

2015

BRITISH MASTITIS CONFERENCE

Organised by

The Dairy Group



The University of
Nottingham

UNITED KINGDOM • CHINA • MALAYSIA

Topics:

- Streptococcus uberis
- Impact of SCC on processors
- Research updates
- Mastitis control in practice
- Motivating staff
- The New Zealand experience

Wednesday 11th November 2015

Sanlam Suite, Worcester Rugby Club,
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GENERAL INFORMATION

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General information

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CHAIRMAN'S INTRODUCTION

Welcome to the 2015 British Mastitis Conference.

The Organising Committee has been busy since last year's conference bringing together an expert group of speakers, not only from the UK, but also New Zealand and Europe. We trust that you will find the programme will prove both thought provoking and stimulating.

This year BMC has linked up with the European Mastitis Research Workers, which held its inaugural meeting in the UK yesterday. We welcome our international colleagues who are also attending this conference.

Our first paper looks at the question of strain typing *Streptococcus uberis* and the benefits of this technology to the control of mastitis. This is followed by a paper on the impact of milk quality and SCC on cheese production.

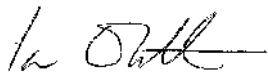
Building on the success of the last two years, we have again selected four posters from the Knowledge Transfer section for oral presentation. The four papers are followed by an opportunity for delegates to debate with the presenters.

After lunch, we will turn our attention to the practical approach of mastitis control on farm by a practice veterinary surgeon. This will be followed by a paper on how to maximise the uptake of mastitis advice on farm, using motivational interviewing techniques. The conference will be closed with a paper on the New Zealand approach to the control of mastitis, and where elements can be applied to the UK and Europe.

This year sees a record number of poster submissions – a total of 16. I would urge you all to make time to review the posters and speak with the authors. Each year the presenters put a great deal of effort into providing the abstracts and preparing and presenting their posters.

As always we endeavour to find you the best speakers with the most relevant (and latest) information. This is only achievable thanks to all our generous sponsors. This year our sponsors are: Lely (UK) Ltd (Gold), BouMatic Gascoigne Melotte Sprl (Gold), Hypred (Gold), Milkrite (Gold), Ambic Equipment Ltd (Bronze), Fullwood Ltd (Bronze), Boehringer-Ingelheim (Bronze), Norbrook Laboratories (UK) Ltd (Bronze), DeLaval Ltd (Bronze), Animax Ltd (Bronze) and Hipra (Bronze). As always the event could not happen without able administration, provided by Karen Hobbs and Anne Sealey at *The Dairy Group*.

Finally, as usual, thank you for attending and supporting the conference. I trust you will have an enjoyable and worthwhile day.



Ian Ohnstad
British Mastitis Conference Chairman
The Dairy Group

TIMETABLE of EVENTS

09:00	ARRIVE / REGISTRATION / COFFEE and POSTER DISPLAY	
09:45	CHAIRMAN'S INTRODUCTION	Ian Ohnstad The Dairy Group, UK
	Session One	Brian Pocknee The Dairy Group, UK
09:55	<i>Streptococcus uberis</i> - strain typing.	Jamie Leigh University of Nottingham, UK
10:25	The importance of milk quality in producing world class cheese consistently.	Mary Quicke Newton St Cyres, UK
10:55	Questions and Discussion	
11:10	COFFEE and POSTERS	
	Research updates (also presented as posters)	Elizabeth Berry BCVA, UK
11:40	Effect of intramammary infections with coagulase-negative staphylococci in early lactating dairy heifers on the quarter somatic cell count and milk yield throughout first lactation.	Dimitri Valckenier Ghent University, Belgium
12:00	Prevalence of <i>Streptococcus uberis</i> in the faeces of dairy cows.	Virginia Sherwin University of Nottingham, UK
12:20	Veterinary demographic factors affecting treatment strategies in clinical mastitis.	Karin Persson Waller National Veterinary Institute, Sweden
12:40	Towards responsible use of antimicrobials without loss of a good udder health.	Karlién Supré Flanders Milk Control Centre, Belgium
13:00	LUNCH and POSTERS	
14:15	WELCOME BACK AND VOTING ON POSTERS	
	Session Three	Brian Pocknee DHC, UK
14:20	Mastitis control in practice.	Keith Baxter Midhurst, UK
14:55	Motivational interviewing - a communication strategy to promote the uptake of advice on mastitis management.	Kristen Reyher University of Bristol, UK
15:30	New Zealand's journey, boldly going where?	Eric Hillerton Cambridge, New Zealand
16:05	Questions and Discussion	
16:20	POSTER AWARD and CLOSE	
16:30	TEA and DEPART	

Titles of Papers and Presenters

Scientific programme

Session One

- Streptococcus uberis* - strain typing. 1-8
Jamie Leigh, University of Nottingham, UK
- The importance of milk quality in producing world class cheese consistently. 9-14
Mary Quicke, Newton St Cyres, UK

Research Update Session (also presented as posters)

- Effect of intramammary infections with coagulase-negative staphylococci in early lactating dairy heifers on the quarter somatic cell count and milk yield throughout first lactation. 15-16
Dimitri Valckenier, Ghent University, Belgium
- Prevalence of *Streptococcus uberis* in the faeces of dairy cows. 17-18
Virginia Sherwin, University of Nottingham, UK
- Veterinary demographic factors affecting treatment strategies in clinical mastitis. 19-20
Karin Persson Waller, National Veterinary Institute, Sweden
- Towards responsible use of antimicrobials without loss of a good udder health. 21-22
Karlien Supré, Flanders Milk Control Centre, Belgium

Session Three

- Mastitis control in practice. 23-27
Keith Baxter, Midhurst, UK
- Motivational interviewing - a communication strategy to promote the uptake of advice on mastitis management. 29-38
Kristen Reyher, University of Bristol, UK
- New Zealand's journey, boldly going where? 39-45
Eric Hillerton, Cambridge, New Zealand

Titles of Posters and Authors

Poster abstracts – presented at the Technology Transfer Session (presenting author underlined):

- A method to significantly reduce the use of intramammary antibiotics at drying off in dairy cow production**
Cyril Crosson¹, Laurent Mériaux^{1, 2}, Thomas Decers^{1, 3} & Marc Belvalette^{1, 4} 47-48
¹Bioteck Lait, 17 boulevard Nominoë, BP 84333, 35743 Pacé Cedex, France; ²Eilyps, 17 boulevard Nominoë, BP 84333, 35743, Pacé Cedex, France; ³France Conseil Élevage, 42 rue de Châteaudun, 75009, Paris, France; ⁴Alysé, 3 rue Jules Rimet, 89400, Migennes, France.
- Milking machine test results – an update**
 Elizabeth A Berry, Mark Scrivens & J Eric Hillerton 49
 Ryelands, Upton Bishop, Ross on Wye, UK; Genus, Alpha Building, London Road, Nantwich, UK; Drumlánrig, Cambridge, New Zealand.
- Startcheck[®] Hipra's diagnostic tool for the detection and quantification of pathogenic bacteria (*Staph aureus*, *E.coli*, *CNS* and coliforms) in bovine milk samples from dairy farms in UK** 51-52
 Alex Gomez¹, Anna Targa & Daniel Zalduendo
¹HIPRA UK, Nottingham, UK; ²HIPRA, Amer (Girona), Spain.
- The prediction of dry period intra-mammary infection status from lifetime cow records**
Andrew C. Henderson¹, Chris H. Hudson¹, Andrew J. Bradley^{1, 2}, Virginia E. Sherwin¹, Martin J. Green¹ 53-54
¹School of Veterinary Medicine and Science, The University of Nottingham, Sutton Bonington Campus, College Road, Leicestershire, LE12 5RD, UK; ² Quality Milk Management Services Ltd., Cedar Barn, Easton Hill, Easton, Nr Wells, Somerset, BA5 1DU, UK..
- In vitro* growth inhibition of bovine intramammary Streptococci against betalactams** 55-56
Karlién Supré, Koen Lommelen, Luc De Meulemeester
 Flanders Milk Control Centre, Lier, Belgium.
- Effectiveness and safety of a novel flunixin meglumine transdermal pour-on solution in the treatment of bovine mastitis**
 Julien Thiry¹, Martin Behr², Albert Boeckh³, Vincent de Haas^{1,3}, Philippe Brianceau³ 57-58
¹ MSD Animal Health Innovation, 49071 Beaucouzé, France; ² MSD Animal Health, MK7 7AJ Milton Keynes, UK; ³ Merck Animal Health, 07940 Madison, USA
- Infection dynamics across the dry period and the impact on a dairy cow's performances throughout the subsequent lactation**
Zyncke Lipkens, Joren Verbeke, Sofie Piepers, and Sarne De Vliegheer 59-60
 M-team and Mastitis and Milk Quality Research Unit, Department of Reproduction, Obstetrics and Herd Health, Faculty of Veterinary Medicine, Ghent University, Merelbeke, Belgium.
- Addition of Metacam[®] (meloxicam) to the treatment of clinical mastitis improves subsequent reproductive performance**
 Scott McDougall¹, Elke Abbeloos², Sofie Piepers³, A Rao⁴, Susana Astiz⁵, Tine van Werven⁶, Jonathan Statham⁷, Natividad Perez-Villalobos⁸ 61-63
¹ AnexaFVC, ² Boehringer Ingelheim, ³ Ghent University, ⁴ University of Liège, ⁵ Instituto Nacional de Investigación y Tecnología Agraria y Alimentaria, ⁶ Utrecht University, ⁷ RAFT solutions Ltd, ⁸ Trialvet Asesoramiento e Investigación Veterinaria.

Titles of Posters and Authors - continued

Poster abstracts – presented at the Technology Transfer Session (presenting author underlined)

Cost-effectiveness of specific mastitis interventions

Peter M. Down¹, Andrew J. Bradley^{1,2}, James E. Breen^{1,2}, Chris H. Hudson¹,
Martin J. Green¹

¹School of Veterinary Medicine and Science, The University of Nottingham, Sutton Bonington Campus, College Road, Leicestershire, LE12 5RD, UK; 65-66

² Quality Milk Management Services Ltd., Cedar Barn, Easton Hill, Easton, Nr Wells, Somerset, BA5 1DU, UK.

A novel milk protein biomarker for dairy animal mastitis and its implementation in the Elisa format

M. Filippa. Addis^{1*}, V. Tedde¹, S. Pisanu¹, G. Puggioni¹, D. Pagnozzi¹, S. Dore², E. A. Cannas², A. Casula³, C. Locatelli³, V. Bronzo³, P. Moroni^{3,4}, S. Uzzau¹

¹Porto Conte Ricerche, SP 55 Porto Conte/Capo Caccia Km 8.400, Loc. Tramariglio, 07041, Alghero, Italy; ²Centro di Riferimento Nazionale per le Mastopatie degli Ovini e dei Caprini (CReNMOC), Istituto Zooprofilattico Sperimentale della Sardegna, Via Duca degli Abruzzi 8, 07100 Sassari, Italy; ³Università di Milano, Dipartimento di Scienze Veterinarie per la Salute, la Produzione Animale e la Sicurezza Alimentare, Via Celoria 10, 20133 Milano, Italy; ⁴Cornell University, Animal Health Diagnostic Center, Quality Milk Production Services, 240 Farrier Rd, Ithaca, NY 14853, USA. 67-68

Milk yield - an important risk factor at drying off?

