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**Risk factors for detection of recurrent
bovine tuberculosis in New Zealand
cattle and deer herds 2005-2011**

A thesis presented
in partial fulfillment of the requirements
for the Degree of Master of Veterinary Studies (Epidemiology)
at Massey University

Kara Dawson

2014

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Abstract

In New Zealand, under the national bTB eradication strategy, bovine tuberculosis (bTB) has had a sustained decrease in prevalence since its peak in 1994 at 1700 infected herds. With the success of control measures, recurrence of infection in cattle and deer herds that have previously tested to a clear status is a problem that has recently become more apparent. Uncontrolled movement of cattle and deer from these herds pose a risk to the bTB eradication strategy.

A retrospective cohort study was conducted to identify herd-level risk factors for bTB recurrence. Data were collected from 356 New Zealand cattle and deer herds that met the following criteria: (1) a culture positive case of bTB had been identified on or after 1 June 2006 (the index bTB episode), (2) the herd status had been cleared by testing that was completed by 1 November 2010, and (3) the clear status was not achieved by destocking. The outcome of interest for this study was defined as detection of a subsequent bTB episode before the end date of the study, 5 May 2011, by routine tuberculin testing or by slaughter surveillance. Herds were censored if no further bTB

episode occurred by 5 May 2011. A Cox proportional hazards model was developed to quantify the magnitude of a series of herd-level risk factors on the daily hazard of bTB recurrence. Disease control area was included in the model as a fixed effect to account for confounding.

There was a positive relationship between the daily hazard of recurrence and: (a) the number of bTB episodes in a herd prior to the first episode (HR [hazard ratio] 3.2 for two prior episodes, 95 % CI 1.2-8.5; HR 86.7 for five prior episodes, 95 % CI 13.8-580), (b) the presence of more than one bTB positive animal at the index bTB episode (HR 2.3: 95 % CI 1.2-4.3) and (c) the presence of one or more cleared test-positives at the final clearance test at the index episode. The proportional hazards assumption was violated for the latter variable so a time dependent covariate was introduced into the model to account for the variable effect of the presence of cleared test-positives at the final clearance test over time. The monthly hazard of recurrence during the first two years after clearance was significantly increased in herds with one or more test-positive animals at the final test (HR 2.8: 95 % CI 1.2-6.4), but this association was no longer significant more than two years after clearance (HR 1.5: 95 % CI 0.6-3.6).

We conclude that the presence of unresolved infection in a herd is a contributor to further bTB episodes in the first two years after clearance. TBfree New Zealand is reviewing policies to increase the sensitivity of detecting residual infection before clearance and to intensify post clearance testing and movement tracking in herds with risk factors.

Acknowledgements

This project came about through a series of observations made by my colleague Dr Jane Sinclair in her course of work as a District Disease Control Manager for the Animal Health Board. We decided to test the hypotheses that arose from these observations, and I am deeply indebted to Jane for her insights, disease management training and support of the project in every way, including hours of assistance with data collection and in discussing the significance and implications of the results.

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I hope that the findings of this project will help to inform disease management policy and practice, and build on the excellent progress being made by TBfree New Zealand in eradicating bovine tuberculosis from New Zealand.

Table of Contents

Abstract.....	iv
Acknowledgements.....	vi
Table of Contents.....	viii
Nomenclature.....	i
List of Publications.....	ii
List of Figures.....	iii
List of Tables.....	v
Introduction.....	1
Literature Review.....	5
2.1 Routine bTB surveillance in New Zealand.....	5
2.1.1 Skin tuberculin testing.....	6
2.1.2 Routine slaughter surveillance.....	7
2.2 Ancillary testing.....	8
2.2.1 Gamma interferon (γ -IFN) assay.....	8
2.2.2 Reactor post mortem.....	10
2.2.3 Culture of pooled lymph nodes.....	11
2.3 Factors influencing bTB persistence.....	12
2.3.1 Test factors.....	12
2.3.2 Animal factors.....	14
2.3.3 Herd level factors.....	15
2.3.4 Agent factors.....	18
2.3.5 Environmental factors.....	21
2.3.6 Epidemiological studies on recurrence of bTB infection.....	23
Materials and Methods.....	26
Results.....	32
4.1 Exploratory data analysis.....	32
4.1.1 Continuous variables.....	32
4.1.2 Herd level categorical variables.....	39

4.1.3 Episode-specific and disease management categorical variables.....	42
4.2 Univariable survival modelling.....	45
4.2.1 Cox models.....	45
4.2.2 Kaplan-Meier analysis.....	51
4.3 Cox proportional hazards modelling.....	57
4.4 Model fit and diagnostics.....	62
4.4.1 Model fit.....	62
4.4.2 Model diagnostics.....	64
Discussion.....	65
Methodological issues.....	68
Conclusions.....	72
Appendix.....	74
References.....	75

