Review

A review of bovine Johne's disease control activities in 6 endemically infected countries

Timothy Geraghty a, *, David A. Graham b, Peter Mullowney c, Simon J. More d

a Scottish Centre for Production Animal Health and Food Safety, University of Glasgow Veterinary School, 464 Bearsden Road, Glasgow, Scotland G61 1QH, United Kingdom
b Animal Health Ireland, Main Street, Carrick-On-Shannon, Co Leitrim, Ireland
c Training Section, Department of Agriculture, 6 East, Agriculture House, Kildare Street, Dublin 2, Ireland
d UCD Centre for Veterinary Epidemiology and Risk Analysis, University College Dublin, Belfield, Dublin 4, Ireland

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ABSTRACT

Mycobacterium avium subspecies paratuberculosis (MAP) is endemic in the bovine populations of many countries and can cause a significant reduction in animal welfare and production efficiency making control desirable. Effective control has proved very difficult to achieve despite multiple regionally coordinated programmes being in existence since the 1920s. The international community increasingly recognises the value in learning from the collective experiences of existing programmes to improve the effectiveness of control. The aim of this review is to outline key aspects of bovine Johne's disease control activities across 6 endemically infected countries to facilitate comparison of current international practice. The background, control activities and monitoring components of programmes in Australia, Canada, Denmark, the Netherlands, the United Kingdom and the United States of America were individually reviewed. Factual accuracy of each review was checked by individuals involved in the respective programmes before the reviews were condensed and combined into a single document presented here, with the complete reviews of each programme available as supplementary material. There was considerable heterogeneity in key aspects of control activity design including goals, responses to declining participation, herd classification, recommended control measures and associated test requirements. The data presented will be of interest to organisations that are involved in developing new or existing regionally coordinated BJD control activities.

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1. Introduction

Mycobacterium avium subspecies paratuberculosis (MAP), the infectious cause of bovine Johne's disease (BJD), is endemic in the bovine populations of many countries (Nielsen and Toft, 2009). The disease is recognised internationally as causing a significant reduction in animal welfare and production efficiency, making control desirable. The potential association between exposure to MAP and Crohn's disease in humans increases the importance of reducing human exposure to this organism (FSAI, 2009).

Regionally coordinated BJD control activities have been in existence since the 1920s (Benedictus et al., 2000) although most still active today were initiated within the last 30 years. Control activities within countries are not uniformly coordinated at a national level, and vary from small, independent programmes targeting limited

* Corresponding author. Tel.: +44 0141 330 5700;
fax: +44 0141 330 5729.
E-mail address: timothy.geraghty@glasgow.ac.uk (T. Geraghty).

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production systems within a defined geographical region to single ‘national’ programmes that include all cattle in a given country (Nielsen, 2009d). Regardless of the level of national coordination, effective control (measurable and sustained reduction in clinical or economic impact, or MAP prevalence) has proved very hard to achieve.

In 2006, in recognition of the significant challenges of achieving effective control, the International Dairy Federation initiated a forum to facilitate the sharing of ideas and experiences between organisations involved in delivering control activities (Kennedy and Nielsen, 2007). This forum was preceded by (and runs in parallel to) other international knowledge transfer initiatives (e.g. the International Colloquium on Paratuberculosis) but was unique in focussing specifically on the design and delivery of control activities. The proceedings from these meetings (Kennedy and Nielsen, 2007; Nielsen, 2009a; Kennedy and Wall, 2012) give some insight into international practice, but do not facilitate a direct comparison between different control activities. The ability to directly compare existing control activities provides the best opportunity to learn from past, collective experiences of BJD control and to design and implement improved control activities in the future.

The aim of this review is to outline key aspects of bovine Johne’s disease control activities across 6 endemically infected countries to facilitate comparison of current international practice.

2. Materials and methods

Six endemically infected countries that had active control activities starting in or before 2007 were identified for inclusion in the review. These countries were chosen purposively, representing regionally coordinated BJD control activities across three continents. To avoid significant errors arising from mistranslation, these countries each had programme material published predominantly in English or with extensive programme details published in the international literature. For each country, an individual review of BJD control activities was performed between February and July 2012, with a focus on the following three areas:

- Programme background (history and development, current structure, aims, organisations involved, funding, voluntary or compulsory participation)
- Programme components: Surveillance and control (testing and classification for low and high risk herds and recommended control activities, distinguishing bio-exclusion activities as those designed to reduce the risk of introduction of MAP into a herd, and bio-containment as those designed to reduce spread of MAP within an infected herd)
- Monitoring and review (participation, surveillance monitoring, programme review and current areas of concern)

Following completion, each country review was sent for external validation of factual accuracy to appropriate individuals involved in the respective programmes. The reviews were sent in July 2012 and completed in July 2013.

Information from each review was then summarised to allow comparisons to be made easily in a single document.

3. Results

The BJD control programmes of Australia, Canada, Denmark, the Netherlands, the United Kingdom and the United States of America were selected for inclusion in this review. Each complete review is included as supplementary material to this publication so that readers can access more detail of all programmes as required.

3.1. Programme background

Herd level prevalence and aims of control activities are shown in Table 1. Sources of funding for control activities are shown in Table 2 (USDA-APHIS-VS, 1999, 2010; Muskens et al., 2000; CVJDCP, 2006; Tiwari et al., 2006; Nielsen et al., 2007; Scott et al., 2007; Weber and Schalk, 2007; VS, 2008; Anon, 2009; CJD, 2009; Nielsen, 2009c; AHA, 2012; CheCS, 2012).

3.1.1. Australia

BJD control activities are coordinated by Animal Health Australia within the National Bovine Johne’s Disease Strategic Plan (NBJDSP, initiated in 1996) (AHA, 2012). It includes prevalence-based geographical zoning, legally required controls, multiple herd scoring systems (‘CattleMAP’, ‘National Dairy Bovine Johne’s Disease Assurance Score (NDJDAS) and ‘Beef only’), and technical notes for best practice (Citer and Kennedy, 2009). Additional control activities are also provided within endemically infected states that are consistent with the NBJDSP (Rogers et al., 2012; Spence, 2012).

3.1.2. Canada

BJD control activities are delivered through multiple provincial programmes (Barker et al., 2012). These are largely independent of one another and in various stages of development but include producer (farmer) education and herd risk assessment (RA)/testing. Guidelines to improve inter-provincial coordination were produced in 2006 within a proposed Canadian Voluntary Johne’s Disease Prevention and Control Programme (CVJDCP) but these were not adopted (CVJDCP, 2006). The Canadian Johne’s Disease Initiative (CJD) was formed in 2006 to highlight the importance of national control and improve inter-provincial coordination (CJD, 2009).

3.1.3. Denmark

BJD control activities are delivered within a single, dairy only programme termed ‘Operation Paratuberculosis’ (OP, initiated in 2006). This programme is coordinated by the Knowledge Centre for Agriculture (Nielsen et al., 2007) and includes standard educational and on farm RA material plus quarterly individual animal testing and herd classification (Krogh et al., 2012).

3.1.4. The Netherlands

BJD control activities have been delivered via the ‘Intensive Paratuberculosis Programme’ (IPP) since 1998. This
Table 1
Estimated true or apparent herd-level prevalence of bovine Johne’s disease (BJD) and aims of control activities in 6 endemically infected countries. MAP = Mycobacterium avium subspecies paratuberculosis.

<table>
<thead>
<tr>
<th>Country</th>
<th>Herd prevalence overview</th>
<th>Specific aim(s) of control activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Endemic in South East dairy and beef (lower prevalence) farms; rare or absent elsewhere</td>
<td>National Bovine Johne’s Disease Strategic Plan (initiated 1996): to minimise minimisation of farms/farm products by MAP and to protect non-infected herds while minimising disruption to trade and the social, economic and trade impact of BJD at herd, regional and national level (AHA, 2012)</td>
</tr>
<tr>
<td>Canada</td>
<td>Infected dairy (9.8–43.1%) and beef (7.9%) herds present in all provinces (Tiwari et al., 2006; Scott et al., 2007)</td>
<td>Canadian Johne’s Disease Initiative (initiated 2006): to reduce the prevalence of BJD (CJD, 2009) Canadian Voluntary Johne’s Disease Prevention and Control Programme (initiated 2006): to reduce prevalence, impact on animal health and economics, to reduce or eliminate MAP in milk, beef cattle and the environment and to provide certification of herds as low risk for BJD (CVJDPCP, 2006)</td>
</tr>
<tr>
<td>Denmark</td>
<td>Endemic in national dairy herd (80–86%); present in beef herd at a lower prevalence (Nielsen, 2009a,b,c,d)</td>
<td>Provincial programmes: vary with province Operation paratuberculosis (initiated 2006): To provide tools to dairy farmers that wish to control BJD; to reduce the over-all prevalence of BJD (Nielsen et al., 2007) Intensive Paratuberculosis Programme (initiated 1998): to enable low-risk trade of cattle between herds and to facilitate eradication of paratuberculosis from known infected herds Milk Quality Assurance Programme (initiated 2006): to reduce the concentration of MAP in milk delivered to processing units (Weber and Schalk, 2007)</td>
</tr>
<tr>
<td>Netherlands</td>
<td>Endemic in the national dairy herd (20–71%) (Muskens et al., 2000); no published reports in small national beef herd</td>
<td>Cattle Health Certification Standards (CheCS) accreditation schemes (initiated 1998): to provide a graded system of accreditation which enables herds to maintain or move towards clear herd tests (CheCS, 2012) CheCS control schemes: Implement a control programme to reduce the detrimental effects on herd productivity (CheCS, 2012)</td>
</tr>
<tr>
<td>UK</td>
<td>Endemic in national dairy (27.6–42.5%) and beef herd (Anon, 2009)</td>
<td>Cattle Health Certification Standards (CheCS) accreditation schemes (initiated 1998): to provide a graded system of accreditation which enables herds to maintain or move towards clear herd tests (CheCS, 2012) CheCS control schemes: Implement a control programme to reduce the detrimental effects on herd productivity (CheCS, 2012)</td>
</tr>
<tr>
<td>USA</td>
<td>Endemic in national dairy (68%) and beef (7.9%) herd (USDA-APHIS-VS, 1999; VS, 2008)</td>
<td>Voluntary Bovine Johne’s Disease Control Plan (initiated 2002): To provide national standards for the control of BJD and to reduce prevalence, impact and risk of introducing BJD to non-infected herds (USDA-APHIS-VS, 2010)</td>
</tr>
</tbody>
</table>

* Apparent herd prevalence based on at least one or two sero-positive animals or environmental culture.

* Estimated true herd prevalence (various methods).

Table 2
Funding for control activities in 6 countries with endemic bovine Johne’s disease infection.

<table>
<thead>
<tr>
<th>Region</th>
<th>Funding for coordination activity</th>
<th>Funding for farm level participation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Animal Health Australia (a not-for-profit company) with government, producer, veterinary and academic representation is funded principally by national dairy and beef industry subscription</td>
<td>Surveillance testing in Free/Protected zones is state/national industry funded; participation in accreditation scheme (CattleMAP) is paid by participant producers (some funding available for beef herds); in Victoria and South Australia some state funding is available for risk assessment and testing</td>
</tr>
<tr>
<td>Canada</td>
<td>Provincial programmes and the Canadian Johne’s Disease Initiative are funded by provincial government and industry bodies (Dairy Farmers of Canada, Canadian Cattlemen’s Association)</td>
<td>All provincial programmes offer some financial subsidy to participant producers (amount varies).</td>
</tr>
<tr>
<td>Denmark</td>
<td>Most costs met through testing and admin fees to participant producers; limited funding from producer levy boards; supportive research received public funding</td>
<td>All costs met by participant producers</td>
</tr>
<tr>
<td>Netherlands</td>
<td>All coordination activities are funded by an annual subscription fee of participating producers. Public funds and funds from the Dairy Commodity Board have been made available for research activities such as the development of the Milk Quality Assurance Programme</td>
<td>Costs associated with the Milk Quality Assurance Programme and Intensive Paratuberculosis Programme are covered by participant producers (although dairy processors funded testing in the Milk Quality Assurance Programme initially)</td>
</tr>
<tr>
<td>UK</td>
<td>Providers of Cattle Health Certification Standards accreditation/control programmes pay a subscription fee to fund central coordination; engagement programmes have variable public and private funding</td>
<td>Costs associated with licensed accreditation/control programmes are met by participant producers; costs and funding associated with engagement programmes are variable</td>
</tr>
<tr>
<td>USA</td>
<td>State and federally funded in the past, now significantly reduced with the aim to adopt a shared public/private model</td>
<td>Subsidised by federal funds in many states; exact amount varies; reducing as federal funding reduces</td>
</tr>
</tbody>
</table>

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Table 3
Tests utilised for surveillance/control activities for bovine Johne’s disease in 6 endemically infected countries.

<table>
<thead>
<tr>
<th>Country</th>
<th>Direct tests used for surveillance/control</th>
<th>Indirect tests used for surveillance/control</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>Faecal culture (individual following positive ELISA, pooled from over 2 years old and environmental for maintenance in dairy herds). Post-mortem with histology can also follow positive ELISA.</td>
<td>Three commercial serum ELISAs: Parachek&lt;sup&gt;TM&lt;/sup&gt; (PRIONICS); Pourquier Paratuberculosis Screening Test (IDEXX); and ID Screen&lt;sup&gt;®&lt;/sup&gt; (IDVET) (over two year olds with defined proportional sample size for screening; 50 animals over four years old for maintenance).</td>
</tr>
<tr>
<td>Canada (surveillance not performed in all provincial programmes)</td>
<td>Faecal culture (environmental in the Atlantic Johne’s disease initiative) and individual samples (proposed in the Canadian Voluntary Johne’s Disease Prevention and Control Programme) from all over 2 year old in pools of 10 for screening</td>
<td>Proposed in the Canadian Voluntary Johne’s Disease Prevention and Control Programme: Unspecified milk/serum ELISA (up to 100 over 2 year olds or all animals in herds of under 100 for screening) Milk ELISA ID Screen&lt;sup&gt;®&lt;/sup&gt;/ (IDVET) (all milking cows quarterly for screening; in infected herds after 2 years participation test negative cows over 150 days from last calving can be skipped)</td>
</tr>
<tr>
<td>Denmark</td>
<td>None</td>
<td></td>
</tr>
<tr>
<td>Netherlands (MQAP and IPP considered separately)</td>
<td>Intensive Paratuberculosis Programme: Individual or pooled (5 per pool) faecal culture of PCR of all cattle of 2 years and older for screening. Follow up positive pools by individual faecal culture. Milk Quality Assurance Programme: Faecal culture or PCR as confirmatory test following positive ELISA</td>
<td>Intensive Paratuberculosis Programme (IPP): Serum ELISA (IDEXX Paratuberculosis Screening Ab Test) of all cattle 3 years and older. Milk Quality Assurance Programme: As IPP or milk ELISA (IDEXX Paratuberculosis Screening Ab Test) of all milking cows for screening annually (status ‘B’ and ‘C’) or biennially (status ‘A’).</td>
</tr>
<tr>
<td>UK (CHECS licensed accreditation schemes only)</td>
<td>Faecal culture/PCR on individual animal samples (all animals over 2 years old for screening; individual confirmatory test following positive ELISA)</td>
<td>Unspecified milk/serum ELISA (all animals over two years old for screening – quarterly for milk, annually for serum; reduced frequency for maintenance test)</td>
</tr>
<tr>
<td>USA</td>
<td>Faecal or post-mortem tissue culture/PCR as confirmatory test following positive ELISA</td>
<td>Unspecified milk ELISA and serum ELISA (all females over 36 months and males over 24 months for screening; 60 animals for minimum maintenance test)</td>
</tr>
<tr>
<td></td>
<td>Faecal culture/PCR of all females over 36 months/males over 24 months for screening, of 30 samples in pools of 5 or of environmental sample for maintenance</td>
<td></td>
</tr>
</tbody>
</table>

PCR = polymerase chain reaction; ELISA = enzyme-linked immunosorbent assay.

provides certification of test-negative herds and guidelines for control of MAP in infected herds. A Milk Quality Assurance Programme (MQAP) was initiated in 2006 with the aim to reduce MAP contamination of bulk milk (Weber and Schaik, 2007; Weber et al., 2008). Dairy producer participation (in either programme) has been a requirement of dairy processors (through terms of delivery) since 2010. Most milk processors do not collect milk from herds containing test positive cattle (Weber, 2012).

3.1.5. United Kingdom
BJD control activities in the UK are delivered via multiple, independent groups. Ten separate programmes are run by breed societies and laboratories, each of which is licensed by the Cattle Health Certification Standards (CHECS, established in 1998) and operates to a common Technical Standard (CHECS, 2012) regarding herd certification and control guidelines. In addition, there are multiple engagement programmes that aim to increase awareness and uptake of control run by levy-funded industry organisations, veterinary practices, animal health and milk processing companies (SRUC, 2010; Orpin et al., 2012). Some milk retailers require regular testing of suppliers’ herds.

3.1.6. USA
BJD control activities are delivered via state programmes that adhere to minimum standards and utilise a standard herd RA produced by the Voluntary Bovine Johne’s Disease Control Programme (VBJDCP, initiated in 2002). The level of producer engagement can increase from education to management and finally to herd testing/classification. Each state programme has a Designated Johne’s Coordinator to facilitate activities (USDA-APHIS-VS, 2010; Carter, 2011).

3.2. Programme components

3.2.1. Testing and classification of low risk herds
‘Low risk’ herds are considered unlikely to contain infected cattle (with variable confidence in prevalence being below a variable cut-off). These herds typically obtain no positive test results after an initial screen or are located within a known low prevalence geographical area. The testing outlined below requires all negative results unless otherwise stated. Specific details of the direct and indirect tests used are presented in Table 3.

3.2.1.1. Australia. Classifications are defined within the NBJDSP, with herds classified as low risk (with three different levels of confidence) either by being in a low prevalence zone or by participation in CattleMAP, Beef Only or the NDBJDAS. Most herds from Free, Protected or Beef Protected zones require no testing other than follow up of suspicious clinical signs. This also applies to Beef herds in high prevalence ‘Management’ zones that have no dairy.
contact (Beef Only). Biennial testing is required for dairy herds (and beef herds with dairy contact) within Beef Protected/Management zones to be classified as low risk. In each herd, up to 300 cattle >2 years old are tested by ELISA (plus follow up faecal culture on positives). Biennial repeat testing allows progress to lower risk classifications but testing reduced numbers of older cattle allows maintenance of status (AHC, 2012).

3.2.1.2. Canada. Herd classification is not uniform across provincial programmes, and has not been defined in most. The Atlantic Johne’s Disease Initiative (AJDI) lists herds with either one (EC Negative Level 1) or more than one (EC Negative Level 2) negative environmental culture (>10 month test interval) (AJDI, 2012). The CVJDPCP defined two low risk classifications but these have not been implemented in provincial programmes (CVJDPCP, 2006). It was proposed that herds complete an RA and have negative results from either an environmental culture or milk/serum ELISA on up to 100 cattle >2 years old to be ‘Stage One’ (maintained by annual RA review and biennial environmental culture). Progress to ‘Stage Two’ would require annual culture of pooled faecal samples collected from all >2 year olds (pools of 10).

3.2.1.3. Denmark. Herd classifications are defined within the OP. The classification is based on a combination of within-herd prevalence and purchase behaviour. The lowest risk herds must have no introduced (purchased) cattle and all milking cattle tested quarterly. The lowest risk classification (score 1) requires a 95% probability that true prevalence is less than 0.5% using a model described by Sergeant et al. (2008) with sensitivity and specificity estimates that have been published recently (Krogh et al., 2012; Nielsen et al., 2013). It is a minimum requirement that 75% of the herd has been tested within the past year or the herd will be classified as ‘non-tested’. The second lowest risk classification (score 2) is defined for herds with no introduced cattle and apparent prevalence of 0%, but with a true prevalence not less than 0.5% in the model described above.

3.2.1.4. The Netherlands. Within the MQAP herds are considered to be at low risk (of having an estimated >10^3 MAP bacteria per litre in delivered milk) when all milking cattle are negative on milk ELISA (or >3 year olds on serum ELISA) and maintenance is by biennial repeat testing (Weber and Schaik, 2007). These herds are assigned status ‘A’. In the IPP, herds can obtain ‘MAP-free’ status following five annual herd examinations for which all results are negative. The first herd examination consists of serial testing of all cattle >3 years old by serology (ELISA) and individual faecal culture or PCR of seropositive animals. The second to fifth herd examinations each consist of serial testing of all cattle >2 years old by pooled faecal culture or PCR (pools of 5) and individual animal faecal culture or PCR of positive pools. Herds move from Level 6–10 with each negative result, and the status of ‘MAP-free’ (level 10) herds is then monitored by biennial herd faecal examinations (Benedictus et al., 2000; Weber et al., 2006).

3.2.1.5. United Kingdom. CheCS licensed programmes accredit herds according to standards defined within the technical document. These require screening of all cattle >2 years old by (quarterly) milk or (annual) serum ELISA or individual faecal culture/PCR. Test negative herds gain ‘Level 2, one year clear’ classification then progress annually for 3 years to level 1 (only a positive direct test result performed in follow-up to a positive indirect test result will remove low risk status). After maintaining level 1 status for 2 years, the test interval for home-bred cattle (serum ELISA or faecal culture/PCR) is biennial provided all culled cattle are tested (CheCS, 2012).

3.2.1.6. USA. In the VBJDCP, low risk herds must have a RA and up to 300 cows >36 months and males >24 months are tested by milk/serum ELISA or faecal culture/PCR for ‘level 3’ classification. Levels 4–6 are obtained by annual repeat testing and are considered the lowest risk herds. Maintenance testing requires lower numbers or pooled/environmental faecal culture (USDA-APHIS-VS, 2010).

3.2.2. b) Testing and classification for control in high risk herds

Classifications used for herds considered at high risk of containing infected cattle often form part of the scale used for low risk herds. Typically these herds contain at least one test positive bovine animal but they may also be untested herds that are located within a geographical region with known high prevalence or herds that have bought cattle into the herd (regardless of any test results).

3.2.2.1. Australia. Strict testing and control of suspect herds is compulsory except in Management zones and dairy herds in Beef Protected zones (AHC, 2012). Within these zones, the NDBJDAS describes 7 classifications for non-low risk herds: 0 and 1 are for non-tested/suspect herds (highest risk); 3–5 following annual ELISA testing of cattle >2 years old with test-prevalence based classifications (>3% to <1.5%); 6 then 7 with 0% test prevalence repeated annually. Cattle that are protected from potential exposure as calves (using an approved calf rearing programme) are eligible for up to an additional 3 points on their classification (Citer and Kennedy, 2009).

3.2.2.2. Canada. No classification system for infected herds is used in any provincial programme and testing is not compulsory. The CVJDPCP guide recommended that herds should be classified by the number of consecutive years they had implemented RA but this has not yet been adopted by provincial programmes (CVJDPCP, 2006).

3.2.2.3. Denmark. There are 8 classifications for high risk herds based on test prevalence and cattle introduction (purchase) history within the OP (Krogh et al., 2012). Score 3 is for herds with no introduced stock but with test prevalence greater than zero and up to 5%. Herds with introduced cattle cannot gain score 1–3 even with a test prevalence of 0% so would be score 4. Scores 5–9 are test prevalence based with score 10 for non-tested herds (highest risk). Herds participating for >2 years can exclude test negative cows.
Table 4
Requirement for written bio-containment risk assessment and selected bio-containment measures for infected herds as part of bovine Johne’s disease control programmes in 6 endemically infected countries (mandatory/optimal status may differ for accredited low risk herds in respective country).

<table>
<thead>
<tr>
<th>Country</th>
<th>Written bio-containment plan</th>
<th>External auditing of compliance</th>
<th>Whole herd destocking</th>
<th>Immediate cull of clinical cases</th>
<th>Regular whole herd testing (with separate management/preferential culling of test positive animals)</th>
<th>Protective calf management</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>O</td>
<td>Yes (protective calf management)</td>
<td>O^</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Canada</td>
<td>O^</td>
<td>No</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Denmark</td>
<td>O^</td>
<td>No</td>
<td>O</td>
<td>O</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>Netherlands</td>
<td>O^</td>
<td>No</td>
<td>O</td>
<td>M</td>
<td>O</td>
<td>O</td>
</tr>
<tr>
<td>UK (CheCS licensed control schemes only)</td>
<td>O</td>
<td>No</td>
<td>O</td>
<td>M</td>
<td>O</td>
<td></td>
</tr>
<tr>
<td>USA</td>
<td>M^</td>
<td>No</td>
<td>O</td>
<td>M (classified low risk herds only)</td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

M = mandatory for participating herds; O = optional for participating herds though may be strongly advised.

^a As part of a combined bio-exclusion and bio-containment risk assessment.

^b This is a legal requirement in Free zones.

that are >150 days from next calving from the herd test protocol.

3.2.2.4. The Netherlands. In the MQAP, herds with test-positive cattle are assigned classification ‘B’ (if all test-positive cattle are culled) or ‘C’ (if any test-positive cattle are retained in the herd). Herds with status B or C are tested by annual herd examinations consisting of a milk-ELISA of all lactating cattle or a serum-ELISA of all cattle > 3 years of age. If an annual herd examination in a herd with status B yields negative results only, then the herd progresses to status A (Weber and Schaik, 2007). In the IPP, levels 1–4 are designated for infected/suspect herds but only 3 and 4 are currently used. Known infected herds are Level 3 and tested by annual individual faecal culture/PCR of adult cattle (test protocol can be altered after veterinary consultation). Pooled faecal sampling is used in herds with <10% individual cattle positive (pools of 5). Young-stock can be included in herd tests at the discretion of the farmer. Level 4 is used for low risk herds (level 6 or higher) that introduce high risk cattle or have inconclusive test results (Benedictus et al., 2000).

3.2.2.5. United Kingdom. There are 3 classifications for infected herds defined in the CheCS technical document for licensed programmes. Testing requirements are as for low risk herds with score 3 and 4 for herds below and above 3% prevalence, respectively. Herds not participating in a CheCS licensed control scheme are level 5 (highest risk) (CheCS, 2012).

