Preventive Veterinary Medicine 109 (2013) 246–257

Contents lists available at SciVerse ScienceDirect

Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

The impact of animal introductions during herd restrictions on future herd-level bovine tuberculosis risk

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ARTICLE INFO

Article history:
Received 23 February 2012
Received in revised form 10 October 2012
Accepted 14 October 2012

Keywords:
Mycobacterium bovis
Tuberculosis
Animal movement
Ireland

ABSTRACT

In Ireland new cases of bovine tuberculosis (bTB) are detected using both field (with the single intradermal comparative tuberculin test (SICTT)) and abattoir surveillance. Once a new case has been detected, herd restrictions, including restrictions on animal movements into and out of the herd, are implemented until the herd has passed two consecutive clear tests. While a herd is restricted, there may be several reasons why it may be desirable to introduce new stock, such as enabling routine management practices to continue 'as near to normal'. In Ireland, introduction of animals during a bTB episode is permitted under specific conditions, with permission from the local veterinary office.

The objectives of this study were (1) to provide an overview of movement events associated with each bTB episode, (2) to determine whether introduction of animals during a bTB episode is associated with increased future bTB risk and (3) to identify the practices relating to the introduction of animals that are the most risky.

All herds that were not restricted at the start of 2006, but experienced a bTB episode during 2006 with 2 or more SICTT standard reactors (the eligible bTB episode) were included in the study. We calculated the number of extended eligible bTB episodes and subsequent bTB episodes that could be directly attributed to introduced animals. The main outcome of interest was the time from de-restriction of the eligible bTB episode to the start of a subsequent bTB episode or the date of the last test prior to the end of the study (31 December 2010). Cox proportional-hazard models were developed, each using a different introduction variable: introduced animals during an episode (yes/no), introduced animals prior to the first retest/first clear test, time from start of episode until first animals introduced and number of animals introduced during the episode.

Only a small proportion of subsequent bTB episodes (1.8%) or extended eligible bTB episodes (2.7%) could be directly attributed to introduced animals. The results highlight an increased risk of a subsequent bTB episode among only a subset of herds that introduced animals during the eligible bTB episode. Specifically, herds that introduced animals early during the eligible bTB episode were at significantly greater future bTB risk than herds where animals were only introduced later. To illustrate, herds that introduced animals after the first retest did not have a significantly different risk compared to herds that did not introduce animals at all. In contrast, herds that did introduce animals prior to the first retest had 1.5 times higher risk of a subsequent bTB episode. Future practices concerning the introduction of animals during an episode now need to be reviewed.

1. Introduction

In Ireland, the national programme to control bovine tuberculosis (bTB) began in 1954. After initial success, the

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http://dx.doi.org/10.1016/j.prevetmed.2012.10.005

number of reactors in Ireland remained at a constant level of between 30,000 and 50,000 annually, before falling more recently to below 30,000 since 2002 and below 20,000 reactors in 2011. Every herd i.e. a distinct epidemiological unit, is tested at least annually using the single intradermal comparative tuberculin test (SICTT) and herds with one or more reactor animals are classified as bTB positive. Herds may also be classified as bTB positive following the discovery of a confirmed tuberculous lesion in an attested animal at slaughter (More and Good, 2006). Once a new case has been detected, herd restrictions, including restriction on animal movements into and out of the herd, are implemented until the herd has passed two consecutive clear SICTT tests (retests where no reactors were detected) at least 42-days apart, the second being at least 4-months after the last reactor left the herd. The protocol for the management of *Mycobacterium bovis* infected herds is described in the 'Veterinary handbook for herd management in the bovine TB eradication programme' (Good et al., 2010) and meets the terms of EU Directive 64/432/EEC and the Bovine Tuberculosis Order 1989–2007.

In Ireland, introduction of animals during a bTB episode (the time period when movement restrictions are imposed on the herd) is permitted under specific conditions. There may be several reasons why the introduction of new stock may be desirable, such as replacing animals that were lost as a result of bTB, moving point-of-calving heifers from a rearing herd to a herd where milking facilities are available, and enabling routine management practices to continue 'as near to normal' despite the bTB restrictions imposed. Generally animals may not be moved into a restricted herd unless the herd owner has permission from the local veterinary office.

The bTB eradication programme in Ireland is informed and underpinned by science, with scientific findings and analysis contributing to a broad range of areas, including management of infected herds. In view of the implications for farm income of restricting the movement of animals into a restricted herd and the absence of research on the risks posed by the introduction of animals during a bTB episode, it is appropriate that the nature and extent of the risk be examined. Several questions are relevant: Is this a risky practice? Should this practice continue? Are there times during a bTB episode when introducing animals is a more/or less risky practice? Would it be prudent to impose certain risk management measures, prior to the movement of animals into a restricted herd? Therefore, the objectives of this study were:

Objective 1:

- To provide an overview of events associated with each bTB episode, during which new animals were introduced into the herd, and
- To clarify the infection status of animals that were introduced during bTB episodes.

Objective 2:

- To determine whether introducing animals during a bTB episode was associated with increased future herd-level bTB risk.

Objective 3: (on the proviso that there is evidence [from objective 2] of an increased bTB risk):

- To identify the practices relating to the introduction of animals that increase future bTB risk and to determine whether the increased risk is associated with the source or herd into which the animals had been introduced.

2. Materials and methods

2.1. Background information

2.1.1. The study population

All Irish herds that were not restricted at the start of 2006 but experienced a bTB episode during 2006 with 2 or more SICTT standard reactors were considered for inclusion in the study. An animal with an increase in skin thickness at the bovine site more than 4 mm greater than the increase at the avian site is classed as a standard reactor. Total reactors include standard reactors and any other animal deemed a reactor based on ancillary testing, epidemiological grounds or a more severe interpretation of the SICTT. A bTB episode commences with a bTB 'breakdown' event, associated with bTB detection (detected during either field or abattoir surveillance), and encompasses the subsequent period of trading restriction. The herd becomes 'de-restricted' (trading restrictions are lifted) following two consecutive clear tests at least 42-days apart, the second being at least 4-months after the last reactor has left the herd. If a herd had more than one bTB episode in 2006, only the first was considered eligible in this study. We excluded all known and suspected dealer/feedlot herds, including:

- herds with a herd size outside of the 10–90% herd size distribution for all eligible bTB episodes in the study. Herd size was taken as the mean herd size during the episode,
- herds that sent >200 animals to slaughter in 2006, and
- herds identified on the Animal Health Computer System (AHCS) as agents, dealers or feedlots.

In summary, we observed a single 'eligible bTB episode' for each enrolled study herd.

2.1.2. Period and unit of interest

The herd was the epidemiological unit of interest. Each study herd was observed throughout the study period, from the start of the eligible bTB episode in 2006 until the end of 2010.

2.1.3. Defining introduction status

For all eligible bTB episodes, 'introduction status' was defined as:

1 = if cattle were introduced into the herd during the eligible bTB episode (that is, there was an introduction of one or more animals – excluding calves aged <42 days when introduced – from another herd during the eligible bTB episode), or
0 = if no cattle were introduced into the herd (except calves aged <42 days) during the eligible bTB episode.