence of infection in cattle that tested negative to the skin tests. An experimental study, in which SICCTs with different tuberculins are randomly allocated and that includes the assessment of infection in SICCT negative animals, could provide more robust conclusions.

Appendix

Table A1. Unadjusted incidence rate of all herd breakdowns (confirmed and unconfi rmed) per 100 herd years at risk by tuberculin type overall and by testing interval over a 42 month comparison period

	Weybridge			Lelystad		
	Breakdowns	Rate	95%CI	Breakdowns	Rate	95% CI
All	5347	5.8	5.6-5.9	7694	5.7	5.5-5.8
Annual testing	4282	14.4	14.0-14.9	6140	11.9	11.6-12.2
Bi-annual testing	677	4.7	4.4-5.1	1007	4.0	3.7-4.2
3 or 4 yearly testing	388	0.80	0.72-0.88	547	0.93	0.86-1.1

Breakdown is allocated to the tuberculin used at the test when the breakdown was first identified. The denominator is calculated as the sum of the times each herd was free from disease preceding a tuberculin test.

- The overall incidence of herd breakdowns is higher per herds at risk tested with Weybridge tuberculin compared to herds tested with Lelystad.

Table A2. Unadjusted rate of reactors per 100,000 animals tested by tuberculin type

	Weybridge		Lelystad	
	Rate	95%CI	Rate	95% CI
Overall	497	484-510	391	381-402
Annual testing	637	619-655	499	485-513
Bi-annual testing	301	275-326	188	170-205
3 or 4 yearly testing	93	82-104	89	77-101

The denominator is number of animals reported tested at each test conducted within a herd

- Incidence of reactors is higher per number of animals tested with Weybridge tuberculin compared to Lelystad although the difference is small in 4 yearly testing areas

Table A3. Unadjusted rate of inconclusive reactors* per 100,000 animals tested by tuberculin type

	Weybridge		Lelystad	
	Rate	95%CI	Rate	95% CI
Overall	26	25-28	21	20-23
Annual testing	30	28-32	24	22-25
Bi-annual testing	19	16-22	16	13-19
3 or 4 yearly testing	17	15-20	17	14-20

* Only includes inconclusive reactors that were slaughtered.
The denominator is number of animals reported tested at each test conducted in a herd

- Incidence of inconclusive reactors is higher per number of animals tested with Weybridge tuberculin compared to Lelystad

Table A4. Proportion of animals confirmed as infected by M.bovis by visible lesion and/or culture

Tuberculin type	All		Reactors		Inconclusive reactors		Direct contacts	
	n	% conf.	n	% conf.	n	% conf.	n	% conf.
Weybridge	70298	33.0	62712	35.4	3308	9.3	4278	12.8
Lelystad	58348	38.3	52023	41.2	2852	9.8	3473	14.2

- A slightly larger proportion reactors, direct contacts and inconclusive reactors tested with Lelystad tuberculin were confirmed as infected compared to Weybridge tuberculin

Table A5. Percent of reactors, inconclusive reactors and direct contacts confirmed by SICCT categories of bovine -avian response and tuberculin type

	2 mm or less		3 to 4 mm		5 to 8 mm		9 mm or more	
	n/N	%	n/N	%	n/N	%	n/N	%
Weybridge	1334/12057	11.8	2623/14667	18.2	5959/21451	28.1	12748/22123	58.5
Lelystad	1287/10036	13.9	2632/10872	24.7	5892/17401	34.3	11962/20041	60.7
P value for difference		<0.001		<0.001		<0.001		<0.001

- The probability for confirmation is higher in animals tested with Lelystad tuberculin compared to Weybridge over all categories of bovine- avian response.

Table A6 Distribution of tuberculin type by region

	Herd tests		Individual animal tests*	
	Weybridge n=198717 %	Lelystad n=232594 %	Weybridge n=12618314 %	Lelystad n=13289133 %
East	8.6	8.7	6.6	7.0
North	21.0	20.9	18.3	18.6
Scotland	6.5	4.8	5.1	3.8
Wales	21.6	24.5	20.3	23.1
West	42.2	41.2	49.7	47.6

*based on number reported to have been tested in a herd at each herd test

- A slightly larger proportion of herds and animals tested with Lelystad tuberculin have been tested in Wales compared to herds and animals tested with Weybridge.

Table A7. Distribution of tuberculin type by t est interval

	Herd tests		Individual animal tests*	
	Weybridge n=198717 %	Lelystad n=232594 %	Weybridge n=12618314 %	Lelystad n=13289133 %
1	56.6	58.1	68.5	70.0
2	19.3	21.6	15.1	15.8
3	0.5	0.3	0.4	0.2
4	23.6	20.0	16.0	13.9

*based on number reported to have been tested in a herd at each herd test

- A slightly larger proportion of herds and animals tested with Lelystad tuberculin have been tested in herds subject to bi-annual testing compared to with Weybridge

- A slightly larger proportion of herds and animals tested with Weybridge tuberculin have been tested in herds subject to four yearly testing compared to with Lelystad

Table A8. Distribution of tuberculin type by season

	Herd tests		Individual animal tests*	
	Weybridge n=198717 %	Lelystad n=232594 %	Weybridge n=12618314 %	Lelystad n=13289133 %
Winter	37.2	28.0	40.5	34.2
Spring	21.7	33.7	19.9	30.5
Summer	17.4	16.3	15.0	13.3
Autumn	23.7	22.0	24.5	22.0

*based on number reported to have been tested in a herd at each herd test

- During the comparison period proportionally more tests with Weybridge tuberculin were conducted in the Winter and the Summer compared to Lelystad
- Proportionally more tests were conducted with Lelystad tuberculin in Spring compared to Weybridge

Table A9. Distribution by test ty pe

	Herd tests		Individual animal tests*	
	Weybridge n=198717 %	Lelystad n=232594 %	Weybridge n=12618314 %	Lelystad n=13289133 %
Short interval test	13.6	11.3	34.4	32.7
Whole herd test	14.4	13.6	17.0	17.9
6 month test	4.3	4.0	9.8	9.9
12 month post 5 month test	2.8	2.4	5.9	5.6
Pre-movement test	19.9	30.0	3.8	6.3
Inconclusive retest	7.9	6.4	0.3	0.3
Contiguous test	2.6	2.4	4.6	4.4
Routine herd test	12.0	10.3	10.6	9.8
TR	9.2	7.6	0.5	0.5
2 W K H U W H V W ,	13.3	12.0	13.2	12.5

*based on number of animals U H S R U W H G W R K D Y H E H Q W H V W H G D W H D F K W H V W L Q W K H K H U G , 2 W K H U W H V W L Q

- A much greater proportion of Lelystad herd tests were pre-movement herd tests compared to Weybridge

Table A10. Distribution of tuberculi n type by herd characteristics

	Weybridge n=198717	Lelystad n=232594
Beef [%]	65.5	63.8
Dairy [%]	31.1	32.8
Herd size Median (IQR)	61 (12-166)	51 (10-154)

- The size of herds tested with Weybridge tuberculin is slightly greater than herds tested with Lelystad