3.2.2.6. USA. Levels 1 and 2 represent low prevalence (test positive) herds in the VBDPC, although most infected herds choose to engage only at the management level rather than progressing to herd classification (USDA-APHIS-VS, 2010). Testing to aid management using environmental culture and prevalence directed individual faecal culture or serum ELISA is advised but not compulsory (Collins et al., 2006).

3.2.3. Recommended control measures for infected herds

Common control measures are presented in Tables 4 and 5. Additional information is provided below. Stock introduction refers to any bovine animal that is brought into a herd (regardless of whether the animal originated from the same country or from outside the country).

3.2.3.1. Australia. In Free zones, destocking of confirmed infected herds is a legal requirement and subsequent cattle sourcing for re-stocking is strictly regulated (AHC, 2012). The alternative bio-containment measures (Table 4) are predominantly optional for most other herds, but may be required in some specific situations (e.g. following detection of infection in a Protected Zone) (AHC, 2012).

3.2.3.2. Canada. Risk assessment and management planning is more coordinated than testing or classification as a national standard veterinary RA (bio-exclusion and bio-containment) was developed by the CJD and is available to all provincial programmes (Barker et al., 2012). Delivery of the RA varies between provinces and any recommended control activities are always voluntary. In Ontario, completion of the RA was required to be eligible for financial assistance for herd testing (OJEMAP, 2012).

3.2.3.3. Denmark. Control measures are implemented following RA by a trained consultant. Individual cows are classified as high, moderate or low risk, based on quarterly milk testing, and preferential culling or separate management (to minimise potential exposure of multiple calves) is advised. Introduction of cattle increases risk score (Nielsen et al., 2007; Krogh et al., 2012).

3.2.3.4. The Netherlands. In both the IPP and MQAP test positive cattle must be culled (Weber and Schaik, 2007). Preventative control measures are farm specific with veterinary input using a standard RA (Para-planner/Para-Infomer). Bio-containment controls are focussed on calf management following modelling research (Groenendaal...
et al., 2003). Stock must not be introduced from higher risk herds in the IPP. In herds with status A in the MQAP, testing of stock introduced from higher risk herds is obligatory for cattle aged ≥ 2 years, and advised for cattle aged 1–2 years.

3.2.3.5. United Kingdom. In addition to the information in Tables 4 and 5, CHeCS licensed programmes are required to complete an annual veterinary plan, remove recent offspring of test-positive cattle quickly (do not retain or sell for breeding), minimise faecal contamination of feed/water, prevent co-grazing with sheep, provide an isolation facility, move cattle off-site for <7 days only, prevent grazing of potentially contaminated pasture, supply mains water only, disinfect shared equipment and load/unload cattle away from main herd. Vaccination is advised for herds with high clinical prevalence (CHeCS, 2012).

3.2.3.6. USA. A veterinary RA and individual cattle identification must be implemented in herds participating in the VBJDCP (USDA-APHIS-VS, 2011). In addition to practices in Table 4 herds must minimise faecal contamination of feed, water, equipment and vehicles, minimise the density of cow-calf pairs (beef) and house weaned young-stock separately from adults (beef and dairy).

3.3. Programme monitoring and review

3.3.1. Australia

The number of infected/lowlow risk herds is published biannually (AHA, 2012) and indicates CattleMAP participation is low and declining (Beef Only is cheaper to maintain) and that uptake of some state control activities in the south east (South Australia) is increasing. The increase is thought to be due to compulsory declaration of risk score at sale in some states, funding from some state producer levies and national industry, promotion by stakeholders, support from dairy processors and reduced ‘stigma’ of infection (Rogers et al., 2012). Factors likely to threaten progress include misplaced reliance on ‘individual business risk’, over estimating stakeholder education and a reliance on limited control tools (Citer and Kennedy, 2012). Risk-based trading removes trade barriers in endemic areas (Citer and Kennedy, 2009).

3.3.2. Canada

Participation in the Ontario programme (with funding) varied regionally between 38 and 70% (Kelton et al., 2012). Around 20% of dairy herds enrolled in the Quebec programme in 2012 but 20% of these dropped out (CAHC, 2012; G. Cote, personal communication). An inter-province investigation of producer attitudes to control indicated that compliance was poor with recommendations considered unnecessary or impractical (Sorge et al., 2010). Other concerns include a lack of education of stakeholders regarding test sensitivity and risks of cattle movement, over-reliance on ‘test and cull’ and a lack of an inexpensive, effective herd test to attract/maintain participation (Kelton et al., 2012; G. Cote, personal communication).

3.3.3. Denmark

The within-herd apparent prevalence for participating herds has dropped by approximately 1% annually since 2006 (Nielsen, personal communication). Significant challenges are reduced funding, a high rate of false positive ELISA results (estimated that most positives in participant herds are now false positives) and the low sensitivity of live cattle direct testing (Nielsen, 2009b; Krogh and Nielsen, 2012).

3.3.4. The Netherlands

Almost all Dutch herds participate in either the MQAP (95% of dairy herds) or the IPP (2% of dairy herds) (Weber, 2012). In 711 herds that joined the MQAP in 2006/2007, there is an increasing proportion of status ‘A’ herds. 30% of these 711 herds have always had ‘A’ status; 15% have always have had ‘B’ or ‘C’ status and 54% have changed status (Weber, 2012).
3.3.5. United Kingdom

Few providers of CHECS licensed programmes publish details of participating herds. The CHECS technical document is reviewed annually. One independent voluntary dairy engagement programme (supported by public funding) reported 2500 participant herds in 2012 (16% of UK dairy farms) with 50% and 80% having poor bio-exclusion and bio-containment RA, respectively (Orpin et al., 2012).

3.3.6. USA

Participation in the VBIDCP peaked in 2007 (9% of dairy herds) then rapidly declined, with several states terminating programmes (Olson, 2010; Patton and Wheeler, 2010; Carter, 2012; Roussel, 2012). Suggested reasons included the removal of federal funding and a lack of perceived economic benefits for participants. Low-risk classifications were less valuable than anticipated. Many herds in Minnesota lost low-risk status due to detection of infection (Roussel, 2012). Future ambitions include increased education of the economic benefits of participation, to develop low cost ‘self assessment’ RA, to build market incentives for low risk herds and to develop shared state/private funding.

4. Discussion

In this review we outline key aspects of bovine Johne's disease control activities across 6 endemically infected countries, to facilitate comparison of current international practices. The greatest challenge in completing the review was ensuring accuracy of the data compiled, given the limited information available in the peer-reviewed literature. Many of the documents used to compile the original review chapters were drawn from non-peer reviewed sources including conference proceedings and websites associated with the control activities. In an effort to ensure accuracy of the compiled information, each original review was sent to between 2 and 5 individuals that were active in coordinating BJD control in their respective countries (18 external reviewers in total). We believe that the data presented is as accurate as could have been obtained for the period considered (February–July 2012). The inevitable delay associated with this review process means that any developments since July 2012 are not presented in this review.

A second significant challenge lay in presenting the results in a uniform format to allow direct comparisons to be made while accommodating for marked heterogeneity in key aspects of control activity design. In Australia there is a single, national programme for all bovine production systems; in Denmark there is a single dairy-only programme and in the Netherlands there are two active programmes, the MQAP and the IPP, with different goals. In Canada there are multiple provincial programmes with minimal coordination, while in the USA multiple state programmes operate to a defined standard. Finally, in the UK there are multiple independent control activities, where the longest established is itself made up of 10 different programmes operating to a defined standard (CHECS licensed schemes). These differences between countries were not the primary focus of the review, though we hope the format of the review provides a sufficient understanding of them to allow direct comparisons of control activity goals, reported challenges, herd certification methods, recommended control measures and all associated testing requirements to be made in context.

There is considerable heterogeneity between the stated goals of the BJD control activities, which include improving food quality assurance (Australia, the Netherlands MQAP), protecting free herds/areas (Australia, IPP in The Netherlands), reducing the number of infected herds (Canada, Denmark, IPP in The Netherlands, USA), providing tools to help producers implement control (Denmark and the UK), providing accreditation of low risk herds (Canada, Denmark, MQAP and IPP in The Netherlands and the UK) and reducing the negative financial, regulatory, social and/or animal welfare impact of infection (Australia, Canada, the Netherlands, UK, the USA) (CVDJCP, 2006; Nielsen et al., 2007; Weber and Schaik, 2007; CJDI, 2009; USDA-APHIS-VS, 2010; AHA, 2012; CHECS, 2012). Eradication is a long term goal in both Denmark and the Netherlands (Benedictus et al., 2000; Nielsen et al., 2007), though the demonstrable achievement would require a more precise definition (Sergeant et al., 2009). The specific goals of a programme often relate to subsequent design of control activities. In Australia, where protecting low risk areas was a priority, animal movement legislation and herd accreditation systems were developed faster than risk classifications to aid control in endemic areas (Citer and Kennedy, 2009). In contrast, when providing tools for control was the priority in Denmark, an accreditation system was only introduced after 5 years (Krogh et al., 2012).

Counteracting a decline in participation is one of the most significant challenges in the USA, the Netherlands (IPP) and Australia, with uncertainty among producers of the cost to benefit ratio of participation being commonly reported as the primary cause. In the USA and Australia, administrators reported that they were over-reliant on ‘individual business risk’ to drive participation (Citer and Kennedy, 2012; Kelton et al., 2012; Roussel, 2012). Economic decision tree analysis for the option of joining a voluntary control programme (Netherlands) found that the preferred option is not to join without a commodity price incentive (Velthuis et al., 2006). However, a milk price differentiation between accredited and non-accredited herds of € 0.005 per litre milk was already sufficient to economically justify participation in the initial assessment of the MQAP (Velthuis et al., 2006).

In response, programmes in several countries have introduced measures to reduce the costs of participation. These include environmental faecal culture for surveillance (Australia, Canada and the USA), reduced testing requirements of low-risk cattle (Denmark), lower test-frequency in test-negative herds than in test-positive herds (IPP and MQAP, The Netherlands) and self-assessment RAs (USA) (van Roermund et al., 2002; Weber et al., 2006; USDA-APHIS-VS, 2010; AHC, 2012; AJDI, 2012). Several programmes have also provided direct government or processor funding to help drive initial participation (USA, Canada, The Netherlands). This can be effective in the short-term but may mask perceived low cost-benefit. In the USA, when direct financial support was subsequently

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reduced, voluntary participation declined rapidly (Olson, 2010). The MQAP (Netherlands) has been strongly supported by dairy processors where milk from test positive herds with test positive cattle is not collected for human consumption by any major milk processor. This makes the cost-benefit of control (at least by culling test positive cattle) indisputable, and participation is very high accordingly. This approach would need careful implementation in lower prevalence areas where the positive predictive value of indirect testing is reduced, though follow-up direct testing would reduce the risk of false positives substantially. There was no significant benefit from trading cattle from certified low risk herds in the USA or Australia (Citer and Kennedy, 2012; Roussel, 2012) though compulsory risk-based trading recently initiated in some states in Australia may stimulate more supportive market conditions.

Herd classification facilitates regionally coordinated control by allowing risk-based trading and providing recognition of progress at individual farm and regional level. Australia, Denmark, the Netherlands and the UK have each defined a system to classify all herds with regard to level of engagement in control activities or apparent prevalence of infection. The highest risk status is typically reserved for non-tested herds in endemic areas. Most scoring systems use test-prevalence as a baseline for classification despite the uncertainty of test results and the costs of regular repeat testing. More recently, additional information including time of participation and recent bio-exclusion and bio-containment practices (assessed by RA tools) have been incorporated into scoring systems in Denmark, Australia and the UK. In Denmark, herds cannot achieve the lowest risk scores if they introduce (purchase) stock (Krogh et al., 2012). In Australia, the risk score for individual bovine animals in dairy herds can be improved by implementing preventative calf rearing practices (Citer and Kennedy, 2009). An engagement programme in the UK uses a combination of test prevalence and results from combined bio-exclusion/bio-containment RA to generate a final herd risk rating (Orpin et al., 2012). Where there are large differences in prevalence of infection between different geographical locations or production systems, these can also be included (as is done in Australia where large areas are very low risk and the beef industry is infected at a lower prevalence than the dairy industry). In Denmark, Bayesian modelling (with information from repeat testing and herd age profile) is used to increase the confidence in low risk classifications (Krogh et al., 2012). In all of these systems, herds that do not participate are given the highest risk rating.

Bio-exclusion control measures focus on introduction of stock in all programmes reviewed, being discouraged (but not forbidden) in all cases. Imposition of official trade restrictions on infected herds was not found to be helpful in endemically infected areas in Australia as it increased the economic and social impact of being classified as infected. Trade restrictions are now being actively removed from the Australian programme and replaced by transparent risk-based trading supported by an appropriate herd classification system. A similar system is being developed in Denmark, and is effective in the Netherlands due to the 97% of herds participating in the IPP or MQAP. In the UK, the USA (levels 1–3 only) and the Netherlands (MQAP only), cattle can be introduced from herds of a higher risk status without loss of the purchasing herd’s classification if post-move testing is carried out (CHecS, 2012). This is permitted to make participation in low-risk classification less inconvenient for producers but increases the risk of introducing infection (Roussel, 2012). In contrast, in Denmark no stock introduction is allowed in the lowest risk categories, and risk associated with the introduced cattle is solely dependent on the risk rating of the herd of origin.

Recommended bio-containment activities are also similar across all control programmes. These focus on calf rearing practices to minimise risk and rate of spread to young cattle (Groenendaal et al., 2003; Ridge et al., 2010; Nielsen and Toft, 2011; CHecS, 2012; Kelton et al., 2012) and identification and preferential culling of high risk cattle. The latter can significantly increase the costs associated with disease control without significantly reducing spread if implemented without effective calf protection practices (Godden et al., 2012; Kelton et al., 2012).

There are differences in the requirement to have a written RA produced by a trained consultant (mandatory in some Canadian provinces, optional in other countries reviewed). The advantages are improved producer education and the opportunity to tailor control measures to individual producers, though costs associated with training and paying consultants are challenging. Plans to introduce ‘self-assessment’ tools are being made in the USA to reduce these costs.

The promotion of regular herd testing to facilitate control also varies across the programmes reviewed (mandatory in the Netherlands and strongly promoted in Australia, Denmark, and some programmes in the UK). The advantages are improved identification of high risk cattle for preferential culling or individual management (particularly around calving). In addition, the regular test facilitates herd classification and may help maintain a focus on implementing preventative management measures for producers. The major disadvantage is the cost and subsequent threat to sustained participation. In the USA, state programmes deliberately promote the implementation of control measures before starting any regular herd testing (USDA-APHIS-VS, 2010).

5. Conclusion

We have reviewed the BJD control activities across 6 countries on 3 continents to facilitate comparison of international practices. The data presented has been extensively reviewed by experts from the respective countries to ensure accuracy, despite a lack of existing peer reviewed original source material. The review highlights several differences in control activity design and goals, herd classification methods, recommended control measures and responses to shared challenges. The data presented here and in the supplementary material available online will be of interest to organisations that are involved in developing new or existing regionally coordinated BJD control activities.
Conflict of interest

No authors had any conflict of interest in the preparation of this document.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at http://dx.doi.org/10.1016/j.prevetmed.2014.06.003.

References


A review of bovine Johne’s disease control activities in 6 endemically infected countries

Supplement 1: Review of bovine Johne’s disease control in Australia

List of Acronyms

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<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>AHA</td>
<td>Animal Health Australia</td>
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<tr>
<td>ANZDP</td>
<td>Australian and New Zealand Standard Diagnostic Procedures for Johne's Disease</td>
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<td>APAV</td>
<td>Accreditation Program for Australian Vets</td>
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<td>BPA</td>
<td>Beef Protected Area</td>
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<td>BVDV</td>
<td>Bovine Viral Diarrhoea Virus</td>
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<tr>
<td>CattleMAP</td>
<td>The Johne's disease Market Assurance Program for Cattle</td>
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<td>CSIRO</td>
<td>Australian Animal Health Laboratory</td>
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<tr>
<td>CVO</td>
<td>Chief Veterinary Officer (state)</td>
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<td>EPDMP</td>
<td>Enhanced Property Disease Management Plan</td>
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<tr>
<td>FEC</td>
<td>Faecal Egg Count</td>
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<td>IN</td>
<td>Infected herd classification</td>
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<tr>
<td>JDCAP</td>
<td>The Victorian State Johne's Disease Calf Accreditation Program</td>
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<tr>
<td>MAP</td>
<td>Mycobacterium avium subspecies paratuberculosis</td>
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<tr>
<td>MN1,2 &amp;3</td>
<td>Monitored negative (1-3) herd classification</td>
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<td>NBJDSP</td>
<td>National Bovine Johne's Disease Strategic Plan</td>
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<tr>
<td>NDBJDAS</td>
<td>National Dairy Bovine Johne's Disease Assurance Score</td>
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<td>NJDCP</td>
<td>National Johne's Disease Control Program</td>
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<td>NSW</td>
<td>New South Wales</td>
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<tr>
<td>PDEP</td>
<td>Property Disease Eradication Plan</td>
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<td>PM</td>
<td>Post Mortem Examination</td>
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<tr>
<td>Qld</td>
<td>Queensland</td>
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<td>SA</td>
<td>South Australia</td>
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<tr>
<td>SCAHLS</td>
<td>Sub-Committee on Animal Health Laboratory Standards</td>
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<tr>
<td>SDR&amp;G</td>
<td>Standard Definitions, Rules and Guidelines</td>
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<tr>
<td>SU</td>
<td>Suspect herd classification</td>
</tr>
<tr>
<td>TCP3</td>
<td>The current Victorian State Voluntary Test and Control Program for Johne's Disease</td>
</tr>
<tr>
<td>Vic</td>
<td>Victoria</td>
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</tbody>
</table>
The Australian National Johne’s Disease Control Programme

1. Industry background
There are currently around 49,000 beef farms in Australia with a national herd estimated at 28 million head of cattle, around 23 million of which are located in the southern and eastern states of South Australia (SA), Victoria (Vic), New South Wales (NSW) and Queensland (Qld) (this figure does not include small scale producers (farmers) where farming is not the primary income source). The dairy sector is much smaller with around 8000 dairy farms and 1.6 million dairy cows. Over 5400 of the dairy farms are located in the small south eastern state of Victoria, and less than 700 dairy herds are located outside of the above states (Fargher and Heffernan, 2011).

2. JD background
JD was first reported in Australia in an imported bull in 1911, and was first reported in home bred cattle in Victoria in 1925 (Ridge et al., 2005). BJD is endemic in the south eastern dairy industry and in small numbers of south eastern beef farms (Victoria, New South Wales, Tasmania, South Australia) but is rare or absent in the rest of the country (AHA, 2012a). The difference in BJD prevalence between states in Australia has been stated to have helped stimulate the development of a nationally coordinated Johne’s disease control programme (AHA, 2012a).

3. Programme Background

3.1 History and Development
The National Johne’s Disease Control Programme (NJDCP) was initiated in 1996, coordinated by Animal Health Australia (AHA; formerly the Australian Animal Health Council), a not-for-profit company established by government (national, state and territorial) and livestock industry stakeholders (AHA, 2012a). The programme has been reviewed and updated regularly since formation. Key developments include:

<1995: Emphasis on state level regulatory control

1996: Initiation of the National Johne’s Disease Control Programme (NJDCP) with priorities to develop a set of rules and definitions and a market assurance programme for sale of cattle from herds with low risk of infection.

1996: Launch of the first National Johne’s Disease Market Assurance Program for cattle (CattleMAP) to provide assurance for sale and movement of cattle from herds with low risk of infection. There are three levels of confidence in disease freedom that herds can achieve, termed ‘Monitored Negative 1-3’ (AHA, 2008).

1997: Launch of the National Standard Definitions and Rules for Cattle governing three areas; (1) to outline criteria for zoning and control of movements between zones; (2) to give guiding principles upon which state and territory governments formulate disease control programmes to suit their circumstances; (3) to complement CattleMAP (AHC, 2012).

1999: Division of the country into zones (free, protected, control and residual zones) and compulsory guidelines on inter-zone movement (requiring some level of herd of origin assessment) (AHA, 2012a). See appendix 1 for current zones and appendix 2 for zone details.
1999: First review of CattleMAP with introduction of a manual for owners and vets, the option to maintain status rather than progress and options to introduce cattle to the herd with appropriate risk management (AHA, 2008).

2001: AHA begins administration of the Accreditation Program for Australian Veterinarians (APAV) which accredits non-government vets to participate in the national animal health system. APAV is similar to the European Official Veterinarian system. Vets must be APAV accredited, have completed the additional National Market Assurance Program training, and be authorised by the state/territory CVO to take part in CattleMAP.

2001: Recognition and differentiation of the national programme into beef and dairy sections, opening up potential to reduce trade restrictions on the minimally affected beef industry.

2003: Endorsement of the National Bovine Johne’s Disease Strategic Plan (NBJDSP) with specific aims to; (1) minimise contamination of farms and farm products by M. avium subspecies paratuberculosis (MAP); (2) to protect the status of non-infected herds while minimising disruption to trade; and (3) minimise the social, economic and trade impact of BJD at herd, regional and national level.

2003: Launch of the 10 point National Dairy Bovine Johne’s Disease Assurance Score (NDBJDAS) to facilitate risk based trading (moving away from zone based regulated trade restrictions) and provide guidance and recognition to infected dairy producers attempting to improve JD status; the score incorporates all existing state scoring systems (primarily from Victoria) and the CattleMAP (DA, 2006) (appendix 3); This is the first time specific bio-containment protocols were included in the national programme in control / residual zones as extra points are gained for calves reared in an audited calf rearing programme. Bovine animals reared under the audited Johne’s disease calf accreditation programme can gain three extra points, and other ‘3 step programmes’ (auditable as part of dairy processors quality assurance programmes) can gain one extra point (AHA, 2003). Declaration of an animal’s score is compulsory for dairy cattle moved or sold in the states of NSW (from 2008) and SA (DA, 2012).

2004: Approval of ‘Beef Only’ herds to allow trade into protected zones in NSW, Qld and SA without herd testing from beef herds with no dairy contact.


2007: 2nd review of CattleMAP which makes a 3 step calf rearing plan compulsory for all dairy herds in CattleMAP (bringing bio-containment guidelines into what was previously a bio-exclusion only programme), options to use electronic records, an exemption where herds include small numbers of other eligible species, and a provision for approval of dairy heifer agistment (rearing) properties among others (AHA, 2008).

2008: Publication of ‘Dairy BJD Technotes’ by Dairy Australia giving best practice recommendations for managing the disease in dairy herds, based on the principles of removing shedders, minimising new infections and avoiding introduction of disease.

2012: Review of the strategic plan with significant changes to the rules and definition with movement to maintain regulatory control in low prevalence populations and establish voluntary
control in endemically infected populations; NSW and the southernmost parts of SA are now classified as a ‘Beef Protected Area’ (BPA) in more formal recognition of the difference between the dairy and beef sectors in these states and regulations remain to limit spread to and within beef herds; Victoria and Tasmania are classified as ‘Management Areas’ (except Flinders Island which is a classified as a protected zone) indicating the disease is well established with control at a voluntary level only, with regulatory control viewed as unsuitable and counter-productive; The NT, Qld and northern SA remain as protected zones and WA remains a free zone. See appendix 1. Publication of a guideline document to increase awareness of the focus on risk based trading within high prevalence populations

3.2 Current Structure
The National Bovine Johne’s Disease Strategic Plan is a sub-programme of the NJDCP that relates to cattle. It is made up of the following key components:

- National guidelines, definitions and rules for compulsory zoning, interzone movements and official control programmes at state level. These are produced by the Animal Health Committee (Committee of National and State Chief Veterinary Officers).
- The National Dairy Bovine Johne’s Disease Assurance Score (NDBJDAS) with compulsory declaration at sale in the dairy compartment of Beef Protected Areas (appendix 3)
- The ‘Beef Only’ herd approval programme (declaration of having no contact with dairy cattle and therefore no requirement for testing to achieve a ‘no evidence of infection’ status); available to qualifying beef herds located within Management Areas
- The National BJD Financial and Non-Financial Assistance Package for infected or suspect beef herds (for helping infected beef herds control or eliminate infection including an Enhanced Property Disease Management Plan EPDMP)
- The Dairy BJD Technotes document giving best practice advice for vets and herd advisors to aid in the management of the disease; other educational material is also available and promoted by Dairy Australia under the banner ‘BJD Aware’ (Condron and Basham, 2012)

The voluntary Australian Johne’s Disease Market Assurance Program (CattleMAP) exists to identify, protect and promote individual herds that are objectively assessed as having a low risk of being infected. CattleMAP is a key component of the NJDCP, but is independent of the NBJDSP.

Diagnostic procedures (relating to diagnosis in all species) are defined in the document ‘The Australian and New Zealand Standard Diagnostic Procedures for Johne’s disease’.

Several state level programmes also exist and have various additional components (e.g. the Victorian Johne’s Disease Calf Accreditation Program – JDCAP (appendix 4); Dairy ManaJD in SA) but all state programmes should be consistent with the NJDCP.

3.3 Programme Aims
The combined stated aims of the NJDCP and the NBJDSP are to:

- Provide a nationally coordinated approach to the management of Johne’s disease in all species (NJDCP)
- Minimise contamination of farms and farm products by MAP (NBJDSP)
Protect the status of non-infected herds while minimising disruption to trade and to minimise the social, economic and trade impact of BJD at herd, regional and national level (NBJDSP) 

(AHA, 2012a)

### 3.4 Organisations Involved

All national coordination is done by Animal Health Australia (AHA; a public, not-for-profit company). The members of AHA are:

- The Commonwealth, State and Territory Governments
- Cattle Council of Australia Inc
- Australian Dairy Farmers’ Federation Limited
- Australian Lot Feeders Association
- Australian Veterinary Association Limited
- The Australian Veterinary Deans
- Various non-cattle related organisation

CattleMAP and the Financial and Non-Financial Assistance for beef herds are all coordinated by Animal Health Australia.

The Cattle Council of Australia (representing the interests of beef producers) and Dairy Australia / The Australian Dairy Farmers Federation Limited (representing the interests of dairy producers) cooperate on individual components of the programme (Financial and Non-Financial Assistance and NDBJDAS) respectively.

