Development and review of the voluntary phase of a national BVD eradication programme in Ireland


The voluntary phase of an industry-led national Bovine Viral Diarrhoea (BVD) eradication programme began in Ireland on January 1, 2012 with the goal of progressing to a compulsory programme in 2013. The development and implementation of the programme in 2012 was informed by a review of current and prior eradication programmes elsewhere in Europe and extensive stakeholder consultation. The programme was based on tissue tag testing of newborn calves in participating herds, with the status of the mothers of calves with positive or inconclusive results requiring clarification. Participating herd owners were required to comply with a series of guidelines, including not selling cattle suspected of being persistently infected. For herds compliant with the guidelines, the results from 2012 counted as one of three years of tag testing anticipated in the compulsory phase of the programme. Testing was carried out in laboratories designated for this purpose by the cross-industry BVD Implementation Group that oversees the programme. Results were reported to a central database managed by the Irish Cattle Breeding Federation, and the majority of results were reported to farmers’ mobile telephones by SMS message. A detailed review of the programme was conducted, encompassing the period between January 1, 2012 and July 15, 2012, based on results from approximately 500,000 calves. This paper describes the establishment and structure of the programme, and the outcomes of the review, including findings at herd and animal level.

Introduction

Bovine Viral Diarrhoea virus (BVDV) genus Pestivirus, family Flaviviridae, is an economically important pathogen of cattle, being found at high prevalence in many countries around the world and associated with significant economic losses (Gunn and others 2004, Anon 2008, Hessman and others 2009, Stott and others 2012).

In 2004, the report of the European Union thematic network on the control of BVD virus concluded that a co-ordinated systematic approach was essential to address the disease at regional or national level, with the identification and removal of persistently infected (PI) animals, along with adequate measures to address biosecurity, and continued monitoring and surveillance being critical factors for success.

Models for national control were considered to fall into two types. The first of these is commonly referred to as the Scandinavian model, whereby herd status is initially investigated using screening tests (bulk tank milk, pooled milk samples from cattle in their first lactation, young stock serological check tests). The absence of serological evidence of exposure to BVDV is taken as strong evidence of freedom of infection, particularly when backed by repeated negative tests and appropriate bioexclusion practices. On the other hand, herds with serological evidence of current or recent infection are required to undergo whole herd individual animal sampling to identify any PI animals present (Lindberg and Alenius 1999, Houe and others 2006). Since some of these PI animals may be in utero at the time of the initial herd screen, such testing may be spread over an extended period, particularly where PI cattle are detected. This approach has been used successfully in Nordic countries and elsewhere in Europe (Synge and others 1999, Rossmanith and others 2010), although typically it has taken 10 years to reach the final stages of national eradication (Lindberg and others 2006).

The alternative model was pioneered more recently in Switzerland (Presi and Heim 2010, Presi and others 2011), and is, therefore, commonly referred to as the Swiss approach, although it is also being used with modifications elsewhere, most notably in Germany (Schirmeier and others 2012). This model dispenses with initial herd screening and, instead, tests all newborn calves (and older cattle in Switzerland) directly for BVDV to identify PI animals. The model dispenses with an initial herd screen, such testing may be spread over an extended period, particularly where PI cattle are detected. This approach has been used successfully in Nordic countries and elsewhere in Europe (Synge and others 1999, Rossmanith and others 2010), although typically it has taken 10 years to reach the final stages of national eradication (Lindberg and others 2006).

Beginning in 2008, the Swiss programme had reduced the proportion of virus-positive newborn calves from 1.8 per cent to under...
0.2 per cent by September 2010 (Presi and others 2010). Additional benefits of this approach were considered to be: reduced sampling costs through integration of sample collection into routine on-farm management practices; an indirect screen of the dam of each calf, with a non-PI status for a calf confirming its dam also to be non-PI; early identification and removal of PI calves, minimising opportunity for spread and input costs prior to removal and a known, lifelong, non-PI status for the majority of calves.

Animal Health Ireland (AHI; www.animalhealthireland.ie) was established in 2009 (More and others 2010) as a not-for-profit partnership between livestock farmers, processors, service providers and government, with a remit to address diseases and conditions of livestock which are endemic in Ireland, but which are not currently subject to EU regulation or coordinated programmes of control. BVD has been identified by industry and animal disease experts as a priority disease to be addressed by AHI (More and others 2011). On January 1, 2012, the voluntary phase of a national BVD eradication programme began in Ireland with the intention of progressing to a compulsory programme of January 1, 2013. This paper describes the development and structure of the programme and presents preliminary results following evaluation of data generated during the first half of 2012.