Andrew J Bradley^{1,2} and Martin J Green²

¹Quality Milk Management Services Ltd, Cedar Barn, Easton Hill, Easton, Wells, BA5 1DU, UK. ²School of Veterinary Medicine and Science, University of Nottingham, Sutton Bonington Campus, Sutton Bonington, LE12 5RD, UK. 69-70

The use of Maldi-Tof mass spectrometry for the identification of bovine mastitis pathogens

Andrew J Bradley, Caroline Hunt and Barbara Payne 71-73
Quality Milk Management Services Ltd, Cedar Barn, Easton Hill, Easton, Wells, BA5 1DU, UK.

Poster abstracts – also as an oral presentation in the Research Updates session (presenting author underlined)

Effect of intramammary infections with coagulase-negative staphylococci in early lactating dairy heifers on the quarter somatic cell count and milk yield throughout first lactation

Dimitri Valckenier, Sofie Piepers & Sarne De Vliegher 15-16

M-team and Mastitis and Milk Quality Research Unit, Department of Reproduction, Obstetrics and Herd Health, Faculty of Veterinary Medicine, Ghent University, Merelbeke, Belgium.

Prevalence of *Streptococcus uberis* in the faeces of dairy cows

Virginia Sherwin, Sharon Egan, Jamie Leigh & Martin Green 17-18

School of Veterinary Medicine and Science, University of Nottingham, Sutton Bonington Campus, Sutton Bonington, LE12 5RD, UK.

Veterinary demographic factors affecting treatment strategies in clinical mastitis

Karin Persson Waller^{1,2}, V. Hårdemark², A.-K. Nyman¹ & A. Duse¹ 19-20

¹National Veterinary Institute (SVA), SE-75189 Uppsala, Sweden; ²Swedish University of Agricultural Sciences (SLU), SE-75007 Uppsala, Sweden.

Towards responsible use of antimicrobials without loss of good udder health

Karlién Supré, Koen Lommelen & Luc De Meulemeester 21-22

Flanders Milk Control Centre, Lier, Belgium.

FURTHER INFORMATION

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A global organization for mastitis control and milk quality

The NMC is a professional organization that promotes research and provides information to the dairy industry to help reduce mastitis & enhance milk quality. For more than 50 years, the NMC has distinguished itself internationally as a leader in meeting those objectives.

What does NMC do?

- Provides a forum for the global exchange of information on mastitis and milk quality
- Publishes educational materials including books, brochures and CDs
- Establishes guidelines for mastitis control and milking management practices
- Monitors technological and regulatory developments relating to udder health, milk quality and milk safety
- Conducts meetings & workshops, providing educational opportunities for all segments of the dairy industry
- Helps fund the National Mastitis Research Foundation

*A commitment to
reducing mastitis and
enhancing milk quality*

Who are the members of NMC?

NMC membership is comprised of people from more than 40 countries, representing a wide range of dairy professionals who share an interest in milk quality and mastitis control. These people include veterinarians, milk quality consultants, dairy producers, university researchers and extension specialists, milk procurement field staff, equipment and supply representatives, regulatory officials, & students.

What can NMC do for you?

The continued pressure to ensure milk safety and improve milk quality, as well as the need to increase production efficiency, requires greater team effort between producers, veterinarians and other dairy professionals. Each team member plays a key role in developing successful mastitis control programs. NMC can serve as your resource for information related to udder health, milking management, milk quality, and milk safety.

Why join NMC?

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- To provide leadership on milk quality issues within the industry
- To participate and learn about mastitis and milk quality developments at NMC meetings
- To establish valuable industry contacts
- To support education and research efforts that help raise awareness and understanding of milk quality issues

NMC membership benefits

- NMC annual meeting and regional meeting proceedings, containing all of the papers and posters presented at the meetings
- The NMC printed and electronic newsletters, addressing the latest information on udder health, milking management and milk quality
- Access to the "members-only" section of the NMC website, which includes the NMC Proceedings Library, NMC newsletter archives, and NMC membership directory
- Opportunities to network with other dairy professionals concerned with milk quality

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the NMC membership.*

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www.nmconline.org;

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STREPTOCOCCUS UBERIS - STRAIN TYPING

James Leigh, Peers Davies, Martin Green, Andrew Bradley, Maqsd Hossain, Richard Emes, Virginia Sherwin & Sharon Egan

School of Veterinary Medicine & Science, University of Nottingham, Sutton Bonington Campus, Leicestershire, LE12 5RD. E-mail: james.leigh@nottingham.ac.uk

SUMMARY

The ability to accurately type bacterial species into meaningful sub-species groups based on either clinically relevant parameters or their underlying genetic structure is important in the implementation of effective disease control measures. *Streptococcus uberis* is a major cause of bovine mastitis in the UK and typing schemes have been developed that enable categorical identification of genetically related sub species types. These have been used to type isolates from clinical cases of bovine mastitis across England and Wales and will be used to type isolates that are carried and shed into the environment. This detailed level of information is vital to enhance our understanding of pathogen transmission and enable better implementation of the most appropriate disease prevention strategies.

INTRODUCTION

Bovine mastitis typically results from infection of the mammary gland and associated tissues and is a consequence of successful colonisation, evasion of host defences and induction of marked and overt inflammatory changes. The infectious agents most associated with bovine mastitis are bacteria.

Different species of bacteria are able to infect the bovine mammary gland and the presence of each species has implications for the methods of control that may be required to reduce the problem on any particular farm. For example, the preponderance of *Streptococcus agalactiae* in a herd would indicate a chronic, underlying contagious (cow to cow) spread of infection. Whereas, a high proportion of *E.coli* would be indicative of infections that mostly spread from the external environment to the mammary gland. In each scenario different measures may be implemented to try to control the underlying problem.

In the same way that species level identification can be of benefit in the management of disease in dairy herds, identification of particular bacterial strains (defined sub species groups) may assist in the development of more effective control measures. One species that has been gaining increasing attention in this respect is *Streptococcus uberis*. Bovine mastitis due to *S. uberis* infection is not controlled well by routine implementation of the five-point control plan (3); suggesting it is largely transmitted to the gland from an environmental niche. Furthermore, the outcome of infection with *S.*

uberis can range from a transient sub-clinical infection to an acute severe clinical mastitis.

The practical challenges for strain typing are; identification of strains that transmit to the gland from a particular niche and prediction of which strains may be more likely to result in clinical disease. These issues are complex and require a combined and holistic approach that necessitates input from those with wide range of scientific, technical and practical expertise.

THE HISTORY OF STRAIN TYPING IN *STREPTOCOCCUS UBERIS*

The early typing techniques

S. uberis belongs to a cluster of species in the bacterial genus *Streptococcus* known as the pyogenic (pus forming) group (4). This includes a wide range of human and animal pathogens all responsible for diseases in which an inflammatory pathology is evident. Many of the early typing techniques for *S. uberis* were based on procedures that had shown some value for the more intensively researched human pathogens. *Streptococcus pyogenes* and *Streptococcus agalactiae* can be unequivocally identified by a serotyping scheme developed in the 1930s by Rebecca Lancefield (5); *S. pyogenes* being Lancefield Group A (GAS) and *S. agalactiae* being Lancefield Group B (GBS). In each case, single antigens located at the bacterial surface can then used for sub species serotyping. In the case of GAS this is the M-protein antigen (of which there are currently over 200 types (6)) and in GBS it is the carbohydrate capsular antigen (of which 10 types have been identified (7)). Repetition of such schemes for *S. uberis* was unsuccessful; *S. uberis* was not amenable to Lancefield typing. Both M-protein of GAS and capsule of GBS play a part in virulence; only recently have surface structures in *S. uberis* that play a role in disease been identified (8, 9) and these are yet to be used in a similar, clinically aligned serotyping scheme.

Various other typing schemes have been investigated for use with *S. uberis*. The early ones were centred on production and susceptibility to bacteriocins (10) (bactericidal proteins released by one strain and often effective against other similar but distinct strains) and bacteriophage (11) (bacterial viruses produced by one strain and able to infect and kill different strains of the same species). Although both initially showed some promise many isolates were untypeable and in the population that could be typed these techniques lacked sufficient resolution to be effective.

The next series of strain typing tools to be developed were based on differentiation of patterns following fragmentation of genomic DNA with restriction endonucleases (enzymes that specifically cut double stranded DNA at a defined sequence). In the most successful of these techniques (Restriction Fragment Length Polymorphism (RFLP), commonly known as DNA fingerprinting (12)) the collection of fragments were separated according to size by a process known as electrophoresis and the banding

patterns obtained (which resemble supermarket bar codes) compared. This typing technique proved to have excellent resolution (many different bar codes were obtained) and was reproducible (the same isolates always showed the same bar code). In terms of a tool to enable comparison of many samples simultaneously or comparison of samples between labs or samples processed at different times it lacked the ease of use and data transferability that was required of a typing tool. However, such DNA fingerprinting still remains a rapid, effective and relatively cheap method for simultaneous analysis of a small number (~50) of isolates.

Multi Locus Sequence Typing (MLST)

MLST is a technique that does not only separate bacterial isolates into types (sequence types; STs) but also indicates the genetic or evolutionary relationship of isolates within a population (13). This technique has been applied to an ever growing list of bacterial species in which the variation in each population is indexed through variation in the DNA sequence within individual isolates. Unlike other typing systems, the data produced is categorical rather than comparative and due to the nature of the data it can be readily transferred electronically.

MLST uses the sequence variation detected in housekeeping genes (alleles) to index evolutionary change or progression. In *S. uberis* seven housekeeping genes (those encoding proteins responsible for core metabolic pathways) are analysed (14). Each new allelic sequence is given a new allele number and once completed each isolate has a seven component code termed the allelic profile. Each new allelic profile is allocated a sequence type (ST).

Another advantage of MLST is that by analysis of several genes the speed of change is indexed around the bacterial chromosome; offsetting the rapid evolution that may be seen in any single gene or any particular region of the genome. Also, variant sequences that have been acquired as a result of horizontal exchange of genetic material are given the same standing as one that has acquired a single point mutation, as a result of aberrant DNA replication or repair. Thus MLST offsets, to some extent, the apparent rapid evolution due to gene transfer. By selection of genes that are not under external selective pressure, but which are constrained by function, MLST provides a framework on which bacterial evolution and underlying population relationships can be evaluated and onto which more rapidly evolving traits can be superimposed.

Two MLST schemes exist for *S. uberis*; one follows the conventions described above (14). The other includes genes under selective pressure (15) and as a result, although it has value for typing, it is less appropriate as a tool for population biology and genetic/evolutionary analysis. The data reported in this communication is derived from the conventional MLST scheme for which the website, <http://pubmlst.org/> is the repository of data.

Recent uses of MLST at the SVMS (Peers Davies)

Most studies investigating *S. uberis* within dairy herds have looked at isolates obtained from only a few herds or over a short duration (16, 17, 18). In a recent study, we have looked at all the clinical *S. uberis* isolates obtained from 52 dairy herds across England and Wales over a 12 month period. These data have provided a considerably better understanding of this pathogen's infection dynamics.

For instance, previous reports had indicated that *S. uberis* showed great diversity, but within a single herd at a single time point there appeared to be a number of cows infected with common strains; implying that local conditions resulted in herd restricted outbreaks by certain strains. The more wide ranging, longitudinal study conducted at SVMS has revealed a diverse range of strains, but also indicated that there may be a few predominant strain types within the UK. From 494 clinical cases 195 different STs were found and of these 148 were only found in a single herd. However, 9 STs were isolated from 192 (~39%) of clinical cases and these were found in multiple herds.