The National Standard Definitions, Rules and Guidelines are produced by the Animal Health Committee (comprising the Chief Veterinary Officers (CVOs) of the Commonwealth, states and territories, and New Zealand, along with representatives from the Australian Animal Health Laboratory (CSIRO) and Animal Health Australia).

The Australian and New Zealand Standard Diagnostic Procedures for Johne’s disease (ANZSDPs) were initially produced by the NJDCP Management Committee and are now maintained by the Sub-Committee on Animal Health Laboratory Standards (SCAHLS).

The Dairy BJD Technical Notes for vets and herd advisors are produced by Dairy Australia, a levy funded support organisation of the Australian dairy industry (DA, 2008).

State programmes are administered by respective state governments. In some states (e.g. SA programme Dairy ManaJD) the milk processing companies provide an external oversight and auditing role free of charge that is reported back to the government (Rogers et al., 2012). Auditing is considered desirable but is not yet implemented in NSW (Spence, 2012).

Approved veterinarians (accredited by APAV with additional CattleMAP training) administer and review the management requirements of CattleMAP at farm level (testing, biosecurity advice etc) and conduct an annual ‘internal’ review.
An external auditor, who has completed a MAP orientation programme, and is approved to undertake Livestock Production Assurance Quality Assurance audits (a separate food safety programme run by Meat and Livestock Australia) conducts a three yearly external review focussing on compliance with requirements of CattleMAP.

3.5 Funding

3.5.1 National Coordination
Animal Health Australia is funded by an annual subscription from members (calculated to a formula based on the Gross Value of Production of the industry or jurisdiction using a three-year rolling average) (AHA, 2012a). With the exception of APAV management, which is a pre-requisite of a number of other state programmes and is jointly funded by all members, the other activities of the NJDCP and NBJDSP are funded by a sub-set of members that are the direct beneficiaries of the programme (primarily the Cattle Council of Australia and the Australian Dairy Farmers Association) and directly by participating producers (see below) (AHA, 2012a).

3.5.2 Farm level participation
Producers participating in CattleMAP pay for the required accredited veterinary services, all laboratory testing and follow up testing and can be asked to pay additional fees toward review and administration of the programme. The up-front costs of getting started in CattleMAP (including veterinary guided development of a management plan and the initial screening test) will vary, but are estimated at around AUS$10 (€8) per head of cattle. There is a AUS$220 (€177) rebate available for testing of beef herds to join the CattleMAP and beef herds can also access a AUS$300 (€242) rebate to partially cover the cost of the External CattleMAP audit provided by the Cattle Council of Australia (AHA, 2006).

The Cattle Council of Australia also funds a ‘Financial and Non-Financial Assistance Package’ for beef herds that are suspected of being infected, to resolve status and those that are known to be infected. Funding is available for development of an Enhanced Property Disease Management Plan (EPDMP), testing as part of the EPDMP (including follow-up testing) and slaughter of high risk cattle. Non-financial assistance includes access to a BJD counsellor who acts as a liaison officer between the producer, supervising veterinarian and regulatory authorities and who may assist with developing management options and access to financial assistance (CCA, 2011).

Testing of suspected cases in beef herds (by any surveillance test, see 4.1.1) is funded in Protected and Free Zones and within a BPA by the Cattle Council of Australia (WADAF, 2012). In Victoria, there is subsidised veterinary fees and testing of cattle over 4 years old for some dairy herds that are participating in the states Test and Control Programme (TCP3) using money from the levy funded Victorian Cattle Compensation Fund (VDPI, 2012). In South Australia, funding to subsidise veterinary advice and laboratory testing is available from state government, administered by the South Australian Cattle Advisory Group. The level of funding is currently being reduced and participants are being asked to accept more of the costs of maintaining their herd status (Rogers et al., 2012).

3.6 Voluntary or Compulsory
The following components of the NJDCP are legally compulsory:

- Johne’s disease is notifiable in all areas (AHA, 2012b)
- Zoning rules (including surveillance and control) and restrictions on inter-zone movements
- Quarantine, investigation and appropriate management of suspected cases in Free zones, Protected zones, and beef herds within the Beef Protected Areas
- Declaration of a dairy animals’ NDBJDAS score when sold in a Beef Protected Area (encouraged in a Management area)

Participation in all other components (including the state level control programmes) is voluntary.

In all zones an advisory programme must be in place that promotes disease prevention, recognition and reporting using e.g. distribution of advisory brochures, public meetings, media releases, advertising etc.
4. Programme Components: Surveillance and Control

4.1 Surveillance

4.1.1 Laboratory testing for surveillance

Approved tests for surveillance are defined in the Australian and New Zealand Standard Diagnostic Procedures for Johne’s disease. Briefly, they are:

- Clinical examination (presumptive / differential diagnosis only)
- Post mortem examination and histology
- Bacteriological culture (on individual, pooled or environmental faecal samples)
- PCR (only as a confirmation of bacteriological culture)
- Three commercial absorbed ELISAs: Parachek™ (PRIONICS); Pourquier Paratuberculosis Screening Test (IDEXX) and ID Screen® (IDVET. The assumed characteristics of the ELISAs are sensitivity and specificity of 15% and >99% respectively (Gwozdz, 2010)

These are applied at the herd level to satisfy surveillance in various components of the NJDCP. Test results must be all negative to prevent dropping into an infected or suspect status (see control below). Testing of cattle less than 2 years old is not recognised for diagnostic purposes within any part of the programme.

Table 1: Herd laboratory testing for surveillance of non-infected herds.

<table>
<thead>
<tr>
<th>NJDCP</th>
<th>Name</th>
<th>Application</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>CattleMAP</td>
<td>Sample test</td>
<td>To assess herd status when initially enrolling in CattleMAP or when attempting to improve CattleMAP herd status biennially (dairy and beef herds); or when establishing an NDBJDAS above 0 (non-assessed) separate to CattleMAP (though most dairies achieve this through hygienic calf rearing – see below)</td>
<td>Cattle over 2 years old by ELISA and reactors followed up faecal culture / PM; sample size is all cattle up to 210 then a sliding scale that plateaus at 300 cattle in very large herds</td>
</tr>
<tr>
<td>NDBJDAS / Non ‘beef-only’ beef herds</td>
<td>Maintenance test</td>
<td>To monitor and maintain current status of a CattleMAP herd</td>
<td>Up to 50 cattle by ELISA and follow up faecal culture, all over 4 years old if possible, and including cattle in poor condition and cattle introduced to the herd in the preceding two years</td>
</tr>
<tr>
<td></td>
<td>Check test</td>
<td>Separate to CattleMAP to support a dairy score of 7 (check tested) on a vendor declaration form for 24 months</td>
<td>As for the maintenance test but only homebred cattle and only in herds with no history of disease; or testing the same cattle by individual / pooled faecal culture or by environmental culture (with strict approved veterinarian sampling procedures and on dairy herds only);</td>
</tr>
</tbody>
</table>
4.1.2 Surveillance for zoning
Zoning rules and definitions were significantly updated in June 2012. For zone definitions see appendix 2; rules are described in the National Standard Definitions, Rules and Guidelines document (AHA, 2012b).

Free Zone
**Definition:** An area in which BJD is not known to occur endemically and is eradicated when detected

**Qualification:** An epidemiological analysis demonstrating the probability the population is free from BJD infection, with a high level of confidence, to the satisfaction of AHC.

**Ongoing Maintenance:** A monitoring, surveillance and compliance activity report must be provided each year to the AHC. In a free zone this must include effective early detection and response activity; structures surveillance activity including non-random and population surveillance; effective measures to prevent introduction and spread; more detail on this report is shown in appendix 5. Any breakdowns must be investigated fully under guidelines provided in the Standard Definitions, Rules and Guidelines.

Protected Zone
**Qualifying:** An epidemiological analysis demonstrating the probability that the population has a very low prevalence of BJD, with a high level of confidence, to the satisfaction of AHC.

**Ongoing monitoring:**
As for the free zone, including the structured investigation of suspected disease.

Beef Protected Area
**Qualifying:** Monitoring and surveillance activity verifies the beef compartment has a low prevalence of BJD, to the satisfaction of AHC.

**Ongoing monitoring:** A monitoring, surveillance and compliance activity report must be provided each year to the AHC though the formal guidelines shown in appendix 5 are not compulsory. Structured investigations of suspected infection must take place in beef herds only.

Management Area
**Qualifying:** A management area is declared when the criteria for any of the above zones cannot be met.

**Ongoing Monitoring:** As for the BPA zone, though disease investigations need only to be performed in herds declaring ‘beef only’ status or in the CattleMAP scheme.

4.1.3 Herd Classification for surveillance
For the purposes of surveillance, herds are classified as having no evidence of infection with various degrees of confidence. See appendix three of a schematic representation of the NDBJDAS score. In order of decreasing levels of confidence these are:

- Herds in a free zone or members of CattleMAP at MN3 level (NDBJDAS 10)
- Members of CattleMAP at MN2 level (NDBJDAS 9)


- Members of CattleMAP at MN1 level (NDBJDAS 8); Beef herds in a Management Area that are declared in writing to meet the requirements of the Beef Only classification; Beef herds in a Beef Protected Area that are not known to be infected and that do not include dairy cattle other than those introduced with a CattleMAP MN1 status or greater or any herd in a Protected Zone.

Further classifications of ‘Tested Four Years Old and over’ and Tested to MAP Standard are also described but its equivalent status is not clearly defined (AHC, 2012).

4.2 Control

4.2.1 Laboratory testing for control

Approved laboratory tests for assisting control of infected herds are as for surveillance tests. There is no compulsory laboratory testing of infected herds in the Management Area unless the herd has ‘Beef Only’ status or is in the CattleMAP scheme. However for dairy (and beef) herds entering the voluntary Victorian Test and Control Program there is a requirement to follow the testing protocols of that programme. Beef herds are generally not encouraged to enter the TCP3 as the National financial and Non financial Assistance Package offers more generous support and a quicker resolution of status.

In the Beef Protected Area, an approved control programme is compulsory for suspected / infected beef herds and voluntary for infected dairy herds. In Protected Zones, Free Zones and beef herds in BPAs, an approved control programme (with or without testing) is compulsory in all infected herds. See section 4.2.4 below for more detail.

Table 2: Herd laboratory testing for assisting control of infected herds.

<table>
<thead>
<tr>
<th>NJDCP</th>
<th>Name</th>
<th>Application</th>
<th>Detail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approved control programme / NDBJDAS / EPDMP</td>
<td>Herd test for infected, suspect or non-assessed herds</td>
<td>For infected dairy herds to progress through the infected herd scores of the NDBJDAS (2-6); or as part of an EPDMP for infected beef herds; or as part of an approved control programme where appropriate</td>
<td>Dependent on approved Test and Control programme or EPDMP details (EPDMP testing requirements vary depending on individual circumstances; the eradication method selected under an EPDMPs is the one designed to most cost effectively give the best result, i.e. return to a not assessed status. EPDMPs must be conducted in accordance with the SDR&amp;G. Experience overtime has demonstrated that test and removal of ELISA positives is unlikely to eradicate BJD from a herd. Many herds elect for a partial destock after a rigorous risk assessment which includes a determination for risk of exposure, whether the disease is in introduced or homebred animals). Currently the TCP3 in Victoria requires ELISA of all over 4 year old with no follow up testing of positives (reactors must be culled within 30 days).</td>
</tr>
</tbody>
</table>
4.2.2 Herd Classification for control
For the purposes of control, herds can be classified as non assessed (NDBJDAS 0) or suspect / infected (NDBJDAS 1). A number of situations can lead a herd to be classified as suspect, including contact with an infected herd and herds containing cattle with a positive test reaction or clinical signs that have not yet been resolved.

Infected herds are those with an infected home-bred animal or an infected purchased animal (confirmed by an approved laboratory test) where there has been potential for spread.

Infected and recently test negative dairy herds are further classified in the NDBJDAS (appendix 3) into:

- Tested high prevalence – average annual test reactors / clinical cases is over 3% (or 4% if only over 4 year olds are tested) (NDBJDAS 2)
- Tested moderate prevalence – average annual test reactors / clinical cases is 1.5% - 3% (or 2% - 4% if only over 4 year olds are tested) (NDBJDAS 3)
- Tested low prevalence - average annual test reactors / clinical cases is under 1.5% (or 2% if only over 4 year olds are tested) (NDBJDAS 4)
- Restricted 1 – one negative test more than 12 months after removal of last known infected animal (NDBJDAS 5)
- Restricted 2 – two negative tests over two years apart with the first 12 months after removal of last known infected animal (NDBJDAS 6)

Note: A similar status progression applies to beef herds (Evan Sergeant, personal communication).

Implementation of an approved calf rearing programme (appendix 4) can allow an infected herd to increase the NDBJDAS (for eligible cattle) by three points if part of the Johne’s disease calf accreditation programme (JDCAP) and by one point if part of a 3 step dairy processor auditable calf rearing programme (AHA, 2003; Bell, 2012).

4.2.3 Cattle movements

Infected cattle
Movement of known infected cattle, other than to slaughter, is controlled by regulation in all zones, other than the Management Zone, where there is a requirement to disclose status at the point of sale. Cattle showing signs of Johne’s disease must not be slaughtered for human consumption (regulated through Australian Meat Standards).

Cattle from infected / suspect herds
Movement of cattle from infected or suspect herds, other than to slaughter, is forbidden in Free and Protected Zones. In Beef Protected Areas, ‘high risk cattle’ (normally, but not always, all cattle from an infected / suspect herd) will be under the same restrictions.

Within and between zone movements
The regulations governing movement of cattle between zones and within zones are summarised in appendix 6 (beef cattle) and 7 (dairy cattle).

Briefly, beef cattle can only move to:
The Free zone if they are not from a Suspect or Infected herd and:

- Monitored Negative 3 Status from the Management Area or
- Monitored Negative 2 or 3 Status (or Check Test or TMS) from the Beef Protected Area or
- have only ever been resident in the Protected Zone.

The Protected Zone if they are not from a Suspect or Infected herd and:

- Monitored Negative 1 Status or from a beef herd with no dairy introductions since 2008 or Dairy Score 8 if in the Beef Protected Area or
- Monitored Negative 1 Status or Dairy Score 8 or Beef Only Status if from Management Area

The Beef Protected Area if they are not from a Suspect or Infected herd and:

Monitored Negative 1 Status or Dairy Score 8 or Beef Only Status or CT Status with a test in last 12 months or TMS or T4YO status if from Management Area

Non Beef Only cattle can only move into the BPA if they are from a check tested herd.

Dairy cattle can move from a management area to a dairy herd in the BPA provided the dairy score is declared, and require MN1 status to enter a Protected Zone and MN3 status to enter a Free Zone. Some exceptions to these rules (e.g. for cattle moving into a feedlot, directly to slaughter or for desexed animals) are defined in the SDR&Gs.

In addition to these, herds in CattleMAP can generally only introduce stock from herds with similar or higher scores, though there are limited exceptions for small numbers of cattle, always requiring that the herd of origin has tested evidence of non-infection. Herds in the Victorian TCP3 can only introduce stock from herds with equivalent or higher NDBJDAS score.

4.2.4 Control on infected herds

There are three specific compulsory control measures to be used as part of the NJDCP.

1. **Property Disease Eradication Plan** – destocking and decontamination or an Approved Test and Control programme (see below) with the specific goal of return producers to unrestricted trading as quickly as possible; an Approved Enhanced Property Disease Management Plan is also described and is very similar but has the additional requirement of restocking from Beef Only or higher herds

2. **Approved Control Program** – A CVO approved program that addresses:

   1. Preventing spread to other farms
   2. Identification of high risk cattle for preferential culling
   3. Calf husbandry to prevent infection of replacement and introduced stock (the national 3 step calf plan applicable only to dairy herds – appendix 4)
   4. Control of dairy effluent discharges (where applicable)
   5. Maintenance of accurate breeding records and cattle identification

3. **Approved Test and Control Program** – As for an Approved Control Program plus regular herd testing, culling of reactors and restrictions on introductions

These control measures are used in the following circumstances:
• All infected herds in free zones must have a PDEP put in place.
• Any infected herd (beef or dairy) in Protected Zones, and infected beef herds in a BPA, must have an approved control programme, test and control programme or PDEP implemented.
• Infected dairy herds in a BPA or in a Management Area are not subject to compulsory controls.

However, voluntary control of infected dairy herds in a Management Area or dairy compartment of a BPA is recognised by progression through the NDBJDAS, and is supported by state programmes / initiatives. In Victoria, the Victorian Voluntary Test and Control Programme (TCP3) is available for some herds (VDPI, 2012). This is very similar in structure to an Approved Test and Control Program. Briefly, it comprises:

• Annual ELISA testing and designation of a preferential cull list
• Department veterinary advice
• Calf rearing as defined and audited in the Johne’s Disease Calf Accreditation Program (JDCAP) (removal of the calf from all sources of adult effluent from 12 hours until 12 months; Colostrum and milk from test negative cows / artificial replacer only)
• Movement restrictions

4.2.5 Control on non-infected herds
Non-infected herds are not subject to any additional control measures other than the movement restrictions and surveillance activities detailed above.

CattleMAP herds have additional requirements to have a biosecurity plan in place (appropriate boundary fences, stock identification and stock handling facilities, compliance with animal movements onto the property and testing protocols) and to carry out an annual risk assessment in conjunction with the supervising veterinarian. Dairy herds in the CattleMAP scheme must comply with a 3 step calf rearing plan audited by standard CattleMAP auditors (appendix 4).
5. Monitoring and Review

5.1 Surveillance Monitoring

The number of known infected cattle herds and CattleMAP herds, listed by state, is published every 6 months in the Official Newsletter of the National Johne’s Disease Control Program and is publicly available through the National Animal Health Information System.

Data were available from June 2003 – September 2010 at the time of writing (2012). General trends are that the number of known infected beef herds is declining but data for dairy herds is not readily available because there is no surveillance or tracing undertaken from dairy herds in the Management Area where the majority of Australian dairies are located. Over 80% of infected herds (dairy and beef) are in Victoria and changes in the national number primarily reflect changes only in this state. See appendix 8. More recent figures are available quarterly at http://nahis.animalhealthaustralia.com.au/public.php?page=out_showtable&outputid=40. For the period April–June 2012 there are 1123 infected cattle herds reported, of which 1034 are located in Vic and NSW.

The number of herds participating in the CattleMAP programme is declining steadily, in part due to the development of a Beef Only status which provides some level of assurance and is cheaper to maintain than a CattleMAP status. See appendix 8.

In South Australia, participation in the state programme (Dairy ManaJD) was reported recently. In 2011, more than 95% of dairy producers were enrolled in the programme (Rogers et al., 2012). Various factors were listed as likely to having help achieve this level of participation including the legislation requiring declaration of NDBJDAS score at sales, funding from the state, positive promotion of the programme by all industry and state government stakeholders, support from dairy processor auditors and a gradual reduction of the ‘stigma’ of being infected and a visit to all non-enrolled herds in 2006 and 2007 by a high profile veterinary practitioner (Rogers et al., 2012).

In NSW the prevalence of known infected herds was reported in 2011 as 11% (86 from 813) in the dairy industry and 0.03% (28 from around 80,000, including all ‘non-commercial’ units) in the beef industry (Spence, 2012).

5.2 Programme Monitoring and Review

Various components of the NJDCP have been reviewed and refined since 1996. This has allowed the NJDCP to adopt new testing procedures, and to refine its structure to accommodate the requirements of recent initiatives such as the NBJDSP and to address stakeholder concerns such as excessive trade restrictions.

The SDR&Gs, currently in the 8th Edition, are regularly reviewed. Recent additions of note include specification of environmental faecal culture and pooled faecal culture to be used as a Check Test in dairy herds and inclusion of the NDBJDAS to facilitate a move toward un-regulated voluntary control in dairy cattle populations (e.g. in Management Areas and the dairy compartment of BPAs).

The CattleMAP programme has been reviewed twice previously and will also continue to be progressively reviewed.
In a recent retrospective analysis of the first 16 years of the programme (Citer and Kennedy, 2012) the following factors were highlighted as being likely to reduce the success of the national programme:

- over estimating the level of understanding and interest in Johne’s disease control of many producers and advisers have when there are competing issues to manage
- assuming that regional and local stakeholders will automatically support a programme designed to deliver national benefits. At times a regional community may place local sectoral interests over the national benefit
- a misplaced reliance on ‘individual business risk’ alone to drive disease control, where short term business priorities, such as sourcing replacement stock, over-ride longer term biosecurity interests
- reliance on only a subset of disease control prevention tools rather than implementing a comprehensive range

In a publication in 2012, the following benefits to moving to risk based trading in management (high prevalence) zones were noted:

- Recognises the need to cater for all producer circumstances
- Removes impact of regulation on individual producers with infected herds or flocks
- Provides trading options while reducing the risk and rate of disease spread
- Provides tools to help producers of infected herds or flocks continue to trade
- Increases awareness and understanding of Johne’s disease risk
- Promotes low risk herds and flocks as sources of replacements (AHA, 2012b)

5.3 Areas of Concern of Current Administrators

The recent endorsement of a revised National BJD Strategic Plan has confirmed stakeholder support for the continuation of the NJDCP and its sub-programmes. However the political and economic environment in which the revised BJD strategic Plan will be implemented is likely to pose a number of different constraints to those in place when the original plan was agreed.

In no particular order:

- Reduced funding for animal health, especially endemic diseases in Australian government departments
- Use of a Public good ‘test’ to determine level of government investment in animal health programmes
- Loss off corporate knowledge as senior and middle management decision makers retire or assume other roles in the national animal health system
- Competing animal health priorities and the need for industry to prioritise the allocation of finite financial resources
- Loss of technical capability in the operational aspects of disease control programmes as government departments, and to a lesser extent industry focuses attention on risk mitigation against the possible introduction of exotic diseases
A misplaced reliance on ‘individual business risk’ alone to drive regional disease control, where short term business priorities, such as sourcing replacement stock, over-ride longer term biosecurity interests

(Lorna Citer and Evan Sergeant, personal communication).
Appendices

Appendix 1: BJD Zoning in Australia is changed in 2012 (AHA, 2012b)

Appendix 2: Description of BJD zones in Australia

<table>
<thead>
<tr>
<th>Zone</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Management area</td>
<td>An area in which infection is managed by the owner under a voluntary assurance approach for movement between herds and voluntary control measures within the herd</td>
</tr>
<tr>
<td>Beef protected area</td>
<td>An area in which there is generally a low prevalence of infection, but which contains a defined Dairy Compartment in which infected herds are present</td>
</tr>
<tr>
<td>Protected Zone</td>
<td>An area in which BJD occurs at very low prevalence and strict regulatory control is implemented upon detection to prevent further spread and lead to eradication</td>
</tr>
<tr>
<td>Free Zone</td>
<td>An area in which BJD is not known to occur endemically and is eradicated when detected</td>
</tr>
</tbody>
</table>
Appendix 3: Overview of the National Dairy BJD Assurance Score (DA, 2006)

National Dairy BJD Assurance Score

HERD TESTING PATHWAY

- CattleMAP MN3: 10
- CattleMAP MN2: 9
- CattleMAP MN1: 8

HYGIENIC Calf Rearing Pathway

- Check Tested: 7 - Cattle eligible for calf credits
- Restricted Stage 2: 6 - Cattle eligible for calf credits
- Restricted Stage 1: 5 - Cattle eligible for calf credits
- Low Prevalence: 4 - Approved Hygienic Calf Program (Implemented for 4 years onwards)
- Moderate Prevalence (Non-Assessed before July 2006): 3 - Approved Hygienic Calf Program (Implemented before July 2006)
- High Prevalence: 2 - Approved Hygienic Calf Program
- Infected or Suspect: 1 - Approved Hygienic Calf Program
- Non-Assessed (After July 2006): 0

Further Testing & Management

Has the herd been tested and an approved control program been implemented?

- NO
- YES

Implement an approved hygienic calf program

Test

- 1 No Action

CattleMAP
Control Program
Infected
Suspect
Non-Assessed
Appendix 4: The 3 step calf plan developed by the national Dairy Industry and incorporated in the Victorian TCP and promoted by Dairy Australia; implementation of the plan can increase a farm’s NDBJDAS score (see appendix 3) (DA, 2006)

STEP 1
Calves should be taken off the cow within 12 hours of birth. Prompt calf removal reduces the exposure to potentially infectious material from either the dam or the environment. Young calves are most susceptible to infection.

STEP 2
Management of the calf-rearing area should ensure that no effluent from animals of susceptible species comes into contact with the calf. Effluent containing faecal material from cattle or goats, alpaca and deer is potentially infectious to calves. By keeping the calf-rearing area free of effluent sources, calves will also be less likely to develop other infections.

STEP 3
Calves up to 12 months old should not be reared on pastures that have had adult stock or stock that are known to carry bovine Johne’s disease on them during the past 12 months. Cattle develop age-related resistance to Johne’s. By the time cattle are 12 months old they are at low risk of becoming infected.
Required content of the monitoring report for Free and Protected zones (AHA, 2012b)

For the Free and Protected Zones, the monitoring, surveillance and compliance programme must include:

1. Effective early detection and response activity including:
   a. awareness programme to enhance recognition of clinical signs and reporting
   b. promotion and use of a standard Adult Bovine Scour Diagnostic Package (see Appendix 1, section 11)
   c. investigation of suspect clinical cases and SU herds using recognised diagnostic procedures (see Appendix 1, sections 1–3) to confirm or exclude Johne’s disease
   d. tracing to and from IN herds to identify the source and possible further spread of infection, with investigation of the traced animals and herds (see Appendix 1, sections 1–3) to confirm or exclude Johne’s disease

2. Structured surveillance activity which may include non-random surveillance activity and population based surveys:
   a. notifiable disease reports
   b. laboratory records of testing for veterinary diagnostic investigations, research, movement and MAP purposes
   c. identification and investigation of high-risk herds
   d. inspection of susceptible livestock at aggregation points (abattoirs, knackery, saleyards)
   e. serological monitoring in accord with Appendix 1, section 15 for northern reactor cattle
   f. use of pooled faecal culture (PFC) to assess herds or groups of animals
   g. use of the Herd Environmental Culture to assess dairy herds
   h. systematic sampling at slaughter.