Materials and methods
The Irish cattle industry
The national Irish cattle population in December 2011 was 5.925M (CSO 2012). Statistics for 2011 indicate that there were 51,638 breeding herds (Department of Agriculture, Food and the Marine, DAFM 2012) distributed non-uniformly across 26 counties, ranging from 0.3 per cent and 0.9 per cent of these herds located in Counties Dublin and Louth to 10.3 per cent and 10.4 per cent in Counties Galway and Cork. Farm size and enterprise type also vary geographically, with herds in the northwestern typically being smaller and predominantly beef-oriented (CSO 2008, DAFM 2012).

The calving profile for the national herd is heavily biased toward the spring, with over 80 per cent of calves born in the first half of the year and a monthly peak of 435,034 in March 2011 (DAFM 2012). In 2011, a total of 215,780 cattle were exported live, with over 90 per cent going to Northern Ireland, Italy, The Netherlands, Spain and Belgium (DAFM 2012). By contrast, total live imports amounted to only 22,381, with 21,330 of these originating in the UK (of which 10,571 went for immediate slaughter). The next most common country of origin was Romania (517) followed by France (306) and The Netherlands (174).

Key steps and groups in the development of the national BVD eradication programme
BVD technical working group
A technical working group (TWG) on BVD was established by AHI in 2009, comprising veterinarians with a special interest in BVD from the state veterinary laboratory service (VLS), academia, private veterinary practice and the pharmaceutical and artificial insemination industries. The initial task of this group was the production of an information leaflet on BVD for farmers and veterinary practitioners that presented consistent guidelines on how to deal with BVD at the individual farm level. Subsequently, the TWG has provided ongoing technical input and advice to the BVD Implementation Group (BVDIG) (see below) on the development and implementation of a national programme.

BVD Steering Group
To develop options for BVD control in Ireland at a national as opposed to farm level, a BVD Steering Group was established in 2010 to review the economic impact of BVD, epidemiological aspects relevant to its control and best practice in terms of BVD eradication programmes elsewhere in Europe.

Key findings from this work were: that the knowledge and test technology to eradicate BVD existed and were being applied successfully elsewhere; identification and prompt removal of PI cattle is critical to success; the trade in PI cattle (including those in utero) must be curtailed; systematic, coordinated programmes have a much greater chance of success than voluntary programmes; the engagement and support of the farming community is vital for success; and reduced economic losses and increased productivity will be primary motivators for engagement at farm level (Barrett and others 2011).

National consultation
Building on the work of the BVD Steering Group, a national consultation process was launched in December 2010 to gather views on support for an industry-led national BVD eradication programme.

The results of the consultation process were collated in the spring of 2011 and indicated strong support for an industry-led national programme using tissue tags as the primary testing method, and delivered through a short-term, intensive programme.

BVD Implementation Group
In June 2011, a BVDIG was convened and has met regularly since then. This drew members from across industry, with representatives from farming and veterinary organisations (Irish Creamery Milk Suppliers’ Association, Irish Co-operative Society, Irish Farmers’ Association, Veterinary Ireland), breed societies (Irish Holstein Friesian Association, Pedigree Cattle Breeders’ Council of Ireland), the Irish Cattle Breeding Federation (ICBF), Teagasc (the national agriculture and food development authority), the School of Veterinary Medicine at University College Dublin, AHI and the DAFM.

Taking into account a number of factors, including the work of the BVD Steering Group, the results of the consultation process and a cost-benefit analysis of the proposed programme (Scott and others 2012), the BVDIG adopted the decision to proceed with the design and implementation of an industry-led coordinated national BVD control programme with the key milestones of voluntary and compulsory phases of the programme beginning on January 1, 2012 and January 1, 2013, respectively.

Structure of the National BVD eradication programme
The programme is based on tissue tag sampling to enable identification and removal of PI calves and identification of herds requiring further testing. It is envisaged that herds will typically undergo three consecutive years of tag testing. This will provide an intensive screening of herds for the presence of BVD virus during each of those years. The higher rate of natural wastage of PI calves relative to their non-PI contemporaries means that the prevalence of PI animals decreases with age (Presi and others 2011, unpublished data). For this reason, calves were considered to be the most appropriate age group to target for virus-based surveillance, with herds that consistently return negative results being very unlikely to contain PI animals. On the other hand, detection of virus in one or more calves merits further investigation within the herd and allows PI animals to be removed at an age when expenditure on production inputs has been minimal. Herds that participated in the voluntary period and which were considered compliant with the guidelines will be recognised as having completed one of the required three years of tag testing.