These data conform to the previous view that the majority of disease is caused by an apparently wide variety of strains, but indicate that the over representation of a strain seen in any one herd in a snap shot may be reflected in a limited array of highly prevalent strains nationally. This level of detailed knowledge starts to change our perspective on the disease and possible intervention strategies. Firstly, from a biological standpoint it becomes interesting to speculate whether these may be a specialised group of STs that are better able to reach the mammary gland to infect and/or are more virulent once inside the gland.

Can we identify types that are more or less virulent? (Maqsud Hossain)

It is well established that different strains of *S. uberis* have reproducibly different virulence for the lactating mammary gland (19, 20). In an attempt to align the strain virulence with the underlying biology and genetics of *S. uberis* we have analysed the genome sequences of 12 distinct strains obtained from clinical and sub-clinical infection of the bovine mammary gland and compared these with the genome of the highly virulent strain, 0140J, and the virtually avirulent strain, EF20 (21).

Although each genomic sequence showed variation from each other the overall level of similarity between sequences was very high. Analysis of the genes present showed that *S. uberis* contains around 1550 genes in its core genome (the basic genome sequence present in all strains); however, in contrast, the pan genome (the of genes detected in all sequences) was not restricted, indicating that *S. uberis* can acquire and retain sequences from a wide array of other (bacterial) sources.

Further analysis revealed that all the known virulence related genes were resident in the core genome and common to all strains. Implying that at least with respect to these genes, virulence toward the bovine mammary gland is an inherent property of all mammary isolates and that the genomic differences underpinning differing virulence are more subtle than simply gene gain/loss.

Can we identify types that are more likely to become into contact with the bovine mammary gland (Virginia Sherwin)

It has been known for a long time that *S. uberis* can be readily isolated from various sites in and around the dairy cow (22, 23). The importance of any particular niche has not been established. The frequency with which *S. uberis* can be isolated from the bodies of cattle was increased in herds with high incidence of *S. uberis*. In very few cases has there been a connection at the strain level to link *S. uberis* in the environment with *S. uberis* found in the mammary gland. In a study in New Zealand, it was shown that strain types found in the mammary gland were often found on the hind legs and feet of dairy cattle (24). In this case, appearance of the strain in the mammary gland pre-dated isolation from the legs/feet, implying environmental contamination from the site of disease rather than the other way around.

Studies of environmental (non-mammary) *S. uberis* are limited in number, probably due to the difficulty in isolation of the bacterium from materials heavily contaminated with other bacterial species. Those studies that have been conducted indicate that *S. uberis* may be concentrated in areas of high cattle traffic (25) and areas where cattle accumulate (26). In pasture based systems, it has been shown that removal of cattle from grazing areas resulted in the decrease and eventual elimination of *S. uberis* from this environment (25). The presence of *S. uberis* in the environment appears to be associated with the reasonably recent (<21 days) presence of dairy cattle.

The commonly held view is that faecal contamination is largely responsible for environmental loading with *S. uberis*. Such consideration stems from the observation that most studies have isolated *S. uberis* from faeces and or rumen contents. Not all dairy cows carry *S. uberis* and the prevalence of faecal shedders ranges from 0-34% (22, 23, 26). One outstanding problem with the association of faecal shedding of *S. uberis* with an increased risk of bovine mastitis is the absence of data that shows the same strain types in faeces prior to their appearance in the mammary gland. In an attempt to investigate this further we have developed a molecular based diagnostic to identify cattle that shed *S. uberis* in their faeces and this has considerably reduced the number of faecal samples that need to be cultured in order to obtain isolates.

This investigation is at an early stage and to date strain typing has not been attempted. Early data using this new technique has identified the proportion of dairy cattle shedding *S. uberis* ranges from between 10-33% (in line with

previous studies in which bacterial culture was used). Furthermore, as this is not a snap-shot study but is sampling a single herd through an entire year at 2-monthly intervals we have been able to identify animals that shed *S. uberis* at one time point but that do not at a subsequent time. Currently these data indicate that no animal appears to be permanently colonised with *S. uberis* and that a good proportion of animals never appear to be colonised. It also implies that crowding / housing is a risk factor for gut carriage of *S. uberis*.

From these samples it will be important to identify if animals shed a single or multiple strains of *S. uberis* and the strains identified from these faecal samples will be compared with those found in the mammary gland causing mastitis in the same herd in a forensic style investigation.

Similar studies could potentially be conducted at other extra-mammary sites that contain *S. uberis* in an attempt to determine the reservoir that best reflects the range of strains found in the contemporary clinical isolates within the same herd.

CONCLUSIONS

The ability to type *S. uberis* strains effectively and in a categorical and transferable way has been established using MLST. This has confirmed the diverse bacterial population that exists as a cause of mastitis. It has also identified that about 40% of clinical cases in the 52 herds investigated were due to infection with a very limited sub set of largely related strains. The biological difference underpinning their predominance is unlikely to be due to the presence/absence of specific genes compared to other mammary isolates. MLST will enable comparison of isolates from different extra-mammary reservoirs of *S. uberis* and identification of those containing populations of strains that reflect those in the clinical cases. This level of detailed understanding of the dynamics of infection will permit control measures to be focussed more effectively at critical points in the transmission of this pathogen in the future.

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NOTES

THE IMPORTANCE OF MILK QUALITY IN PRODUCING WORLD CLASS CHEESE CONSISTENTLY

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The farm makes around 200t per year of traditional (cylindrical) cloth bound cheeses, mainly cheddar, from the milk of our 500 cross bred cows. Our aim is to produce world class cheese, sold world class around the world. While we aim for the most complex, balanced, long lasting flavours we can achieve, and for this we need the milk most tailored to our requirements. However, all cheesemaking and dairy production needs milk of the correct compositional and microbial quality for the use. This paper describes what we require in our business, and what we have found to make a difference.

Milk quality matters for cheese making

- Fat & Protein quantity, quality and ratio
- Cell Count and mastitis
- Microbiology – from the cow and external

Breed effects

- Fat & protein type and ratio
- Size & shape of udder & teats
- Yield & immune status especially at conception

Herd effects

- Relaxed cows (whistle not shout)
- Avoid muddy gateways
- Well clipped tails and singed udders
- Cull persistent cases
- 1 case/month or investigate

Milking routines

- No washing (spread problems, stuck on)
- Start at the front and work back
- If in doubt, draft her out
- Cluster alignment
- Observation e.g. faulty pulsation
- Removing clusters
- Emollient
- Train people to routines

Milking Machine

- Teat end damage
- Overmilking vs under-milking
- ACRs
- Parlour with high vacuum
- Slipping liners
- Adrian Joe

Environment

- Change from mass bedding with paper to 4:1 proper sawdust (not MDF):lime
- Cubicles scraped 2x/day, handful of mix per cubicle per day to keep them dry
- Fresh feed immediately after milking to keep them standing 1/2hr to allow teat canals to close
- Discourage cows from lying out (train heifers)

Normal udder & teat flora

- Streps, staphs, micrococci
- Corynebacteria, coliforms
- Lactococci, pseudomonads, yeasts

Useful members of cheesemaking flora

- Lactic Acid Bacteria (LABs), some micrococci, Arthrobacter, Microbacterium, Brevibacterium, Staphs

LABs

- Gram +ve, non-motile, non-spore forming bacteria
- Strictly fermentative metabolism producing lactic acid as and end product
- Streps, enteros, lactobs, leuconostocs, lactococcus, pediococcus etc

Terroir

- Distinctive flavour of a place, in part from the farm's microflora
- Micrococci – enzymatic activity
- Symbiotic activation of lactobacilli and streptococci
- 'Brothy' flavours

Psychrotrophs

- e.g. Pseudomonas
- Slow growing, in aged milk

- Enzymes survive pasteurization: Extracellular proteases and lipases not deactivated by pasteurization
- Off colour, flavour, odour: bitterness & rancidity in aged cheese

Mastitis

- Indirect link to quality of cheese
- Inflammation – damage to epithelial cells by pathogens or leukocytes
- Decrease in cells' capacity for synthesis
- Decrease in milk yield
- Decrease in lactose, increase in salt
- Inflammation: widened endothelial & epithelial junctions
- Nutrients between blood & milk
- Plasminogen - Proteolytic degradation of casein
- Less A & B casein, more G-casein

Impact of mastitis on cheesemilk

- Reduction in casein available for curd formation
- Reduces curd tension & curd firmness
- Loss of fat, protein & total solids in whey

High Somatic Cell Count

- Delay starter culture growth, inhibits acid production = delays fermentation
- Higher pH of milk & reduction in lactose may affect acidification profile
- Affects clotting enzymes (activity pH dependent)

Mastitis impact on cheese flavour

- Yield affected > 175
- Increase in cheese moisture > 200
- Macrophage-derived lipolytic enzymes in severe mastitis – damage milk fat globule membrane
- Lipase activity – rancid, oxidized flavours

Late lactation

- High fat and weak protein
- Irish target <25% late lactation milk

Pathogens from mastitis

- High fat and weak protein
- Irish target <25% late lactation milk

Cheesemaking

- Process – impact of protein
- Impact of fat
- Lactose

Pasteurization

- Raw
- Thermized
- Pasteurized
- Correct cheesemaking (reaching the correct lactic acid within the recipe's time) destroys pathogens even when challenged with bTB (over time)

Starter

- Controlling microbial populations to lactose fermenting, lactic acid and beneficial flavour producing
- Bulk starter (artisan cheddar), wild collected many species
- Industrial starter: freeze dried cultures, single strain with adjunct species
- % - dependent on recipe and cheesemaker skill

Rennets

- Animal, microbial, fermentation derived
- Plant: cynara cardunculus etc
- Cuts casein, -ve charge dropped, allowing coagulum to form, including fat and moisture
- Cut at correct time
- Too soon, lose fines in whey
- Too late, difficult to cut, holds moisture, excess acidity on maturation

Cutting, stirring scalding

- Releases whey
- Firms curd
- Holds fat
- Controls acidity development
- Cheesemaker skill, even cut, slow scald

NSLAB

- Arise from udder
- Arise also from the dairy
- Sensorial attributes and defects
- Growth primarily after lactose metabolized by starter/udder LABs

Whey off

- Most critical point: too late, lose calcium & texture
- Too early: slow, high moisture excess acidity & bitterness on maturation
- Curd cooling through fastest LAB growth point
- Protein wants to form a mat

