

<b>Institution:</b> University of Nottingham
<b>Unit of Assessment:</b> 6; Agriculture, Veterinary and Food Science
<b>Title of case study: Implementing the British Dairy Herd National Mastitis Control Scheme. The “DairyCo Mastitis Control Plan”</b>
<p><b>1. Summary of the impact</b></p> <p>The University of Nottingham (UoN) led research that resulted in the design, evaluation and national implementation of a new approach to mastitis control on British dairy farms; the ‘DairyCo Mastitis Control Plan’. The programme, which commenced in 2009, was implemented on farms holding 10-15% of all British dairy cows. The uptake of the scheme is continually increasing and has generated savings to the British dairy industry to the order of £5-10M per annum.</p>
<p><b>2. Underpinning research</b></p> <p><i>Key researchers:</i></p> <p>Professor Martin Green: Professor of Cattle Health and Epidemiology (UoN 2006– present)          Dr Andrew Bradley: Clinical Reader in Dairy Production Medicine (UoN; 2009– present)          Dr James Breen: Lecturer in Cattle Health and Production (UoN; 2009– present)          Chris Hudson: Lecturer in Cattle Health and Production (UoN; 2009– present)</p> <p>The DairyCo Mastitis Control Plan is the first instance of a coordinated nationwide scheme to control a common endemic disease that is not driven or financed by government (DairyCo are the levy board which utilise dairy farmer levy payments in Great Britain). The UK nationwide mastitis control scheme was based entirely on the programme of research led by Prof Green, the main elements of which were:</p> <ul style="list-style-type: none"> <li>• <b>The design and initial testing of the control scheme.</b> A carefully structured, novel approach to mastitis control that incorporated multiple elements of the Green group’s previous research was evaluated in a randomised controlled trial. This new approach included a novel strategy to evaluate farm infection patterns and a software-enhanced method to identify and select the most beneficial farm interventions. The research found that the new control method resulted in a reduction in clinical and sub clinical mastitis by 20% in a one year period [1].</li> <li>• <b>Refinements to the initial scheme; the result of further research.</b> Subsequent studies (funded by the Wellcome Trust; [a]), using detailed information collated from a randomised controlled trial, were conducted to evaluate how to further optimise the use of the control plan for specific cows and farm circumstances [e.g. 2-4]. These refinements included identification of strategies appropriate for specific farm situations, and were used to update the original research and allowed Nottingham researchers to formulate the entire ‘DairyCo Mastitis Control Plan’ as delivered nationally in Great Britain.</li> </ul> <p><b>Informing methods to train participants to use the control plan [a-e].</b> Research, using Bayesian approaches, identified potential uncertainty in outcomes when implementing the control plan, which was associated both with management interventions and also with the initial beliefs of veterinary surgeons [5 &amp; 6]. Results indicated that for some management practices, high levels of uncertainty in efficacy existed and that this could be mitigated by using repeated iterations of the control plan. These principles are used in training participants in delivery of the DairyCo Mastitis Control Plan.</p>
<p><b>3. References to the research</b></p> <ol style="list-style-type: none"> <li>1. Green, M.J., Leach, K.A., Breen, J.E., Green, L.E. and Bradley, A.J. (2007) National intervention study of mastitis control on dairy herds in England and Wales. <i>The Veterinary Record</i>, 160(9): 287-93 doi:10.1136/vr.160.9.287.</li> <li>2. Green, M.J., Bradley, A.J., Medley, G.F. and Browne, W.J. (2007) Cow, farm, and management factors during the dry period that determine the rate of clinical mastitis after calving. <i>Journal of Dairy Science</i>, 90(8): 3764-3776 doi: 10.3168/jds.2007-0107.</li> <li>3. Green, M.J., Bradley, A.J., Medley, G.F. and Browne, W.J. (2008) <b>Cow, Farm, and Herd Management Factors in the Dry Period Associated with Raised Somatic Cell Counts in Early</b></li> </ol>