3. Effective measures to prevent the introduction and/or spread including
   a. awareness programme to enhance knowledge of movement restrictions
   b. legally prescribed movement restrictions into the zone (consistent with cattle regulations – see appendix X)
   c. monitoring of compliance with importation conditions using the NLIS database or/and other methods, such as permits, health certification, declaration or waybill system
   d. monitoring of movements from high-risk herds within the zone using NLIS database and/or other methods
   e. random or targeted compliance checks at checkpoints, saleyards or on properties
   f. investigation by an inspector of any alleged breach of movement restrictions, with penalties for non-compliance or false declarations
   g. quarantine of all IN, RD, TLP, TMP, THP and SU herds within zone with movement from the herd only in accord with section 2.6

4. Information management system to collate and report on monitoring, surveillance and compliance activity

5. An epidemiological analysis must be undertaken on a five yearly basis to maintain Free Zone and Protected Zone status.
Appendix 6 – Within and inter zone movement requirements for beef cattle (AHC, 2012)

**BEEF CATTLE**

**Free Zone**
High-risk animals from IN or SU herds to slaughter only, except with CVO approval. Animals from SU herds with CVO approval. No BJD restrictions for other herds. No BJD restrictions for other herds.

Mandatory health certificate\statement; declaration that cattle were born and grazed only in a BJD Protected Zone in NT, QLD or SA and have grazed only with cattle that meet these conditions.

**Protected Zone**
High-risk animals from IN or SU herds to slaughter only, except with CVO approval. Animals from SU herds with CVO approval. No BJD restrictions for other herds.

Mandatory health certificate\statement; MN1 CattleMAP herd or beef herd that has not introduced dairy or dairy-cross cattle since 1 March 2008, unless at or above Dairy Score 8.

**Beef Protected Area**
Restrictions for IN or SU status herds. Mandatory declaration of Dairy Score from Dairy Compartment herds.

Mandatory health certificate\statement; MN1 CattleMAP status, CT status, TMS or T4YO with a herd test or within the last 12 months.

**Management Area**
No restrictions for movement within the area. Voluntary declaration of CattleMAP or Beef Only status is encouraged.

Mandatory health certificate\statement and MN3 CattleMAP status.
Appendix 7 – Within and inter zone movement requirements for dairy cattle (AHC, 2012)

**DAIRY CATTLE**

**Free Zone**
High-risk animals from IN or SU herds to slaughter only, except with CVO approval. Animals from SU herds with CVO approval. No BID restrictions for other herds.

- Mandatory health certificate\statement and MN3 CattleMAP status.

**Protected Zone**
High-risk animals from IN or SU herds to slaughter only, except with CVO approval. Animals from SU herds with CVO approval. No BID restrictions for other herds.

- Mandatory health certificate\statement and MN1 CattleMAP herd.

**Dairy Compartment of the Beef Protected Area**
Mandatory declaration of Dairy Score.

- Mandatory health certificate\statement and declaration of Dairy Score.

**Management Area**
No restrictions for movement within the area. Voluntary declaration of Dairy Score is encouraged.

- Mandatory health certificate and MN3 CattleMAP status.

- Mandatory health certificate\statement and MN1 CattleMAP herd.
Appendix 8: Number of known infected herds (blue line) and low risk herds with CattleMAP status (red line) as published in the Official Newsletter of the National Johne’s Disease Control Programme (AHA, 2012a).

This is a composite of infected beef and dairy herds, though infected dairy cattle in Management and Beef Protected Areas are not necessarily traced.
References


A review of bovine Johne’s disease control activities in 6 endemically infected countries

Supplement 2: Review of bovine Johne’s disease control in Canada

List of Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>ACAAF</td>
<td>Advancing Canadian Agriculture and Agri-Food Program</td>
</tr>
<tr>
<td>BMP</td>
<td>Best Management Practice</td>
</tr>
<tr>
<td>CAHC</td>
<td>Canadian Animal Health Coalition</td>
</tr>
<tr>
<td>CCA</td>
<td>Canadian Cattlemen’s Association</td>
</tr>
<tr>
<td>CJDI</td>
<td>Canadian Johne’s Disease Initiative</td>
</tr>
<tr>
<td>CVJDPCP</td>
<td>Canadian Voluntary Johne’s Disease Prevention and Control Program</td>
</tr>
<tr>
<td>DFC</td>
<td>Dairy Farmers of Canada</td>
</tr>
<tr>
<td>JD-PP</td>
<td>The Johne’s disease prevention pathway</td>
</tr>
<tr>
<td>JD-SP</td>
<td>The Johne’s disease herd status pathway</td>
</tr>
<tr>
<td>OJEMAP</td>
<td>Ontario Johne’s Education and Management Assistance Program</td>
</tr>
<tr>
<td>OMAFRA</td>
<td>Ontario Ministry of Agriculture, Food and Rural Affairs</td>
</tr>
<tr>
<td>RAMP</td>
<td>Risk Assessment and Management Plan</td>
</tr>
<tr>
<td>USDA</td>
<td>United States Department of Agriculture</td>
</tr>
</tbody>
</table>
The Canadian Voluntary Johne’s Disease Prevention and Control Program

1. Industry background

There are 12,746 dairy farms in Canada (in 2012), with an average herd size of 72 cows. There is an active dairy industry in all provinces although over 10,000 of the dairy farms are situated in the provinces of Quebec and Ontario. The total number of dairy cows is estimated at 987,000 plus an additional 443,100 dairy heifers (CDIC, 2012) and a detailed provincial overview is available at http://www.dairyinfo.gc.ca/index_e.php?s1=diff-ferme&s2=farm-ferme&s3=nb. Milk production is regulated at the provincial level. The beef industry is larger with an estimated 83,000 farms, 4.47 million cattle and an average herd size of 61 cows. All provinces have some beef production, although 70% of beef cattle are located in Alberta and Saskatchewan (CB, 2012). A detailed overview is available at http://www.beefinfo.org/Default.aspx?ID=16&ArticleID=31&SecID=1.

2. JD background

There are various published investigations of Johne’s disease prevalence in Canada. Individual cattle seroprevalence estimates across the Provinces range from 1.3% (Prince Edward Island) to 7% (Alberta), with herd level prevalence, based on at least two seropositive cattle, ranging from 9.8% (Ontario) to 43.1% (Manitoba) (Tiwari et al., 2006). A study of cull dairy cows in the Atlantic Provinces indicated an individual cattle histological / culture positive prevalence of 16.1% (McKenna et al., 2004). Due to differences in study design and test limitations, it is not known whether there are differences in true prevalence between provinces. Sero-prevalence studies in beef herds have reported individual cattle and herd level prevalence (based on 2 positive cattle) of 1.5-4.5% and 2.3-23.4% respectively (GA-ARD, 1998; VanLeeuwen et al., 2006; Scott et al., 2007).

3. Programme Background

3.1 History and Development

2002: Formation of the Canadian Animal Health Coalition (CAHC), a project driven organisation addressing issues of concern to industry and government, funded by industry and government (CAHC, 2012a)

2006: CAHC develops the Canadian Voluntary Johne’s Disease Prevention and Control Program (CVJDPCP) guidelines by utilising and building on the regional programme from Alberta and drawing from a pilot programme in Ontario with influences from Australia, the Netherlands and the US (CVJDPCP, 2006). Formation of the Canadian Johne’s Disease Initiative (CJDI) led by the Dairy Farmers of Canada (DFC), the Canadian Cattlemen’s Association (CCA) and the CAHC. The CJDI aims to reduce the prevalence of Johne’s disease by highlighting the importance of JD prevention at the national level and coordinate key activities beneficial to provincial JD control programmes (CVJDPCP, 2006).

2007: Initiation of the Quebec Voluntary Paratuberculosis Prevention and Control Program (Barker et al., 2012)

2010: Initiation of the Alberta, Ontario and Manitoba Provincial control programmes (Barker et al., 2012).

3.2 Current Structure

The CVJDPCP, coordinated by the CJD, currently consists of several provincial programmes (in various stages of development and implementation) and each with its own unique structure. Guidelines for coordination of provincial programmes were produced in 2006, though provincial programmes have not adopted them uniformly. There is therefore minimal national coordination of Johne’s disease control in Canada at present.

The CVJDPCP (2006) document outlines two pathways for participant herds (never implemented in any provincial programme):

1. **The prevention pathway (JD-PP)** suited to herds not committed to testing allowing an entry point for high prevalence herds; no testing is required with herds cycling through annual (10-14 monthly) repetition of Best Management Practice (BMP) assessments. Eventually the herd can test to monitor progress or enter into the JD-SP.

2. **The herd status pathway (JD-SP)** suited to low prevalence / negative herds interested in testing to achieve confidence in and recognition of a low prevalence status.

The CJD has a policy to encourage dairy producers (farmers) into the prevention pathway as a priority, as this allows participation with minimal herd testing requirements (CAHC, 2012a). As a result, the current provincial programmes require minimal or no herd status pathways for low prevalence herds and most provincial programmes are currently available to dairy producers only. A Johne’s disease information sheet for beef producers, (broadly consistent with the detail of the CVJDPCP 2006) has been produced and a pilot beef project is currently underway in Ontario (CJD, 2011).

The following broad components are consistent between all provincial dairy programmes (Barker et al., 2012).

- Education of producers, veterinarians and the public
- On-farm risk assessments administered by trained veterinarians
- Testing (at herd and / or cow level)
- Applied research

The on-farm risk assessments are the most consistent part of the provincial programmes (due to national standards being developed by a CJD technical committee). The detail of the other components varies significantly between provinces, particularly in herd testing and classification (Barker et al., 2012). The Quebec, Ontario, Alberta and Atlantic programmes are sufficiently developed to have information from them included in this review.

To give an example, the key components of the Ontario Johne’s Education and Management Assistance Program (OJEMAP) are:

- Education of producers, advisors and public regarding Johne’s disease through a range of activities including newsletters and periodic articles. A Johne’s disease Focus Farm pilot
The Alberta Johne’s Disease Initiative has the aim ‘to increase the awareness of JD in the Alberta dairy industry and encourage the implementation of Best Management Practices’ as well having other more specific participation goals (Ollis, 2011; AM, 2012).

3.4 Organisations Involved
The CAHC is a not-for-profit organisation serving Canada’s farmed animal industry. Its members include the Canadian Animal Health Institute; Canadian Beef Breeds Council; Canadian Cattlemen’s Association; Canadian Colleges of Veterinary Medicine; Canadian Livestock Genetics Association; Canadian Meat Council; Canadian Veterinary Medicine Association and the Dairy Farmers of Canada; as well as a number of non-veterinary / bovine organisations (CAHC, 2012a).

The CJDI is a collaborative organisation with members from industry, government and veterinary schools, led by the Dairy Farmers of Canada, The Canadian Cattlemen’s Association and the Canadian Animal Health Coalition (the first two are members of the last) (CAHC, 2012a). Within the CJDI there is both an advisory and technical committee.

Provincial programmes have representation from producer groups, provincial government, universities, milk recording organisations and veterinary associations. With the exception of Quebec, all provincial programmes were initiated by producers; in Quebec the programme was initiated by the provincial government but with strong producer support (Barker et al., 2012). As an example, the OJEMAP partners’ are shown in appendix 2.

National coordination is aided by each province having a provincial coordinator responsible for increasing awareness of JD and the control programme, distribution of educational material,
facilitating veterinary training, participating in national coordination activities and collecting and reporting data to the national data collection centre (The Canadian Animal Health Surveillance Network) (CVJDPCP, 2006).

The current risk assessment documentation used in the provincial programmes was developed from an existing model produced by the Ontario Ministry of Agriculture, Food and Rural Affairs (OMAFRA) and CanWest DHI (a not-for-profit milk recording organisation) (CVJDPCP, 2006).

In the Atlantic, Alberta and Ontario provincial programmes the vet that conducts the risk assessments must first be trained and certified by the respective organisers (AJDI, 2012; AM, 2012; OJEMAP, 2012)(Ann Godkin, personal communication).

In the Atlantic programme, sample collection for environmental culture must be done by appropriately trained project personnel (AJDI, 2012).

All testing required by the provincial programmes is provided by laboratories that are accredited to perform the specific tests they offer (Barker et al., 2012).

3.5 Funding

3.5.1 National / Provincial Coordination

Initial funding for the CJD came from the Advancing Canadian Agriculture and Agri-Food Program (ACAAF – a national government programme) and from industry (CAHC, 2012a). It is currently funded by the Dairy Farmers of Canada (representing and funded by dairy producers) and the Canadian Cattlemen’s Association (representing beef producers and funded provincially by ‘check-off’ tax revenues from sale of cattle) (Barker et al., 2012).

Funding for each of the provincial programmes comes from both government and industry (see appendix 1). As an example, the OJEMAP funders are shown in appendix 2 (OJEMAP, 2012).

3.5.2 Farm level participation

Funding for farm level participation varies with each provincial programme. All provincial programmes offer some level of direct financial assistance for participant producers.

Producers participating in OJEMAP must pay the private veterinarian for the initial risk assessment and management plan (RAMP) assessment annually. For a single herd test of all lactating cattle (serum or milk ELISA completed once within a 90 day time window), producers can receive a reimbursement of $8 (€6) per head tested. In order to be eligible for this money, the RAMP must have been completed, and any cattle with a ‘high titre’ must be considered at high risk of shedding and be removed from the herd (not to another herd or the food chain) within 90 days of testing. A further $500 (€383) is available per ‘high titre’ bovine animal removed from the herd, to aid further on farm Johne’s disease control. These cattle are not permitted to enter the food chain (Kelton et al., 2012a; OJEMAP, 2012).

In the Atlantic Johne’s Disease Initiative, herd screening tests (environmental culture) and veterinary risk management assessments are fully funded and individual bovine animal tests are partially funded in herds with a positive screening test (AJDI, 2012).
In Quebec, the government funds 75% of the veterinary risk assessment and follow up visit in the first two years, and 40% of laboratory fees (Genevieve Cote, personal communication).

In Alberta, the vets receive $200 (€155) when they complete a risk assessment; all additional costs are borne by the producer.

### 3.6 Voluntary or Compulsory

Participation in all of the provincial programmes is currently voluntary. From those participating there are some components of the provincial programmes that are compulsory in order to receive direct producer funding (lab fee reimbursement, payments following culling of test positive cattle).

In the OJEMAP, in order to qualify for test funding and payments following culling of test positive cattle, a RAMP must be completed and any high titre cattle must be culled from the herd within 90 days of testing, without going to another herd or the food chain (OJEMAP, 2012).

In Quebec, all producers who wish to access their results must sign an affidavit stipulating that they will not sell any test positive cattle, which is enforced through a provincial cattle traceability programme not available outside of Quebec at this time (Barker et al., 2012).
4. Programme Components: Surveillance and Control

4.1 Surveillance

Surveillance activities (of low prevalence / test negative herds) are poorly coordinated between provincial programmes. There is a proposed structure for surveillance of low prevalence / test negative herds laid out in the CVJDPCP (2006) termed the ‘Herd Status Pathway’, but it has not yet been implemented in any provincial programme. It is outlined below, though it is not clear whether this structure will be utilised by the provincial programmes as they develop. Only the AJDI has distinct classification guidelines.

4.1.1 Laboratory testing for surveillance

The CVJDPCP (2006) guidelines state that the minimum herd testing suitable for surveillance of low prevalence herds include ‘strategic’ environmental faecal culture or a milk / serum ELISA on 100 randomly selected cattle in their second lactation or over (or all such cattle if there are less than 100 in the herd). A second level of testing for surveillance includes testing of all cows in their second lactation or older by pooled faecal culture (10 cows or less per pool) (CVJDPCP, 2006).

Neither of these have been implemented in any provincial programme.

4.1.2 Herd Classification for surveillance

According to the CVJDPCP (2006) guidelines, herds that have completed a BMP assessment within the last 6 months and that have only negative results from a minimum herd test (see 4.1.1) are eligible for ‘Stage One’ status. Such herds are able to maintain this ‘Stage One’ status by repeating the BMP assessment annually and obtaining negative results from strategic environmental faecal sample culture every two years. If a positive result is obtained, individual faecal culture of all cattle, followed by removal of culture positive cattle, is required to maintain Stage One status (CVJDPCP, 2006).

Herd classifications can progress to ‘Stage Two’ status by testing of all second lactation or older cattle by pooled faecal culture (10 cows or less per pool). Maintenance of Stage Two status requires an annual BMP assessment, plus repeat testing of all in their second lactation or older by pooled faecal culture every 12 months. None of these guidelines have been adopted by the provincial programmes.

The only provincial programme with a clearly defined herd classification system for surveillance of low prevalence herds is the Atlantic Johne’s Disease Initiative (AJDI). The AJDI lists herds with either one (EC Negative Level 1) or more than one (EC Negative Level 2) environmental culture negative test result on a central website. Consecutive samples are collected between 10 and 26 months apart (AJDI, 2012). There is a disclaimer on the website stating that ‘being listed on the Register does not guarantee that a herd or farm is free of the MAP’ (AJDI, 2012).

4.2 Control

Control activities are only moderately coordinated across the various provincial programmes, with veterinary guided herd assessments generally similar, but herd testing requirements varying significantly (Greg Keefe, personal communication).
4.2.1 Laboratory testing for control
The CVJDPCP (2006) guidelines state that no herd testing is required for entry into and maintenance of the ‘Prevention Pathway’. However, it does allow for herd testing to be conducted within the Prevention Pathway, either as a method of monitoring progress or as an entry into the ‘Herd Status Pathway’.

In contrast, several of the provincial programmes have written protocols for testing of herds that enter their ‘control’ programmes; although herds are not obliged to conduct testing (e.g. they can chose to conduct veterinary guided risk management without any testing). There are differences between what is required for a herd test in different provinces.

For the OJEMAP funding is available to test all lactating cattle by serum or milk ELISA, on a single day, once. The test must completed within a specific 90 day time window (which is region specific, to avoid overwhelming laboratories).

The Atlantic Johne’s Disease Initiative has made a single environmental culture test (collected by project personnel based on USDA guidelines – see US document) free to all participants. They also then part fund a single round of individual bovine animal testing either by serum or milk ELISA or faecal PCR ($6 / €5 per test) for herds with a positive environmental culture result.

4.2.2 Herd Classification for control
The CVJDPCP guidelines (2006) state that herds in the ‘Prevention Pathway’ will receive ‘recognition’ for each consecutive year that they participate (e.g. for each year they repeat the veterinary risk assessment). However, none of the provincial programmes have adopted this and therefore classification for control only distinguishes between herds that are enrolled and herds that are not enrolled.

Test results are confidential in all programmes, usually passed to the vet that conducted the herds risk assessment.

4.2.3 Cattle movements
There is no national control of movement of Johne’s disease test positive cattle in Canada. In Quebec, all producers who wish to access their results must sign an affidavit stipulating that they will not sell any test positive cattle (Barker et al., 2012). In Ontario, if producers wish to receive funding for herd testing, all high titre cattle must be removed from the herd within 90 days, without going to another herd or entering the food chain (Kelton et al., 2012a).

4.2.4 Control in infected herds
The ‘prevention pathway’ detailed in the CVJDPCP guidelines (2006) state that control in infected and unknown status herds is provided primarily by a veterinary risk assessment, and implementing a set of action points agreed between the vet and the producer. In the guidelines the key objectives are stated as:

- Preventing calves from being exposed to infected cattle and their manure
- Keeping calving areas clean and dry
- Avoiding feeding infective colostrum / milk
- Determining the presence and/or prevalence of disease; managing test-positive cattle; eliminating high-risk cattle
- Preventing contamination of feed, water and pastures
- Not purchasing cattle infected with MAP
- Monitoring progress of herd management plan

Given the variable requirement for testing in most provincial programmes, the objectives of identifying and managing ‘high risk cattle’ and monitoring progress of the management plan cannot currently be achieved in all provincial programmes.

The format of the risk assessment is said to be well coordinated across all provincial programmes, although only the OJEMAP have made the documentation available to view online (Barker et al., 2012). In this programme, it is recommended that a maximum of three changes be agreed at the end of any risk assessment. The completed RAMP form is faxed to the provincial coordinator (OJEMAP, 2012).

### 4.2.5 Control in non-infected herds

Control on non-infected farms is identical to control on infected farms. No provincial programme currently attempts to identify non-infected herds with any level of confidence (although the Atlantic Johne’s Disease Initiative identifies herds with negative environmental culture tests; see 4.1.2 for details).
5. Monitoring and Review

5.1 Surveillance Monitoring
As the provincial Johne’s disease programmes have started only very recently, and in the absence of any structured surveillance testing, success of the various programmes in reducing the prevalence of Johne’s disease cannot be evaluated at present.

The number of herds participating in the Ontario programme is published on their website routinely (see appendix 3). In 2010, 700 herds and 49,633 cows were tested. Approximately 1% of cattle tested had a positive result, and only 0.1% were of sufficiently high-titre to require culling (Kelton et al., 2012b).

A CJDl update in March 2012 reported that the Atlantic JD Initiative surpassed 95% of its year one goal for uptake in the first 6 months; that the programme enrolment in the Quebec programme recently increased by 200 herds (estimated 20% and 1% of dairy and beef herds respectively) and that 37% of Alberta’s dairy producers have enrolled in the programme (CAHC, 2012b). It was stated that 20% of participants in the Quebec programme stopped after a few years due to a lack of interest (Genevieve Cote, personal communication).

5.2 Programme Monitoring and Review
The 5 year voluntary beef and dairy JD programme is undergoing evaluation by the provincial government and partners; results are not currently available (CAHC, 2012b).

An investigation into the attitudes of dairy producers to voluntary control programmes across Ontario, Manitoba, Saskatchewan, Alberta and British Columbia indicated that compliance with recommended changes was generally poor, with on average only 2 of 6 changes being implemented. Main reasons for poor compliance were cited as not believing the change was necessary or the available farm amenities did not allow the change to be made. The authors concluded that communication of associated benefits of implementing changes needs to be improved to increase compliance with recommended management practices (Sorge et al., 2010).

A comparison of participants (n= approx. 700) and non-participants (n= approx. 300) in the Ontario Voluntary Johne’s Disease Control Program in 2010 indicated that participant herds were larger, produced more milk per cow, had lower bulk tank average SCC, kept better health records, had better fertility performance (heifer age at first calving and pregnancy rate) and had a higher overall herd management score.

Kelton and Perkins (2012) reported that the top ten recommendations made from 662 RAMPs in 2010 (prior to limitation to 3 recommendations) were:

1. Don’t buy cows or buy only from low risk herds
2. Remove calves quickly from maternity the area
3. Feed more colostrum to newborn calves and feed it on time
4. Don’t walk through feed bunk or calf pens with dirty boots
5. Collect and feed low risk colostrum to calves born from high risk cows
6. Separate the newborn calf from the cow
7. Don’t feed non-saleable milk to calves
8. Don’t use the calving pen as the hospital pen
9. Re-test the herd annually
10. Feed low risk milk to calves

In addition to review of the control programme, Canada also has a national network of MAP researchers who meet annually to share research ideas, progress and results, and are currently working on a funding application for approximately $2million over the next 5 years to fund collaborative research focused on the organism (MAP), the host (the cow) and control strategies (D. Kelton, personal communication).

5.3 Areas of Concern of Current Administrators
A recent publication from programme administrators outlines the following concerns regarding the CVJDPDCP (Kelton et al., 2012b):

- A lack of education in all stakeholders regarding ‘test negative’ not implying ‘disease free’ when discussing Johne’s disease
- A lack of education among producers that test and cull alone will not achieve eradication
- A requirement for increasing a ‘buyer beware’ culture among primary producers in the absence of any official movement control of high risk cattle
- A significant challenge in the near future for all provincial programmes will be maintaining participant interest in the programme and continuing to attract non-participants to engage; at a recent presentation the authors stated that the biggest challenge lay in designating the method and frequency of follow-up testing

There is also a concern that in the Ontario programme that the Johne’s disease prevalence may be higher in the non-participant minority, acting as a threat to the long term success of the programme (Kelton et al., 2012b).

In Quebec, the administrators are concerned regarding declining interest leading to a high drop-out rate, plus vets running out of time to perform follow up visits within 12 months of the original risk assessment (Genevieve Cote, personal communication).
Appendices

Appendix 1
Canadian Provincial Johne’s Disease control programs that make up the national control efforts coordinated by the CJDI (Barker et al., 2012).

<table>
<thead>
<tr>
<th>Provincial Johne’s Disease Initiative</th>
<th>Year Initiated / Duration:</th>
<th>$ invested / to invest:</th>
<th>Initiative Partners:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Quebec Voluntary Paratuberculosis Prevention and Control Program</td>
<td>2007 -</td>
<td>$1.6 Million</td>
<td>Government – Academia- Industry</td>
</tr>
<tr>
<td>Ontario Johne’s Disease Education and Management Assistance Program</td>
<td>2010- 2014</td>
<td>$2.4 Million</td>
<td>Industry – Academia- Government</td>
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<td>Manitoba Johne’s Disease Initiative</td>
<td>2010 - 2013</td>
<td>$175,000</td>
<td>Government – Industry - Academia</td>
</tr>
<tr>
<td>Alberta Johne’s Disease Initiative</td>
<td>2010 - 2013</td>
<td>$730,000</td>
<td>Industry – Academia- Government</td>
</tr>
<tr>
<td>Atlantic’ Johne’s Disease Initiative</td>
<td>2011 - 2014</td>
<td>$1.1 Million</td>
<td>Government - Academia- Industry</td>
</tr>
<tr>
<td>British Columbia Johne’s Disease Initiative</td>
<td>2011 – 2013</td>
<td>$100,000</td>
<td>Government- Industry - Academia</td>
</tr>
<tr>
<td>Saskatchewan Johne’s Disease Working Group</td>
<td>Periodic meetings</td>
<td>–</td>
<td>Government - Academia – Industry</td>
</tr>
</tbody>
</table>

1 Atlantic Canada includes Nova Scotia, New Brunswick, Prince Edward Island, and Newfoundland and Labrador
Appendix 2

Screenshot detailing organisations involved in the Ontario Johne’s Education and Management Assistance Program (OJEMAP, 2012)

INDUSTRY SUPPORTERS

Thank you to the following supporters of the Johne’s Education and Management Program:

FUNDING PARTNERS
- Dairy Farmers of Ontario
- Guernsey Canada
- Holstein Canada
- Holstein Ontario
- Jersey Canada
- Jersey Ontario
- Progressive Dairy Operators
- OMAFRA
- Ontario Association of Bovine Practitioners
- Ontario Cattlemen’s Association

EX-OFFICIO SUPPORTERS
- University of Guelph and Ontario Veterinary College

OBSERVERS
- Canadian Livestock Genetic Association
- Ontario Dairy Council
- Small Ruminant Association

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Appendix 3
Screenshot detailing number of participants in the Ontario Johne’s Education and Management Assistance Programme in 2011 (OJEMAP, 2012).