Clothbound cheese

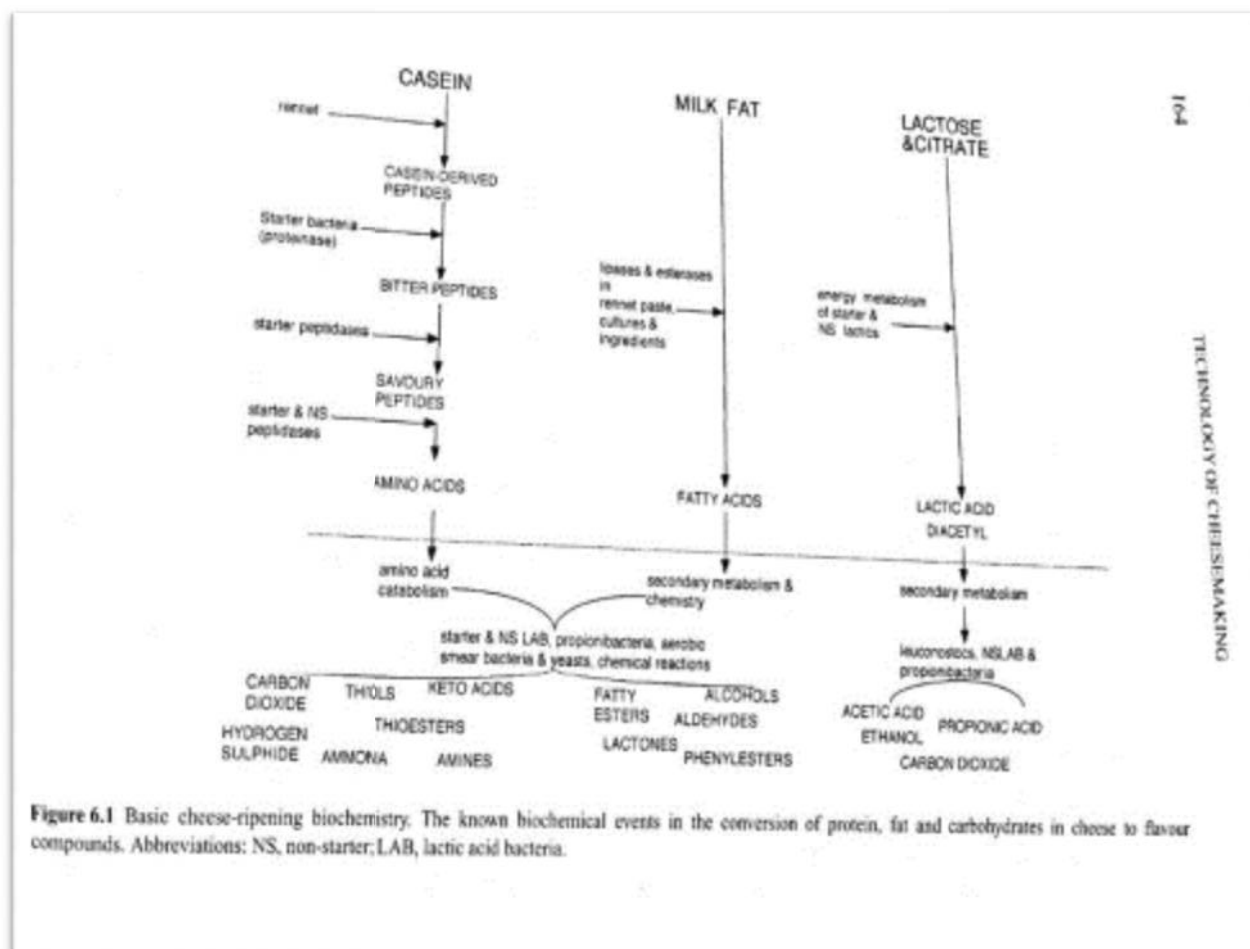
- Cloth applied with lard
- Allows moisture loss – differentially affects maturing through body of cheese
- Forms rind to protect cheese
- Encourages moulds on rind – flavour impact
- Mite consumes mould and lard if properly controlled

Maturing

- Proteolysis
- Lipolysis
- Glycolysis
- Dependent on moisture, fat, protein & acidity & temperature
- Maturing pathways many & various
- Desirable flavours dependent on cheesemaker and storeman skill

Grading

- Independent grader
- Assesses moisture, fat, protein and acidity by organoleptic methods
- Forecasts quality and flavour of cheese many months ahead



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NOTES

EFFECT OF INTRAMAMMARY INFECTIONS WITH COAGULASE-NEGATIVE STAPHYLOCOCCI IN EARLY LACTATING DAIRY HEIFERS ON THE QUARTER SOMATIC CELL COUNT AND MILK YIELD THROUGHOUT FIRST LACTATION

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A high proportion of heifers freshens with an intramammary infection (IMI). The most commonly recovered bacteria in that case are the group of coagulase-negative staphylococci (CNS). Intramammary infections caused by CNS as a group are characterized by a limited increase in somatic cell count. Interestingly, heifers infected with CNS in early lactation yield more milk throughout their first lactation than non-infected heifers^{1,2}. Until now, however, all studies measured daily milk yield (MY) at the heifer level and not at the quarter level whereas the infection status of heifers was an aggregate of the quarter-level infection statuses. Only matching IMI statuses and MY at the quarter level will allow for definitive conclusions.

The aim of this study was therefore to determine the association between the quarter IMI status in early lactation (1-4 days in milk, DIM) and the qSCC and qMY throughout first lactation.

In total, 82 Holstein Friesian heifers housed on 3 Flemish commercial dairy farms were enrolled. All herds were equipped with automatic milking systems (AMS) (DeLaval), enabling the measurement of the daily MY at the quarter level. The average herd sizes were 185 (herd 1), 60 (herd 2) and 130 (herd 3) lactating cows. Quarter milk samples were collected from 1-4 until 133 DIM on a two-weekly basis for bacteriological culturing and determination of the qSCC (Direct Cell Counter, DeLaval). All data were analyzed using linear mixed regression models (SAS 9.4) with qMY and the natural transformed qSCC (LnqSCC) as continuous outcome variables, respectively, and heifer and quarter as random effects. Both models included herd as fixed effect, infection status in early lactation as categorical independent variable of main interest and DIM and its quadratic term as continuous independent variables.

The quarter IMI status at calving was determined based on the bacteriological culturing results of the milk samples collected between 1-4 DIM (n = 325). Overall, 220 (67.7%) quarter milk samples were culture-negative, 70 (21.5%) quarter milk samples were positive for CNS, 20 (6.2%) quarter milk samples were positive for other pathogens. Also, 15 (4.6%) quarter milk samples yielded 3 or more different bacterial species and were considered to be contaminated.

The quarter milk SCC (cells/mL) and daily MY (kg) throughout first lactation for non-infected and CNS-infected quarters, respectively, are shown in Table 1. Quarters that were infected with CNS at calving had a significantly higher qSCC ($P < 0.05$) during the remainder of the lactation compared to non-infected quarters. A numerically higher daily MY was observed in CNS-infected quarters compared to non-infected quarters at every sampling though the differences were not significant ($P = 0.393$). Including LnSCC as predictor in the model resulted in a slightly more pronounced, though yet not significant, difference in daily MY between non-infected and CNS-infected quarters.

Our data reinforce that IMI with CNS in fresh dairy heifers moderately increase the qSCC in the affected quarter throughout first lactation. In spite of this increase, CNS-infected quarters did at least not produce less than non-infected quarters.

Table 1: Average SCC and daily MY in quarters that were non-infected and CNS-infected at calving

DIM	Somatic cell count (cells/mL)		Daily milk yield (kg)	
	Non-infected	CNS-infected	Non-infected	CNS-infected
0 - 11	353 483	406 625	4.86	4.91
12 - 25	62 628	93 848	6.90	7.02
26 - 39	53 793	61 596	7.84	7.97
40 - 53	43 752	64 093	8.04	8.28
54 - 67	48 394	68 118	8.00	8.27
68 - 81	42 143	82 204	7.88	8.11
82 - 95	50 318	73 880	7.62	7.85
96 - 109	50 565	71 987	7.56	7.94
110 - 123	46 055	78 457	7.52	7.89
124 - 137	70 836	100 762	7.42	7.72

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NOTES

PREVALENCE OF *STREPTOCOCCUS UBERIS* IN THE FAECES OF DAIRY COWS

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INTRODUCTION

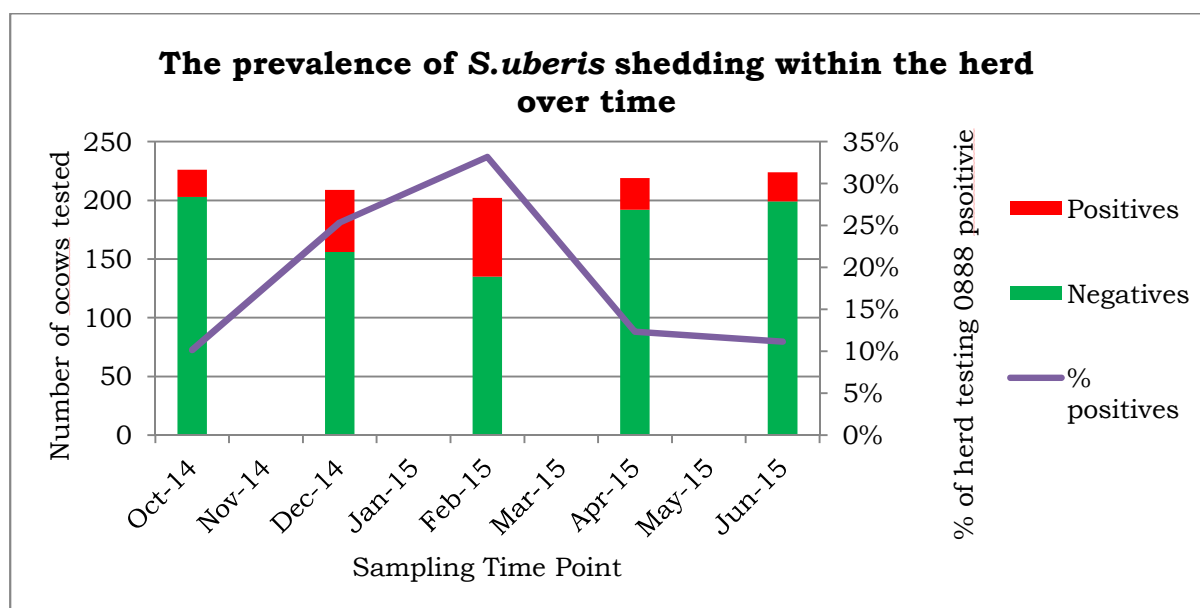
Streptococcus uberis (*S.uberis*) is the most prevalent cause of mastitis in the UK at an incidence of 16 cases per 100 cows per year (1). It is classified as an environmental pathogen, with a large amount of heterogeneity within the species (6). Previous research has indicated that to detect *S.uberis* in the environment, cows must have been present within the last 2 weeks (5). This suggests that cows are likely to be acting as a reservoir, with shedding probably via faeces. With the isolation of *S.uberis* from the rumen at the end of 1960s (2), further research has highlighted the presence of *S.uberis* in cow faeces, using different laboratory diagnostics (7, 4, 6). In one study, 23% of faecal samples tested positive in a New York grazing dairy herd (8) whilst in a separate study, a prevalence of 5.6% was reported in a grazing herd in New Zealand (Pryor, PhD). The aim of this study was to determine the prevalence and shedding patterns of *S.uberis* in the faeces of dairy cows in a UK herd.

METHOD

All cows in a 250 cow dairy herd in the East Midlands, with a previous history of *S.uberis* mastitis, were sampled five times over a 10 month period, at 2 monthly intervals. Rectal faecal swabs were taken and DNA was extracted using a phenol-based technique described by Hill & Leigh (3). Identification of the specific *S.uberis* genes was performed using polymerase chain reaction. Statistical modelling was used to explore potential risk factors for faecal shedding of *S.uberis*.