## Impact case study (REF3b)

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4. Breen, J.E., Green, M.J. and Bradley, A.J. (2009) Quarter and cow risk factors associated with the occurrence of clinical mastitis in dairy cows in the United Kingdom. *Journal of dairy science*, 92(6): 2551-61 doi: 10.3168/jds.2008-1369.
5. Green, M.J, Browne, W. J., Green, L. E., Bradley, A. J., Leach, K.A., Breen, J.E. and Medley, G.F. (2009) Bayesian Analysis of a Mastitis Control Plan to Investigate the Influence of Veterinary Prior Beliefs on Clinical Interpretation. *Preventive Veterinary Medicine*, doi:10.1016/j.prevetmed.2009.05.029.
6. Green, M.J, Medley, G.F., Bradley, A.J and Browne, W.J. (2010) Management interventions in dairy herds: Exploring within herd uncertainty using an integrated Bayesian model. *Veterinary Research*, 41, 22 DOI: 10.1051/vetres/2009070.

### Underpinning research projects:

- a. 2006 - 2010: Optimisation of farm strategies for the control scheme. Project title: Use of Bayesian statistical methods to investigate farm management strategies, cow traits and decision-making in the prevention of clinical and sub-clinical mastitis in dairy cows.' PI Prof Martin Green, University of Nottingham. Funder: Wellcome Trust (Fellowship – WT076998) - £404,000.
- b. 2008-2012: Implementation and evaluation of the national programme. Project title: The DairyCo Mastitis Control Plan Co- P.I.s Prof Martin Green, Dr Andrew Bradley, Co-Is: Dr James Breen and Mr Chris Hudson, University of Nottingham. Funded by DairyCo UK. (Jointly held with industrial partner Quality Milk Management Services Ltd.) - £310,000.
- c. 2009-2013: Evaluation of the influence of variation in veterinary beliefs on mastitis control. Project title: A quantitative (Bayesian) assessment of veterinary surgeons clinical beliefs in order to improve preventive healthcare for dairy cattle. PI. Prof Martin Green, University of Nottingham. Funder: Wellcome Trust (WT087797) - £313,000.
- d. 2012-2013: Continuation and evaluation of the national mastitis control programme. Project title: Continuation of the DairyCo Mastitis Control Plan. Co-P.I.s Prof Martin Green, Dr Andrew Bradley, Co-Is: Dr James Breen and Mr Chris Hudson, University of Nottingham. Funder: DairyCo UK - £281,000.
- e. 2012-present: Continued optimisation of farm strategies for control: A Bayesian decision-theoretic framework to evaluate and optimize decision making for mastitis control in the UK Mastitis Control Scheme. BBSRC CASE studentship ~£91,000.

Evidence of the international quality of the research is indicated by the publication of the papers in international, peer-reviewed journals (*Journal of Dairy Science* and *Veterinary Research* are the top rated journals in the fields of dairy and veterinary research respectively), invitations for the researchers to present the work at international conferences and continuous funding of the work over a period of 10 years by the Wellcome Trust and DairyCo.

## 4. Details of the impact

Bovine mastitis, an inflammation of the mammary gland following bacterial invasion, is the foremost endemic infectious disease of dairy cattle worldwide. Mastitis is financially the most important disease of dairy cattle, causing annual production losses of more than £170M in the UK and US\$ 2.0B in the USA, and is one of the most important diseases of farmed livestock. The welfare implications of mastitis are severe and were highlighted in recent UK Farm Animal Welfare Council Reports on the Welfare of Dairy Cattle. The impact of bovine mastitis on the environment is also important because an increased incidence of mastitis requires more cows to produce a given quantity of milk resulting in an increased environmental footprint. In Great Britain the incidence of mastitis in dairy cattle is between 47 - 65 cases per 100 cows per year. Mastitis has a multi-factorial aetiology and any control programme has to involve a number of management changes in order to derive benefit. The DairyCo Mastitis Control Plan is a new control strategy to enable veterinarians and consultants to identify best interventions for individual dairy farms and produce a farm-specific preventive plan. The plan includes a novel piece of software to enable trained users to carry out the process. The control plan produces a hierarchical ranking of possible farm interventions, and places them in order of likely efficacy, dependent on the farm's mastitis

