

Institution: Royal Veterinary College
Unit of Assessment: A 6 Agriculture, Veterinary and Food Science
Title of case study: Control Strategies towards eradication of Bovine Viral Diarrhoea
1. Summary of the impact (indicative maximum 100 words)

Interdisciplinary research at the Royal Veterinary College (RVC) has provided core evidence on which global efforts are based in order to eradicate one of the most economically damaging diseases of the cattle industry. The research findings have helped steer national programmes to eradicate Bovine Viral Diarrhoea (BVD) across Europe, South Asia and Australasia, reducing economic losses. Professor Joe Brownlie has additionally led pilot programmes in the UK, providing data for a national scheme, campaigned widely to highlight the issue and secured farming industry awareness and support through media exposure.

2. Underpinning research (indicative maximum 500 words)
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Sixteen years of multidisciplinary research at the RVC – the integration of epidemiology, immunology, microbiology and pathology – led by Joe Brownlie, Professor of Veterinary Pathology (Emeritus from 2009) - has contributed significant progress towards the control and eradication of BVD around the world. Brownlie moved to the RVC from the Institute for Animal Health in 1996, (where he had discovered the complex viral pathogenesis causing mucosal disease and developed the first vaccine to offer foetal protection.)

In 2002, RVC became a member of a new European Union Thematic Network for the control of BVD. The group examined systematic approaches to control, emphasising that vaccination did not provide a complete solution.

In 2004, Brownlie and his team embarked on a five-year, £1.4m DEFRA-funded programme of BVD research. The group showed the exquisite molecular variation existing between isolates on farms, which has, for the first time, permitted detailed molecular epidemiology [1] and, as a result, contributed to a fuller understanding of disease transmission and biosecurity risks. This work further demonstrated that the available vaccines were still appropriate for use in the UK.

Building on earlier research into strategic measures for BVD control, Brownlie co-authored a 2006 review [2] that presented a viable, systematic model for BVD control across Europe that (regardless of vaccination use) necessitated effective biosecurity, elimination of Persistently Infected (PI) animals and surveillance, and the need for cooperation from farmers' organisations.

In 2008, the RVC group demonstrated that infected, recovered and immune animals have the potential to cause infection in BVD Virus-naïve cohorts for far longer than previously demonstrated or anticipated. This knowledge has informed the biosecurity requirements of the Cattle Health Certification Standards (CHeCS) [3].

The outputs of the Thematic Network [4] were used in planning and implementing the Swiss national mitigation programme for BVD in 2008, and in 2012, researchers led by Katharina Stärk, Professor of Veterinary Public Health Policy (from 2007), from RVC's Veterinary and Epidemiology Public Health group, undertook an economic analysis of the programme to identify positive net economic benefit [5].

In collaboration with veterinarians and farmers, Brownlie devised longitudinal on-farm studies in Scotland, East Anglia and Somerset to define production losses and the cost-benefit of eradicating BVD on UK farms in order to provide real data to support a national programme of disease control. In 2012 Brownlie published results from the Somerset study that showed an increase from 41% to 71% BVDV-free farms after the three years of management [6], with 10/20 of the initially infected farms being cleared of the disease and the others set to follow.

Other quality and Relevance Indicators

Brownlie. BVDV Determination of molecular and cellular mechanisms of virulence in field and emerging viruses. Defra. 2004-09. £1,309,950 + 2008-11. £117,540.

Brownlie. BVD control programme in Norfolk and Suffolk. EBLEX. 2006–08. £24,000.

Brownlie. Contract for the Supply of technical inputs in support of BVD control campaign funded under RDPE. AHDB. 2012-14. £25,000.

Brownlie was awarded the Selbourne Research Medal in 2007, by the Association of Veterinary Teachers and Research Workers of Great Britain and Ireland “in recognition of excellence and achievement in veterinary research and the Dalrymple-Champneys Cup and Medal in 2008, by the British Veterinary Association in recognition of long and outstanding services to veterinary science.