RESULTS

The prevalence of faecal shedding within the herd was shown to vary over time, increasing during the housed months to a prevalence of 33% in February. The prevalence whilst the herd were housed outdoors was ~10% (Figure 1). Of the cows sampled on all five occasions, only 34% of the cows were negative on all five occasions and 45% of the herd only shed once. The initial findings of the statistical model showed that there was an increased risk of shedding *S.uberis* if the cow was over-conditioned, in early lactation and during housing, as well as if the cow was in first lactation.



Further work is being undertaken to examine the significance of previous shedding on the likelihood of future shedding of *S. uberis*. Relationships between shedding and mastitis are also being evaluated including identification of strain types.

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NOTES

VETERINARY DEMOGRAPHIC FACTORS AFFECTING TREATMENT STRATEGIES IN CLINICAL MASTITIS

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Mastitis is the most common disease among dairy cows, and has negative effects on animal welfare as well as farm economy. Clinical mastitis is also one of the most common reason to use antimicrobial treatment in dairy cows. In Sweden, around 70% of the antimicrobial treatments in cattle are due to clinical mastitis. The veterinary practitioners have a big responsibility to use antimicrobials prudently to reduce the risk for bacterial antimicrobial resistance. Studies on attitudes to pain and use of analgesics in cattle have indicated that treatments may vary among veterinarians depending on demographic factors (1, 2, 4). If such factors also affect treatment strategies in clinical mastitis are, however, unknown. The objective of the study was, therefore, to investigate if treatment strategies in clinical mastitis, with emphasis on use of antimicrobials, differ among Swedish veterinarians due to year and country of exam, gender, geographical region, numbers of treated mastitis cases per month, and post-graduate training in dairy herd health.

A web-based questionnaire was created, and was sent in October 2013 to 741 veterinarians with a record of treating at least one case of bovine clinical mastitis in 2012. The questionnaire included demographic questions about the veterinarians (see above) as well as questions about strategies on bacteriological diagnostics (BAC; 5 questions), use of antimicrobials (ANT; 5 questions), use of other treatments and measures (OTH; 7 questions), and follow-up of cases of clinical mastitis (FOL; 5 questions). The effects of demographic factors were tested using multivariable logistic regression models.

In total, 267 (36%) veterinarians answered the questionnaire satisfactorily and were included in the study. Among those, the median year of exam was 2003 (range 1971-2013), and 82% got their exam in Sweden. The proportion of women and men was 74% and 26%, respectively. The distribution between regions was 45%, 20%, 30% and 4% for south, east, north and across regions, respectively. Fifty-eight % of the veterinarians treated 0-8 cases of mastitis per month while the rest treated more than 8 cases. Almost one-third (28%) of the veterinarians had post-graduate training. The distribution of gender and year of exam for included veterinarians did not differ from that of the contacted veterinarians.

Year of exam (9 of 22 questions; 0 BAC, 3 ANT, 3 OTH, 3 FOL) and post-graduate training (6 of 22; 1 BAC, 3 ANT, 1 OTH, 1 FOL) were the demographic factors that were significantly associated with the largest numbers of questions followed by gender (4 of 22; 1 BAC, 2 ANT, 1 OTH, 0 FOL), number of mastitis cases per month (4 of 22; 1 BAC, 1 ANT, 1 OTH, 1 FOL), geographical region (3 of 22; 1 BAC, 0 ANT, 2 OTH, 0 FOL) and country of exam (1 of 22; 0 BAC, 0 ANT, 1 OTH, 0 FOL).

The questions associated with the largest numbers of demographic factors were if the choice of antimicrobial therapy is affected by knowledge about earlier udder infections in the herd (more common among veterinarians examined before 2003, male veterinarians, veterinarians treating more than 8 cases per month, and veterinarians with post-graduate training), use of NSAID (more common among veterinarians examined 2003 or later, veterinarians with exam from another country than Sweden, and female veterinarians), and follow-up of treatment results using SCC (more common among veterinarians examined before 2003, veterinarians treating more than 8 cases per month, and veterinarians with post-graduate training). Overall, veterinarians examined before 2003, veterinarians with post-graduate training, and veterinarians not working in the south region seemed to be more inclined to follow current national guidelines (3) on treatment of clinical mastitis.

In conclusion, demographic factors were associated with veterinary treatment strategies in clinical mastitis. The associations did, however, only explain a small part (2-22%) of the variation of the answers. Thus, studies on other important factors are needed to improve knowledge about veterinary treatment strategies.

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NOTES

TOWARDS RESPONSIBLE USE OF ANTIMICROBIALS WITHOUT LOSS OF A GOOD UDDER HEALTH

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INTRODUCTION

On dairy farms, the majority of antimicrobials is used for the intramammary treatment of udder health problems (1). Tackling udder health issues by increasing preventive measures and drying-off healthy cows without antibiotics might support responsible use of antimicrobials. In the presented study performed in Flanders, Belgium, 4 dairy herds were assisted towards a more prudent use of antibiotics by advising on udder health and by introducing selective dry cow therapy.

METHODS

The 4 herds with on average 63 adult cows participated in the DHI program. Farmers registered all clinical mastitis cases and drug usage. Monitoring udder health was done by a herd check at the start of the project, followed by evaluation of DHI data on a monthly basis combined with regular visits during the 18-mo study period. Standard milk culture was performed for all clinical mastitis cases and some subclinical cases, and based on the result, an approach for each problem cow (treatment, culling or dry off) and/or adaptation of preventive measures on herd level was proposed to the farmer after consulting the farms' veterinarian.

Quarter level milk samples were taken of every cow not earlier than 10 days before dry-off and within 4 days after calving. Selective dry cow treatment was introduced in 3 consecutive steps, going from a very strict to a more moderate protocol (Table 1). Each cow (irrespective of antimicrobial treatment at dry off) received internal teat sealants.

Table 1: Inclusion criteria to dry-off without intramammary antimicrobial treatment

Criteria	Protocol 1 Sept. '13 – Jan. '14	Protocol 2 Feb. '14 – Sep. '14	Protocol 3 Oct. '14 – Mar. '15
Clinical mastitis	Absent in preceding lactation	Absent in preceding lactation	Absent in preceding lactation
Milk Yield at dry off	< 15 kg	< 15 kg	< 15 kg
Cow level Somatic cell count	< 150.000 cells/mL on each DHI test day in preceding lactation	< 150.000 (heifer) or < 100.000 cells/mL (cow) on each of the last 3 DHI test days	< 150.000 (heifer) or < 100.000 cells/mL (cow) on each of the last 3 DHI test days
Pathoproof PCR*	Not performed	Absence of major pathogens	-**
Quarter level Somatic cell count	< 100.000 cells/mL	Acceptable	-**
Culture	Negative	Negative	-**

*Real time PCR targeting mastitis pathogens; **Performed but no inclusion criterion

The antimicrobial consumption of the adult dairy cows was quantified as the number of standardized treatment days a cow received per year. One dry cow injector accounted for one day-under-treatment per injector (1).

RESULTS AND DISCUSSION

Udder health (bulk milk somatic cell count and percentage of clinical mastitis cases) remained good or improved. On average, every animal received antimicrobial treatment during 6.4 days per year compared to 8.0 days before the study. The consumption of critically important molecules decreased by half (1.9 to 0.9 days). In total, 16.2 % of the cows were dried off without antimicrobial injectors; with 31.8 % of the cows in the last protocol. More quarters that were culture negative at dry-off contained minor pathogens at calving when cows were dried off without antibiotics; but not major pathogens. Udder health (somatic cell count and clinical mastitis) in the next lactation was not influenced by administration of antibiotic injectors at dry off (Figure 1).

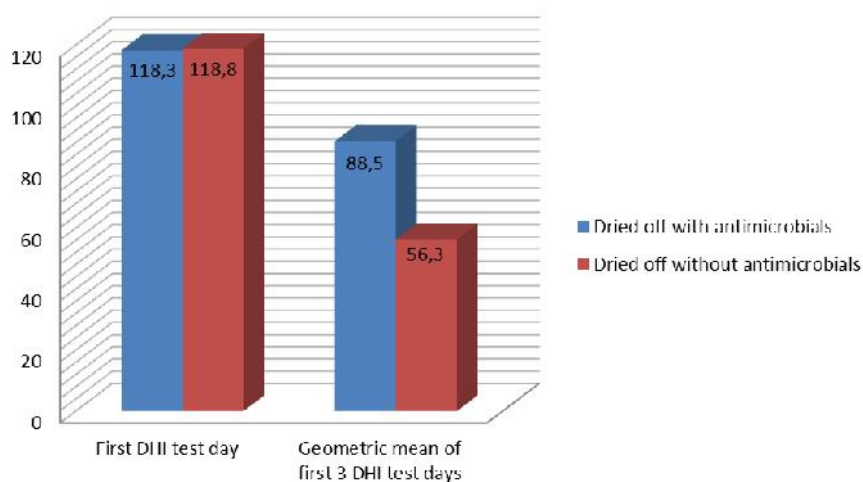


Figure 1: Individual somatic cell count (* 1,000 cells/mL) in early lactation of cows dried off with compared to without antimicrobials

We propose selective dry-cow therapy based on protocol 3 (Table 1), besides the use of internal teat sealers and a good dry-cow management. Extra tools, e.g. real-time PCR targeting mastitis pathogens on cow level or standard culture on quarter level, were not needed to obtain good results but might enhance trust and therefore, might help to extend the implementation of selective dry cow therapy. Selective dry cow treatment together with monitoring or improving udder health, can lead to a responsible and even decreased use of antimicrobials.

ACKNOWLEDGEMENTS

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NOTES

MASTITIS CONTROL IN PRACTICE

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SUMMARY

Veterinarians face increasing challenges in the development and implementation of mastitis control. This paper reflects the author's current approach to delivering practical advice at farm level.

INTRODUCTION

Mastitis is frequently cited as the costliest disease facing the cattle industry. The detrimental image often projected to the consumer is that of a production disease resulting from substandard welfare, requiring the excessive consumption of antibiotics and a risk of engendering resistance in human pathogens. In the current economic situation, it may be difficult to engage in depth with farmers on the subject of mastitis control. Conversely, it also gives opportunity, as more enlightened producers seek to improve productivity and efficiency.

If veterinarians are to have an input to control and manage mastitis, we must be able to engage with farmers, measure and quantify the problem, and convince them that investing in consultancy is a useful exercise. Even before the concerned vet sets foot on the farm, there are tools available: milk recording information, tube usage, perhaps some bacteriology results. Mastitis as a whole may be a multifactorial problem, and must therefore be regarded in a holistic fashion. The use of standardised tools, such as the DairyCo Mastitis Control Plan may be useful, especially for investigators lacking in confidence or experience (Green et al 2007). Whatever the approach, it must be logical and systematic, and must be appropriate to the individual requirements of the farm.

So, first we have to identify the problem farm. Does the farm have a rolling bulk milk somatic cell count over 200 000 cells/ml? Direct financial loss due to milk quality penalties being deducted? A clinical mastitis case rate of over 35%? More than 1 in 12 of early lactation cows with clinical mastitis? Particularly stringent farm assurance requirements? Any one of these represents an intervention opportunity to benefit both advisor and recipient.

Next, we should consider the nature of the problem: are we dealing with contagious pathogens, environmental organisms, or a combination? Bacteriology may be useful, on clinical and subclinical cases. Frequently a combination of different pathogens may be found to be present, requiring an overall strategy rather than just focussing on a particular element.