Sampling and guidelines for participation in the voluntary phase of the programme
During 2012, tissue samples were collected using a third (button) tag bearing the official identification number of the animal on which it was used. Herds effectively entered the voluntary phase of the programme by ordering buttons tags. As part of this process, they undertook to comply with the following programme guidelines:

1. To tag all calves at the earliest opportunity but not later than seven days after birth.
2. To test all calves born into the herd, including stillbirths, using the tissue sample (button) tag.
3. To return samples to the designated laboratory of choice at the earliest opportunity but not later than seven days after sampling.
4. To carry out all necessary follow-up testing following the discovery of a PI animal, which at minimum includes the testing of the dam (termed DAMPI) of the positive calf, and if found positive, the other offspring and descendants of the dam that remain on the farm (termed OFPI).
5. Not to move (sell) PI animals off farm, and to isolate them from other cattle until they are culled or slaughtered.
Empty samples
Based on experiences in Switzerland (Prest and others 2011) the BVDIG recognised that a small proportion of samples would be found to contain no tissue (empty) when received at the testing laboratory. Where this occurred, owners were informed and instructed to resample the animal, using either a blood sample or a tissue tag.

Confirmatory testing
Where a calf or older animal tested positive (or inconclusive) for BVD virus, the programme encouraged a retest of that animal to differentiate between PI and transiently infected (TI) states. This could again be done using either a blood sample taken and submitted by a veterinary practitioner or a further tissue tag, again labelled with the animal’s official ID. It was recommended that these samples be taken 3–4 weeks after the initial sample, with a further positive or inconclusive result after this interval being interpreted to indicate a BVD PI state (Anon 2008).

Where a tissue sample was submitted for the retest and gave a negative result, a protocol was established whereby the result was not reported until both samples had been retrieved from the testing laboratories, and DNA testing carried out to confirm that both had come from the same animal. In the event that this proved not to be the case, the result was not reported to the database, and the herd owner advised of this in writing.

It has been demonstrated that a ‘diagnostic gap’ exists when testing blood samples from young calves by ELISA due to potential interference from maternally derived antibodies against BVD virus (Hilbe and others 2007, Fux and Wolf 2012). To minimise the risk of this giving rise to false negative results, veterinary practitioners were instructed to send such blood samples to the Central Veterinary Research Laboratory (CVRL) of the VLS of DAFM (acting as a de facto national reference laboratory) where they were tested by a real-time RT-PCR-based protocol designed to address this issue. To encourage submission of blood samples to the CVRL, no laboratory fees were applied for these samples. Where such samples were instead sent to other testing laboratories, protocols were put in place to prevent ELISA-generated negative test results from calves aged 45 days or less being accepted by the database, with this limit having been determined by laboratory studies (unpublished data).

Disposal of PI calves
The programme guidelines did not compel the slaughter of calves considered to be PI (either positive or inconclusive on initial test, and not subject to retest, or retested with positive or inconclusive results). However, the strong recommendation of the BVDIG was that they should be slaughtered as soon as possible to minimise the opportunity for onward transmission of infection both within and between herds. Additionally, it is well recognised that while PI calves may be apparently normal at birth they tend to become ill-thrive, and many will die before reaching slaughter weight or breeding age (Houe 1993, Taylor and others 1997, Walder and Kennedy 2005, Presti and others 2011, Richeson and others 2012).

While there was no specific legal prohibition on the sale of PI cattle in place in 2012, a series of measures were put in place to discourage their sale. First, programme participants were made aware of potential liabilities under existing legislative provisions (Common Law Act 1893; Sale of Goods Act 1980; Criminal Damage Act 1991; Criminal Justice (Theft & Fraud Offences) Act 2001) should they knowingly sell a PI animal without making the purchaser aware of that fact. Additionally, the attention of programme participants was drawn to the fact that the prior test histories of animals held on the ICBF database transfers to the purchaser upon completion of the sale, allowing them to access dates and results of previous tests.

Finally, herd owners with positive or inconclusive results received a telephone call from their local District Veterinary Office (DVO) confirming that the DVO had received notification of the result, reminding them that the animal should not be sold unless retested and found negative, and making them aware of the financial incentives available from DAFM.

Programme incentives
For 2012, DAFM agreed, subject to certain conditions being met, to pay €15 toward the cost of disposal of calves culled due to a positive BVD result, and a €100 welfare payment per cow when 2012-born beef breed calves were slaughtered and removed to a knackery due to positive BVDV test results (www.agriculture.gov.ie/animalhealth-welfare/diseascontrol/bovineviraldiarrhoeabvd/. Accessed March 21, 2013).

Communication of the programme
From September 2011 onwards, the programme was extensively promoted through a range of media. This included a series of articles in the national farming and veterinary press and distribution of farmer and veterinary information leaflets, production of a video on the programme, which was shown at marts, and a series of regional information evenings for farmers and veterinary practitioners between November 2011 and January 2012. An extensive information resource was also developed and maintained at (www.bvdfree.ie).

Laboratory testing
In preparation for the voluntary year of the programme, a protocol for designation of laboratories to provide BVDV test results for tissue tag samples was established (www.animalhealthireland.ie/page.php?id=34). Laboratories were required to apply in writing to the BVDIG, stating the sample types and test methods for which they wished to be designated. Laboratories were also required to agree to abide by the terms and conditions of designation and to meet or commit to meeting certain specified criteria. These included:

- satisfactory participation in technical exercises delivered by the CVRL;
- accreditation to ISO 17025 for designated tests and sample matrices
- demonstration of their capacity to accurately transfer results electronically to the programme database;
- reporting of 95 per cent of results within 7 working days and 100 per cent of results within 10 working days.