3. References to the research (indicative maximum of six references)

1. Booth, RE, Thomas, CJ, El-Attar, LM, Gunn, G, Brownlie, J. 2013 A phylogenetic analysis of Bovine Viral Diarrhoea Virus (BVDV) isolates from six different regions of the UK and links to animal movement data. *Veterinary research*; 44: 43 DOI:10.1186/1297-9716-44-43
2. Lindberg, A, Brownlie, J, Gunn, G J, Houe, H, Moennig, V, Saatkamp, H W, Sandvik, T, Valle, PS. 2006 The control of bovine diarrhoea virus in Europe: today and in the future. *Rev Sci tech Offic Int Epiz*, 25:961-979 <http://www.oie.int/doc/ged/D3781.PDF> [accessed Sep/13]
3. Collins, M E, Heaney, J, Thomas, C J & Brownlie J. 2009 Infectivity of Pestivirus following persistence of acute infection. *Veterinary Microbiology*; 138:289-296 DOI.org/10.1016/j.vetmic.2009.04.022
4. 2006 Position paper of EU Thematic Network for BVD control <http://www.bvdv-control.org/bilder/Position%20paper%20BVDV%20Control%20EU%20TN.pdf> [accessed 7/13]
5. Häslar, B, Howe, KS, Presi, P, Stärk, KD. 2012 An economic model to evaluate the mitigation programme for bovine viral diarrhoea in Switzerland. *Prev. Vet. Med.*; 106(2):162-73. DOI.org/10.1016/j.prevetmed.2012.01.022
6. Booth, RE, Brownlie, J. 2012 Establishing a pilot bovine viral diarrhoea virus eradication scheme in Somerset. *Veterinary Record*;170(3):73 DOI:10.1136/vr.100191

4. Details of the impact (indicative maximum 750 words)

Bovine virus diarrhoea (BVD), a pestivirus infection of cattle, is one of the most economically damaging viral diseases affecting cattle in the UK, costing dairy and beef cattle producers up to £61 million per year, according to Defra estimates. It is viewed as one of the most costly diseases affecting the cattle industry worldwide (losses reported at US\$10-80 per head). Inefficiencies in livestock management additionally impact upon food security and agricultural greenhouse gas production, exerting a broader impact on the economy.

The virus is maintained by a small population of animals that become persistently infected (PI) whilst in the uterus during the early stages of pregnancy. PI calves, representing 1% of UK cattle, often die prematurely with respiratory or enteric disease, or suffer from reproductive disorders and stunted growth. The complex pathogenesis of BVD – elucidated by Brownlie’s group – has demonstrated that vaccination is not a simple or complete solution.

The research into persistence of virus, detectable by PCR, after recovery of acutely infected animals has guided accreditation of cattle health schemes, for effective herd biosecurity, incorporated into the UK Cattle Health Certification Standards (CHeCS) [a]. The Executive Director of CHeCS confirms: “*The Rules in the Technical Document cover Accredited Free; Vaccinated Monitored Free; and Eradication Programmes for BVD. They detail blood testing and bulk milk testing methods as well as quarantining requirements. RVC’s research, particularly its work on persistence of virus, detectable by PCR, after recovery of acutely infected animals has informed the text that lays out these requirements for approved schemes – such as the Herdsure Accreditation programme, offered by the AHVLA.*” [b]. The datasheets produced by the Animal Health and Veterinary Laboratories Agency, for interpretation of BVD blood and milk tests reflect this [c]. The Veterinary Investigation Officer responsible for this at the AHVLA notes: “*The data sheets produced by AHVLA Scientific providing the methodology for performance of the BVD tests*

Impact case study (REF3b)

and their interpretation have included additional results from RVC Research. [...] RVC Research found that the period for a PCR positive result in acute infection could extend for up to 80 days. In any control or eradication scheme, persistently infected animals need to be identified and removed from the herd whilst animals acutely infected seroconvert and recover and can be retained safely. The test data sheets provided by AHVLA highlight the possible potentials for confusion and emphasise the importance of differentiating between the possible causes of a positive result. This is to ensure that infection is managed in the herd and comply with the requirements of accredited herd health schemes.” [d].

RVC’s wide-ranging research in this field has informed worldwide programmes aimed at eradication. Brownlie’s work to identify effective control interventions through pilot studies in the UK and drawing on the model programme devised in 2006, has positioned him as the ‘go-to’ adviser for international governments and organisations committed to BVD eradication. After earlier membership of the Scottish Government’s Strategic Science Advisory Panel, he played a leading role in the launch of Scotland’s national BVD eradication programme in 2011, running a series of master classes, based on his group’s findings for hundreds of farmers and vets. The President of the National Farmers Union, Scotland, supports this: *“The work of Professor Brownlie’s research team has created a significant part of the veterinary science base on which BVD control programmes worldwide have been built... they have been key in driving progress at farm level. The development of control networks where expertise has been inbedded [sic] into the programme has provided real value.” [e].* Brownlie sat on the Animal Health Ireland Working Group to advise on the launch of Ireland’s eradication programme in 2009 [f] and travelled to New Zealand and Bangladesh a year later to advise on their programmes, lecturing farmers and vets. Between 2008 and 2012, he gave close to 100 lectures to farmers [g], veterinarians, professional associations and government organisations worldwide, including in Australia and Southern African countries.