The predisposing factors which are leading to IMI should be identified. These might be divided into three categories: the milking process, the milking machine, and the environment. A dedicated visit to the farm at milking time is the only way to assess these factors, without the distractions of routine veterinary work.

The milking process

Getting the trust of milking staff to undertake their normal procedures can be difficult. The presence of an extra person in a milking parlour, particularly if he or she is not a regular visitor to the farm, can immediately arouse suspicion. Personnel may immediately be on their best behaviour and demonstrate immaculate technique and painstaking attention to detail. The investigator may have to resort to subterfuge: observation from a discreet hidden position, pretending to be fascinated by some facet of the parlour machinery, or being engrossed in looking at teat ends, or even apparent absorption by phone technology.

Critical control points in the milking process:

- Do the milking staff wear gloves, and change them when soiled?
- Do cows enter the milking parlour readily, without the milkers having to push them in from the collecting area?

- Are teats foremilked to check for clinical mastitis changes?
- Are teats then cleaned with a single use wipe or towel, to the point of being spotless?
- Is a suitable “prep-lag” time, usually about a minute, being allowed for the milk let-down reflex to occur?
- Is a post-milking teat disinfectant being applied to completely cover all teats?

The milking machine

- Modern milking technology and maintenance has greatly improved in recent years. However, there are still some fundamental aspects of milking machines that can have a significant effect on milk quality. Many of these factors can be monitored without the use of specialised measuring equipment.

- Are the liners fit for their intended purpose? Have they been changed within the defined time interval? The modern trend for disinfection between cows can have a significant influence on the lifespan of rubber. It is estimated that the standard interval between liner changes, of 2 500 milkings, may have to be reduced by up to a third where compounds such as peracetic acid are used. If this is not respected, the deterioration in liner performance may have adverse effects on milking speed and on teat condition.

- An essential part of analysing the performance of liners is to perform teat end scoring, immediately after cluster removal and before application of post milking disinfection. The DCMP scoring method is simple, repeatable, and effective at highlighting problems. As well as examining teat ends, the presence of such adverse effects as teat rings (oedema at the base of the teat) and congestion should be noted.
- Is there sufficient volume in the clawpiece of the cluster? Is there sufficient air admission into the cluster to permit the removal of milk to the pipelines, without excessive turbulence which may cause splashing of teats with milk, and potentially infectious bacteria?
- Is there any evidence of liner slip, detectable as audible squawks from the cluster, or of clusters falling off the cow for no reason? Liner slip has been identified as a significant contributor to the incidence of elevated levels of intramammary infection.
- Are the clusters detached gently from the cow, with no sign of discomfort? Vacuum fluctuations at cluster removal can contribute to risk of infection.

Environment

It has been well documented that environmental organisms, particularly coliforms and environmental streptococci, have become of increased significance in the last 20 years in the UK, compared to those traditionally regarded as being of an infectious nature such as staphylococci. To mitigate the challenge, cows must be as clean as possible, which means they should be presented for milking in such a state as to require minimal removal of adherent material. Hygiene scoring of cows in the parlour, again using a simple system such as that contained in the DCMP, will allow a judgment to be made on the environment in which cows are housed.

An environmental assessment should involve the measurement of bedded areas, for lactating, dry and calving cows. Cow comfort is an integral part of environmental mastitis control, so other factors, such as lameness, may also indicate that there is an environmental challenge

Cows at grazing may also be at risk of an environmental mastitis challenge. Sheltering under trees in hot weather may represent a particularly severe problem, where they stand and lie in a relatively small area.

Above all, don't forget dry cows, calving cows (and especially heifers) and fresh calved cows. These animals are the highest risk groups for environmental mastitis.

Treatment of IMI

The Responsible Use of Medicines in Agriculture Alliance (www.ruma.org.uk) has done much to enshrine sound principles in a basic common sense framework. It is then up to the advising veterinarian and the farmer to ensure adherence as far as is practically possible, to develop a sound plan to minimise the necessity for treatment.

- Does the farm have a sound protocol for different mastitis situations?
- Is it readily accessible?
- What should they do with mild clinical cases, severely affected or toxic cows, repeat cases, subclinical infections?
- Do all staff understand the protocols, and how to administer treatments properly?
- Do they record all clinical cases in a format which is readily accessible for analysis and review?

What aspects of antimicrobial usage might be altered by the veterinarian? There is increasing recognition that certain infections, such as coliforms and the coagulase negative staphylococci, may not be influenced by treatment with antibiotics. There is increasing interest in the use of on farm diagnostics to differentiate the types of bacteria present in clinical cases, (Viora et al 2014). This may enable farm staff to either use narrow spectrum antibiotics, or even dispense with antibiotics and just treat clinical signs with non-steroidal anti-inflammatory medication.

Do farm staff use their on farm medications in an appropriate fashion? The successful resolution of infections such as *Streptococcus uberis* may depend on the length of the treatment period used (Swinkels et al 2014). A recurrent issue in practice is the apparent failure of treatment of coliform infections, where the affected quarter may no longer contain any viable bacteria, but instead of milk there is leakage of serum which may be mistaken for active infection. Liaison with the veterinarian in such cases should be encouraged.

The use of selective dry cow therapy, in which antibiotic intramammaries are not infused into cows fulfilling certain requirements, is increasingly used (Bradley et al 2011). This is often to fulfil requirement of premium milk contracts, but also in the pursuit of RUMA principles, and at the very least to reduce the cost of medicines to farms!

CONCLUSION

Effective mastitis control is a cornerstone of the modern dairy industry. Farm veterinarians are well placed to provide advice. Increasing concern

over the use of antimicrobials on farms also provides opportunity to promote best practice on farm.

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NOTES

MOTIVATIONAL INTERVIEWING - A COMMUNICATION STRATEGY TO PROMOTE THE UPTAKE OF ADVICE ON MASTITIS MANAGEMENT

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SUMMARY

In the UK dairy industry, mastitis is an endemic disease representing not only a financial and emotional burdens for farmers (1, 2) but a less than ideal state for the dairy cow (3). Despite significant advances in scientific research into the risk factors and management strategies that are implicit its occurrence, the implementation of changes in on-farm housing and management still appear to be inadequate.

The science behind suggested changes to improve mastitis management is often well known, and advising in order to prompt enactment of these changes is most often the role of the herd veterinarian, whose training and advising of farmers places them at the forefront of knowledge dissemination (4). However, whilst veterinarians recognise their influence and the need to be proactive advisors, acting upon this awareness in daily practice is a challenge (1). An enhanced awareness of what motivates behaviour change on-farm, in addition to evidence-based communication approaches that support this process, is essential to help drive the dairy industry towards improvement. This paper discusses the impact of mastitis on the dairy industry, the complexities of promoting behaviour change and the uptake of veterinary advice on farm. It specifically focusses on how Motivational Interviewing - an evidence-based communication methodology employed in the medical sciences - may offer veterinarians a route towards improved uptake of advice.

INTRODUCTION

In recent decades, advances in the management and diagnoses of mastitis have led to improvements in on-farm incidence of the disease. Clinical mastitis has reduced from approximately 150 cases per 100 cows per year in the 1960s to 46 cases per 100 cows per year in the latest known study in the UK (5). Average bulk milk somatic cell counts (BMSCC) have also reduced from 573,000 cells/ml in 1971 to 200,000 cells/ml in 2009 (6). However, a closer look at this data reveals that clinical mastitis rates show huge variability, with Bradley et al. (5) indicating nearly 25% of farms (n=97) registering >100 cases per 100 cows per year. Additionally, the average BMSCC of 200,000 cells/ml still equates to approximately 20% of the national herd being infected at any given time. Therefore, whilst overall levels of clinical and subclinical mastitis have arguably improved, many farms are still experiencing excessively high levels of this disease, and all are likely to have some experience of mastitis every year.

In consequence, mastitis reflects a considerable financial burden for UK farmers, and has significant welfare implications for dairy cattle. Mastitis costs the average farmer £145, £436 and £1418 per affected cow per year for mild, severe and fatal cases, respectively (7). It can affect the profitability of dairy farming long-term, through negative effects on udder health, milk production, veterinary costs and culling risk, particularly when major pathogens are implicated in disease occurrence (8). Cow welfare is also infringed, with mastitis causing udder pain that increases with mastitis severity (9), leading to increased responsiveness to pain (10) and altered behavioural patterns indicative of a cognitive component to this pain (11). Exploring why mastitis persists on farm, in light of recent research on the practical and psychological components of implementing behaviour change, is therefore critical to promote the uptake of advice and reduce the incidence of mastitis on farms in the UK.

WHY DOES MASTITIS PERSIST?

The persistence and high variability of mastitis on farm is often attributed to factors associated with the farmer - perhaps they do not know enough about disease control? Perhaps they are limited by practical constraints? Or are they are not fully aware of the problem?

Lack of knowledge of disease control can, by its very definition, inhibit progress towards mastitis management on farm. However, research suggests that even farmers described as 'hard to reach' by advising veterinarians feel they have sufficient knowledge to deal with mastitis, and can easily access udder health information when needed (12). It is therefore more likely that a barrier between intention and action exists, where possessing knowledge of risk factors and management factors does not *ipso facto* generate management change. However, this is by no means unique to farmer behaviour: knowledge of a problem is rarely sufficient to generate remedial action in many areas of human health, such as alcohol consumption, tobacco use and dietary amendments (13).

Practical constraints on time, labour, finance and farm facilities have also been reported by farmers as barriers to disease control (14). The effect of these constraints on behaviour is not straightforward, however; when farmers (n=213) were asked to rate the importance of these types of barriers upon their acting to control disease (lameness), a large variation in perceived importance was witnessed (Figure 1; Leach et al. (14)). As such, it is critical to be aware that no single factor can be generalised to be the limiter for all farmers, and that the factors most often cited as inhibiting behaviour change (knowledge, time, labour, cost) are not rated as 'extremely important' barriers by the majority of farmers.

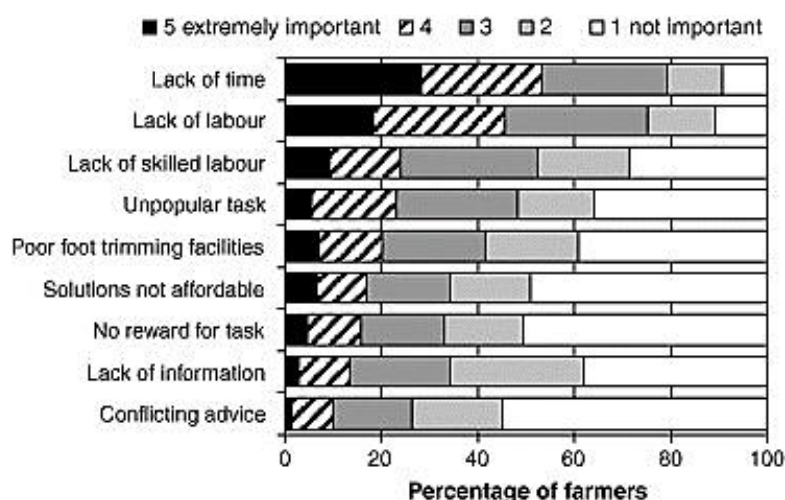


Figure 1. Percentage of farmers (n=213) considering the suggested barriers to lameness control “extremely important” to “not important” (14).