Data management and reporting of results
Programme database
Database provision and the management and reporting of results were provided by the ICBF (www.ICBF.com). On July 15, 2012, a total of 64,367 breeding herds were registered on the database, representing 79 per cent of all such herds (DAFM 2012). Using a standard approach, registered herds were categorised as beef, dairy and dual purpose. For subsequent analysis, herds were categorised by size according to the following ranges: <10, 10–15, 26–50, 51–100, 101–150, 151–250 and >250 females aged two years and over.

All herd owners have automatic right of access to their test results on the database. This allows them to see the test history for their herd, copies of letters issued to them and to generate declarations of test negative results for cattle in their herds. Additionally, they may also authorise others, including their veterinary practitioner, to access their results.

Programme inputs
The database receives inputs from a number of sources and of various types:

- from the tag suppliers: details of tag orders allowing programme uptake to be monitored;
- from DAFM’s Animal Information and Movement database: herd details in real time, including registrations of births, assigned parentage and movements into and out of programme herds;
- from each designated laboratory: test results in a standardised format;

Programme outputs
The key output from the database was test results which were issued on a daily basis. Where the database held a mobile telephone number, these were reported by SMS (text message). Otherwise, results were issued by post. The programme recognised four possible results for an
individual sample: negative, positive, inconclusive and empty (no tissue present). With the exception of negative results, the database also generated standard letters for each result providing the details of the animal tested, its results and the registered dam, offering advice on next steps and providing a sample submission form for follow-up testing.

Other database outputs included:

- additional letters in relation to DAMPI and OFFPI animals, including where these were located in other herds following their sale;
- information to testing laboratories, for example, identifying samples to be submitted for DNA testing;
- data to marts, transmitted via the Animal Health Computer System (AHCS) of DAFM, to enable virus-positive cattle to be excluded from sale, and test-negative cattle to have their results displayed;
- data to dairy processors to enable central deduction of payments;
- reports to BVDIG and DAFM.

Mid-year review
During the second half of 2012, the database was used to conduct an extensive review of the programme based on a study period of January 1, 2012 to July 15, 2012. The primary goal was to generate descriptive data for as many aspects of the programme as possible to allow the BVDIG to evaluate performance and behaviours across multiple aspects of the programme and assist with decision making. Additionally, it would provide insights into relative strengths and weaknesses that could be incorporated into programme amendments and to target communications around the compulsory programme more efficiently.

Results
Laboratory designation
At the end of the study period, eight laboratories had been designated, with a current list maintained on the AHI website (www.animal-healthireland.ie/page.php?id=34). The choice of test method and kit was left to each laboratory; the majority using E\textsuperscript{TM} antigen detection ELISA to test individual samples, while others used RT-PCR (or a combination of both). Where RT-PCR was used, samples were typically initially screened in pools, with the pool size set by each laboratory based on manufacturer’s guidelines, in-house validation studies and cost. The performance characteristics of these test methods were taken to be similar to those described previously by Presi and Heim (2010).

Herd-level participation-descriptive data
The breakdown of the 64,367 herds registered on ICBF by size and type is given in Table 1, with the largest proportion being designated beef (46,282, 71.9 per cent), followed by dairy (14,752, 22.9 per cent) and dual (4,333, 2.5 per cent). There were clear differences in herd size distribution between herd types, with the largest proportion (39.8 per cent) of beef herds containing between 11 and 25 females aged two years and over, while for dairy and dual herds, a size of 51–100 was most common (47 per cent and 30.0 per cent, respectively).

Participation according to herd size and type
By the end of the study period, 574,997 button tags had been ordered for use in 9707 herds. For the purposes of further analysis, a programme herd was defined as one for which at least one BVDV result was received during the study period. On this basis, there were 5770 programme herds, of which 45.4 per cent, 46.5 per cent and 4.8 per cent were dairy, beef and dual purpose, respectively. There was, therefore, a proportionately greater uptake amongst dairy farmers, with 28.7 per cent, 8.9 per cent and 12.5 per cent of dairy, beef and dual purpose herds participating.

The size distribution of programme herds is shown in Table 1. There was an overall bias toward larger herds among programme herds. This is consistent with the observation that the number of tags sold as a percentage of the national calf crop (27.4 per cent) exceeds the uptake at herd level.

Geographical distribution of programme herds
Nationwide, 13.6 per cent of ICBF herds participated in the programme (Table 2), although the level of uptake varied when analysed at county level with minimum and maximum participation rates of 7.0 per cent and 25.6 per cent (Leitrim and Waterford, respectively). Overall, the level of participation was higher in the south and east of the country relative to the north and west, reflecting to some extent at least the higher proportion of dairy herds in the southeast.