pattern. The DairyCo Mastitis Control Plan encompasses the entire process; from farm diagnosis, to identification of the best control measures, to implementation of the measures on farm – all based on the research detailed in this statement. For example, control measures could include making alterations to the cow's environment, changing the milking procedure or changing dry cow nutrition. The control plan incorporates all aspects known to influence the risk of mastitis but uniquely does so in a way to identify the optimal control strategy for each individual farm. Over two hundred and fifty veterinary surgeons and consultants have been trained in the application of the control plan since 2009 (**Source 2**), and it continues to be implemented in a coordinated way throughout Great Britain (**Sources 1 & 2**). The national acclaim and media attention (**Sources 3, 4, 5 & 6**) provides evidence of the scheme's widespread uptake and influence.

Approximately 90% of the work to develop the scheme was conducted by researchers at Nottingham. UoN researchers provided the **entire underpinning information** for the development and implementation of the national mastitis control scheme, in terms of its technical make up, optimisation, execution and evaluation. The national scheme was designed and tested in a randomised controlled trial and this directly led to the scheme being chosen and started by DairyCo UK. The original control plan was honed prior to national launch, through the subsequent analytic research that introduced refinements. Bespoke software was developed to translate the research findings into a format appropriate for use on a national scale (the DairyCo "ePlan"), and this software was designed from the findings of the research described (**Source 2**).

Current analysis of farms in the mastitis control scheme (2009 - 2012) indicates that a reduction in clinical disease of between 10-20% per year is being achieved (**Source 7**) and this means that, in the first three years of operation the scheme has provided multi million pound savings to the dairy industry (**Sources 2 & 7**). The scheme has coverage across the whole of Britain and is available to all British dairy farms. The total population of cows in Britain is ~1.6 million and in the first three years the scheme (2009-2012) was implemented on 980 farms containing >10% of the cow population (**Source 7**). The economic value to the British dairy industry from the improvements made by these farms is >£3 million p.a. in terms of clinical disease alone (**Source 2**) and £5-10M p.a. when subclinical disease is included (**Source 7**). There are many beneficiaries of the scheme. Dairy farmers benefit from reduced clinical and subclinical mastitis with large financial gains, improved cow welfare, reduced environmental imprint and improved sustainability of milk production. The wholesale and retail sector benefit from improved image and value of milk produced. The veterinary sector benefits from increased sustainability of the practice model, with increased focus on disease prevention rather than treatment.

The research and national control programme have had an international impact by being incorporated into other national disease policies and programmes. This influence is evident in a variety of countries, including the Netherlands (Prof Green presented the research to key opinion leaders in the Dutch National Udder Health Programme, in 2009 and 2011, and also gave a keynote presentation to the international conference on Udder Health and Communication (**Source 8**), the USA (**Source 9**), Australia (Prof Green presented the GB scheme to managers of 'Countdown Downunder', the Australian national mastitis programme, and the DairyCo Mastitis Control Plan is being used to direct and inform the programmes in Australia (**Source 9**) and Chile (Prof Green was invited to present to key academic and industrial leaders in 2012). In a statement (2013), the Countdown Project Leader in Australia stated " *Of particular interest to Countdown was the design incorporated into the investigation pathway as delivered by trained GB milk quality advisers outlined within the DairyCo framework. We are also impressed with some of the adviser-farmer communication pathways employed by the DairyCo scheme such as the interactive adviser map on the web resource. It is clear to me, having been involved with the Countdown project since its inception, that we have many useful things to learn about project design, delivery and evaluation from the DairyCo scheme* " (**Source 10**).