Whole herds tested vs. herds that completed program and received reimbursement

Testing Window
References

A review of bovine Johne’s disease control activities in 6 endemically infected countries

Supplement 3: Review of bovine Johne’s disease control in Denmark

List of Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
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<tbody>
<tr>
<td>AP</td>
<td>Apparent prevalence</td>
</tr>
<tr>
<td>DCF</td>
<td>Danish Cattle Federation (now renamed as the ‘Knowledge Centre for Agriculture: Cattle’)</td>
</tr>
<tr>
<td>TP</td>
<td>True prevalence</td>
</tr>
</tbody>
</table>
Operation Paratuberculosis: The Danish Voluntary Bovine Johne’s Disease Control Programme

1. Industry background
The Danish dairy industry has followed the same trend as other countries with reducing farm numbers and increasing farm size. In 2011, there were around 4100 dairy farms in Denmark with an average herd size of 127 cows and average production quota of 1142 tonnes (DAFC, 2012a); in 2012 there are around 3800 herds with an average size of 152 cows / herd and a total of 577578 dairy cows. This compares to 9800 farms with an average of 66 cows and total dairy cow numbers of 670,000 in 2000. The Danish suckler cow industry is much smaller and is also declining (from 123,000 cows in 2000 to 101,000 in 2010) (DAFC, 2012b) but consists of a much larger number of smaller herds. In 2010 there were 8412 herds with suckler cows and an average herd size of 13 cows (DAFC, 2011).

2. JD background
Johne’s disease has been present and reported in Danish cattle for the last century. In the 1960’s regional individual adult cattle prevalence estimates using the CFT and culture of mesenteric lymph nodes ranged from 1.8- 2.3%. A bulk tank milk study was conducted with an optimised ELISA in 1999 (including around 25% of the national herd) and indicated a true prevalence of 80-86% depending on the region considered (Nielsen, 2009b). More recently, further geographical variance in dairy herd and within dairy herd test prevalence has been reported, with highest regional estimates of 91% and 5-8.5% respectively (Bihrmann et al., 2012). Prevalence estimates in the beef population have rarely been reported although clinical disease does occur and prevalence is likely to be lower than in the dairy population (Nielsen, 2009a). A serological study of 2345 non-dairy cattle at slaughter indicated an estimated true prevalence of 15.7% in dairy breeds (coming from non-dairy farms) compared to just 0.8% in non-dairy breeds (Okura et al., 2010).

3. Programme Background

3.1 History and Development
1999: Groups representing the Danish cattle industry (that later formed the DCF - see below) and three veterinary research institutions initiate an extensive research project named the ‘Kongeåprojekt’ into the diagnosis and epidemiology of paratuberculosis

2002: Formation of the Danish Cattle Federation (DCF) to represent the interests of the cattle industry, including the milk processors (via the Danish Dairy Board), the beef industry (via the Danish meat board), the producers / farmers (via the Danish Agricultural Advisory Services) and the cattle breeding organisations).

2003: Follow up research is carried out into pathogenesis, infection dynamics and intervention to prevent paratuberculosis

2005: Following publication of the results of the research projects in producers’ magazines there is overwhelming support for initiation of a national programme expressed by producers at a tour of producers meetings by the DCF board. The demand for programme comes from producers, not from industry or veterinary authorities.
2006: ‘Operation Paratuberculosis’ (the Danish national control programme) is initiated for Danish dairy producers as a voluntary programme

2007: 537 members (around 10% of all dairy producers) (Nielsen et al., 2007a)

Jan 2008: Use of vaccination is prohibited (it was previously permitted with permission from the veterinary authorities and approximately 20-30 herds were vaccinated at that time)

Oct 2008: The ELISA test used in the programme changes making prevalence comparisons from before and after the change more challenging. The change is from an in-house test to a commercial test (ID Screen® from ID vet, Montpellier, France).

2009: The possibilities of reduced testing requirements were introduced for herds participating for at least 2 years to reduce costs of continued participation. Approximately 50% of participants changed to the ‘reduced scheme’ with the rest staying with the ‘full test scheme’.

2011: Implementation of a Herd Certification scheme as part of the control programme in recognition that being able to join such a scheme was and remains a significant motivator for producer participation.

3.2 Current Structure
The programme is coordinated by a single, part-time, DCF employed project coordinator, who is supported by a steering committee (also referred to as an advisory board) (Nielsen et al., 2007a). The programme is designed only for dairy producers with no equivalent system for beef producers or for other susceptible species (Nielsen, 2009a).

Key components of the programme are:

- A herd manual that provides educational material and a structure for completing on farm risk assessment and creating a management plan (Nielsen et al., 2007a).
- A herd testing programme based on quarterly individual bovine animal milk ELISA testing with the primary aim to categorise individual cattle as high, medium or low risk of being infectious for management at point of calving.
- A herd classification system that incorporates both the results of recent ELISA test results, presence of non-home bred cattle and status of farm of origin of purchased cattle (Krogh et al., 2012).

3.3 Programme Aims
Original aims:

- To provide tools to producers that wish to control paratuberculosis
- To reduce the over-all prevalence of paratuberculosis in Denmark
- Long term - to eradicate paratuberculosis with the establishment of successful control strategies, cost-effective surveillance and certification programmes.

(Nielsen et al., 2007a)
3.4 Organisations Involved

The programme was initiated and is managed by the Danish Cattle Federation (DCF), now named the Knowledge Centre for Agriculture: Cattle (Nielsen et al., 2007a). The steering committee consists of members from within and external to the DCF. See appendix 1 for details of the steering committee (Nielsen et al., 2007a).

Herd consultants working with the Johne’s control programme receive training made available by the DFC. Only around 2/3 of such consultants are veterinary surgeons; the rest are bovine animal scientists (Nielsen et al., 2007a).

3.5 Funding

3.5.1 National Coordination

The vast majority of the costs of the programme are met through participant producers paying for testing (Nielsen et al., 2007a). In addition, an annual herd fee of 350DKK (€47) per participant farm is charged for programme maintenance (Okura et al., 2010). In 2011 a supplementary fee for the use of certain tools (printouts of lab-results in processed ways) within the programme of 250 DKK(€34) /producer and 100 DKK(€14) /farm for veterinarians and advisors was introduced.

The DCF employs the project coordinator. Funding is made available through the above fees and from the Danish Milk and Beef Levy boards (levy board funding is reducing in recent years). The initial and continuing research programmes have received public funding. Funds from the DCF and the government have been use to produce an information DVD (Nielsen et al., 2007a).

3.5.2 Farm level participation

Direct costs associated with participation visit(s) by a local herd consultant, laboratory fees and implementation of management practices to reduce transmission) are borne entirely by participant producers. Sampling costs are minimised by utilising milk samples that are collected for milk recording purposes either by the producer (most popular) or by a milk recording technician (Nielsen et al., 2007a)(Nielsen, personal communication). Approximately 90% of Danish dairy herds are in the milk recording scheme.

Lab fees are approximately 28.6DKK (€3.85) per milking cow per test. Assuming 81% of the herd are producing milk on any one day (Danish average) total lab fees per year for a 100 cow herd are 9266DKK (€1246.59) or 92.6DKK (€12.47) per cow per year (Nielsen, personal communication).

Herd risk assessments are normally only performed once per herd (when they begin the project) and are charged by the herd consultant, at an estimated fee of 2000-2500DKK (€269 – €336). There is no requirement for an official review of the risk assessment. Continued advice is provided in most cases through a routine comprehensive herd consultancy service and therefore the Johne’s advice is not charged separately (Nielsen, personal communication). There is no formal requirement to follow up the compliance with or review of the original risk assessment findings.

3.6 Voluntary or Compulsory

Denmark has no regulatory control of Johne’s disease except that producers cannot sell milk from ‘diseased’ cows and live cattle cannot be traded if they are diseased (and it can be proven the seller is responsible for the condition) (Nielsen et al., 2007a). Participation in the JD control programme is entirely voluntary. Test-positive cattle are extremely rarely sold. Test-results are stored in the Danish
Cattle Database and transferred to the purchaser if sold nationally. An unpublished study from December 2009 revealed that of 2,708 cattle exported to the United Kingdom from 2006 to 2009, none were ELISA positive. Of these, 2,176 (80%) were <2 years of age and had not been tested (Nielsen, personal communication).
4. Programme Components: Surveillance and Control

4.1 Surveillance

4.1.1 Laboratory testing for surveillance

Laboratory testing for surveillance was only recognised in the programme with the advent of a herd certification scheme in 2011. It builds on test information generated from test protocols that were already being utilised to aid control of infected herds, described in section 4.2.1 below (Krogh et al., 2012). In addition, the apparent prevalence in source herds of any purchased / introduced bovine animal is also accounted for (Krogh et al., 2012).

4.1.2 Herd Classification for surveillance

Herds are classified into one of 2 categories to facilitate surveillance of potentially non-infected herds. In order to be eligible for these categories there must be no non-home bred cattle in the herd and at least 75% of cows (i.e. cattle that have calved) in the herd must have been tested in the last 12 months. There are a further 8 categories within the same framework for control of infected herds (see 4.2.2 below).

Information generated from the most recent existing quarterly milk ELISA test results (or from a single test for herds not in the quarterly sampling scheme) are:

- **AP** - Apparent prevalence (e.g. proportion of ELISA test positives at test used for certification purposes (Krogh et al., 2012))
- **TP** - True prevalence (AP corrected for the test Sp and Se and the herd’s age distribution (Nielsen et al., 2007b))
- **P_{low}** – The probability that the herd prevalence is lower than the estimated true prevalence from all participating herds; the figure in current use is around 2-4% (Nielsen, personal communication)

These are utilised to define the following categories:

<table>
<thead>
<tr>
<th>Category</th>
<th>Purchase history</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No non-homebred cattle in the herd</td>
<td>AP = 0; TP &lt;0.5%; P_{low} &gt;0.95</td>
</tr>
<tr>
<td>2</td>
<td>No non-homebred cattle in the herd</td>
<td>AP = 0 (but other criteria for 1 not met)</td>
</tr>
</tbody>
</table>

4.2 Control

4.2.1 Laboratory testing for control

The aim of testing for control is to classify adult cattle by risk of being infectious; building on the assumption that ELISA positivity is sufficiently correlated with the onset of shedding (Nielsen, 2008). Testing is done by antibody ELISA on milk samples taken for milk recording purposes. Prior to October 2008 a commercially available antigen (Allied Monitor, Fayette, Missouri, USA) was used and adapted in house for milk samples as previously described (Nielsen et al., 2002). Briefly, antigen and conjugate were doubled in concentration, and samples were diluted 1:2 in *Mycobacterium phlei* only. Since October 2008, a commercially available ELISA has been utilised (IDScreen, ID-Vet, Montpellier, France). The change was made as the commercial ELISA appeared to have improved characteristics and was better correlated with onset of shedding (Nielsen, personal communication).
In participating herds all milking cattle are tested 4 times annually. After each test day cows are placed into one of the following 6 categories (Nielsen et al., 2007a):

<table>
<thead>
<tr>
<th>Score</th>
<th>Criteria</th>
<th>Interpretation</th>
<th>Risk group</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Repeated negative over at least 2 samples</td>
<td>Not infectious</td>
<td>Green</td>
</tr>
<tr>
<td>1</td>
<td>Single negative result</td>
<td>Not infectious</td>
<td>Green</td>
</tr>
<tr>
<td>2</td>
<td>Positive last sample, negative previously</td>
<td>Infected, infectious and affected</td>
<td>Yellow</td>
</tr>
<tr>
<td>3</td>
<td>Last 4 tests negative, one previous positive result</td>
<td>Infected and infectious</td>
<td>Yellow</td>
</tr>
<tr>
<td>5</td>
<td>Last result negative but multiple previous positive results</td>
<td>Infected and infectious</td>
<td>Yellow</td>
</tr>
<tr>
<td>9</td>
<td>Last 2 or more results positive</td>
<td>Infected, infectious and affected</td>
<td>Red</td>
</tr>
</tbody>
</table>

Testing requirements can be reduced for herds that have been participating for at least 2 years. In such herds, cows that are more than 150 days from the next expected calving and have previously tested negative can be skipped (Nielsen, personal communication).

4.2.2 Herd Classification for control
Herd classification for control is a continuation of the categories defined for surveillance of low risk herds, taking into account both the purchase history, the apparent prevalence on the farm of origin of purchased cattle and the apparent prevalence at the most recent test day (Krogh et al., 2012).

Untested herds are considered category 10. This means that all herds (regardless of whether they participate in the voluntary control programme) receive a category and untested herds automatically receive the highest risk category (Krogh et al., 2012).

<table>
<thead>
<tr>
<th>Category</th>
<th>Purchase history</th>
<th>Criteria</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>No non-homebred cattle in the herd</td>
<td>AP = up to 5%</td>
</tr>
<tr>
<td>4</td>
<td>Purchased cattle from herds with AP 0-5% only</td>
<td>AP = 0%</td>
</tr>
<tr>
<td>5</td>
<td>Purchased cattle from herds with AP 0-5% only</td>
<td>AP &lt; 5%</td>
</tr>
<tr>
<td>6</td>
<td>Purchased cattle from herds with AP &gt;5% or from non tested herds</td>
<td>AP &lt; 5%</td>
</tr>
<tr>
<td>7</td>
<td>No purchased cattle or purchased cattle from herds with AP 0-5% only</td>
<td>AP = 5-15%</td>
</tr>
<tr>
<td>8</td>
<td>Purchased cattle from herds with AP &gt;5% or from non tested herds</td>
<td>AP = 5-15%</td>
</tr>
<tr>
<td>9</td>
<td>Any purchase history</td>
<td>AP &gt; 15%</td>
</tr>
<tr>
<td>10</td>
<td>Any purchase history</td>
<td>Untested</td>
</tr>
</tbody>
</table>

4.2.3 Cattle movements
Herd classification for control is a continuation of the categories defined for surveillance of low risk herds, taking into account both the purchase history, the apparent prevalence on the farm of origin of purchased cattle and the apparent prevalence at the most recent test day (Krogh et al., 2012). Neither ‘diseased’
nor how the producer might be considered responsible are clearly defined, though in a JD context it seems likely that known test positive cattle or cattle with clinical signs cannot be sold to another producer. Recent court cases suggest that selling infected, non-diseased (test negative) cattle will not be considered violation of current legislation because it should be common knowledge that the between herd prevalence is high (Nielsen, personal communication).

4.2.4 Control on infected herds
Protocols for control on infected herds are initiated by a risk assessment conducted by a trained local herd consultant (in 2007 112 herd advisors had been trained of which 2/3 were practicing vets) (Nielsen et al., 2007a). Training is not a prerequisite for veterinarians and advisors to do advisory work on Johne’s disease.

The risk assessment document is very similar to those used by the United States system, and was developed using the US dairy risk assessment document as a template. The risk assessment also includes risks for transmission of Salmonella Dublin (Nielsen et al., 2007a). Following risk assessment a tailored management plan is drawn up by the herd consultant and the producer.

Advised management practices vary for ‘green’, ‘yellow’ and ‘red’ cows. Culling of ‘red’ cows is advised before she next calves. Culling of ‘yellow’ cows is not routinely advised (Nielsen et al., 2007a). Instead, culling is only advised under the following circumstances:

- A bovine animal has repeated high antibody titres (red cow)
- The animal demonstrates clinical disease (diarrhoea, milk drop etc)
- There are very few yellow cows in the herd

Additional control strategies focus primarily on calving practices and pre-weaned calf feeding. Green cows can stay in group calving accommodation, and their milk / colostrum can be used for all calves. Yellow cows should be calved in individual pens with the calf removed within 15 minutes and pens cleaned post calving. Red cows should not enter the calving area at all (they should be culled pre-calving). Low risk ‘green’ cows, particularly older ones, are preferred for production of colostrum for a colostrum bank (Nielsen et al., 2007a).

4.2.5 Control in non-infected herds
Control in apparently non-infected herds follows the same principles as for infected herds. In order to qualify for a low risk category the herd must have no (category 1-2) or nearly no (cat 3) test positive cows at the most recent test. This in turn means that they must have no / almost no ‘yellow’ or ‘red’ cows present in the herd and in practice such herds will have very few required management changes.
5. Monitoring and Review

5.1 Surveillance Monitoring

The ‘surveillance’ component of the programme regarding certification and monitoring of low prevalence herds has been started too recently to have been reviewed (Krogh et al., 2012). The distribution of within herd prevalence among participating herds is published online weekly (http://kvaegvet.dk/ParaTB/PrevGraf7.html). This has dropped by approximately 1% per year since the beginning of the programme (Nielsen, personal communication).

5.2 Programme Monitoring and Review

Currently, 28% of Danish dairy producers (with around 40% of the countries dairy cattle) participate in Operation Paratuberculosis (Krogh and Nielsen, 2012). In February 2009 100 non-participant producers were contacted to identify reasons for non-participation. 51 felt that they had no infection and did not want to complete the interview; another 5 gave only a partial interview. The commonest other reasons cited were excess costs / low cost: benefit ratio to participation (31/44); waiting to see the experience of others in the programme (24/44); considered themselves free of the infection (23/44); too many changes required (13/44); expected to retire from farming in near future (8/44); and insufficient advice on control (4/44) (Nielsen, 2009a).

The predominant reasons for participating were to improve cattle health, avoid production losses and to achieve herd certification in 4-10 years (Nielsen, 2009a). See appendix 2.

A recently published multivariable analysis of the association between implementing specific management procedures and reducing test prevalence (across 1081 participant producers) found an association between reduced test prevalence and the following factors: proportion of cattle purchased; culling of repeat test positive cattle; use of waste milk from high risk cow groups. The authors suggest that a lack of correlation with other control actions may be due to a relatively short study period (the study was conducted just 4 years after the start of the programme) (Nielsen and Toft, 2011).

5.3 Areas of Concern of Current Administrators

Implementation of recommended actions to reduce transmission is varied in participating herds. Many recommendations are not followed, and successful long-term control in such herds is considered unlikely (Nielsen, 2009a). A useful way of monitoring compliance with risk-assessment based recommendations has not yet been identified (Krogh and Nielsen, 2012). See appendix 3.

Reduced funding from the milk and beef levy funds means that few new activities can be launched and system maintenance is becoming increasingly challenging (Krogh and Nielsen, 2012). This has also reduced ongoing research activities. Reduced funding may be reflective of an increased interest in antimicrobial resistance, milk quality and animal welfare at the expense of Johne’s disease within the industry (S. Nielsen, K. Krogh, personal communication).

The third of the original aims (to eradicate paratuberculosis with the establishment of successful control strategies, cost-effective surveillance and certification programmes) is now considered ‘on hold’ by the current administrators (Nielsen, personal communication).
The lower within herd prevalence in participating herds is also considered a significant challenge. Currently, the median apparent prevalence is 2.5%. The ‘in-practice’ test-specificity has been estimated to 98.7% (Nielsen et al., 2013) and consequently, most of the test-reactions are now false-positives. Follow up direct testing (either by faecal culture or faecal PCR) is not considered a viable option currently by programme coordinators, due to poor sensitivity (Nielsen, personal communication).

It is recognised that while herds within the programme appear to be successfully reducing infection prevalence, there is no reliable data available for herds not participating in the programme.

One author who has been particularly influential in the design and implementation of the programme is concerned at the lack of external review; he feels that his personal views have been implemented almost entirely and that an increased external validation may have been appropriate (Nielsen, personal communication).

**Addendum – Data transfer and availability**

All data are transferred to the Danish Cattle Database, which is hosted by Knowledge Centre for Agriculture (www.vfl.dk, former DCF). Most vets or advisors have access to their clients’ data, but the clients need to provide permission to do so. Test results and results from the certification scheme are only made available for potential buyers of cattle with permission from the seller. Government, milk processors and general public have no access to the data (except in summary form), because there is no legislation on this. This is in contrast to infections on which there is legislation, e.g. *Salmonella Dublin* where you can find the status of a herd on all herds (S. Nielsen, K. Krogh, personal communication).
Appendices

Appendix 1: The steering committee (roles and origins) supporting the coordinator of Operation Paratuberculosis, the Danish Johne’s disease control programme (Nielsen et al., 2007a).

<table>
<thead>
<tr>
<th>Group</th>
<th>Role and origin</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 herd health advisors</td>
<td>2 animal scientists operating as locally as herd health advisors</td>
</tr>
<tr>
<td></td>
<td>2 veterinary practitioners operating as locally as herd health advisors</td>
</tr>
<tr>
<td></td>
<td>1 veterinary consultant operating as locally as herd health advisor</td>
</tr>
<tr>
<td>1 laboratory representative</td>
<td>Steins Laboratory that perform the laboratory tests</td>
</tr>
<tr>
<td>1 RYK*-coordinator</td>
<td>1 coordinator representing the 4 RYK centres</td>
</tr>
<tr>
<td>1 veterinary chief</td>
<td>Responsible for political issues and coordination with other programmes</td>
</tr>
<tr>
<td>1 programme manager</td>
<td>Coordination of Operation Paratuberculosis</td>
</tr>
<tr>
<td>2 communication persons</td>
<td>Coordination of communication and writing of professional publications</td>
</tr>
<tr>
<td>1 Cattle Database representative</td>
<td>Data management and extraction of results in useful formats for</td>
</tr>
<tr>
<td></td>
<td>management of paratuberculosis on a herd level</td>
</tr>
<tr>
<td>1 scientist</td>
<td>Programme designer and responsible for assuring that facts and</td>
</tr>
<tr>
<td></td>
<td>programme contents are consistent</td>
</tr>
</tbody>
</table>

*) RYK is the recording and milk yield control scheme.

Note: The composition of the Steering committee has changed recently and is now comprised of: 4 herd health advisors (2 animal scientists, 2 veterinary practitioners); 1 laboratory representative; 1 RYK coordinator representing the 3 RYK centres; 1 programme manager; 1 communication person; 1 scientist; 1 cattle database representative.
Appendix 2: Reasons for participation in Operation Paratuberculosis from 1013 respondents to a questionnaire distributed from December 2008-March 2009. Respondents could cite multiple reasons for participation (Nielsen, 2011).

