A Case Control Study of Herds Which Fail the Tuberculin Test Six Months after being De-restricted for Tuberculosis

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Introduction

The six-month check (SMC) test, is the first full herd test carried out on a herd six months after it has been derestricted following a tuberculosis outbreak. If a herd has further reactor animals at the SMC, it is restricted again. If it passes the test, it reverts to annual surveillance testing. Over the period 1981 to 1990 , the risk of a herd having one or more tuberculin reactor animals at the SMC test has been approximately three times greater than that for a clear herd undergoing a routine surveillance test. Nationally in 1990, 10.0% of SMC tests on herds revealed reactor animals compared with 3.2% of surveillance tests. An understanding of the factors responsible for the high breakdown rate in recently de-restricted herds is required if more successful strategies for reducing tuberculosis levels are to be defined. The objective of the case-control study reported here was to determine factors associated with herds failing the SMC test in Counties Laois, Tipperary North and Wexford in 1990.

Selection of case and control herds.

Herds in the study were selected from those herds which had a SMC test in 1990 in Tipperary North, and from a Veterinary Inspector (V.I.) area in Counties Laois and Wexford. A herd was defined as a case if it had at least one animal deemed reactor at the SMC test. A herd was considered a control if there were no reactor animals at the SMC tst. The number of control herds selected was equal to the number of case herds in each area. The control group in each area was selected by systematic sampling of all herds in the area that passed their SMC test in 1990.

Data collection

A standardised questionnaire was used by the seven Veterinary Inspectors who collected data for the study. Information was obtained on the following factors:

Enterprise type
Herd size
Severity of tuberculosis breakdown prior to the SMC test
Timing of SMC in relation to season
Location of herd relative to area of high prevalence (Black Spot)
Contiguity to a herd restricted between clearance and SMC
Buying in animals between clearance and SMC tests
Animals with bovine reaction >2mm remaining in herd over the restriction period
Grazing animals on pasture within two months of slurry being spread which had been stored for less than two months
Suitability of houses for disinfection
Presence of badgers on farm.

Statistical Analysis

Data were analyzed in two stages. Firstly, the association between possible risk factors and failing the SMC test was examined for each factor individually using the statistical software package, Epi Info (Dean, Dean, Burton and Dicker, 1990). Unadjusted odds ratios were determined for categorical risk factors and tested for statistical significance using the chi-square test. Means for non-categorical risk factors were calculated and tested for significance using Student's t-test or Kruskal-Wallis test.

In the second stage, unconditional multiple logistic regression analysis was used to evaluate the relationship between significant risk factors and failing the SMC test while simultaneously controlling for possible confounding factors or interactions between factors (Schlesselman, 1982). The statistical software package, Egret, was used for the analysis (Statistics and Epidemiology Research Corporation,1991).

Results

The study population, which was divided equally between cases and controls, consisted of 154 herds from Co. Tipperary North, 48 herds from Co. Laois and 34 herds from Co. Wexford. Of the 236 farms in the study, 133 farms had a dairy enterprise; 112 farms, a beef enterprise; 149 farms, a store enterprise; and 98 farms, a suckler enterprise. Over 80% of farms had more than one enterprise type.

Bivariate analysis

The unadjusted odds ratios of failing the SMC test for statistically significant categorical risk factors are shown in Table 1. Means of non-categorical risk factors for cases and control herds are summarised in Table 2.

Table 1. Unadjusted odds ratios of categorical risk factors.

Risk Factors	Cases	Controls	Odds of Failure
Beef Enterprise	58.5%	36.4%	2.46***
Contiguous to rest. herd	83.0%	71.2%	1.98*
Bought in animals	65.2%	47.4%	2.08**
Std/Severe Inc retained	71.2%	57.6%	1.82*
Exposure to fresh slurry	21.2%	5.1%	5.02***

Results of chi-square test:
*p<0.05; **p<0.01; ***p<0.001.

Table 2. Summary of non-categorical risk factors.

Risk Factors	Cases Mean ± SE	Controls Mean ± SE
Herd Size	114.7+- 81.7	86.0+- 61.3*
Weeks between clearance-SMC	29.0+- 6.3	28.7+- 5.9
Prevalence of reactors/restr	4.7+- 8.9	3.4+- 3.4
Duration of restriction	26.0+- 14.3	24.0+- 9.6

Probability value for t test: *p<0.01

Herds which failed the SMC test were significantly larger than herds which passed the test. Farms with a beef enterprise were 2.46 times more likely to fail the SMC than farms without a beef enterprise. These factors are probably related because in this study beef herds were also the larger herds.