Finally, farmer *awareness of the disease* has been indicated in a variety of studies as an issue in disease management (e.g. lameness - 14, 15). With mastitis, however, awareness is certainly at the forefront of dairy production. Following Regulation (EC) 853/2004 (16), milk above 400,000 somatic cell count (SCC) is deemed unfit for human consumption; below this level, dairy farmers are financially rewarded for low and penalised for high SCC, as this measure reflects milk quality through its taste, keeping ability and capacity to be made into other products (6). As such, many farmers monitor cows closely for signs of mastitis, record SCC regularly and have a direct financial consequence to variations in this parameter. Mastitis is still endemic in dairy cattle, however, and may indeed be increasing (6). This illustrates that whilst awareness may be essential to instigate motivation, it is in itself insufficient to guarantee change.

It is therefore clear that the persistence of mastitis on farm is complex and cannot readily be attributed to the practical considerations often posited. To appraise issues in the uptake of advice, therefore, we need to understand further the complexities contributing to farmer decision-making.

WHAT DRIVES FARMER DECISION-MAKING?

Having explored factors that may be implicit in the high levels of mastitis on dairy farms, it may at first appear that farmer decision-making is not always clear and understandable. For example, farmers may self-report that they already have sufficient knowledge about mastitis risk factors, management and cost, although they may fail to translate this knowledge into remedial action. Exploring this phenomenon more fully by accounting for the ‘human factor’ implicit in farmer behaviour can offer a more nuanced understanding, allowing barriers to be conceptualised in the wider context of how numerous factors contribute to farmer behaviour and the potential for change. There are many models describing the psychological processes associated with behaviour, of which the Theory of Planned Behaviour (TPB, 17) is one of the best established.

The TPB (17) suggests that intentions to carry out a behaviour are a product of three factors: attitudes, subjective norms and perceived behavioural control (Figure 2). This theory posits that for farmers to implement mastitis control measures, they must first believe the disease is unfavourable (attitude), that they have a higher level of the disease than they should (subjective norm) and that they can do something about the disease (perceived behavioural control). Without these key attributes, behaviour change simply does not occur.

In this light, the high levels of mastitis that exist on farm in spite of numerous advances in scientific research are not only explicable, but validated. This complex disease affects all UK herds, ensuring normalisation of its presence both in farmer attitudes and subjective norms. There is also no one simple solution, reducing farmer perception of self-efficacy in disease management and increasing farmer ambivalence over control measures. Without interventions that explore these areas in addition to the factors more typically defined as barriers, progress in decreasing the incidence of mastitis is unlikely to occur.

Jansen et al. (18) have already reported that farmer attitudes on mastitis, mapping readily into the Theory of Planned Behaviour (Table 1), are actually better predictors of on-farm incidence of mastitis than self-reported behaviours. The power of these ‘human factors’ in disease outcomes is therefore a phenomenon that should be captured within interventions targeted at behaviour change.

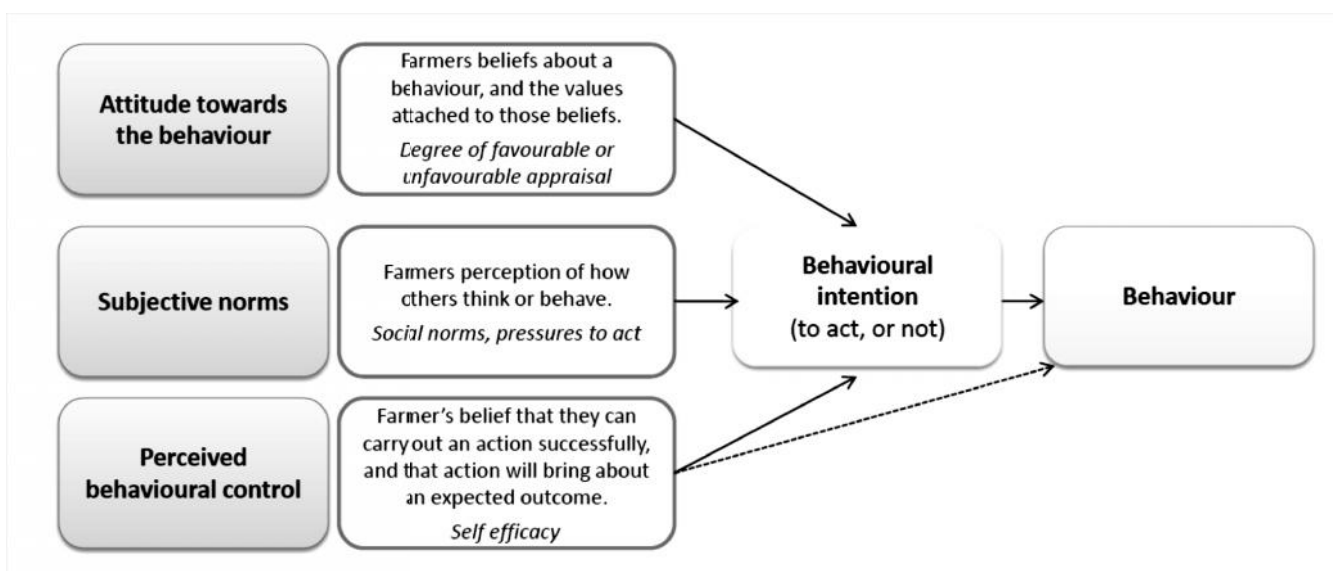


Figure 2. The Theory of Planned Behaviour (17)

Table 1. Attitudinal categories and the Theory of Planned Behaviour (from Jansen et al. (18))

Theory of Planned	Attitudinal category	Example of variable
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Behaviour		
Attitude	Normative frame of reference	<i>Satisfaction level percentage clinical mastitis cases per year</i>
Subjective norms	Farmer's context	<i>Farmers' year of birth</i>
	Communication	<i>Want to know more about mastitis via discussion with colleagues</i>
	Effect of bulk milk somatic cell count penalties	<i>Perceived effect on farmers' behaviour if BMSCC penalty level decreases</i>
Perceived behavioural control	Knowledge	<i>Perceived knowledge about the effect of farm management on mastitis</i>
	Perception of control	<i>Mastitis causes are difficult to influence</i>
	Other	<i>Too little time to work on mastitis prevention</i>

EXISTING MASTITIS INTERVENTIONS

As a result of this developing understanding of farmer behaviour, there has already been a paradigm shift within interventions aimed at improving the uptake of advice. An increased recognition of both farmer attitudes and autonomy in herd health processes has underpinned an alteration from mere knowledge transfer to knowledge exchange. In the former, providing information was generally perceived as sufficient to influence behaviour, whilst in the latter the provider assumes responsibility for engaging the individual – in possession of their own knowledge and experience - in the advisory process.

The DairyCo Mastitis Control Plan (DMCP) is an intervention that aims to reduce mastitis on farm. Farmers that join the plan are visited by a plan deliverer, who will assess in detail both disease records on the farm in addition to all aspects of daily management. This information is fed into the DMCP programme, which provides feedback on the risk factors on farm and management solutions that could be used to amend them. Whilst a heavily data-driven approach, these results are tailored to the individual farmer by the plan deliverer (a veterinarian) to promote engagement and uptake of advice. Based on the veterinarian's perception of the farmer's wishes, needs and practical constraints, the veterinarian will grade the recommendations by priority, and establish a farm-specific plan. This approach offers the flexibility to combine recommendations with knowledge of a farmer's attitudes and perceived efficacy in disease management, rather than a 'one size fits all' approach'.

As a result, use of the DMCP has been shown to reduce mastitis: farms show a mean decrease of 22% in the proportion of the herd with clinical mastitis when

implementing the plan (19). However, mastitis reduction is heavily dependent on the level of compliance with initial recommendations; Bradley et al. (19) found significant improvements were only witnessed within farms implementing >33% of advisory recommendations (65% of cohort). Anecdotally this variable compliance has been attributed to aspects of the advisory process, where communication at the point of delivery has failed to engage farmers in the plan recommendations. But are these anecdotal reports supported by research into veterinary communication?

VETERINARY COMMUNICATION

At present, communication research in the veterinary sciences focusses predominantly on the domestic context. These data suggest that clinical communication skill in the veterinary profession is lacking: veterinarians rely predominantly on closed questions in data gathering, rarely employ empathetic statements in relationship building and rarely encourage client participation in appointments (20). The ability to empathise is arguably in the shortest supply, as it was absent from 59% of consultations (n=64) observed by MacArthur and Fitzgerald (21) and 93% of consultations (n=300) observed by Shaw et al. (20).

Within the dairy context, however, communication research is still in its infancy. Work by Jansen (1) indicates similar trends, with recorded herd health consults (n= 17, mean duration 96 minutes) demonstrating a heavy reliance on closed questions, minimal solicitation of farmer opinion and veterinarian dominance in agenda setting. Whilst farmers in this study still reported satisfaction with their veterinarian, this led Jansen (1) to suggest that tackling many barriers to the uptake of advice on farm could be achieved by veterinarians '*applying elementary communication techniques to their (veterinary) advice*'.

When considering how best to move forward to stimulate behaviour change and the uptake of advice on farm, it appears then that attending to these deficits in communication is therefore key, in addition to recognizing the practical and psychological complexity of disease management. Research on risk factors and management strategies, in addition to well thought-out interventions, already exist; perhaps the veterinary profession merely need a communication approach to fully engage farmers with the opportunities these provide? We propose that Motivational Interviewing (MI), a communication methodology from the medical sciences, could fill this gap.

MOTIVATIONAL INTERVIEWING

As discussed, farmer behaviour surrounding mastitis is underpinned not only by practical considerations, but also by established beliefs, many of which may conflict when considering how to address issues on farm. In light of this, the ambivalence over how to proceed in tackling these diseases is, arguably, central to their persistence. Combined with this complexity are the effects of veterinary communication, a clinical skill that the evidence base suggests has much room for improvement.

In the medical sciences, MI evolved to address conceptually similar issues. Developed initially as a communication method to improve patient outcomes in the treatment of problem drinking, it arose in response to early research (22) indicating that a substantial proportion of variance in client relapse rates was attributable to therapist's interpersonal style. This stimulated a researcher and practitioner in the field, Bill Miller, to develop and formalise a clinical therapy style that would encourage an empathetic, non-confrontational counselling manner in treatment: MI (23). Since that time MI has evolved into an conceptual model, supporting a communication methodology that explores and resolves ambivalence in an individual to address the motivational processes that facilitate change (24).

Since its emergence, clinical experience and extensive empirical research have tested the principles and methodologies of MI. Now considered an evidence-based practice, research indicates its efficacy in a wide spectrum of medical care settings (25, 26), with applications to non-medical fields such as environmental inspection (27) and probation supervision (28) indicative of its potential to meet more diverse challenges. Fundamentally, MI represents a shift from the 'directive' style traditionally employed to target change (as witnessed in typical veterinary communication), to a focus on 'guiding' the individual towards and supporting change that is driven by personal values and concerns.

In consequence, utilising this communication methodology fits ideally with the need to stimulate meaningful change in veterinary communication strategies, whilst also accounting for and focusing on the ambivalence common over the complexities of mastitis management. It will also encourage farmers to explore the practical and psychological considerations surrounding their behaviour, offering the potential for meaningful and sustained change. Finally, the MI approach has a striking practical benefit above many existing interventions: with the development of an effective training package, use of MI within the veterinary community could become widespread at a relatively low cost, to be used at will within established interventions or in routine, everyday discourse on farm to aid in promoting widespread behaviour change.

