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Patterns of calving and young stock movement in Ireland and their implications for BVD serosurveillance

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ABSTRACT

The Republic of Ireland has a national eradication programme for bovine viral diarrhoea virus (BVDv) based on tissue-tag testing of calves to identify persistently infected animals (PIs). It has been proposed that serological testing of a sample of home-bred young stock would be a more cost effective surveillance mechanism than continued tissue-tag testing in herds which have previously been found to be BVD-free. These animals would have to be at least 6 months of age to avoid interference from maternal antibodies in test results. To examine the potential practicality of this system, we identified birth profiles and movements of calves born in Ireland during 2014 and 2015. We found that birth profiles for both beef and dairy animals were more evenly distributed throughout the year than often assumed, which should be borne in mind when evaluating the suitability of a single round of serological testing in the autumn for every herd. A large amount of movement was identified, with approximately 43% of calves experiencing a move before they reached 10 months of age, including moves to another Irish herd, to a knackery, to export, or to slaughter. Approximately 19% of calves had moved to other breeding herds in Ireland within this period. There were distinct patterns according to movement type, month of birth and herd type. The majority of herds moved either all or none of their calves in the first 10 months of life. These results indicate that young stock serological testing is unlikely to be an appropriate surveillance mechanism for all BVDv-free herds, as (i) many herds would not be able to supply a large enough sample of suitably aged home-bred young stock at a single point in time and (ii) PIs which would have been picked up by tissue-tag testing soon after birth would have moved from their home herd, to infect other herds, before serological testing could be conducted.

1. Introduction

Bovine viral diarrhoea virus (BVDv) is an economically important viral pathogen that is endemic in most countries in the absence of systematic control (Lindberg and Houe, 2005; Lindberg et al., 2006). Losses occur primarily through reduced reproductive performance and increased morbidity and mortality, particularly in calves as a result of immunosuppression and secondary infections (Stott et al., 2010; Barrett et al., 2011). The role of cattle that are persistently infected (PI) with BVDv, as a result of in utero infection between approximately 30 and 120 days of gestation, in maintaining and spreading infection is well recognised (Lanyon et al., 2013). Identification and removal of PI animals is therefore a central element of control at herd, regional and national levels, coupled with biosecurity and surveillance (Lindberg et al., 2006). Using this approach, a number of European countries have either completed, or are currently undertaking, national eradication programmes, including Norway, Sweden, Finland, Denmark, Austria, Germany, Scotland, Belgium and Ireland (Rossmanith et al., 2010; Presi et al., 2011; Ståhl and Alenius, 2012; Graham et al., 2014; Laureyns, 2014; Nagy et al., 2014; Norström et al., 2014).

In the Republic of Ireland (henceforth referred to as 'Ireland'), the eradication programme began with a voluntary year in 2012 (Graham et al., 2014) before proceeding to a compulsory national programme supported by legislation (Anon, 2012, 2014), on 1st January, 2013. All decisions regarding the programme are taken by a BVD Implementation Group (BVDIG) drawn from across the industry and chaired by Animal Health Ireland (AHI; www.animalhealthireland.ie). Scientific advice is provided to the BVDIG by a technical working group (TWG) convened by AHI.

Taking into account a range of considerations, the BVDIG elected to implement a programme based on tissue-tag testing of newborn

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calves, similar to those previously implemented in Switzerland and Germany (Ståhl and Alenius, 2012). Testing conducted in 2013 provided baseline national data, with 0.66% of approximately 2.1 million calves considered to be PI and 11.3% of herds having one or more positive results. In 2014 and 2015, these levels fell to 0.46% and 0.33% (animal level) and 7.6% and 5.9% (herd level) respectively (Clegg et al., 2016). The prevalence of PI births has continued to decline into 2016, with only 0.15% of calves born in August being considered PI. Herds qualify for a negative herd status (NHS) within the programme if they satisfy the following three conditions: (i) a minimum of three years of tissue-tag testing; (ii) a negative status (assigned directly or indirectly) for all animals in the herd and (iii) no PI animals in the herd in the preceding 12 months. Approximately 61,000 out of 78,000 breeding herds currently (August 2016) have NHS status.

As the programme moves towards eradication, the TWG has been considering the introduction of alternative, serological, surveillance options for herds with NHS, particularly the use of young stock screening, often referred to as spot testing or young stock check testing (YSCT). This approach, supplemented in dairy herds by testing of milk samples, has formed the basis of the successful eradication programmes run in the Scandinavian countries (Lindberg and Alenius, 1999; Houe et al., 2006; Løken and Nyberg, 2013). The principle of check testing is that where a PI animal is present it will transmit infection to the majority of animals in the management group within a relatively short period of time. Therefore screening of a limited number of (typically 5–10) home-bred animals for antibodies to BVDv can provide an effective means of surveillance, with detection of antibodies being consistent with presence of BVDv in the management group (and by extension the herd where a sufficient degree of contact occurs) within the lifetime of the animals sampled. Typically 5–10 animals are chosen for sampling from each separately managed group of the desired cohort (Lindberg and Alenius, 1999), with 10 being the sample size recommended for Irish herds by the TWG (unpublished data), although the required number may differ according to herd structure and management (Jordan, 1996; Cameron and Baldock, 1998).

