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Husbandry practices, badger sett density and habitat composition as risk factors for transient and persistent bovine tuberculosis on UK cattle farms

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Abstract

Bovine tuberculosis (bTB) is a persistent problem in cattle herds in Great Britain and Ireland. Farm management and cattle husbandry practices can influence the risk of transmission of bTB and hence the likelihood of bTB breakdown ($\geq$1 reactor to the tuberculin skin test). Biological differences are expected in the transmission dynamics, and hence risk factors for bTB breakdown, on farms where infection persists in the herd compared to farms where infection is more sporadic or short-lived.

Comparative case–control studies were performed to test farm management practices as potential risk factors for transient (under breakdown restrictions for $\leq$6 months) and persistent (under breakdown restrictions for >6 months) bTB breakdown over 5 years (1995–1999) on 179 and 171 UK cattle farms, respectively. Farms were characterised for badger sett density and farm habitat composition by ground survey, farmers were questioned retrospectively on management practices, and cases and controls were identified from national tuberculin test records.

Controlling for routine tuberculin testing interval, log-transformed herd size, regional location, badger sett density and farm habitat complexity, multivariable logistic regression identified increased odds of both transient and persistent breakdown on farms that bought-in cows (odds ratio (OR) $\geq$ 4.9; 95% confidence interval (CI) $\geq$ 1.1;22.8). In addition, the purchase of >50 head of cattle (OR = 4.0, 95% CI = 1.0;16.0) and the storage of manure for $\geq$6 months (OR = 4.4; 95% CI = 1.3;15.4) were risk factors for transient breakdown, whereas the use of silage clamps (OR = 9.1; 95% CI = 2.0;40.8)

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increased the risk of persistent breakdown. Decreased odds of both transient and persistent breakdown were associated with higher stocking densities (>3 cattle/ha) (OR $\leq$ 0.2; 95% CI $\leq$ 0.1;0.9), and running mixed herd enterprises compared to only beef or dairy (OR = 0.1; 95% CI = 0.0;0.7) was an additional protective factor against persistent breakdown. In these analyses, the covariates log herd size and tuberculin testing interval were significant predictors of both transient and persistent breakdown, whereas active badger sett density and regional location only affected the risk of persistent breakdown.

The collective results suggest that the probability of transient breakdown is most strongly influenced by the purchase of cattle over other management variables and covariates, whereas the probability of persistent breakdown appears to be mostly affected by management factors relating to type of herd enterprise and silage storage in addition to the relative density of badgers. Implications for bTB management are discussed.

Keywords: Bovine tuberculosis; *Mycobacterium bovis*; Case–control study; Risk factor; Epidemiology; Cattle; Farm management; Badger

1. Introduction

Bovine tuberculosis (bTB) is a persistent economic and veterinary problem in cattle herds in the UK despite the policy of cattle herd testing and slaughter (Defra, 2005a). Badgers (*Meles meles*) are implicated as an important wildlife reservoir and an obstacle to reducing bTB incidence (Krebs et al., 1997; Donnelly et al., 2005; Griffin et al., 2005; Woodroffe et al., 2006). There is general consensus that cattle husbandry and farm management practices also contribute to heightened risk of herd breakdown ($\geq$1 animal reacting to the tuberculin skin test) (Krebs et al., 1997; Phillips et al., 2000, 2003; Johnston et al., 2005). The perceived risks relate to (i) environmental biosecurity including farm waste management and foodstuff storage (Scanlon and Quinn, 2000; Garnett et al., 2002), (ii) contact between cattle and badgers or their excreta at pasture (White et al., 1993; Hutchings and Harris, 1997; Courtenay et al., 2006), (iii) herd characteristics such as herd size, farm enterprise and animal movements (Griffin et al., 1996; Marangon et al., 1998; Green and Cornell, 2005; Johnston et al., 2005; Gilbert et al., 2005; Carrique-Mas et al., 2005; Gopal et al., 2006), and (iv) animal management including stocking densities, feeding and grazing regimes (Benham and Broom, 1989; Scantelbury et al., 2004). Preventive husbandry measures aimed to reduce some of these associated risks are advised (Phillips et al., 2000).

In the UK, routine ''whole-herd'' tuberculin skin tests are performed at intervals of 1, 2, 3 or 4 years depending on bTB incidence within the parish. Upon the discovery of a skin test reactor, the animal is culled and infection classified as confirmed on detection of visible lesions at post-mortem and/or *Mycobacterium bovis* growth in cultures of lymph node material (Corner, 1994). The remaining herd is placed under movement restriction until one (if the breakdown is unconfirmed) or two consecutive (if the breakdown is confirmed) ''whole-herd'' 60-day tuberculin skin tests prove negative. Additional reactors disclosed at follow-up 60-day check tests result in delays of months to years in lifting movement restrictions, with clear consequences to farm production.