Herd prevalence by type and location
Initial test results were available for 412,440 animals of all ages. The distribution of positive or inconclusive (POSINC) results at herd level was evaluated by herd type and geographical location (province and county levels). Results are summarised in Table 2.

POSINC results were found in 1350 herds (15.2 per cent). When considered at provincial level, the overall prevalence detected in programme herds was similar in Ulster (16.6 per cent), Munster (15.7 per cent) and Leinster (16.1 per cent), and lower in Connacht (11.9 per cent). However, when considered at county level, even these overall prevalence figures show a relatively wide range within the same province (eg, 11.8–24.0 per cent, Donegal-Monaghan, 8.8–21.5 per cent, Longford-Louth). To some extent at least these differences appear to reflect differences in herd type distribution between counties.

When analysed by herd type, 20.6 per cent of dual herds, 18.1 per cent of dairy herds and 11.6 per cent of beef programme herds contained cattle with POSINC results.

Within a given herd type, prevalence figures showed some variation at provincial level, ranging from 17.2 to 21.9 per cent (Munster, Connacht, dairy), 10.0 to 15.4 per cent (Connacht, Ulster, beef), and 19.6 to 21.4 per cent (Connacht-Ulster, dual). Wider variations were observed within each herd type when analysed at county level, ranging from 0.0 to 23.3 per cent (Leitrim-Dublin-Louth, dairy), 5.2 to 21.4 per cent (Leitrim-Dublin, beef), and 0.0 to 50 per cent (Donegal/Longford-Roscommon Wicklow, dual). However, in some cases, these prevalence values were based on data from very small numbers of herds (eg, Roscommon, n=3 dual herds; Table 2).

Herd prevalence by herd type and size
The distribution of herds with POSINC results was further evaluated by herd size based on the number of females aged two years and over on January 1, 2012, according to the following classifications: ≤10, 11–25, 26–50, 51–100, 101–150, 151–250 and >250.

### TABLE 1: Distribution of 8770 programme herds by type (dairy, beef and dual purpose)

<table>
<thead>
<tr>
<th>Herd size</th>
<th>Dairy</th>
<th>Beef</th>
<th>Dual</th>
</tr>
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<tbody>
<tr>
<td>≤10</td>
<td>17/324 (0.4/2.2)</td>
<td>530/13,754 (12.9/29.7)</td>
<td>13/478 (3.1/14.3)</td>
</tr>
<tr>
<td>11-25</td>
<td>105/297 (2.6/5.6)</td>
<td>1,502/18,436 (36.6/39.8)</td>
<td>32/654 (7.7/19.6)</td>
</tr>
<tr>
<td>26-50</td>
<td>780/3,592 (18.4/24.3)</td>
<td>1,371/10,466 (33.3/22.6)</td>
<td>184/1,000 (18.4/20.0)</td>
</tr>
<tr>
<td>51-100</td>
<td>2,276/9,933 (52.3/47.0)</td>
<td>604/3,383 (14.4/29.9)</td>
<td>67/281 (14.8/48.4)</td>
</tr>
<tr>
<td>101-150</td>
<td>779/2,084 (18.4/14.1)</td>
<td>8/134 (2.0/0.7)</td>
<td>79/721 (11.0/17.9)</td>
</tr>
<tr>
<td>151-250</td>
<td>284/696 (6.7/4.7)</td>
<td>20/82 (0.5/0.2)</td>
<td>26/99 (2.6/2.0)</td>
</tr>
<tr>
<td>&gt;250</td>
<td>59/166 (1.4/1.1)</td>
<td>3/14 (0.7/0.0)</td>
<td>5/5 (1.2/0.5)</td>
</tr>
</tbody>
</table>

For each size category, the number of programme\textsuperscript{1} herds and the total number\textsuperscript{2} of herds on the database is shown. Additionally, these numbers are shown as a percentage of all the programme herds of each type\textsuperscript{3} and the total number of programme herds for that type and size category\textsuperscript{4}.
When the numbers of herds with POSINC results were expressed as a percentage of the total number of programme herds in each size category, a clear relationship between herd size and herd prevalence was apparent (Fig 1). While mean herd prevalence in dairy, beef and dual purpose herds was 18.1 per cent, 11.6 per cent and 20.6 per cent, respectively, the prevalence range by herd size for these herd types was 0.0–40.0 per cent (dairy), 0.1–40.0 per cent (beef) and 0.0–39.0 per cent (dual purpose herds). Limited numbers of herds were available for inclusion in calculations for larger herd size categories.

Animal level data
Analysis of initial results at animal (calf) level
Initial results were available for a total of 392,869 calves born during the study period, of which the majority originated from dairy herds (289,932; 74 per cent), with smaller numbers from beef (82,170; 21 per cent) and dual-purpose herds (20,767; 5 per cent). 0.61 per cent of calves had an initial positive or inconclusive result recorded for the remaining samples (98.93 per cent).