Serological testing for BVDv is normally conducted when calves are old enough to no longer test positive due to the presence of any maternally derived antibodies (MDA) (Muñoz-Zanzi et al., 2000; Sagar, 2003), typically between 6 and 9 months of age. The youngest cohort of animals is normally selected for this serological screen, for 2 reasons. Firstly, the presence of non-maternally derived antibodies in this group is a strong indication of the current or recent (since they were born) presence of a PI animal within the management group or the wider herd. Secondly, BVD vaccines are typically administered from 15 months of age onwards prior to breeding and sampling of this age cohort therefore avoids possible complications due to the detection of vaccine-induced antibodies (Cowley et al., 2012; Sayers et al., 2015; Graham et al., 2013, O'Neill et al., 2008). Furthermore, it is recognised that each separately managed group within the target age range must be sampled to provide a high herd-level sensitivity (HSe) (Houe et al., 2006). The national calving profile in Ireland is heavily biased to spring (DAFM, 2016), reflecting the importance of grass-based production systems. Based on this calving pattern, it is anticipated that the majority of herds would conduct YSCTs in the autumn of each year.

In the context of the Irish programme, HSe is considered important, with the possibility that PI calves might be sold from herds prior to check testing being performed being a particular concern, especially where these move to other breeding herds. Two particular management practices are of concern in relation to this. Firstly, many dairy herds sell some or all of their bull calves within weeks of birth, meaning that this management group is not available for check testing. Secondly, some 16,500 suckler herds operate a suckling to weaning system (Hennessey and Moran, 2012), with spring-born calves being sold in the autumn of their birth year, meaning that there may not be any animals in the preferred age group available for testing, particularly if no females are retained as breeding replacements. A further possible issue for both enterprise types is that an extended calving season may mean that not enough calves born in a given year have attained the lower age limit for sampling within a check test or that there may not have yet been sufficient time for the spread of the virus from a recently born PI to older calves.

The present study was therefore undertaken to (i) characterise the calving patterns of Irish herds and thereby investigate the degree to which herds would be able to provide a cohort of uniformly aged young stock for serological testing and (ii) characterise the calf movements from these herds by age, sex and enterprise type, to examine the potential for PI calves to be traded prior to serological testing taking place.

2. Methods

2.1. All data processing was conducted in Microsoft SQL Server 2012 and graphical outputs produced using Microsoft Excel 2010.

2.1.1. Birth and movement data used for the study

Analyses were carried out for all Irish herds in which calves were born in 2014 or 2015. Data on the characteristics of calves (birth herd, sex, breed and date of birth) and their movements during this period were drawn from the Animal Identification and Movement system (AIM) maintained by the Irish Government's Department of Agriculture, Food and the Marine (DAFM), which records all calf registrations and cattle movements in Ireland. Information from DAFM (Elizabeth Lane, 2016, pers. comm.), combined with a preliminary examination of movement records suggested that moves made less than 9 days before export from Ireland very often constituted movement into assembly herds as part of the export process. Therefore, these movements were not included as moves separate to the export move.

The AIM system assigns a breed to each calf based on the breed of their sire (rather than dam). We classified each calf as of beef or dairy type according to their breed. Following DAFM (2016), we classified animals as of dairy type if they were of the following breeds: Ayrshire, Brown Swiss, Holstein/Friesian, Jersey, Normande and Norwegian Red. The remaining breeds were classified as beef, and were as follows: Angus, Aubrac, Blonde d'Aquitaine, Belgian Blue, Belted Galloway, Bazadais, Charolais, Dexter, Galloway, Hereford, Highland, Irish Maol/Droimeann, Kerry, Longhorn, Limousin, Marchigiana, Montbeliarde, MRI/MRY, Piedmontese, Partenaise, Rotbunte, Romagnola, Salers, Shorthorn, Simmental.

Following Good et al. (2009), we classifed Irish cattle herds as being of beef or dairy enterprise type if ≥66% of their stock were from beef or dairy breeds, respectively, calculated using their end of year herd profiles for 2014 and 2015. All other herds were classified as 'mixed', unless they had no stock at the end of the year in both 2014 and 2015, in which case they were classified as 'unknown'. This allowed us in turn to assign the enterprise type of the herd to each calf – i.e. dairy, beef, mixed, or unknown enterprise type.

2.1.2. Analysis of calving patterns

For each herd in Ireland producing calves in 2014 or 2015, we calculated the number of calendar months during which calves were born in each of these years, and examined how these data differed according to the enterprise type (beef, dairy or mixed) of the herd. In addition, so as to be able to illustrate the distribution of breeding amongst individual herds, we randomly selected one hundred of our study herds from each enterprise type and calcu-