<table>
<thead>
<tr>
<th>Reasons for participation in programme</th>
<th>Yes</th>
<th>(%)</th>
<th>No or do not know</th>
</tr>
</thead>
<tbody>
<tr>
<td>Herd certification within 1-3 years</td>
<td>245</td>
<td>(24%)</td>
<td>768</td>
</tr>
<tr>
<td>Herd certification within 4-10 years (or 1-3 years)</td>
<td>796</td>
<td>(79%)</td>
<td>217</td>
</tr>
<tr>
<td>Herd certification to provide animals for sale</td>
<td>488</td>
<td>(48%)</td>
<td>525</td>
</tr>
<tr>
<td>Control following production losses in the herd</td>
<td>454</td>
<td>(45%)</td>
<td>559</td>
</tr>
<tr>
<td>Control to avoid production losses</td>
<td>822</td>
<td>(81%)</td>
<td>191</td>
</tr>
<tr>
<td>Control to improve animal health</td>
<td>882</td>
<td>(87%)</td>
<td>131</td>
</tr>
<tr>
<td>Control to improve food safety</td>
<td>553</td>
<td>(55%)</td>
<td>460</td>
</tr>
</tbody>
</table>

Appendix 3: Implementation of recommended actions for reducing transmission of MAP on 1113 producers participant in Operation Paratuberculosis that responded to a questionnaire survey (Nielsen and Toft, 2011)

<table>
<thead>
<tr>
<th>Management routine</th>
<th>No.</th>
<th>Percent</th>
<th>Recommendation*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Calvings of Red* and Yellow* cows separated from calvings of Green cows</td>
<td>54</td>
<td>5%</td>
<td>R</td>
</tr>
<tr>
<td>a) No Red calvings; Green separated from Yellow cows</td>
<td>54</td>
<td>5%</td>
<td>R</td>
</tr>
<tr>
<td>b) Green separated from Red and Yellow</td>
<td>275</td>
<td>25%</td>
<td>R</td>
</tr>
<tr>
<td>c) Green separated from Red, not Yellow</td>
<td>285</td>
<td>26%</td>
<td>(R)</td>
</tr>
<tr>
<td>d) Green, Yellow and Red not separated at calving</td>
<td>499</td>
<td>45%</td>
<td>N</td>
</tr>
<tr>
<td>2. Removal of calves from high-risk dams within 2 hours after calving</td>
<td>107</td>
<td>10%</td>
<td>R</td>
</tr>
<tr>
<td>a) No Red calvings; Removed from Yellow cows</td>
<td>107</td>
<td>10%</td>
<td>R</td>
</tr>
<tr>
<td>b) Removed from Red and Yellow</td>
<td>645</td>
<td>58%</td>
<td>R</td>
</tr>
<tr>
<td>c) Removed from Red, not Yellow</td>
<td>192</td>
<td>17%</td>
<td>(R)</td>
</tr>
<tr>
<td>d) Not removed</td>
<td>169</td>
<td>15%</td>
<td>N</td>
</tr>
<tr>
<td>3. Cleaning of calving facilities after calvings</td>
<td>285</td>
<td>26%</td>
<td>R</td>
</tr>
<tr>
<td>a) After Red and Yellow cows’ calving</td>
<td>285</td>
<td>26%</td>
<td>R</td>
</tr>
<tr>
<td>b) After Red, not after Yellow cows’ calving</td>
<td>216</td>
<td>19%</td>
<td>(R)</td>
</tr>
<tr>
<td>c) Not cleaned after Red or Yellow cows’ calving</td>
<td>612</td>
<td>55%</td>
<td>N</td>
</tr>
<tr>
<td>4. Use of colostrum</td>
<td>598</td>
<td>54%</td>
<td>R</td>
</tr>
<tr>
<td>a) Only from Green cows, not from Red and Yellow</td>
<td>598</td>
<td>54%</td>
<td>R</td>
</tr>
<tr>
<td>b) Used from Yellow, not from Red</td>
<td>282</td>
<td>25%</td>
<td>(R)</td>
</tr>
<tr>
<td>c) Used from Red, not from Yellow</td>
<td>112</td>
<td>10%</td>
<td>N</td>
</tr>
<tr>
<td>d) Used from Red, Yellow and Green</td>
<td>121</td>
<td>11%</td>
<td>N</td>
</tr>
<tr>
<td>5. Use of waste milk and milk from cows with high somatic cell count</td>
<td>745</td>
<td>67%</td>
<td>R</td>
</tr>
<tr>
<td>a) Only from Green cows, not from Red and Yellow</td>
<td>745</td>
<td>67%</td>
<td>R</td>
</tr>
<tr>
<td>b) Used from Yellow, not from Red</td>
<td>219</td>
<td>20%</td>
<td>(R)</td>
</tr>
<tr>
<td>c) Used from Red, Yellow and Green</td>
<td>149</td>
<td>13%</td>
<td>N</td>
</tr>
</tbody>
</table>

* Cows are separated into “Red”, “Yellow” and “Green” cows based on repeated milk antibody ELISA tests. Red cows have repeated positive results. Green cows repeated negative, and Yellow cows’ results fluctuate or have recently become positive. Each herd is tested 4 times per year.
* R = Follow recommendation by Danish Cattle Federation. (R) = partly follow the recommendation. N = do not follow the recommendation.
References


Nielsen, S.S., 2009a. Parameters used to assess the efforts to control paratuberculosis in Denmark. Monitoring success of paratuberculosis programs: Proc. 2nd Paratuberculosis Forum, 14-20


**A review of bovine Johne’s disease control activities in 6 endemically infected countries**

**Supplement 4: Review of bovine Johne’s disease control in the Netherlands**

List of Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>MQAP</td>
<td>Milk Quality Assurance Programme initiated in 2006 with the aim to reduce the concentration of Map in milk delivered to milk factories based on regular individual bovine animal ELISA testing (formerly the Bulk Milk Quality Assurance Programme).</td>
</tr>
<tr>
<td>IPP</td>
<td>Intensive Paratuberculosis Programme, aiming at providing a mechanism for low-risk trade of cattle between herds and elimination of Map from infected herds.</td>
</tr>
<tr>
<td>JohneSSim</td>
<td>A stochastic simulation model that simulates the transmission and control of Johne's disease within herds</td>
</tr>
<tr>
<td>LTO</td>
<td>The Dutch Farmers Organisation</td>
</tr>
<tr>
<td>NZO</td>
<td>Dutch Dairy Organisation</td>
</tr>
<tr>
<td>PPN</td>
<td>Paratuberculosis Programme Netherlands; a project run from 2000-2005 to develop a national approach to control Map. In this project, the MQAP was developed. From 2006 onwards, PPN has also been used as an acronym for the MQAP in some communications in Dutch language.</td>
</tr>
</tbody>
</table>
Johne’s disease control programmes in the Netherlands

1. Industry background
Dairy is the predominant cattle industry in the Netherlands, with the trend of a decreasing number of larger herds occurring over the last 20 years. In 2012 there were an estimated 17,398 dairy producers (farmers) and 2.6 million dairy cattle, including youngstock. The suckler / beef industry is smaller with an estimated 21,145 farms with 1.6 million cattle, also including young-stock (G. van Schaik, personal communication).

2. JD background
In a study conducted in 1998 in dairy herds, the true prevalences on cow and herd levels was estimated by Muskens, Barkema et al. (2000) as 2.7±6.9% and 31±71%, respectively, based on a test sensitivity that ranged from 0.3 to 0.4 and a specificity that ranged from 0.985 to 0.995.

A recent report on a cohort of herds that voluntarily entered a milk quality assurance programme (MQAP, see below) in 2006 and 2007 indicated that the proportion of herds with test-positive cattle decreased from 55% at the first herd examination to 20% at the most recent herd examination (Weber, 2012). However, it is important to note that this cohort was a non-random selection of Dutch dairy herds, predominantly owned by farmers with an interest in the control of paratuberculosis. Therefore, these data are not suitable to make inferences on the (apparent) prevalence in the general Dutch dairy population.

There are no published reports on the prevalence in beef cattle in the Netherlands.

3. Programme Background

3.1 History and Development

**Before 1952:** Sporadic testing with intradermal Johnin allergy test and faecal culture

**1952:** Subsidy is paid to producers (from government) for culling clinically suspected cattle and it becomes forbidden to sell cattle positive by the intradermal allergy test to other producers

**1958:** In participating herds, all cattle older than 18 months of age are tested by the complement fixation test

**1979:** Increased focus on early detection in young cattle by 6-monthly intra-dermal testing of cattle aged 4 – 18 months. In cattle over 18 month of age positive intra-dermal test results were confirmed by CFT; subsidies for culling test positive and clinically affected cattle were increased

**1983:** Initiation of a vaccination programme as the subsidised test and cull programme was making poor progress and becoming excessively expensive; vaccination was observed to be successful in reducing clinical incidence but not in controlling the infection in persistently infected herds (van Schaik et al., 1996; Benedictus et al., 2000; Kalis et al., 2001).

**1997:** Institute for Animal Science and Health, and Animal Health Service initiate development of a plan for the eradication of paratuberculosis from the Netherlands at the request of the Ministry for Agriculture, Environment and Fisheries (Benedictus et al., 2000; Groenendaal et al., 2003).
1998: Initiation of the voluntary ‘Intensive Paratuberculosis Programme’ with two streams: protection and certification of non-infected herds (‘unsuspected herds programme’) in order to reduce between-herd transmission by enabling low-risk trade of cattle between herds (Weber et al., 2006) and elimination of infection from identified infected herds (‘infected herds programme’) using both preventive management measures and test and cull’ (Benedictus et al., 2000; Groenendaal et al., 2003).

1999: Initiation of the project ‘Preparation for the collective control of paratuberculosis in The Netherlands’ with the aim to prepare a potentially compulsory national control programme. This project included both field and modelling studies to inform the development of a national control strategy (Benedictus et al., 2000; Groenendaal et al., 2002; Groenendaal et al., 2003).

2000: The project ‘Preparation for the collective control of paratuberculosis in The Netherlands’ was superseded by the project ‘Paratuberculosis Programme Netherlands’ (PPN) (Franken, 2005). The aim was to further study alternative control strategies to be implemented in a national control programme (Groenendaal et al., 2003). The PPN project culminated in the development of a Milk Quality Assurance Programme (MQAP) for paratuberculosis (van Roermund et al., 2005; Velthuis et al., 2006; Weber et al., 2008).

2006: Launch of the Milk Quality Assurance Programme (MQAP) for Dutch producers which is developed within PPN and continues to run in parallel with the IPP. The MQAP remains a voluntary programme and simplifies the testing requirements (development is supported by modelling work) with primary use of individual bovine animal milk / serum ELISA. The focus is on reducing the contamination of milk with MAP rather than on eradication of the infection (Franken, 2005; Weber and Schaik, 2007).

2006: Reduction of monitoring requirements for certified ‘Map Free’ herds (level 10 in the IPP) from annual to biennial pooled faecal culture from all cattle over 2 years old (5 cattle per pool). This is supported by modelling work on test sensitivity and herd contact patterns and is considered necessary as the expense of maintaining MAP-free status is recognised as a disincentive for continued participation (van Roermund et al., 2002; Weber et al., 2006).

2008: The dairy processing industry covers the majority of costs for producers participating in the MQAP which significantly increases participation from 10% to 85% of dairy producers (Weber et al., 2009).

2009: The dairy processing industry reduces financial input covering only the participation fee of the MQAP.

2010: Participation in MQAP or IPP becomes compulsory for dairy herds delivering milk to the dairy processors. The requirement to participate has been detailed in the terms of delivery of the dairy processors. No more funding is provided for participation or laboratory testing. All costs are covered by the participating producers.

January 2011: The dairy processing industry requires dairy herds delivering milk to their factories to have status A (all test negative cattle) or B (test positive cattle have been culled) in the MQAP or status 6 or higher in the IPP.
3.2 Current Structure

Key components of currently active control activities are:

- MQAP – An ELISA based Milk Quality Assurance Programme used to licence delivery to the milk processors with a 3 point herd classification structure (Franken, 2005; Weber and Schaik, 2007; Weber et al., 2009; Weber, 2012)
- IPP - A 10 point certification programme for both infected and non-infected herds, termed the Intensive Paratuberculosis Programme to facilitate low-risk cattle trade and elimination of the infection from known infected herds (Benedictus et al., 2000; van Roermund et al., 2002; Weber et al., 2006)
- Paraplanner / Parainformer – a risk assessment tool for use on farm to assess and reduce the bio-exclusion and bio-containment risks associated with paratuberculosis

3.3 Programme Aims

The goal of the MQAP is to reduce the concentration of *Mycobacterium avium* subsp. *paratuberculosis* in milk delivered to the milk factories. Specifically, the goal is to decrease the number of herds with a concentration of MAP in bulk tank milk over $10^3$ per litre (based on assumptions regarding effectiveness of pasteurisation) (Franken, 2005; Weber and Schaik, 2007).

At the initiation of the IPP in 1998 the goals were reported to be to reduce the risk of consumers being exposed to MAP, to minimise the economic loss caused by paratuberculosis and to eradicate MAP from farms with ruminants in the Netherlands (Benedictus et al., 2000).

To reach this, the programme aimed to reduce the within-herd and between-herd transmission rates of the infection (Benedictus et al., 2000). To reduce the between-herd transmission of the infection, infectious contacts between herds need to be reduced. Thus, more specifically, the aims of the IPP have been stated as to eliminate Map from known infected herds and to enable low-risk trade of cattle between herds (G. van Schaik, personal communication).

3.4 Organisations Involved

Multiple organisations have been involved in the development of Johne’s disease control since 1998 including government, industry and academic institutions.

GD Animal Health (formerly Animal Health Service) is the primary provider of non-regulatory animal health services in the Netherlands, providing disease surveillance, animal health programmes and laboratory testing facilities. They are a not-for-profit organisation with a full cost recovery operating model. Annual turnover is estimated at €50 million (More, 2008; Anon, 2012). They currently administer all national control activities (both the IPP and the MQAP).

3.5 Funding

3.5.1 National Coordination

The previous national coordination activities of the ‘Preparation for the collective control of paratuberculosis in The Netherlands’ and ‘Paratuberculosis Programme Netherlands’ that led to the MQAP, were funded by the Dutch Dairy Board and the Ministry of Agriculture, Nature Management and Fisheries (currently the Ministry of Economic Affairs) (Franken, 2005; More, 2008). Commodity
board funds are generated primarily from levies on dairy producers and the dairy processing industry (approximately 50:50) (More, 2008).

All operational activities of GD Animal Health relating to paratuberculosis are funded by participant producers, although in 2008 and 2009 these activities were partially funded by the dairy processing industry (Franken, 2005; More, 2008; Weber, 2012).

3.5.2 Farm level participation

MQAP
In 2008, the majority of costs for participating producers were covered by the dairy processing industries (Weber et al., 2009). This funding reduced over 2009 and removed in 2010, when all costs of participation were met by participant producers. Participation in the MQAP has increased to over 95% of Dutch dairy producers (Weber et al., 2009).

IPP
The costs of the programme for activities including certification, control and risk assessment are charged directly to participant producers (Franken, 2005). Participation in the IPP has declined to under 2% of Dutch dairy producers (Weber et al., 2009).

3.6 Voluntary or Compulsory

Participation in either the BMQAP or the IPP became compulsory for all dairy producers in 2010. Milk will only be collected from farm with status A (all cattle test negative at most recent screen) or B (all test positive cattle from the latest screen, and their last born calves, culled from the herd) (Weber, 2012) or status 6 to 10 in the IPP.

Prior to 2010, all programmes had been voluntary. There had been a previous discussion on whether to make the IPP compulsory but it was eventually decided to maintain it as a voluntary programme (Benedictus et al., 2000; Groenendaal et al., 2003; Franken, 2005).

4. Programme Components: Surveillance and Control

4.1 Surveillance

4.1.1 Laboratory testing for surveillance

MQAP
All herd examinations in the MQAP are performed by testing individual milk samples of all lactating cattle or serum samples of all cattle of three years of age and older with the Pourquier ELISA (Institut Pourquier, Montpellier, France) (Weber and Schaik, 2007). Note: Since 2011 this test kit is owned and marketed by Idexx. Farmers are entitled to confirm positive ELISA results by individual faecal PCR-assay or culture. If the result of the confirmatory test is negative, the bovine animal is considered test-negative. However, confirmatory testing of faecal samples is only recommended in herds not known to be infected.

When all results are negative, the herd enters the surveillance component of the programme and is assigned status A. The test-negative herd is tested every other year thereafter (Weber and Schaik, 2007).
IPP
The IPP describes laboratory surveillance requirements for test negative herds as an initial serum ELISA all cattle over 3 years of age and faecal culture of sero-positive cattle (Weber et al., 2006). This is followed by annual culture or qPCR of pooled faecal samples (individual samples pooled into groups of 5 in the laboratory) of all cattle over 2 years of age (Benedictus et al., 2000; Kalis et al., 2000). In 2006 the testing requirements for surveillance of ‘Map-free’ (level 10) herds was reduced from annual to biennial pooled faecal culture from all cattle over 2 years old (5 cattle per pool) (van Roermund et al., 2002; Weber et al., 2006).

4.1.2 Herd Classification for surveillance

MQAP
The MQAP has a single classification ‘A’ for herds that were negative at the last herd (Weber and Schaik, 2007) screen. It should be noted that this classification does not imply that the herd is not infected, but only that it has a low risk for having a higher amount of MAP bacteria than $10^3$ bacteria per litre in delivered bulk tank milk.

IPP
The IPP describes 6 classifications for herds that are believed to be free from infection, with increasing confidence of freedom from infection with each increase in classification (status 6 to 10). Level 10 is addressed as ‘Map-free’. Herd owners can declare themselves free (over the last three years) from clinical Johne’s disease and enter at level 5. This was previously checked against the GD Animal Health Service laboratory results database, but there are currently no herds with level 5 status (Weber, personal communication). Level 6 is obtained following the first negative ELISA screen described above. Annual progression from 6-10 occurs with each negative herd faecal culture result as described above (leading to an 89% (Weber et al., 2004) to 99.9% confidence in freedom at level 10 (Benedictus et al., 2000).

4.2 Control

4.2.1 Laboratory testing for control

MQAP
Herd are initially tested as described above (4.1.1). ELISA test positive cattle can have their status confirmed by faecal culture or qPCR, the result of which is taken as definitive (Weber, 2012). However, this is not recommended to herds in the control procedure (i.e. herds with a history of positive paratuberculosis results) and most farmers that have had cases confirmed in their herds in the past take the ELISA result as definitive (Weber, personal communication).

Herd with positive cattle have three options for testing to aid control:

- Individual serum ELISA on cattle over 3 years old annually
- Individual milk ELISA on all lactating cattle annually
- Individual faecal culture on cattle over 2 years, once every 2 years (Franken, 2005)

IPP
Known infected herds are assigned status 3 and tested by annual herd examinations by individual faecal culture or qPCR of all adult cattle in the herd. Following consultation between the producer
and the veterinary practitioner, this scheme can be tailor-made to biannual herd examinations or to include young stock between 1 and 2 years of age. In low prevalence herds (<10% positive results of individual faecal samples), herd examinations may consist of examination of pooled faecal samples (pools of 5) followed by testing individual faecal samples of cattle in positive pools (Benedictus et al., 2000).

4.2.2 Herd Classification for control

MQAP
Herd that have test-positive cattle at their most recent screening are classified as ‘B’ when the test positive cattle are culled and as ‘C’ while the test positive cattle remain in the herd (Weber et al., 2009).

IPP
Of the levels 1 – 5 only status 3 and 4 are still in use. Level 3 is for herds which have an infected status. These herds try to reach an unsuspected status by a combination of preventive management and lowering the infection rate through detection and removal of shedders with faecal examinations. Level 4 is an observation status in case of purchase of cattle with an unknown status or inconclusive test results. Test-positive herds are assigned status 3, and can progress to status 6 after having obtained a subsequent annual herd examination with negative test-results only (Weber, personal communication).

4.2.3 Cattle movements

MQAP
Herd with status ‘A’ can import cattle from other herds with status A or an unsuspected status (6 – 10) in the IPP without restrictions. Purchases of cattle of two years of age or older from herds with a lower or unknown status must pass a blood-ELISA test with a negative result. Producers are encouraged to purchase cattle from status ‘A’ or unsuspected herds only (Weber, 2012).

IPP
Herd with status 5 or higher can only purchase cattle (for periods of greater that 7 days) from herds with equal or higher certification status. If cattle are purchased from a herd with a lower status, the herd status is reduced to that of the imported animal (Benedictus et al., 2000).

4.2.4 Control in infected herds

MQAP
Required control activities, beyond culling of test positive cattle, are not regulated within the MQAP. Modelling studies indicated that control procedures (other than culling) do increase the probability of obtaining the preferred herd status A, but have no effect on the milk quality of herds with status A (van Roermund et al., 2005; Weber et al., 2008). Therefore, implementation of control procedures (other than culling) has no influence on herd classification (Franken, 2005). However, infected herds are encouraged to use ‘good preventive management measures’ to limit the transmission of infection within the herd and to cull the last born calves of test positive cows (Franken, 2005). Herds that have new test-positive cattle must cull these animals in order to avoid getting status ‘C’ and problems with the delivery of milk to processors; it is therefore in the producers interest to implement good management practices to reduce incidence of infection (Weber, 2012). Repeat
positive test-results are an incentive to take such preventive measures (Weber, personal communication).

It is recognised that if producers fail to implement successful measures, the proportion of ‘A’ herds will stay the same or decrease over time (Weber et al., 2005).

**IPP**

In addition to identification and culling of infected / test-positive individual cattle, control on infected herds is focussed on calf rearing practices following modelling work indicated that this would have the greatest effect in reducing prevalence of infection long term (Groenendaal et al., 2003).

Specific practices have not been regulated, but are tailor made to individual farms as described above (4.2.1). A bio-containment and bio-exclusion risk assessment tool has been developed for use within the IPP (Para-planner / Para-Informer) (Groenendaal et al., 2003; Franken, 2005). It is not clear how extensively it is now used following the decline in participation in the IPP.

It has been reported that a positive attitude and motivation of the producer is likely to be the primary driver of implementation of successful on-farm control protocols, and that communication to producers should be designed to maximise motivation to continue implementing appropriate management protocols. The same author reports that many of the required changes in management are ‘impossible to monitor’ and making them compulsory within the programme may have the counterproductive effect of reducing producer motivation (Groenendaal et al., 2003).

### 4.2.5 Control in non-infected herds

**MQAP**

There are no required practices for control in test-negative ‘A’ status herds within the BMQAP (Weber, 2012) except for the requirement of testing adult cattle introduced from herds with a lower status.

**IPP**

Control activities are defined by the restrictions on purchased cattle as described in section 4.2.3 above (Benedictus et al., 2000).

### 5. Monitoring and Review

#### 5.1 Surveillance Monitoring

Participation in both the MQAP and IPP have been reported widely. Participation in either programme is compulsory for all dairy producers delivering milk to the Dutch dairy processing industry. However, participation in the IPP has declined to less than 2% of producers and was never more than 5%.

In addition, the status of 711 herds that joined the BMQAP in 2006 / 2007 (without prior participation in the IPP) was reported recently. There has been a trend in these herds of an increasing proportion of status ‘A’ herds, with a reduction in both status ‘B’ and ‘C’ herds. 30% of these herds have always had ‘A’ status; 15% have always have had ‘B’ or ‘C’ status and 54% of herds
have fluctuated between ‘A’ and ‘B’ / ‘C’ (Weber, 2012). Milk producers must now achieve status B as a minimum.

5.2 Programme Monitoring and Review

Programme monitoring and review has been carried out several times since 1998, supported by significant modelling work and subsequent published research. See section 3.1 above for an overview (Benedictus et al., 2000; Groenendaal et al., 2002; Groenendaal et al., 2003; Franken, 2005; Weber et al., 2005; Weber and Schaik, 2007; Weber et al., 2009; Weber, 2012).

5.3 Areas of Concern of Current Administrators

Positive results of additional laboratory examinations (not prescribed by programme regulations) for participants in the MQAP or IPP affects the status of those herds. When producers carry out additional testing, cattle that tested positive must also be culled from those herds. Additional testing is thus discouraged which may negatively influence the control of paratuberculosis.

A further concern are the status A herds that introduce cattle from herds with a lower status. When initiating the programme, firm restrictions on such introductions were considered a disincentive to participation, and consequently not put in place. Furthermore, it was anticipated that the requirements of having to test adult introduced cattle would alert producers to the risks of purchasing cattle from herds with a lower status. However, in the long term, such introductions may cause an increased spread of infections between herds. Therefore, the feasibility of such restrictions may have to be reconsidered.

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Paratuberculosis
A review of bovine Johne’s disease control activities in 6 endemically infected countries

Supplement 5: Review of bovine Johne’s disease control in the United Kingdom

List of Acronyms

<table>
<thead>
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<th>Acronym</th>
<th>Full Form</th>
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<tbody>
<tr>
<td>AFBI</td>
<td>Agri-food and Biosciences Institute</td>
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<tr>
<td>AHDB</td>
<td>Agriculture and Horticulture Development Board</td>
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<tr>
<td>BCVA</td>
<td>British Cattle Veterinary Association</td>
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<tr>
<td>CHeCS</td>
<td>Cattle Health Certification Standards</td>
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<tr>
<td>DEFRA</td>
<td>Department for Environment, Food and Rural Affairs</td>
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<tr>
<td>JAG</td>
<td>Johne’s Action Group</td>
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<tr>
<td>JTG</td>
<td>Johne’s Technical Group</td>
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<tr>
<td>NML</td>
<td>National Milk Laboratories</td>
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<tr>
<td>SAC</td>
<td>Scottish Agricultural College</td>
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<tr>
<td>AHVLA</td>
<td>Animal Health and Veterinary Laboratory Agency</td>
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1. Industry background

There are an estimated 9.7 million cattle of all ages and production systems in the United Kingdom (DEFRA, 2012). Dairy farms number around 15,700 with a total female breeding herd (aged two years or over) of around 1.8 million cattle. The dairy industry has followed the familiar trend of moving toward a smaller numbers of larger farms over the last 15 years. Appendix 1 shows the regional allocation of milk quota across the United Kingdom in 2010 (Wiseman, 2011). The female breeding beef herd (over two years old) is around 1.6 million. In 2008, there were an estimated 65,900 beef holdings (DEFRA, 2012; UKAgri, 2012).

2. JD background

A recent multi-organisation study to estimate the prevalence of JD in the national dairy herd found an individual bovine animal ELISA positive prevalence of 2.5% with 65% and 38% of herds having at least one and two ELISA positive cattle respectively. After Bayesian modelling (with information from multiple test types), the prevalence of Map infected dairy herds was estimated to be 34.7% (27.6-42.5%) (Anon, 2009). The prevalence in the UK beef herds is unknown (Arbuckle, 2006). In the Orkney Islands, individual animal and herd level ELISA positive prevalence in beef herds has been estimated as 3.7% and 65% (based on at least one positive animal) respectively; 8% of beef herds had an ELISA positive prevalence above 10% (Beasley et al., 2011).

3. Programme Background

There is currently no coordinated national Johne’s disease control program in the UK. However, there are several projects concerned with Johne’s disease control at a national level, and many private veterinary practices are engaging in control at farm level supported by discussion forums and commercial laboratories. Major projects are described in this report. See appendix 2 for a schematic overview.

3.1 History and Development

Prior to 1998: Three individual herd health schemes offer Johne’s disease control programs (Herdcare by Biobest / Bloxham laboratories; Premium Cattle Health Scheme by the SAC; Bovi Health Scheme by Axient Laboratories).

1998: Cattle Health Certification Standards (UK) is established as a non-trading company following a conference that considered improvement of the UK’s non-regulatory infectious disease management. CHeCS provides minimum standards for private Johne’s disease accreditation and control programs published in a technical document; CHeCS licensees privately run herd accreditation programs. CHeCS is centred initially on rules to identify and accredit Johne’s ‘free’ herds but evolves over time to increasingly provide guidance on control of infected herds.

1999 – 2012: Annual review of the minimum standards of CHeCS (described in a technical document) by a technical working group.

2007: Launch of myhealthyherd.com, a privately owned company that provides an internet based herd health planning tool including a Johne’s disease module; the company is formed as an off-shoot from a previous herd health planning project within the BCVA.
2008: The Agriculture and Horticulture Development Board (AHDB; a levy funded farm industry support group) launch the not-for-profit dairy advisory organisation Dairy Co to replace the Milk Development Council.

2009: In response to their Farmers’ Forum, Dairy UK (a dairy industry lobby group) hosts a conference with the aim to raise awareness of Johne’s disease among dairy producers (farmers). An integrated report of the prevalence of JD in the UK dairy herd is published at this conference (Anon, 2009).

2009: Dairy UK form the Johne’s Action Group (JAG) with representation from producers and producer unions, vets, milk purchasers, milk testing laboratories, DairyCo, CHeCS and Government agencies. The JAG has a short term goal of raising awareness and discussion of JD across the dairy industry, and a long term goal of encouraging commercially viable ways of reducing disease prevalence. The JAG allows free discussion and exchange of ideas between interested parties, which due to a lack of funding must all find a commercial benefit from participation. A sub-group of industry experts, the Johne’s Technical Group (JTG), is appointed to provide technical guidance.

2010: Publication of a ‘Johne’s toolkit’ by the JAG which gives broad guiding principles of Johne’s disease control and links to other sources of information for interested stakeholders

2010: Launch of Paraban, a multi-stakeholder project with funding for three years which primarily aims to improve Johne’s disease knowledge exchange in Scotland (Gunn, 2010).