The balance of 1013 results available for analysis related to confirmatory tests following an INIPOSINC result. The majority of these were blood samples (71 per cent), indicating that the herd owner had involved their veterinary practitioner. Overall, combined data (blood and tissue samples) found that almost all samples from animals with an initial inconclusive result (n=50) were negative on retest (94 per cent), whereas, the majority of calves with an initial positive result were positive on retest (82.7 per cent). When considered as a single dataset, 20.9 per cent of samples with an INIPOSINC result were negative on retest, consistent with these animals having been TI at the time of first sampling.

The interval between receipt of initial and retest samples following an initial empty or INIPOSINC result was also investigated. The shortest median interval to resubmission was associated with empty samples (22 days min/max=5/234), whereas, the...
TABLE 3: Fate of 2012-born calves from programme herds with an initial positive or inconclusive (POSINC) result by herd type (dairy, beef and dual purpose) and overall, showing the number of calves that were culled, sold or remained in the birth herd at the end of the study period. The numbers in parentheses show the parallel analysis for calves that were subject to confirmatory testing with a further POSINC result.

<table>
<thead>
<tr>
<th>Herd type</th>
<th>Outcome</th>
<th>(Sub) total %</th>
</tr>
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<tbody>
<tr>
<td>Dairy</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Culled</td>
<td>73.5 (79.1)</td>
</tr>
<tr>
<td></td>
<td>Sold</td>
<td>4.2 (2.6)</td>
</tr>
<tr>
<td>Beef</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Culled</td>
<td>22.3 (18.3)</td>
</tr>
<tr>
<td></td>
<td>Sold</td>
<td>0.5 (0.3)</td>
</tr>
<tr>
<td>Dual purpose</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Culled</td>
<td>42.5 (36.7)</td>
</tr>
<tr>
<td></td>
<td>Sold</td>
<td>0.0 (0.0)</td>
</tr>
<tr>
<td>Combined</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Culled</td>
<td>677 (71.9)</td>
</tr>
<tr>
<td></td>
<td>Sold</td>
<td>2.9 (1.6)</td>
</tr>
<tr>
<td></td>
<td>Still in herd</td>
<td>29.4 (26.4)</td>
</tr>
</tbody>
</table>

DNA confirmatory testing

During the study period, DNA testing was carried out in 56 cases where a confirmatory test was conducted on a tissue sample with negative results. In only four cases (7 per cent) did the profiles of paired samples indicate that they did not come from the same animal. Two of these were resolved following contact with the herd owners. Letters were issued to the remaining two herd owners in July 2012 informing them of the findings, advising that the most recent (negative) result was invalid, that the status of the animal on the database would remain unchanged and requesting a follow-up sample.

Follow-up testing of dams of calves

When the mothers of calves that have been given a POSINC result on confirmatory testing, and which were therefore considered to be PI were tested, a total of 8.5 per cent gave a positive result. Similar to the situation with confirmatory testing of calves, 75.9 per cent of DAMPI animals were tested by blood sample, with a tissue sample taken from the remainder.

The birth year of 101 dams with a positive result was analysed. Over 70 per cent were born in 2010 and 2009 (35.6 per cent and 36.6 per cent, respectively), with 19.8 per cent, 4 per cent, 5 per cent and 1 per cent born in 2008, 2007, 2006 and 2005, respectively.

‘Trojan’ animals (pregnant females which are not themselves PI but which are carrying a PI fetus)

The data were analysed to estimate the frequency with which programme calves tested during the study period had been born to dams that had been purchased while pregnant with these calves. A total of 392,859 calves were born into programme herds during the study period. Of these, 12,679 (3.23 per cent) were born to heifers or cows that had entered those herds within 8 months of the registered calving date, and were therefore considered to have been in calf at the time of purchase.

In total, 1,444 calves born to these potential ‘Trojan’ dams gave an INIPOSINC result, representing 6.2 per cent of all such calves.

**Discussion**

A key feature of the voluntary phase of the national BVD eradication programme in Ireland is that it is industry-led, with responsibility for the shape of the programme, and the ultimate decision to proceed with the voluntary phase in 2012 resting with the cross-industry BVDIG. Many of the factors which led Switzerland to adopt a tissue testing approach without initial serological categorisation of herds also applied in Ireland. A range of studies had demonstrated a high seroprevalence at herd and animal level, with little evidence of change over an extended period of time (Gunn 1987, Graham and others 2001, O’Neill and others 2008, Cowley and others 2012). Cattle densities are also high, both at animal and herd levels (Abernethy and others 2013) and a high level of animal movements, coupled with pasture-based production systems and fragmentation of farm holdings are considered to facilitate spread of infection between herds (Denny and Wilesmith 1999, Ashe and others 2009, DAFM 2012). Further support for the use of a tissue tag-based programme came from the consultation process, which overall indicated a strong preference for farmers taking responsibility for sampling their own animals as part of routine management procedures.