There was a significant difference between case and control herds in the mean number of reactor animals per herd disclosed over the restriction period prior to the SMC test (3.9 reactors vs 2.3 reactors). However, when reactor numbers were adjusted for herd size, there was no significant difference in the prevalence of reactor animals over the restriction period between case and control herds. A herd in which at least one animal with a lesion was disclosed over the restriction period was no more likely to fail the SMC test than a herd in which no animals with lesions were disclosed.

Over 75% of all herds in the study were contiguous to a restricted herd at some time between their clearance test and the SMC test. Herds failing the SMC test were twice as likely to be contiguous to another restricted herd than herds passing the test (P=0.03). An important fact identified by the study was the absence of any significant association between a herd being located in a "Black Spot" area and its failing the SMC test. Time and space relationships are significant at the level of the herd and are less so at the wider area level.

Of the study population 56% of herds had one or more animals bought in between the clearance test and the SMC test. Herds with bought-in stock were twice as likely to fail the SMC as herds which

did not (P=0.006). In 36 (27%) of the 133 herds which bought in animals, a bought-in animal was recorded as a reactor animal at the SMC test.

There were 152 (64%) herds in the study from which animals with standard and/or severe inconclusive readings to the SICT test were not removed over the restriction period. Such herds were almost twice as likely to fail the SMC than herds without such animals (P=0.03). The retained inconclusive was deemed reactor at the SMC in 24 (16%) of the 152 herds in which they occurred.

Between the clearance test and SMC test 31 (13%) herds in the study population had animals graze pasture within two months of slurry being spread on it which had been stored for less than two months. Though representing a minority of herds, those engaged in this practice were five times more likely to fail the SMC than herds not so exposed (P=0.001).

Approximately 60% of all farms in the study were reported as having badgers present on farm in 1990. There was no association between presence of badgers on the farm and failing the SMC test.

Multivariate Analysis

Using multiple logistic regression analysis, logistic regression coefficients and their associated standard errors were obtained from the fitted model and were used to calculate adjusted odds ratios with 95% confidence intervals for the risk factors associated with failing the SMC test (Table 3.).

Table 3. Adjusted odds ratios with 95% confidence intervals of risk factors for herds which failed the SMC compared with herds which passed the test.

Risk Factors	Adjusted Odds of Failure	95% Confidence Interval
Exposure to slurry stored <2mths.	7.66	(2.72, 21.59)
Beef Enterprise	2.38	(1.34, 4.25)
Bought in animals	2.00	(1.12, 3.59)
SICT test inconclusive animal in herd	1.97	(1.09, 3.56)

For herds which were comparable on all factors in the model except exposure to slurry stored less than two months, the relative odds of failing the SMC test associated with exposure to slurry was 7.66. Put another way, after adjusting for all other variables in the study, herds which failed the SMC test were 7.66 times (95% Confidence between 2.72 and 21.59 times) more likely to have been exposed to slurry stored less than two months and spread less than two months than herds which passed the test. A similar explanation is in order for the remaining risk factors detailed in Table 3.

The logistic regression model can be reformulated to provide the odds of failing the SMC test given the presence of each risk factor (Schlesselman, 1982). Table 4 lists the probabilities of failing the SMC test given the presence of each risk factor alone.

Table 4. Probabilities of failing SMC given a single risk factor being present.

Risk Factor	Probability of failing SMC
Slurry exposure	0.0823
Beef enterprise	0.0272
Buying cattle	0.0229
Inconclusive remaining	0.0226

Conclusions

1. The findings of this study support previous findings of the possibility of cattle becoming infected with *Mycobacterium bovis* from the faeces of tuberculous cattle. The fact that 87% of herds in the study did not graze cattle on ground which received a recent application of slurry stored < 2 months is some evidence to suggest that advice about slurry handling is being acted on.

2. The results support findings of other investigations in relation to the importance of cattle purchase, clustering effect of breakdowns (contiguous association), removing SICT inconclusives and herd size as factors influencing a herd's chances of failing the SMC test.

3. The results of the study indicate that herds in "Black Spot" areas are no more likely to fail their SMC test than herds in any other area. That is, "Black Spots", as defined at the time of the study, appear not to be a significant risk factor. Consequently the use of a herd's location in a "Black Spot" as a means of predicting a higher risk of herd breakdown requires to be reviewed.

4. The lack of any association between the likelihood of a herd failing the SMC test and the presence of badgers on the farm needs careful appraisal. Presence of badgers on the farm was used as a proxy variable for presence of tuberculous badgers on the farm, the latter information being unobtainable. As only a small proportion of badgers are infected with *M. bovis* (Dolan and Lynch, 1992), the insensitivity of the proxy variable may have reduced any association between badgers and failing the SMC test, were one present.

References.

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