The lectures are part of a proactive strategy, backed by the RVC, to disseminate practical findings from research into BVD control globally. In 2011 Brownlie and Richard Booth (Postdoctoral researcher from 2010 then Lecturer in Veterinary Extension Services and Infectious Diseases of Cattle from 2012) contributed to educational webinars produced by IDEXX Laboratories, the global market leader in diagnostics for animal health, which featured three one-hour programmes about the virus. From 260 registrations, 142 individuals, including veterinarians and students, from nine countries participated live, with feedback averaging 8.7/10. The webinars remain available on the IDEXX website [h]. The RVC has developed a substantial online BVD resource on its website, including podcasts, videos, presentations, papers and press articles [i]. In 2011, the site averaged 2,000 hits per month, with downloads up more than 80% on the previous year, in 2012 this was up to 2,900 per month, with downloads up a further 40%. 40-50% of the visitors originate in the UK and around 15% from the US, with over 20 countries making up the remainder [j].

The Swiss mitigation programme is scheduled to run from 2008 to 2017, with break-even estimated in 2012. Scotland and Ireland are pressing ahead with national control programmes, guided by the work to which RVC has contributed.

Brownlie has campaigned for the introduction of a national BVD eradication programme for England and Wales, drawing on field research in East Anglia and the West Country. Prior to the REF impact period, he advised BIS on its Foresight Programme on ‘Detection and Identification of Infectious Diseases’ and, having secured the support of the UK’s Chief Veterinary Officer, he established the National BVD Control Group in order to lay the foundations for a future national programme. The UK CVO confirms the contribution from RVC research: *“The research findings and Professor Brownlie’s direct advocacy, informed by this work, have contributed substantially to the management of this disease, which is a major global issue for the cattle industry. Professor Brownlie has been an indefatigable proponent of the application of BVC control measures in the field.” [k]* In 2008 Brownlie brought the Group under the English Cattle Health and Welfare Group (ECHWG, now CHAWG) [l], set up to ensure the delivery of DEFRA’s Animal Health and Welfare Strategy to the cattle sector in England. The ECHWG immediately made BVD control one of its six priorities, and this remains an important component of its activities [m].

Impact case study (REF3b)

As part of the UK pilot programmes, Brownlie has sought exposure in specialist media to raise awareness of BVD among vets and farmers, together with political and industrial support for the national programme in England and Wales, through several articles from 2008 to 2012, including pieces in Farmers Weekly and the Veterinary Times. This coverage has contributed to Brownlie receiving an average of two professional enquiries a week for BVD-related advice [n].

Eradication programmes – as modelled by the Swiss scheme take around 10 years to reach final phases, so full impact is protracted. However, RVC's economic analysis of the Swiss programme has shown a substantial margin over eradication cost is achievable. Although a UK-wide programme has yet to be implemented, at both at individual farm and national level (abroad), uptake of livestock management and disease control measures for BVD, informed by the RVC's work and active role in dissemination, has already delivered financial, health and welfare benefits.

5. Sources to corroborate the impact (indicative maximum of 10 references)

- a. http://www.checs.co.uk/media/pdf/CHeCS_Tech_doc_final_Version_2012-1.pdf [accessed 31 Jul 2013]
- b. Statement from Executive Director of Cattle Health Certification Schemes. Held by RVC.
- c. <http://science.vla.gov.uk/Tests/SearchResultsDetailed.aspx?SiteName=CDT&Search=&TestCode=TC0655&PriceListCategoryId=16>
<http://science.vla.gov.uk/Tests/SearchResultsDetailed.aspx?SiteName=CDT&Search=&TestCode=TC0709&PriceListCategoryId=16> [accessed 20 Nov 2013]
- d. Statement from Veterinary Investigation Officer of the Animal Health and Veterinary Laboratories Agency. Held by RVC.
- e. Statement from President of National Farmers Union, Scotland. Held by RVC.
- f. [http://www.animalhealthireland.ie/ckfinder/userfiles/files/BVDINF%20web%20v4_0%20July%202011\(1\).pdf](http://www.animalhealthireland.ie/ckfinder/userfiles/files/BVDINF%20web%20v4_0%20July%202011(1).pdf) [accessed 31 Jul 2013]
- g. <http://www.farmersguardian.com/home/livestock/livestock-news/eradicate-bvd-with-tough-testing-and-biosecurity/42740.article> [accessed 31 Jul 2013]
- h. https://www.idexxlearningcenter.com/idexx/user_activity_info.aspx?id=1383&SSOTOKEN=0 [accessed Jul/13] First of 3 Idexx webinars
- i. <http://www.rvc.ac.uk/bvd/> [accessed 31 Jul 2013]
- j. Webstats held at RVC.
- k. Statement from UK Chief Veterinary Officer. Held by RVC.
- l. <http://archive.defra.gov.uk/foodfarm/policy/animalhealth/eip/pdf/echawg-mtg080605.pdf> [accessed 31 Jul 2013].
- m. <http://demo.eblex.org.uk/wp/wp-content/uploads/2013/06/Cattle-Health-and-Welfare-Report.pdf> [accessed 31 Jul 2013]
- n. Records of correspondence held at RVC.