2011: Review of the CHeCS technical document leads to an increase in testing requirements to achieve ‘free’ accreditation (from 2 herd tests 12 months apart to 3 tests 12 months apart) due to an unacceptably high risk of accrediting infected herds.

2011: Launch of a 4 year project titled ‘On farm strategies to reduce the impact of Johne’s disease in British dairy herds’ by the levy funded organisation DairyCo with the aim of identifying best practice measures for control of Johne’s disease and to evaluate control measure’s effectiveness and economic efficiency; multiple colleges and universities are collaborating in the project.

2012: Activities of some stakeholders within the JAG, and particularly analysis of dairy herds currently using the JD control component of myhealthyherd.com, are presented as ‘A Johne’s disease engagement program in the UK’ at the 3rd ParaTB forum in Sydney.

2012: The CHeCS technical document review includes significant modification of the herd accreditation categories, moving away from the terminology of ‘accredited free’ toward categories that reflect reducing prevalence / risk of infection. Other changes include requirement of veterinary control plans to be sent to the scheme provider for herds participating in the accreditation scheme.

2012: 2nd Dairy UK / Dairy Co coordinated conference on Johne’s disease control in the UK, titled ‘Johne’s disease: moving the agenda forward’; initial guidelines likely to be published by the Dairy Co project initiated in 2011 are presented at the conference.

3.2 Current Structure
There is no single, coordinated Johne’s disease control in the UK at present. This review will focus on the CHeCS licensed commercial herd health schemes. The accrediting body is the Cattle Health...
Certification Standards (CHeCS). There are 10 licensed commercial herd health schemes available to producers in the United Kingdom and the Republic of Ireland.

All licensed schemes must adhere to the minimum standards as defined in the CHeCS technical document. The document also details the minimum standards required for control of IBR, BVD and Leptospirosis (CHeCS, 2012).

The technical document outlines two Johne’s disease programmes that are in turn available through the commercial providers:

- A Johne’s disease accreditation program
- A Johne’s disease reduction program

A document describing a UK ‘Johne’s Engagement Programme’ was presented at the 3rd ParaTB forum in Sydney, 2012 (Orpin et al., 2012). The document outlines the activities of some of the stakeholders within the JAG, and makes reference to the JAG toolkit and the existence of the CHeCS scheme. However, the activities described do not constitute any recognised or coordinated national programme. Neither the Dairy Co nor Paraban projects are described. However, due to the presentation at the 3rd ParaTB forum, the activities described are included in this review and referred to as the Johne’s Engagement Programme (JEP).

Paraban is a multi-centre knowledge exchange and awareness raising program in Scotland that is studying Johne’s disease intensively on nine ‘Demonstration’ farms. It has not yet published any specific recommendations (expected November 2013).

No details of the DairyCo project ‘On farm strategies to reduce the impact of Johne’s disease in British dairy herds’ have been published at the time of this review.

### 3.3 Programme Aims

**CHeCS**

Prior to 2012, the stated aim of the Johne’s disease accredited free programme was to:

‘Demonstrate the herd has tested free from Johne’s disease, to maintain freedom from Johne’s disease, and to allow the sale of stock as accredited free of Johne’s disease’.

However, this was modified in 2012 to:

‘Provide a graded system of accreditation which enables herds to maintain or move towards clear herd tests. The grading system can be used to classify the level of risk of Johne’s disease associated with buying cattle from these herds’

The aim of the dairy / beef disease reduction programme is to:

‘Implement a control programme to reduce the detrimental effects on herd productivity caused by this disease. The long-term goal is to achieve freedom from the disease but the removal of reactors is not a strict requirement. In order to achieve accreditation for Johne’s disease participating herds are required to join the Johne’s Disease Accreditation Programme’.

**JEP**
The aims of the JEP are consistent with those of the JAG toolkit; primarily to increase engagement in JD control in UK dairy herds through education, raising awareness, defining disease status and implementing controls (Orpin et al., 2012)

**Paraban**
The aims of the Paraban project are to ‘exchange current knowledge, expertise, perspectives, experiences, ideas and visions for the best practice for Johne’s Disease control between meat and milk producers, industry stakeholders, scientists and veterinarians’ (Gunn, 2010). Additional objectives are to:

- Determine the most cost effective approaches to Johne’s disease control
- Optimise control regimens for Scottish beef and dairy farms
- Deliver legacy best practice guidelines to aid control of Johne’s disease in cattle

### 3.4 Organisations Involved

CHeCS is a non-trading organisation owned by the British Cattle Veterinary Association (BCVA), the National Cattle Association (Dairy), the National Beef Association and Holstein UK. Technical support is also provided by State Veterinary Services, the Milk Development Council (now DairyCo), the Central Association of Auctioneers and Valuers, The Animal Health and Veterinary Laboratories Agency and The Livestock Auctioneers Association. The primary role of CHeCS is to produce and maintain the technical document that details the rules of the various cattle health schemes, and to accredit commercial provider’s schemes that comply with these rules (Duncan, 2000; Brigstocke, 2010).

There are 10 commercial health schemes for Johne’s disease currently licensed by CHeCS. The organisations running these include commercial laboratories, the Scottish Agricultural College and breed societies (CHeCS, 2012).

**Table 1: CHeCS licensed Johne’s disease control programmes available in the UK.**

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Health Scheme Name</th>
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<tr>
<td>NationWide Laboratories</td>
<td>Advance Cattle Health Scheme</td>
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<td>Agri-food and Biosciences Institute</td>
<td>AFBI Cattle Health Scheme</td>
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<td>Biobest</td>
<td>HiHealth Herdcare</td>
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<tr>
<td>Jersey Island Genetics Ltd</td>
<td>Limo Leader Herd Health Programme</td>
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<td>Irish Limousin Cattle Society Ltd</td>
<td>Munster Herd Health</td>
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<tr>
<td>Munster AI Farm Services Group Ltd</td>
<td>NML Herdwise (only milk based program with CheCS approval)</td>
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<tr>
<td>National Milk Laboratories</td>
<td>Premium Cattle Health Scheme</td>
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<tr>
<td>SAC Veterinary Services</td>
<td>Shetland Animal Health Scheme</td>
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<tr>
<td>Shetland Islands Council</td>
<td>VLA Herdsure Cattle Health Improvement Service</td>
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<tr>
<td>Veterinary Laboratory Agency</td>
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Private veterinarians that administer CHeCS programs are expected to complete a British Cattle Veterinary Association (BCVA) CPD day on infectious disease. Whether they do this or not is not currently audited (G. Caldow, personal communication).

**JEP**
The JEP describes activities of some of the stakeholders within the DairyUK JAG, particularly the uptake of a software support programme by dairy producers and vets (myhealthyherd.com).

Paraban
Paraban contributors include representatives of individual producers, the Scottish red meat industry, the dairy industry, academic institutions, producers unions and similar organisations, food retailers, animal feed companies, veterinary practices, independent laboratories and the Scottish Food Standards Agency (Gunn, 2010).

3.5 Funding

3.5.1 National Coordination
CHECS is funded by its owners (BCVA, the National Cattle Association, the National Beef Association and Holstein UK). It received start up funding from the Milk Development Council (Dairy Co – a levy funded not for profit organisation) and the Royal Association of British Dairy Farmers (a membership funded independent lobby group).

Providers of licensed herd health programmes pay an annual licence fee that is used to maintain the technical document and other central CHECS activities. It was originally intended that this money would be used to fund an independent auditing of licensed programmes but this has not yet been instigated (G. Caldow, personal communication). Licensed programmes are currently audited by the CHECS Chief Executive Officer.

JEP
Conference coordination in 2009 and 2012 was funded by Dairy UK. The JAG and JTG receive no funding, leading all stakeholders to pursue their own commercial interest. In some areas government (through the Rural Development Program for England) and milk processor funding was available to aid producer uptake of a software support programme (see below) (Orpin et al., 2012).

Paraban
Funding for Paraban was in part from Government through the Scottish Funding Council (the national strategic body that is responsible for funding teaching and learning provision, research and other activities in Scotland’s academic and higher education institutions) (Gunn, 2010).

3.5.2 Farm level participation
Farm level participation is funded entirely by participant producers when they chose to enrol in a commercial health scheme.

As an example, a dairy producer with 150 cows over 2 years old that joins the Premium Cattle Health Service (Johne’s disease) offered by the SAC will pay the following fees:

- £60 (£72) joining fee and annual membership fee
- £600 (£720) (£4 X 150) annual screening test lab fee for 5 years
- £600 (£720) (£4 X 150) bi-annual screening test fee thereafter (if following the non-home bred and cull screen – see below)
Additional follow up testing would be variable at cost depending on prior results, at the rate of £30.70 (€36.84) and £26 (€31.20) for faecal bacteriology and PCR respectively.

Fees payable to other providers will vary.

Veterinary fees to complete biosecurity assessments and for sample collection (where serum / faeces are used) would be paid separately, in addition to the above. The amount would be agreed between the producer and the private veterinary practitioner (estimated at around £400 / year (€480).

**JEP**
Fees for veterinary risk assessment, subscription to myhealthyherd.com and any desired testing are paid by participating producers, with government subsidisation of 70% available in some areas (Orpin et al., 2012).

**Paraban**
All 9 Demonstration producers participating in the project were required to be a member of a Health Scheme (PCHS or HiHealth) either at enrolment or soon after. The Paraban project covers the cost of all laboratory testing for Paratuberculosis. The producer is required to pay the veterinary costs of the first annual herd test. Veterinary fees associated with a second whole herd test in the same year or any additional tests, including faecal PCR, are paid for by the project.

### 3.6 Voluntary or Compulsory

Membership of any private CHeCS approved cattle health scheme is voluntary.

Once membership is taken up, the rules of the scheme become compulsory. If a participant producer is found to be breaking the rules of the scheme any accredited status would be removed.

**JEP**
Participation in activities described as the JEP is voluntary.

**Paraban**
Demonstrations producers were recruited via their private vets and participation is voluntary; the producers are free to leave the project at any time.
4. Programme Components: Surveillance and Control

4.1 Surveillance

4.1.1 Laboratory testing for surveillance

Specific laboratory test kits are not defined for use in approved herd health schemes. However, laboratories must be accredited to carry out their chosen tests to international quality standard ISO/IEC 17025.

Surveillance of low prevalence / test negative herds is achieved through the Johne’s disease accreditation program. All cattle over 2 years of age must be tested by serum / milk antibody ELISA, or by individual cattle faecal culture / PCR (that are pooled by the testing laboratory into batches of 5). Quarterly milk antibody testing may also be used, with 4 consecutive tests plus a one off serum ELISA testing of all non-milking eligible cattle being taken as a single clear test.

Cattle that test positive on an antibody test must be placed in isolation as a suspected reactor. A faecal test (culture / PCR) or post mortem test (culture / PCR / histological examination of the ileocaecal junction and associated lymph nodes) must be done to resolve the status of the animal; if positive the animal is confirmed as a reactor. Where cattle test positive for antibody in a milk sample, or positive ‘close to the cut-off threshold’ by serum ELISA, then at the laboratory’s discretion retesting after one month may be carried out using serum ELISA. If it is negative on that occasion then it is not a reactor.

If no additional testing is done, the animal is classified as a reactor by default.

It is advised that ELISA testing should not be carried out within 3 months of an intra-dermal tuberculin test due to the risk of cross reaction and false positives. When this occurs inadvertently any cattle with positive results should be separated from test negative cattle and re-tested after 1 month and, if still positive, at 3 months after the original blood test.

In addition to the above, any bovine over 6 months of age with signs consistent with Johne’s disease (diarrhoea and weight loss) must be examined by a veterinary surgeon and, if the veterinary surgeon cannot be sure that Johne’s disease is not the cause the animals must be isolated and tested as above.

For large herds (at least 20 homebred cattle over 2 years old) that have successfully maintained level 1 status for two years there is an option to follow a ‘non-homebred and cull screen’ program. Homebred cattle must be tested as above every 24 months; non-home bred cattle must be tested as above every 12 months; any bovine animal scheduled for culling (excluding finishing cattle) must be tested as above before leaving the herd.

If a reactor is confirmed at any stage, 12 months must pass before another herd test can be taken that will count toward progressing up the accreditation levels.

JEP

There are no specific herd testing requirements under JEP, but the organisations involved have predominantly promoted a ‘prevalence directed’ test of 30 cattle in the herd to be tested by milk ELISA as an initial screen. Criteria for selection of ‘most likely infected’ cattle include age, cell count,
fertility performance and lameness (NML, 2011). It was noted that the sensitivity of this test varies with cow selection and that ‘veterinary involvement’ is critical (Orpin et al., 2012). Estimation of sensitivity has not been published. Several UK laboratories also offer this screening test independent of any control program (NML, 2011). Veterinary guided further testing (non-specified) is then advised on an individual herd basis, with no further testing an option. Vets are encouraged to interpret results along with bio-exclusion and bio-containment risk assessments.

Paraban
Twice yearly serum ELISA testing of all breeding cattle over 1 year of age in the herd is advocated with repeat testing of cattle with an inconclusive result (between one and 3 months later). Faecal samples from sero-positives are tested by PCR. However, there is an emphasis on feasibility of implementation of testing and control strategies thus some between-farm variation of testing protocol with regard to frequency exists. Post mortem testing of test positive (and test negative cows as controls) as they pass through the abattoir is being performed by the University of Glasgow. In addition, sampling of the external environment of each Demonstration farm has been carried out by the James Hutton Institute in order to investigate whether knowledge of soil characteristics may be used to inform risk based management decisions of where to graze cattle to minimise exposure to MAP.

NB – some large retailers with direct milk suppliers have started making quarterly milk antibody screening and reporting of repeat test positive cattle compulsory for milk suppliers; no other controls are required at present (Orpin et al., 2012).

4.1.2 Herd Classification for surveillance
Prior to 2012, there were only two levels of classification for surveillance; herds were ‘accredited free’ or not. In the 2012 review, a 5 level categorisation was introduced, with two levels for test negative herds and three for test positive herds (see also section 4.2.2 below). The first two levels are for test negative herds:

Level 1 – For herds with 3 consecutive herd tests at least 12 months apart with no reactors identified; the year that a herd first achieves this status is also identified (e.g. Level 1, 2012 for a herd that achieves this level in 2012). This level is the direct equivalent of the previous ‘accredited free’ status.

Level 2 – For herds with 1 or 2 (termed ‘one year clear’ and ‘two years clear’ respectively) herd tests with no reactors identified

JEP
Under JEP, herds are reported to be given one of three classifications by combining biosecurity and bio-containment risk assessments, ‘resilience / immunity’ and surveillance (laboratory test) data, though specific inclusion criteria have not been published. The classifications are:

- Test positive high, medium and low risk herds
- High risk test negative herds
- Low risk test negative herds
4.2 Control

4.2.1 Laboratory testing for control
Requirements for herd testing to facilitate control are described in both the accreditation and the disease reduction programs and are identical to those outlined in 4.1.1. However, follow up testing of ELISA positive cattle is discretionary and not compulsory within the disease reduction programs.

Dairy herds following the quarterly individual animal milk tests within the disease reduction program are advised to use the test results to classify individual cattle as high, medium or low risk of being infectious to facilitate on farm control (see 4.2.4 below). The classification system is based on the Danish testing system. The criteria are:

- **High risk** – Two consecutive milk antibody tests positive or one serum antibody test positive
- **Medium risk** – One positive test in her current lactation (if this is the last test before dry off she should be serum tested and re-classified appropriately)
- **Low risk** – More than two consecutive negative milk tests or a single negative serum test, regardless of any previous results

**JEP**
The document outlining the JEP encourages testing requirements to be decided on an individual farm basis with veterinary guidance; no specific testing protocols are described though quarterly milk testing is reported to be popular.

**Paraban**
Like JEP, the emphasis is on a flexible regimen on a farm by farm basis for both testing and control strategies, with the implementation of gold standard practices as far as practicable. Control options are discussed at steering group meetings and are based on test results, farm history and farm goals; the most feasible and achievable best practice measures are identified for that farm. The steering group discussion panel comprises of the producer and his vet together with representatives from industry and health schemes, epidemiologists and other scientists from the Paraban project. Best practice control measures typically implemented are immediate isolation of sero-positives and subsequent removal from the herd (cull), with the progeny of test positives not retained for breeding.

4.2.2 Herd Classification for control
Prior to 2012 there was no defined herd classification system for herds with test positive cattle; herds were either participating in a disease reduction program or they were not. In 2012, 2 levels were included within the accreditation program for test positive herds that were willing to comply with the rules of the accreditation scheme (see 4.2.4 below). The categories are:

Level 3 – Herds with less than 3% prevalence of reactors at the most recent herd test (or no more than a single reactor in herds with less than 33 eligible stock)

Level 4 – Herds with over 3% prevalence of reactors at the most recent herd test (or more than a single reactor in herds with less than 33 eligible stock)

A final level (level 5) is defined for herds that are not complying with the mandatory requirements of the accreditation program (see 4.2.4 below), regardless of whether testing is performed or not. By
default, all herds not participating in the accreditation program (regardless of whether they participate in the disease reduction program) are scored at level 5.

**JEP** – see section 4.1.2 above.

### 4.2.3 Cattle movements

There are no restrictions on the movement of confirmed or suspected Johne’s disease infected cattle in the national legislation of the United Kingdom.

Cattle can be added from an equivalent or lower level herd without any isolation or testing requirements, and with no effect on herd status.

Cattle from non-accredited herds and higher level herds can also be introduced into an accredited herd of any level, though this is discouraged. The incoming bovine animal must be isolated on arrival and test negative by both faecal culture and serum antibody ELISA before introduction; they must also be re-tested annually (regardless of the current herd testing being utilised). When these are completed the herd will maintain their current level, though the bought in cattle are only ever considered as being at the level of their herd of origin (CHeCS, 2012).

Cattle from accredited herds if any level can attend shows or sales etc for periods of up to 7 days, provided that direct contact with other cattle is avoided (CHeCS, 2012).

### 4.2.4 Control on infected herds

Until 2012, test and cull was the only specific control measure detailed in the CHeCS rules for infected herds.

In 2012, the required control measures were increased for infected herds in the accreditation scheme (levels 3 and 4).

The following must be performed:

- Reactors must be culled ‘as soon as is practical’ and kept separate from calves and the breeding herd until removed; offspring of a reactor (born or reared after the reactor status was known) must not be kept for breeding
- A health plan, signed by the herd owners vet, must be submitted each year with the annual blood screen; the plan must include details of mandatory culling and the farm specific instructions to implement the following advisory guidelines:
  - Minimise faecal contamination of stock, especially around calving and give guidelines on faecal / slurry management
  - Keep feed and water ‘as free from faecal contamination as possible’
  - Provide mains water to cattle at pasture (unless on extensive grazing of at least 50 hectares); natural water sources should be fenced off
  - Co-grazing with sheep should be prevented (unless on extensive grazing of at least 50 hectares)
  - The last two calves born from a subsequent reactor should not be kept or sold for breeding
For herds in the disease reduction program, the following is stated in the CHeCS document as being advised:

- Reactors and their offspring are not retained for breeding and are removed as soon as practical
- Management procedures (not defined) are implemented to reduce the exposure of cattle to infection

In addition, the CHeCS technical document defines criteria for classifying dairy cattle in herds within the disease reduction program that use quarterly milk testing into three risk categories:

- **High risk** – an animal with two consecutive quarterly milk ELISA positive results or a single serum ELISA positive result
- **Medium risk** – an animal with a single milk ELISA positive result in her current lactation
- **Low risk** – a cow with more than two consecutive milk antibody ELISA negative results or a single serum antibody ELISA negative result

It is advised that a management strategy for medium and high risk cows be agreed between the vet and the producer, and further states that where possible high risk cattle should be removed from the herd before calving and medium risk cows should be ‘isolated at calving to avoid risk of infecting young-stock’ (CHeCS, 2012).

Vaccination is advised for use in herds where there is a sufficiently high prevalence of ELISA positive cattle in a herd to prevent test and cull being a reliable option for control. It states that vaccination should continue until no clinical cases occur for at least two years.

All herds (whether in the accreditation or disease reduction scheme) must comply with the following biosecurity protocols:

- Cattle must not graze pasture previously grazed by (or applied with slurry from) non-accredited cattle within the last 12 months
- Colostrum must not be introduced from non-scheme herds or from health scheme herds of a lower status
- Farm and veterinary equipment must be cleaned and disinfected (with DEFRA approved product) before use when it is shared with other herds
- Cattle should be delivered to and picked up from a site isolated from the main herd
- An isolation facility must be available (separate air, drainage and dung storage); if an bovine animal tests positive when in isolation all dung must be treated as dung from non-accredited cattle when spread (see above)

**JEP**
Individual control programs are tailored to farms by trained veterinarians, utilising the myhealthyherd.com Johne’s disease module. Options are reported to include test and cull, improved farm management, vaccination, breeding to beef, replacing infected breeding cows with non-infected cattle over time. No further details have been published (Orpin et al., 2012).
4.2.5 Control on non-infected herds

Herds in the accreditation scheme with no test positive cattle (levels 1 and 2) must comply with the same rules as herds in the accreditation scheme at higher levels. See section 4.2.4 above. Reactors must be removed from a herd immediately, and when identified result in a move to level 3 or 4 depending on the number identified. See section 4.2.2 above.

JEP – see 4.2.4.
5. Monitoring and Review

5.1 Surveillance Monitoring
There are no regularly published data regarding participation in CHeCS approved programmes. Data from the various herd health schemes is not coordinated (G. Caldow, personal communication).

All providers were contacted by the author to ask for this information, but very few replied with definite numbers, and some were unwilling to supply information as they felt it was commercially sensitive.

Some providers publish details of accredited herds (with permission from the herd owner) on their own websites.

**JEP**
In a recent presentation 50% of participating herds (n=2503) were reported to be at high risk of introduction of Johne’s disease and 80% of herds were at risk of rapid spread of Johne’s disease should they be infected. Results of laboratory testing have not been reported (Orpin et al., 2012).

**Paraban**
Within herd prevalence of sero-positive cattle on demonstration farms at the beginning of the project was between 2% and 45% (where the 45% figure was observed in a previously vaccinated herd and not considered representative of natural infection). A decrease in sero-prevalence has been observed on all Demonstration farms across the 2 years of the study to date (S. Huntley, personal communication).

5.2 Program Monitoring and Review
The CHeCS technical document is reviewed annually by a technical group that comprises representatives from CHeCS licensed cattle health schemes plus a number of ‘recognized international experts’ on each disease.

5.3 Areas of Concern of Current Administrators
This section cannot be completed due to the fragmented nature of the national Johne’s programme in the UK currently.
Appendices

Appendix 1: Regional allocation of milk quota in the United Kingdom (Wiseman, 2011)

Appendix 2: Overview of JD projects in the UK as of January 2013
References


A review of bovine Johne’s disease control activities in 6 endemically infected countries

Supplement 6: Review of bovine Johne’s disease control in the United States of America

List of Acronyms

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<tr>
<th>Acronym</th>
<th>Description</th>
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<tr>
<td>APHIS</td>
<td>Animal and Plant Health Inspection Service</td>
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<tr>
<td>DJC</td>
<td>Designated Johne’s Disease Coordinator</td>
</tr>
<tr>
<td>JCV</td>
<td>Johne’s Disease Certified Veterinarians</td>
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<tr>
<td>JDIP</td>
<td>Johne’s Disease Integrated Program</td>
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<tr>
<td>MAP</td>
<td>Mycobacterium avium subspecies paratuberculosis</td>
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<tr>
<td>NAHMS</td>
<td>National Animal Health Monitoring Systems</td>
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<tr>
<td>OJT</td>
<td>Official Johne’s disease test</td>
</tr>
<tr>
<td>RAMP</td>
<td>Risk Assessment and Management Plan</td>
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<tr>
<td>USAHA</td>
<td>United States Animal Health Association</td>
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<tr>
<td>USDA</td>
<td>United States Department of Agriculture</td>
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<tr>
<td>VBJDCP</td>
<td>Voluntary Bovine Johne’s Disease Control Program</td>
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<tr>
<td>VJDHSP</td>
<td>Voluntary Johne’s Disease Herd Status Program</td>
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<tr>
<td>VS</td>
<td>Veterinary Services</td>
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The U.S. Voluntary Bovine Johne’s Disease Control Program

1. Industry background
There are approximately 91 million cattle in the USA, the vast majority being beef animals with only around 9.2 million dairy cattle (USDA, 2012). Both the beef and dairy industry are changing toward smaller numbers of larger farms. There are an estimated 753,000 beef cow farms and 65,000 dairy farms. All states have some beef cow-calf production but almost 50% are in the central and mid-western states of Texas, Nebraska, Missouri, Oklahoma, South Dakota, Montana and Kansas. All states have some dairy industry. California is the largest dairy producer (21% of all U.S production) with California, Wisconsin, New York, Idaho and Pennsylvania contributing over 50% of all U.S production. Dairy production is declining in the southern and eastern states and expanding in the west and mid-west (USDA, 2010b; USDA, 2010a) (appendix 1).

2. JD background
A National Animal Health Monitoring Systems (NAHMS) study in 1996 estimated a herd prevalence of 35-47% in the U.S dairy industry, based on herds with at least 1 ELISA positive animal (USDA-APHIS-VS, 1997). A second national study in 2007 found 68% prevalence of MAP culture positive dairy herds from environmental samples, with a higher prevalence in larger herds (95% prevalence in dairy herds with 500 cows or more) (VS, 2008). A similar study in beef (cow-calf) herds in 1997 conservatively estimated a herd prevalence of 7.9%, based on a sampling strategy to detect a minimum 10% within herd prevalence (USDA-APHIS-VS, 1999). More recent estimates of beef (cow-calf) herds were not available through NAHMS.