**TABLE 4: Frequency distribution of herds generating one or more positive or inconclusive (POSINC) results according to the number of calves with an initial POSINC result**

<table>
<thead>
<tr>
<th>Number of calves with POSINC result</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
<th>9</th>
<th>10</th>
<th>11</th>
<th>12</th>
<th>13</th>
<th>15</th>
<th>17</th>
<th>21</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beef %</td>
<td>69.2</td>
<td>85.7</td>
<td>93.8</td>
<td>96.1</td>
<td>97.2</td>
<td>97.7</td>
<td>98.2</td>
<td>98.6</td>
<td>99.3</td>
<td>99.5</td>
<td>99.7</td>
<td>99.8</td>
<td>99.8</td>
<td>99.8</td>
<td>99.8</td>
<td>100.0</td>
</tr>
<tr>
<td>% Cumulative</td>
<td>69.2</td>
<td>85.7</td>
<td>93.8</td>
<td>96.1</td>
<td>97.2</td>
<td>97.7</td>
<td>98.2</td>
<td>98.6</td>
<td>99.3</td>
<td>99.5</td>
<td>99.7</td>
<td>99.8</td>
<td>99.8</td>
<td>99.8</td>
<td>99.8</td>
<td>100.0</td>
</tr>
<tr>
<td>Dairy %</td>
<td>63.1</td>
<td>79.4</td>
<td>86.7</td>
<td>91.5</td>
<td>94.2</td>
<td>96.1</td>
<td>97.2</td>
<td>98.1</td>
<td>98.5</td>
<td>98.8</td>
<td>99.3</td>
<td>99.5</td>
<td>99.6</td>
<td>99.7</td>
<td>99.9</td>
<td>100.0</td>
</tr>
<tr>
<td>% Cumulative</td>
<td>63.1</td>
<td>79.4</td>
<td>86.7</td>
<td>91.5</td>
<td>94.2</td>
<td>96.1</td>
<td>97.2</td>
<td>98.1</td>
<td>98.5</td>
<td>98.8</td>
<td>99.3</td>
<td>99.5</td>
<td>99.6</td>
<td>99.7</td>
<td>99.9</td>
<td>100.0</td>
</tr>
<tr>
<td>Dual %</td>
<td>68.8</td>
<td>88.8</td>
<td>93.8</td>
<td>96.3</td>
<td>98.8</td>
<td>98.8</td>
<td>100.0</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>% Cumulative</td>
<td>68.8</td>
<td>88.8</td>
<td>93.8</td>
<td>96.3</td>
<td>98.8</td>
<td>98.8</td>
<td>100.0</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<td>-</td>
</tr>
<tr>
<td>Overall %</td>
<td>65.6</td>
<td>82.2</td>
<td>89.6</td>
<td>93.4</td>
<td>95.5</td>
<td>96.8</td>
<td>97.7</td>
<td>98.4</td>
<td>98.9</td>
<td>99.1</td>
<td>99.4</td>
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<td>99.7</td>
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<td>95.5</td>
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<td>97.7</td>
<td>98.4</td>
<td>98.9</td>
<td>99.1</td>
<td>99.4</td>
<td>99.5</td>
<td>99.7</td>
<td>99.8</td>
<td>99.9</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Results are presented by herd type and overall. In each case the cumulative % of herds is also shown.
The development of a programme of this scale presented significant logistical challenges, with the availability of tissue sample tags providing traceability back to each sampled animal, ensuring adequate provision of accredited testing capacity, and the ability to manage large volumes of data being uppermost amongst these.

During 2012, official identity tags capable of taking a tissue sample were not available in Ireland. Consequently, it was necessary for the supplier holding the tender for provision of official identity tags to establish a system whereby farmers could order a tag button capable of taking a sample and bearing the full identification number to match each official identity tag. The requirement to use a third tag for tissue sampling may have discouraged some farmers from participating in the voluntary phase of the programme due to the additional cost and labour. However, the ordering of almost 600,000 tags during the study period suggests that this was not a significant deterrent. This was borne out by the findings of a survey delivered to both participating and non-participating herd owners, the full results of which will be published separately.