Nomenclature

AIC	Akaike's Information Criterion
bTB	Bovine tuberculosis, caused by <i>Mycobacterium bovis</i>
DCA	Disease Control Area
γ -IFN	Bovine gamma interferon testing of whole blood for reactivity to tuberculin
HR	Hazard ratio
NVL	No visible lesions of bovine tuberculosis at slaughter inspection
VFA	Vector Free Area: geographic region of New Zealand where bTB is not known to exist in the wildlife
VRA	Vector Risk Area: geographic region of New Zealand where bTB is known to exist in the wildlife

List of Publications

Dawson, KL., Bell A., Kawakami RP., Coley K., Yates G., Collins DM. (2012)

Transmission of *Mycobacterium orygis* (*M. tuberculosis* complex species) from a tuberculosis patient to a dairy cow in New Zealand. *Journal of Clinical Microbiology* 50(9):3136-8

Dawson, KL., Stevenson, MA., Sinclair, J., Bosson, M. (2014) Recurrent bovine

tuberculosis in New Zealand cattle and deer herds. *Epidemiology and Infection*, doi:10.1017/S0950268814000910.

List of Figures

Figure 1: Bar chart showing numbers of cattle and deer herds classified as bTB infected from 1985 to 2012 (Source: Animal Health Board, New Zealand 2012).	4
Figure 2: Scatterplot of herd size vs proportion of herd with bTB lesions for 356 New Zealand cattle and deer herds infected with bTB between 2005 and 2011.	35
Figure 3: Box-and-whisker plot of herd size category vs proportion of herd with bTB lesions for 356 New Zealand cattle and deer herds infected with bTB between 2005 and 2011.	36
Figure 4: Geographical representation of the four Disease Control Areas.	37
Figure 5: Barplot of number of bTB episodes in the herd history prior to the study period for 356 New Zealand cattle and deer herds.	38
Figure 6: Herd type composition of the dataset, compared with the national herd (data held by OSPRI New Zealand).....	40
Figure 7: Kaplan-Meier survival curve with 95% confidence intervals: time to detection of a subsequent bTB episode for 356 New Zealand cattle and deer herds that had experienced one episode in the study period.....	52
Figure 8: Kaplan-Meier survival curve: time to detection of a subsequent bTB episode for 356 New Zealand cattle and deer herds that had experienced one episode in the study period, stratified by Disease Control Area.	53
Figure 9: Kaplan-Meier survival curve: time to detection of a subsequent bTB episode for 356 New Zealand cattle and deer herds that had experienced one episode in the study period, stratified by single vs. multiple animal bTB episodes.....	54
Figure 10: Kaplan-Meier survival curve: time to detection of a subsequent bTB episode for 356 New Zealand cattle and deer herds that had experienced one episode in the study period, stratified by number of bTB episodes prior to the index study episode.	55
Figure 11: Kaplan-Meier survival curve: time to detection of a subsequent bTB episode for 356 New Zealand cattle and deer herds that had experienced one episode in the study period, stratified by whether or not a test-positive animal or animals were found at the final clearance test.....	56

Figure 12: Plot of scaled Schoenfeld residuals vs. time for the variable level “rxyn1” (the presence of test-positive animals at a final clearance test), showing evidence of violation of the assumption of proportional hazards.	59
Figure 13: Plots of scaled Schoenfeld residuals vs time for the time dependent covariates in the final model. a = test-positive animals identified at final clearance test; ≤ 730 days at risk. b = test-positive animals identified at final clearance test; > 730 days at risk. Compare with Figure 12.	60
Figure 14: Plot of estimated cumulative hazard function <i>versus</i> Cox-Snell residuals, showing closeness of overall fit of model predictions.	63
Figure 15: Disease management decision making processes for final clearance testing in use at the time of the study.	74

List of Tables

Table 1: Variables available for a survival analysis of recurrent bTB episodes in cattle and deer herds in New Zealand detected with infection after 1 June 2006 and cleared before 1 November 2010.....	29
Table 2: Descriptive statistics for non-normally distributed continuous variables for 356 New Zealand cattle and deer herds.	34
Table 3: Descriptive statistics for herd level categorical variables for 356 New Zealand cattle and deer herds which had experienced one episode of bTB in the study period....	41
Table 4: Descriptive statistics for episode-specific and disease management categorical variables for 356 New Zealand cattle and deer herds which had experienced one episode of bTB in the study period.	44
Table 5: Univariable association between time to detection of a subsequent bTB episode and independent herd level variables for 356 New Zealand cattle and deer herds detected with TB infection after 1 June 2006 and cleared before 1 November 2010.	46
Table 6: Outputs of univariable Cox models for episode specific variables.....	47
Table 7: Outputs of univariable Cox models for disease management variables.	50
Table 8: Output of the final multivariable Cox proportional hazards regression model of factors associated with bTB recurrence interval. Data from 356 New Zealand cattle and deer herds that experienced a bTB episode (the index episode) after 1 June 2006 and had been cleared by 1 November 2010.	61