3. Programme Background
3.1 History and Development
Key stages in the development of the Voluntary Bovine Johne’s Disease Control Program (VBJDCP) include:

1993: United States Animal Health Association (USAHA) adopt a model Johne’s disease herd certification program but it is deemed too expensive and does not achieve national acceptance

1995: USAHA appoint a National Johne’s Disease Working group to assist the existing Johne’s Committee of the USAHA in developing a national, coordinated Johne’s disease effort in conjunction with the States and cattle industry. A strategic plan is formed with national educational campaign, a Voluntary Johne’s Disease Herd Status Program for cattle and guidelines to assist infected herds


2002: The USDA, Animal and Plant Health Inspection Service (APHIS) and Veterinary Services (VS) use the VJDHSP as a model to develop Uniform Program Standards for a national ‘Voluntary Bovine Johne’s Disease Control Program (VBJDCP).

2004: 1st meeting of the Johne’s Disease Strategic Plan Sub-Committee (a sub-comitee of the USAHA) where 5 new objectives are agreed: 1) Increase producer (farmer) participation; 2) improve
educational efforts; 3) Close gaps in knowledge about Johne’s disease; 4) Improve reporting; 5) Develop an eradication plan

2008: 2nd meeting of the Johne’s Disease Strategic Plan Sub-Committee with various changes in strategy direction. Significant changes include 1) Move away from a government program toward a public/private partnership; 2) Update the herd classification system; 3) Move toward Risk Assessment becoming a self-directed process (e.g. reducing compulsory specialist veterinary input) and to phase out JD management plans (to be replaced by total herd health plans); 4) Focus research onto diagnostic test, control strategies and vaccines

2010: The USDA-APHIS-VS amend the Program Standards including a new Herd Classification System which replaces the previous ‘Test Negative Program’; inclusion of the use of a milk ELISA, allowing technicians to collect test samples on farm and reducing the frequency of risk assessments to every three years (Patton and Wheeler, 2010).

3.2 Current Structure

The VBJDCP is designed as a cooperative programme administered by State governments and supported by industry and the Federal Government. There program has three key themes:

- 1st level: **Education** of primary producers regarding the costs and prevention, control and elimination strategies for Johne’s disease (requires no management or testing by producers)
- 2nd level: **Management** to help establish good management strategies on farms (currently requires producers to conduct a risk assessment and create a herd management plan)
- 3rd level: **Herd testing and classification** to identify low prevalence test positive / test negative herds (requires a risk assessment, herd management plan and herd testing)

To deliver these themes the VBJDCP has the following key components:

1. **A defined set of Uniform Program Standards** which lays out the administrative structure, the procedures for delivery of the three themes (education, management and herd testing and classification) and details of approved laboratories and laboratory procedures
2. **A manual for conducting risk assessments and developing management plans** for Johne’s disease (separate beef and dairy editions)
3. **A state Designated Johne’s disease Coordinator (DJC)** for each participant state, with wide ranging responsibilities primarily regarding implementing and auditing a VBJDCP at state level. The DJC is supported by the State Advisory Committee
4. **Educational materials** including a central website termed ‘Johne’s Information Central’ plus multiple information leaflets and FAQ documents etc. They are produced by the National Johne’s Disease Education Initiative, part of the National Institute for Animal Agriculture (Patton and Wheeler, 2010; USDA-APHIS-VS, 2010; NJEI, 2012).

Individual states utilise the above components to offer a state program for farm level participation. State programs must meet or exceed the level set out in the Uniform Program Standards to be recognised as a part of the national VBJDCP. Producers enrol in the state program, rather than in a national program. 50 states had an approved program at the peak of the program, but with the reduction in federal funding many states have discontinued their program. An exact current number is not available.
Although not part of the control program, it is also worth noting the **Johne's Disease Integrated Program (JDIP)**, a comprehensive consortium of scientists whose mission is to promote animal biosecurity through the development and support of projects that are designed specifically to enhance knowledge, promote education, develop real-world solutions and mitigate losses associated with Johne’s Disease. It is an international collaboration of over 80 universities, government agencies, private organisation and the USDA, part funded largely by competitive awards from the National Research Initiative (NRI) and the National Institute of Food and Agriculture (NIFA) of the USDA. It was formed in response to a National Academies of Science report into gaps in Johne’s disease knowledge. Funding from JDIP’s current competitive grant is also nearing an end. The organization is currently transitioning to a Mycobacterial Disease Multistate Initiative. This will help to maintain the network that has been developed and provide a vehicle to use in pursuing additional funding opportunities (Ken Olsen, personal communication).

### 3.3 Programme Aims

The aims of the VBJDCP are to provide national standards for the control of Johne’s disease (USDA-APHIS-VS, 2010).

Additional stated aims from the Johne’s disease strategic plan subcommittee (2008) are, through a public/private partnership, to increase the availability of effective tools to reduce:

- The prevalence of MAP/Johne’s disease in the national herd
- The impact of Johne’s Disease on individual farms
- The risk of introducing Johne’s Disease to uninfected herds

### 3.4 Organisations Involved

The Uniform Program Standards are compiled, updated and approved by:

- **The USAHA Johne’s disease committee** - a broad group of government, industry and university representatives whose purpose is to facilitate communications between key stakeholders in an effort to provide the USAHA with recommendations to control and eventually eradicate *Mycobacterium paratuberculosis* from the United States
- **The National Johne’s Disease Working Group** – a subcommittee of the USAHA Johne’s disease committee
- **State Veterinarians**
- **Industry representatives**
- **USDA-APHIS-VS**

The manual for conducting risk assessments is authored and updated by the National Johne’s Disease Working Group.

The ‘Johne’s Information Central’ website and other educational material are produced and updated by the National Johne’s Education Initiative, a group within the National Institute for Animal Agriculture and funded with a National Disease Eradication Program Grant from the USDA.

The State Advisory Committees (or working groups) are made up of producers, beef and dairy representatives, private vets, university and extension personnel along with State and Federal regulatory personnel and act to support the DJC.
Risk Assessment and Management Plans (RAMPs) are currently conducted by State or Federal personnel or by Johne’s Disease Certified Veterinarians (JCVs). JCVs are accredited veterinarians that undergo further and continued education (with recognised guidelines on initial training and refresher courses every 5 years) on Johne’s disease and demonstrate adequate knowledge to the DJC.

Samples for herd testing must be collected by or under supervision of an accredited veterinarian (approved by the APHIS Administrator to perform functions required by State-Federal-Industry cooperative programs) an animal health official (an employee of APHIS or the state animal health department with authority to carry out programme activities) or an authorised agent (an individual who has undergone training specified by the DJC to perform sample collection). The approval of authorised agents has allowed milk collected under the Dairy Herd Improvement program (a milk recording service) to be used for program testing. No more specific guidelines on milk sample collection are described (USDA-APHIS-VS, 2010).

3.5 Funding

3.5.1 National Coordination
National coordination activities have been funded with federal funds via USDA. This funding is currently being significantly reduced (likely to be withdrawn entirely in September 2012), and there is a strategy to move toward a shared public / private funding model. Additional funds are generated through state-cooperative agreements for use at state level. See appendix 2.

3.5.2 Farm level participation
Farm level participation (Risk Assessment, Management Plans, sample collection, laboratory fees) has been subsidised in many states by federal and state funding with the level of subsidisation varying between states. As federal funds have been reduced their use has been directed toward laboratory proficiency testing and creation of educational material and field studies; there is a current strategy to move toward state and industry stakeholders subsidising participant funding and to develop ways to build up market incentives for achieving a high herd classification score (low risk of JD) (Schwartz, 2008; Patton and Wheeler, 2010).

For example, in New York State, the RAMP is provided free of charge to producers, but sample collection and laboratory fees are not (though ELISAs and PCR are partly subsidised). Of 700 herds participating in the management program, only 30 have adopted the herd classification program with most non-certified herds not using any testing at all (Dr. J. Bennett, DJC for NY, personal communication). The state program has the VBJDCP as only one component of a broader herd health program.

3.6 Voluntary or Compulsory
The VBJDCP is entirely voluntary. However, since May 2000, domestic cattle that test positive for Johne’s disease by an Official Johne’s disease test (OJT - an organism detection test) conducted by an approved laboratory cannot be moved interstate except for slaughter (some exceptions apply).
4. Programme Components: Surveillance and Control

4.1 Surveillance

Surveillance is achieved through the herd testing and classification component of the VBJDCP (the third level of participation in the program), with the purpose to identify herds with a low prevalence of JD or all test negative status. In order to qualify for herd testing and classification, a herd must have a current risk assessment and management plan (RAMP) in place (see sections 4.2.3-4.2.5 below).

4.1.1 Laboratory testing for surveillance

All testing program must be approved by the DJC and laboratory tests must be conducted in approved laboratories. Laboratory tests are divided into direct individual animal tests where a positive result is definitive (termed Official Johne’s disease test – OJT) and herd screening tests used for herd classification, where positive results are followed up using an OJT.

OJTs: Faecal / tissue culture, faecal PCR or histology of tissue taken from an individual bovine animal.

Herd screening tests: Individual bovine animal ELISA (milk or blood) of an appropriate subset (see below), environmental faecal culture / PCR (only applicable in some instances) and pooled faecal culture or PCR (individual samples of an appropriate subset combined into pools of 5 before testing) are all utilised in herd testing.

The minimum initial screening test allows entry into the lowest classification (level 1) or maintenance of classifications 4 -6 (USDA-APHIS-VS, 2010). This consists of either 60 cattle tested by ELISA, 30 cattle tested individually by a direct test, 30 cattle tested in pools of 5 by a direct test or 6 environmental faecal cultures (dairy herds only).

More robust herd testing is required for progression of classification or entry above level one. Progression is awarded by repeating this test annually (10-14 month window) (USDA-APHIS-VS, 2010) (appendix 3). The required number of cattle to be tested varies with herd size and choice of screening test. In herds with less than 300 eligible cattle (females over 36 months or males over 24 months) all such cattle must be tested regardless of which test is used. In larger herds, reduced subsets of randomly selected cattle can be tested, with smaller subsets tested when using a direct detection test compared to an ELISA. See appendix 3.

4.1.2 Herd Classification for surveillance

Assuming all negative results from screening tests, herds are classified at level 3 in the initial year and progress one level annually with each negative screening test until reaching level 6. Levels 4-6 therefore indicate low risk of infection with increasing confidence (though the levels of confidence are undefined).

An alternative to annual progression is to maintain classification at level 4-6 using the minimum initial screening test detailed above.

Low prevalence of positive results are permitted in the herd classifications 1-3. The herd classification cut-offs for low prevalence herds vary with the screening test used and the herd size. See appendix 4.
Individual cattle that test positive by a herd screening test are classified as ‘suspicious’ and must be tested by an OJT to definitively diagnose the animal as infected. However, in already known infected herds, or in individual bovines with clinical signs of Johne’s disease, a positive screening test is interpreted as definitive.

Vaccinating herds can obtain levels 4 to 6 only once vaccination is discontinued. Only OJTs can be used in previously vaccinated herds looking to progress through herd classifications.

4.2 Control

4.2.1 Laboratory testing for control
Herds that have a test positive prevalence above the maximum cut-off for level 1 can only enter the management level of the VBJDCP. Herd testing is not required by the national guidelines, though it is strongly encouraged. It is suggested that optional herd testing for these ‘high’ prevalence herds be conducted using guidelines provided in the ‘Consensus recommendations on diagnostic testing for the detection of paratuberculosis in cattle in the United States’ (Collins et al., 2006). Briefly, these guidelines recommend environmental culture (dairy) or prevalence directed individual bovine animal culture / ELISA (beef) and individual ELISA to aid detection of the most infective cattle (dairy or beef). Seed-stock farms are advised to set eradication as the goal, and to test by individual faecal culture (culling any cow, and her offspring, that test positive).

4.2.2 Herd Classification for control
Herds with positive results above the maximum cut-off for level one classification can only enter the management level of the VBJDCP. There is currently no national scheme to classify herds according to prevalence of infection above maximum cut-offs stipulated for level 1 (appendix 4). State control programs can designate these if they choose. For example the NY state control programme has ‘control levels’ for infected herds before progressing to the nationally recognised certification levels for low prevalence / negative herds.

Levels 1-3 in the herd classification programme allow for classification of reducing prevalence of test positive cattle in low prevalence herds. See section 4.1.2 above.

4.2.3 Cattle movements
With the exception of interstate movement of OJT positive cattle (see 3.6 above) there are minimal restrictions on cattle movements. It is recommended, but not compulsory, that herds participating in a management program or at certification levels 1-3 only purchase cattle from other herds participating in the management program or from certified herds.

For herds with classification status 4-6, there are restrictions on cattle introduction. See 4.2.5 below.

4.2.4 Control in infected herds
The management level of the VBJDCP is designed to recognise producers with an unknown prevalence or known moderate / high prevalence of Johne’s disease that implement meaningful management practices to control the introduction (bio-exclusion) or spread (bio-containment) of MAP.

A risk assessment first identifies the practices that are likely to facilitate entry and spread of MAP and a management plan indicates the agreed steps to be taken to reduce these risks. Detailed
guidelines are laid out in the manuals for conducting risk assessments and developing management plans (beef and dairy). The RAMP must be sent to and approved by the DJC.

Minimum requirements are that all cattle are individually identified. Further minimum guidelines are published in the Uniform Program Standards:

- Keep maternity and calving areas clean, dry, and free of manure. Wherever possible, use individual calving pens, or minimize cow density. The maternity and calving area should not house non-calving or sick animals, nor should it be immediately adjacent to mature cattle housing areas.
- Ensure cattle added to the herd come only from status-level or documented low-risk sources. Record the source and manage additions as higher risk cattle unless you have evidence to the contrary.
- Minimize the exposure of young stock to manure from adult cattle.
- Minimize exposure of livestock to other cattle and other susceptible animal species that may be infectious.
- Feed calves colostrum from an individual, identified, low-risk, test-negative cow, or a suitable quality colostrum replacer.
- Minimize contamination of feed, water, equipment, and vehicles with manure.
- Segregate, test, and remove clinical suspects from the herd as soon as possible. Make recommendations to reduce the risks from official test-positive cattle by humanely euthanizing the animals or sending them to slaughter.

Dairy herd specific:

- Immediately separate from adult cattle any heifer calves and bull calves that will be retained in the herd or sold for dairy purposes.
- After receiving colostrum, only give calves pasteurized milk or a quality milk replacer.
- Keep young stock free from exposure to the manure of mature cattle, house by age, and separate from older cattle.

Beef herd specific:

- Minimize the density of cow and calf pairs as much as possible.
- Use feeding practices that reduce manure contamination of water, feed, and feeding areas as much as possible.
- Raise weaned replacement cattle physically separate from older cattle.

4.2.5 Control in non-infected herds
Control in non-infected herds (classifications 4-6) is similar to that in infected herds as a RAMP must also be conducted. In addition, herd classification is reduced to the lowest level of classification of any purchased stock. There is an option to purchase stock from lower classification and maintain status by testing all purchased cattle from one year of age every 6 months by an OJT for three consecutive tests, obtaining negative results, and including them in annual herd screening tests.
5. Monitoring and Review

5.1 Surveillance Monitoring

Participation in both beef and dairy farms in the years 2000 – 2010 have been reported in recent publications. Participation peaked in 2007 at 2021 (0.03% of all beef herds) and 6797 (9% of all dairy herds) respectively (Carter, 2012; Roussel, 2012). Although official reports differ marginally, in 2010 there were only around 940 enrolled beef herds and 3671 enrolled dairy herds (Patton and Wheeler, 2010; Carter, 2012). Participation has continued to decline.

From herds participating in the Minnesota Program, 22% of 374 herds that reached Level 1 were later found to be positive, with an estimated median within herd prevalence of 16%. 25% of 229 herds that reached Level 2 were later found to be positive, with an estimated median within-herd prevalence of 11%. 7% of 85 herds that reached level 3 were later found to be positive (Roussel, 2012).

5.2 Program Monitoring and Review

As detailed in section 3.1 above, the program has been updated several times since official adoption in 2002.

Changes to the strategic plan are made first before modifications are made to the program itself.

Significant recent developments in the strategic plan (which are yet to be fully implemented in the program) are:

- To focus educational efforts on demonstrating the potential economic and biosecurity benefits of prevention and control of Johne’s disease
- To develop self assessment RA tools for producers
- To phase out current management programs
- To make vaccine and safe vaccine delivery systems available
- To look for ways to build market incentives for achieving low risk / prevalence
- To market the benefits of a state / cooperative funded program rather than a federally funded program

In addition, JDIP has funded several recent relevant surveys which have acted to review the current VBJDCP.

A survey of national dairy producers (mailed to approximately 15% of the dairy producers in each state). The survey sought to identify barriers to and incentives for participation in the VBJDCP (Patton and Wheeler, 2010). 1902 surveys were analysed. Results of interest are

- Approximately 1/3 of respondents did not know if their state had a Johne’s program
- Concern over Johne’s was the primary reason identified for participating in the program. Financial incentives, such as reduced testing cost and Risk Assessments, were positive factors
- Over 80% listed Farm magazines and Veterinarians as primary Johne’s Information sources. Veterinarians, farm magazines and extension were the most reliable sources of information
• Participants in the VBJDCP indicated they were willing to pay a premium for replacement stock that had a high probability of being free from JD

A second recent survey was also conducted of DJCs and industry stake-holders (beef organisations, dairy coops, Dairy Herd Improvement Association service providers etc) which aimed to assess the impact of JD education component of the program (Olson, 2010). Results were reported at the JDIP conference, 2011. Significant findings were:

• The program to date has increased producer awareness of JD
• Of 32 states that replied, the vast majority reported reduced testing, RAMPs, veterinary certifications, educational events and committee meetings as consequences of reduced federal funding. See appendix 5.
• There has been significant development of an infrastructure capable of serving industry (certified veterinarians etc) but it is significantly threatened by funding cuts
• Several states reported that their program is shutting down due to lack of funding, where others are seeking non-federal (state / industry) funding to maintain them.

The National Demonstration Herd Project was initiated to evaluate the long-term feasibility (2005-2010) and effectiveness of management-related practices designed to control Johne’s disease on dairy and beef cattle operations. Results suggest that management efforts initiated since the beginning of the project have been effective in reducing MAP prevalence. Results also suggest that making sure udders and legs of cows in the calving area are clean, using individual animal calving areas (or allowing fewer cattle in the calving area), and preventing Johne’s disease clinical or suspect cattle from entering the calving area should receive primary consideration with regard to control of Johne’s disease on dairy operations. On beef operations, separating cow/calf pairs from Johne’s clinical or suspect cattle, and preventing cow access to accumulated or stored manure should receive primary consideration with regard to control of Johne’s disease on beef operations.

5.3 Areas of Concern of Current Administrators

There is a significant and rapid reduction in participation in the VBJDCP, with several states reporting a ‘shutting down’ of their programs (Olson, 2010). Suggested reasons include a decline on federal funding (and a lack of recognition by industry of the economic benefits of the program), along with local factors such as how much time the DJC could spend promoting the program (Roussel, 2012). Federal funding is expected to be reduced to zero at the end of September 2012 (Dean Goeldner, personal communication). The reduction on federal funding is the greatest concern for current administrators.

There are many infected cattle sold on the open market as infected herds do not usually use ‘organism detection tests’ and ELISA positive cattle are not regarded as definitively infected under federal law.

There has also been concern expressed that implementation of control of Johne’s disease may not be profitable to commercial cattlemen as long as it is not considered a zoonotic disease. In addition, the herd status, when achieved, was less valuable to herd owners than had been anticipated and the removal of herd status due to positive test results led to disappointment (Roussel, 2012).
Addendum – Data transfer and availability

Test results are provided to the producer and the producer’s veterinarian (assuming the veterinarian submitted the test samples). The State also has the test results and discretion over how they are used (in some states vets had access to all test results, in others a court order was required to gain access). When federal funding was paying for much of the testing, most States were entering summarised (and presumably anonymous) test results into a national database. They were then combined into a national set of figures that could be used in presentations at stakeholder meetings like USAHA. When federal funding was reduced most of the State data entry (and much of the testing) ended. Currently the national database is not a reliable source for the testing that is still occurring (K. Olsen, A. Roussel, D. Goeldner, personal communications).

Dairy producers in all states still have access to milk ELISA testing (that they pay for) through the DHIA system.
Appendices

Appendix 1: U.S milk production (million pounds) and changes in milk production 2001-2009 (USDA, 2010b).

Appendix 2: Federal funding of the VBJDCP (Roussel, 2012)

<table>
<thead>
<tr>
<th>Year</th>
<th>Total Federal Funds (millions)</th>
<th>Dollars to states (millions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2000</td>
<td>1.5</td>
<td>0</td>
</tr>
<tr>
<td>2001</td>
<td>2.5</td>
<td>0</td>
</tr>
<tr>
<td>2002</td>
<td>2.7</td>
<td>0</td>
</tr>
<tr>
<td>2003</td>
<td>21</td>
<td>12</td>
</tr>
<tr>
<td>2004</td>
<td>18</td>
<td>10</td>
</tr>
<tr>
<td>2005</td>
<td>18</td>
<td>8</td>
</tr>
<tr>
<td>2006</td>
<td>13</td>
<td>6</td>
</tr>
<tr>
<td>2007</td>
<td>12</td>
<td>5</td>
</tr>
<tr>
<td>2008</td>
<td>10</td>
<td>1.5</td>
</tr>
<tr>
<td>2009</td>
<td>7</td>
<td>2.5</td>
</tr>
<tr>
<td>2010</td>
<td>7</td>
<td>1.2</td>
</tr>
<tr>
<td>2011</td>
<td>3</td>
<td>0</td>
</tr>
</tbody>
</table>
Appendix 3: Statistical subset sample size guide for testing to allow progression of classification in the VJDCP (USDA-APHIS-VS, 2010).

<table>
<thead>
<tr>
<th>Number of cattle in herd (36 months or older)</th>
<th>Minimum Number of Cattle to Sample (36 months or older)</th>
<th>ELISA Testing</th>
<th>MAP Detection Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>≤ 300</td>
<td>Test all</td>
<td>Test all</td>
<td>Test all</td>
</tr>
<tr>
<td>301 – 400</td>
<td>Test all</td>
<td>Test all (up to 313)</td>
<td></td>
</tr>
<tr>
<td>401 – 500</td>
<td>Test all</td>
<td>324</td>
<td></td>
</tr>
<tr>
<td>501 – 600</td>
<td>Test all (up to 531)</td>
<td>332</td>
<td></td>
</tr>
<tr>
<td>601 – 700</td>
<td>540</td>
<td>338</td>
<td></td>
</tr>
<tr>
<td>701 – 800</td>
<td>547</td>
<td>342</td>
<td></td>
</tr>
<tr>
<td>801 – 900</td>
<td>552</td>
<td>345</td>
<td></td>
</tr>
<tr>
<td>&gt; 901</td>
<td>580</td>
<td>360</td>
<td></td>
</tr>
</tbody>
</table>
Appendix 4: Herd Classification of test negative (surveillance) or low prevalence (control) herds (USDA-APHIS-VS, 2010).

Table 1. Herd Testing Strategies to Achieve JD Herd Classification Levels

<table>
<thead>
<tr>
<th>Herd Size*</th>
<th>Testing Strategy</th>
<th>Herd Classification level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Maximum proportion positive to achieve level (no rounding)</td>
</tr>
<tr>
<td>1-99</td>
<td>ELISA</td>
<td>≤1.5%</td>
</tr>
<tr>
<td></td>
<td>ELISA/Ind MAPDT*</td>
<td>≤1.5%</td>
</tr>
<tr>
<td></td>
<td>Individual MAPDT</td>
<td>≤6%</td>
</tr>
<tr>
<td></td>
<td>Pooled MAPDT</td>
<td>≤15%</td>
</tr>
<tr>
<td></td>
<td>Environment MAPDT*</td>
<td>0%</td>
</tr>
<tr>
<td>100-199</td>
<td>ELISA</td>
<td>≤2.5%</td>
</tr>
<tr>
<td></td>
<td>ELISA/Ind MAPDT</td>
<td>≤1.0%</td>
</tr>
<tr>
<td></td>
<td>Individual MAPDT</td>
<td>≤6.5%</td>
</tr>
<tr>
<td></td>
<td>Pooled MAPDT</td>
<td>≤15%</td>
</tr>
<tr>
<td></td>
<td>Environment MAPDT</td>
<td>0%</td>
</tr>
<tr>
<td>200-299</td>
<td>ELISA</td>
<td>≤3.5%</td>
</tr>
<tr>
<td></td>
<td>ELISA/Ind MAPDT</td>
<td>≤1.5%</td>
</tr>
<tr>
<td></td>
<td>Individual MAPDT</td>
<td>≤7%</td>
</tr>
<tr>
<td></td>
<td>Pooled MAPDT</td>
<td>≤13%</td>
</tr>
<tr>
<td></td>
<td>Environment MAPDT</td>
<td>0%</td>
</tr>
<tr>
<td>≥300</td>
<td>ELISA</td>
<td>≤4.0%</td>
</tr>
<tr>
<td></td>
<td>ELISA/Ind MAPDT</td>
<td>≤2.0%</td>
</tr>
<tr>
<td></td>
<td>Individual MAPDT</td>
<td>≤7.5%</td>
</tr>
<tr>
<td></td>
<td>Pooled MAPDT</td>
<td>≤11%</td>
</tr>
<tr>
<td></td>
<td>Environment MAPDT</td>
<td>0%</td>
</tr>
</tbody>
</table>

*ELISA/Ind MAPDT—ELISA with followup individual MAPDT
*Environment MAPDT—This testing strategy is only available for dairy herds (not beef herds)
*Herd size—Number of the test-eligible animals in the herd
Appendix 5: Summary of responses from DJCs when asked about the impact of reduced funding on the state VBJDCP; There were 32 replies in total (Olson, 2010).

<table>
<thead>
<tr>
<th>Measure</th>
<th>Number of states</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fewer individual samples</td>
<td>25</td>
</tr>
<tr>
<td>Change in type of test</td>
<td>12</td>
</tr>
<tr>
<td>Fewer RAMPs completed</td>
<td>25</td>
</tr>
<tr>
<td>Fewer committee meetings</td>
<td>19</td>
</tr>
<tr>
<td>Fewer certification / recertification</td>
<td>24</td>
</tr>
<tr>
<td>Fewer educational events</td>
<td>22</td>
</tr>
<tr>
<td>Other items</td>
<td>1</td>
</tr>
</tbody>
</table>
References