Given the industry-led nature of the programme, the BVDIG recognised that the majority of the testing would have to be conducted in non-government laboratories, rather than by the VLS of DAFM. A process was therefore established which laid down the specific criteria that laboratories would have to meet in order to be designated to provide testing to the programme and the terms and conditions associated with designation. A series of open meetings were held to inform laboratories of these requirements, and to provide a forum for ongoing dialogue. While VLS did not conduct large volumes of testing, they fulfilled several other critical roles, including the provision of a series of technical exercises, supply of panels of BVD test materials, and the performance of confirmatory testing on blood samples with INIPOSINC results. The delivery of over 400,000 test results during the study period, with an average turnaround time of less than five days (data not presented) demonstrated the ability of the designated laboratories to markedly increase capacity in response to industry needs, and gave an indication that this could be developed further to meet the requirements of a compulsory programme. Reflecting the industry-led nature of the programme, farmers paid for testing, with costs typically less than €4 per sample. The choice of which laboratory to use rested with the farmer, although a number of dairy processors put in place arrangements with individual laboratories which were then offered to their suppliers. Such arrangements ensured a competitive price and also enabled payments to be deducted centrally. Additionally, the associated communications from processors were considered to help drive uptake of the programme.

The importance of effective data management in this type of programme has been acknowledged previously (Presi and Heim 2010) and was delivered in the Irish programme by development of the required functionality within the pre-existing, comprehensive ICBF database. The use of SMS messaging ensured that results were communicated promptly and in a cost-effective manner, and was well accepted by farmers, being particularly beneficial to dairy farmers who wished to sell bull calves in the first month of life.

The data generated during the review period provided important baseline data for the national herd along with valuable insights into farmer behaviours that have informed the decision taken by the BVDIG to progress to a compulsory programme that began on January 1, 2013.

Overall, 20.9 per cent of calves with an INIPOSINC result were negative when subjected to a confirmatory retest, with this being interpreted as evidence of their having undergone a transient infection with BVD. Presi and others (2011) reported a similar figure rate of TI calves tested in 2011 in the German national eradication programme. Fulton (2012) recently reviewed a number of US surveys, which reported prevalence of PI animals ranging from 0.09 per cent to 0.55 per cent from cattle in a range of management systems. Similar to the situation in Ireland, regional variation in virus detection rates has been described elsewhere, with the prevalence of virus-positive results ranging from 0.55 per cent to 1.13 per cent between Swiss Cantons (Presi and others 2011), while Schirmeier (2012) reported the prevalence of PI calves in different German Landes to be in the range 0.02–0.58 per cent. When considered at herd level, the Irish figure of 15.2 per cent was more similar to the figures of 20.02 per cent reported from Switzerland than the 4.11 per cent figure reported from Germany, with Fulton (2012) reporting a range of herd prevalences from a review of US studies of 2.7–16.9 per cent. These variations between regions and countries are considered to reflect a range of influences, including management, housing systems and population structures (Houe and others 1999).

In the majority of herds, the number of calves with an INIPOSINC result was low. However, the data presented in Table 4 indicate that for a very small number of herds the impact was much more severe, with up to 21 INIPOSINC results detected. These are considered to result in large numbers of PI-born PI calves, and to result in a high proportion of PI calves that would not be detected in the first round of testing, it is highly unlikely that compliance with the programme guideline relating to the non-sale of positive animals was high, and that the measures put in place to discourage their sale were effective. Indeed, the overall incidence of sale of confirmed PI calves (1.6 per cent) from programme herds compares favourably to data for confirmed PI animals detected in 2009–2011, which found that 13.6 per cent had moved subsequently (J Fagan, unpublished data). On the other hand, the level of retention of INIPOSINC calves, particularly in suckler herds, presumably in an attempt to obtain some slaughter value, is a concern. By contrast, the median interval to removal of PI animals in the Swiss programme was 14 days, overseen by the regional veterinary offices (Presi and Heim 2010). The benefits of their prompt removal are recognised (Barrett and others 2011, Ridpath and others 2012) given that these animals are
a constant source of infection. While financial incentives were made available to encourage disposal of PI calves, these did not fully compensate herd owners. The absence of a legal requirement to cull PI animals has discouraged the need for on-going efforts to communicate the benefits of prompt removal.

A further key subject of communication relates to herd biosecurity. The purchase of PI animals and direct or indirect contact with PI cattle in other herds are recognised to be amongst the key means of introduction of infection into herds (Lindberg and Ailenius 1999). Although it is recognised that the proportion of traded cattle born in programme-herds is recognised to be amongst the key means of introduction of infection into herds (Lindberg and Ailenius 1999). Although it is recognised that the proportion of traded cattle born in programme-herds is amongst the key means of introduction of infection into herds (Lindberg and Ailenius 1999).

In conclusion, the incorporation of a voluntary phase into the national BVD eradication programme in Ireland has provided an opportunity to test many of the programme’s component parts, to generate baseline data in relation to the programme, and to allow farmers to provide evidence of their support for such a programme by participating in it. Taking these and other factors into account, the BVD IG decided in autumn of 2012 to progress to a compulsory programme from January 2013. This has been supported by the award by DAFM of a tender to provide tissue sample-enabled official identification tags and their introduction of legislation in support of a programme.

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References


Development and review of the voluntary phase of a national BVD eradication programme in Ireland

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