The impact of the British national mastitis control scheme is highlighted by its recommendation in the National Dairy Cow Welfare Strategy – a national strategy for cow welfare supported by all of the major dairy organisations (**Source 3**). Further evidence of the extent of the impact is found on the DairyCo website (**Source 2**). The scheme is supported by the British Cattle Veterinary Association (**Source 4**).

**5. Sources to corroborate the impact**

1. *Evidence of the nationwide mastitis control scheme and the number of participants;* [www.mastitiscontrolplan.co.uk/](http://www.mastitiscontrolplan.co.uk/) 2012.
2. DairyCo website to provide evidence for the nationwide mastitis control scheme and details in the three year Project Report; (<http://www.dairyco.org.uk/technical-services/mastitis-control-plan>) 2012.
3. *Evidence of the high profile and widespread recognition of the value of the mastitis control plan;* National Dairy Cow Welfare Strategy; (<http://www.thedairysite.com/articles/2884/dairy-cow-welfare-strategy-2011-report>) 2011.
4. *Evidence of the high profile and widespread recognition of the value of the mastitis control plan;* The British Cattle Veterinary Association (<http://www.bcva.eu/bcva/education/documents/dairyco-mastitis-control-plan-current-progress-implementing-national-mastitis-co>) 2009.
5. *Evidence of the high profile and widespread recognition of the value of the mastitis control plan - industry press articles.* E.g. [www.fwi.co.uk/Articles/2010/07/01/122062/DairyCo-mastitis-plan-ahead-of-target.htm](http://www.fwi.co.uk/Articles/2010/07/01/122062/DairyCo-mastitis-plan-ahead-of-target.htm) 2010 and [www.farmersguardian.com/three-stage-control-plan-for-high-cell-counts-and-mastitis/27598.article](http://www.farmersguardian.com/three-stage-control-plan-for-high-cell-counts-and-mastitis/27598.article)) 2009.
6. *Evidence of the high profile and widespread recognition of the value of the mastitis control plan - veterinary practices and clinical specialist facilities* E.g. [www.ed.ac.uk/polopoly\\_fs/1.18296!fileManager/dhhsnewsletteraug09.pdf](http://www.ed.ac.uk/polopoly_fs/1.18296!fileManager/dhhsnewsletteraug09.pdf) 2009, [http://www.stdavids-farmvets.co.uk/docs/2010\\_november\\_stdavids\\_newsletter.pdf](http://www.stdavids-farmvets.co.uk/docs/2010_november_stdavids_newsletter.pdf) 2010, (<http://www.roseveanvets.co.uk/userfiles/file/Farm%20Animal%20Information/Dairy%20Co%20Mastitis%20Plan.pdf>) 2010.
7. *Evidence of current success and impact of the scheme;* DairyCo Mastitis Control Plan, Three Year Report; [http://www.dairyco.org.uk/non\\_umbraco/download.aspx?media=13702](http://www.dairyco.org.uk/non_umbraco/download.aspx?media=13702) 2012.
8. *Examples to provide evidence of international reach of the unique approach to mastitis control* (<http://books.google.co.uk/books?id=KhjywJqW-dQC&pg=PT6&lpq=PT6&dq=international+conference+on+Udder+Health+and+Communication+2011+green&source=bl&ots=B2X80fvmaA&sig=IsEC8aFeaxbzznvF0y3zGg3xiM&hl=en&sa=X&ei=j2NAUen8JMnLQQXV2oHoAQ&ved=0CFkQ6AEwBw>) 2011
9. Grant application placed in the USA to use the British scheme as a framework to develop a similar, multi-state scheme for mastitis control in the USA (communications with Professor and Programme Director, Quality Milk Production Services, Cornell University – confidentially held by University of Nottingham). *Provides corroboration for the international reach or influence of the scheme.*
10. Statement by Countdown Project Leader on behalf of Dairy Australia. *Provides corroboration for the international reach of the scheme and adoption of concept by other countries in implementing similar schemes.* 2013.