CONCLUSIONS

It is evident that targeting the 'human factors' underlying mastitis incidence on farm - in combination with education and training of veterinarians in communication methodologies - is critical to improving the uptake of veterinary advice. We propose that MI could meet these needs by not only improving a veterinarian's ability to engage clients with change, but also empowering farmers to utilise their own knowledge and motivations in herd health discussions. Ultimately, we hypothesise that this approach will result in an increase in the uptake of veterinary advice on farm through exploring farmers' ambivalence and personal beliefs about change, resulting in improved management of mastitis and, ultimately, cow welfare.

As a result, our research on this topic first aims to develop a detailed picture of the current advisory and communication strategies employed by UK cattle veterinarians on mastitis and herd health, and the attitudinal positions of both veterinarians and farmers on these experiences. This research will underpin the development of an MI training package designed specifically for this context, to be trialled and evaluated before being made available to the veterinary profession.

Preliminary investigations into this topic are being made using a mixed methods approach, incorporating both quantitative and qualitative data on veterinarian-farmer communication. This talk will review quantitative analysis of the language employed in lameness and mastitis consults in role-play sessions (n=15, mean duration 11.2 minutes) between cattle veterinarians and an actor (experienced in medical and veterinary education). We will also cover initial findings of a second qualitative investigation into veterinarian-farmer communication during routine consults at UK dairy farms (n=14). We hope to convey critical insight into the nature of, and influences on, veterinary communication with farmers, and to appraise the potential for MI to be harnessed as a communication methodology by the veterinary profession to promote the uptake of advice.

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NOTES

NEW ZEALAND'S JOURNEY, BOLDLY GOING WHERE?

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SUMMARY

Over that past 50 years mastitis control in New Zealand's dairy industry followed the same processes as in the other significant dairy countries but tailored to suit the very tight seasonal calving system key to New Zealand production success. This took milk quality and mastitis control only so far. To make further progress a new approach has been introduced that includes practical tools and significant amounts of education and ownership. This is working and milk quality is probably at its best ever level for New Zealand. Like producers in all other major dairy farming nations, New Zealand dairy farmers are having to negotiate new and additional roadblocks including tighter controls on residues and chemicals in use on farm, antimicrobial resistance, restrictions on use of dry cow treatments, concerns on internal teat sealants, and who knows what next. This paper will discuss how New Zealand dairy farmers are dealing with these challenges whilst they continue with other upheavals including system changes, new technologies and a milk price that has crashed far below the cost of production.

INTRODUCTION

I was born when there was (just) still a British Empire, when schools were about books and pencils and paper and rulers (often used across the knuckles) and the wall featured a map of the world. It seemed that most countries (a quarter anyway) were pink including a couple of islands tucked in the bottom right corner of that world map. Those islands had a flag, not at all like the Australian flag, indicating their attachment to Great Britain. In the school books we learnt about lambs grown in Otago and about Jersey cows grazing grass in Taranaki. We collected, and pinned to the map, labels from butter and cheese all made from those cows in New Zealand. Then, in 1973, the world as such ended when the UK joined the Common Market and market access for New Zealand products was hugely restricted.

New Zealand dairy farmers, previously surviving mostly on its agricultural links to the UK, fell into economic distress. The Kiwis adopted their usual mantra of 'harden up' and reinvented their farming system based on low cost, no subsidies whatsoever, commodity production and a lot of stainless steel. They fed the explosion in fast and processed food through milk powders, cheese and various fractionated milk components. The days of making high fat Jersey milk, separated to make butter and whey fed to pigs, were replaced by milking Friesians, later by Kiwi-cross, cows that had to calve every 365 days, maybe only milked for 250-270 days and that ate perennial ryegrass and clover. This system became highly successful and

New Zealand became the lowest cost producer on the planet, exported 97% of production (about 30% of world traded milk products) and expanded in different ways from average herd size to reclaiming provinces from sheep to feeding cows when hungry!

Twenty five years ago milk quality was generally not a common topic of conversation anywhere, mastitis was and so was cell count to some extent and in some countries. Then there was Council Directive 92/46/EEC setting quality limits. Bacterial standards have never been a major concern in New Zealand as all export product is heat treated (and dried) but the cell count of the raw product became important in market access. Until then New Zealand happily applied the Five-point mastitis control plan as, and when, farmers saw fit. Meeting a limit of 400,000 cells/mL was a new problem. A group, principally Murray Woolford, Ian Hook, Mel Eden and Larry Smith (on sabbatical from the USA), developed the Seasonal Approach to Managing Mastitis (SAMM) plan, introduced in 1993.

SAMM

The plan was described in a 76 page booklet covering everything from detecting mastitis, its causes, treatment, prevention, influence of the milking machine and control etc., i.e. everything comprised in the Five-point plan but customising it for New Zealand conditions. [Fortunately the booklet for farmers was only 13 pages.]

The measure of success to be achieved was defined as a national average bulk milk somatic cell count (BMSCC) below 150,000 cells/mL.

A major aid to farmers was that the various dairy companies of the day introduced cell counting on each milk pick-up with the results available before the next morning milking. Mastitis detection was essentially an alert from an increase in vat cell count and then looking for the offending cow(s). Application of the SAMM plan over about fifteen years was accompanied by a suite of technical advances in dairy farming. Those most relevant included:

Milking systems - these saw probably the greatest advances with problems identified by Bob Grindal in 1988 quite swept away largely by technical advances by the milking machine companies in response to ISO/BS standards: claw bowls increased to 250 mL and more, short milk tubes became 10 mm id, alternate pulsation became standard, cup removers were set to 400 L/min and 5 s delay, milk flow became stratified and washing turbulent rather than vice versa.

Culling - offending cows were usually culled but daily vat and individual cow cell counting led to smarter decisions

Teat disinfection - some better chemicals and application technologies became available but not many in New Zealand yet.

Treatment - some new drugs became available but little else changed except the risk of antibiotic resistance and fictitious problems such as CNS.

Dry cow treatments – these have changed beyond recognition since the 1970s. Introduction of cephalosporins brought real full dry period protection to add to cure. Out of the mists of Ireland, partly by way of New Zealand, came a teat sealant, internal, inert and durable, that actually worked to prevent new infections.

These developments on the Five-point plan were built into management plans for five (?) seasons of the year, hence SAMM.

- Late lactation period
- Drying-off period
- Dry period
- Calving period
- Lactation period

This works for a tight seasonal system where all cows calve in about six weeks, culls go well before the end of the season, as grass gets short, and the whole herd is usually dried off on the same day. Much of the information was provided to farmers through magazines such as the Dairy Exporter. One of the first iterations of the plan was a season calendar.

NEW ZEALAND'S MASTITIS AND MILK QUALITY STATUS

Like many dairy farmers worldwide, 'cow cockies' go to their vet twice a year, just before calving, to get a supply of intramammary antibiotics, and, after they come back from the beach in late summer, for their dry cow tubes. They usually go only twice because they do not have a lot of mastitis and it is all in early lactation, hence within a few weeks. Simply, about 80% of clinical cases occur at or soon after calving, are caused by *Streptococcus uberis*, and new infections stop well before Christmas. In late lactation, often accompanying a change to once-a-day milking, a small clinical mastitis spike occurs due to *Staphylococcus aureus*.

The impact of the SAMM plan has been that a typical New Zealand dairy farm deals with about 20 cases/100 cows/year and from 1992 to 1996 the annual average vat cell count was reduced from about 280,000 to 175,000 cell/mL. But then it started to creep up again as no further incentives existed to keep it low and the amount of milk (actually milk solids – protein + fat) was too valuable. By 2008 the annual average vat count was nearly 225,000 cells/mL. Importantly, at this time the dairy companies and the cattle vets introduced the requirement for a 'dry cow consult'. Each autumn, when planning drying off, the farmer and vet have to review the mastitis and milk quality performance of the farm and herd, and make

considered decisions on drying cows off and managing mastitis in the next season. Useful as this has been, in 2008 the dairy industry set to work on SmartSAMM, a successor tailored to changed needs and to try to nail that original target of 150,000 cells/mL.

SMARTSAMM

This new programme melds SAMM and the Australian Countdown Down-under into a relaunched management approach. Its targets are 150,000 cells/mL bulk milk somatic cell count average for the season, 8-10 cases treated per 100 cows per lactation and 1-2% of cows in the herd culled directly due to mastitis. The plan includes all that was good before with a comprehensive series of technical notes and guidelines supplemented with new tools such as the Healthy Udder Service, the Gap Calculator and the Mastitis Focus Report. And there is extensive training. It can all be accessed at <http://www.dairynz.co.nz/animal/managing-mastitis/>

Healthy Udder Service

An accredited Healthy Udder Service veterinarian works with the herd owner and farm staff to identify goals and prioritise areas for improvement, develop policies and procedures supported by skills training, review progress and provide on-going support. Most of these vets are also accredited to carry out detailed mastitis investigations, and access demerit relief under Fonterra's Mastitis Support Programme. This programme kicks in when the milk supply fails to meet quality levels of cells, bacteria, residues etc.

Gap Calculator

The Calculator estimates the potential economic benefits of 'closing the gap' between the herd's actual performance and the target performance, for udder health and milk quality. It comes on paper or as a spreadsheet. It is the basis for the vet to identify the goals and prioritise the areas for improvement.

Mastitis Focus Report

The Mastitis Focus Report provides a two-page summary of the constantly changing udder health status of the herd, using data routinely collected on your farm. It helps with early identification of emerging mastitis issues and planning for critical times e.g. after calving and before drying off. The latter is going to be even more crucial in future.

So far SmartSAMM (OK, the farmers and vets applying it) is delivering. Cell count last season got down to about 160,000 cells/mL on a steep downward slope aided by a growing milk volume. But....The season was marked by a huge drop in milk price probably too late to affect DCT purchases. Now the milk price is part of the international spiral downwards and way below the

cost of production. This means a major squeeze on costs with little in the way of feed supplements being bought, bull of the day and lease bulls having a new popularity, a surge in early season culls and a likely moratorium on veterinary help.

SURFING A NEW WAVE

With the ink hardly dry on SmartSMM and the start of an even more absurdly wild milk price and production rollercoaster, the requirements of the international dairy industry have started changing again, and possibly faster. New Zealand is dealing with five main challenges and requirements not all unique to New Zealand; but some of the solutions may be.

Residues and sanitisers

New Zealand farmers have suffered in recent years from adulteration of milk and milk products that was nothing to do with them – melamine and supposed botulinum toxin. Now they have had to respond rapidly to remove any potential for residues from plant washing and teat disinfection. This derives from market insistence, driven by infant formula (one of our few added value products) specifications where the requirement is not to satisfy the international trade requirement of less than the MRL - maximum residue limit, the safe or ineffective level - but be below the limit of detection (LoD). Chemical detection technologies have advanced so much recently that the LoD is often 100 times or more below the proven safety level. Milk buyers/processors are now working one-by-one through a long list of what they do not want in milk and milk products.

More than two years ago Fonterra started testing milk collections for various residues. This led at the start of the 2013-14 season to a requirement to rinse milk plants before milking. The testing was extended to all milk collections. From June 2014, Fonterra has imposed a financial penalty if certain detergent residues are detected in the bulk milk. This has led to the disappearance of quaternary ammonium compound detergent/disinfectants as they can be detected even after plant rinsing.

The next target was NPE (nonyl phenol ethoxylates). NPE are present as a surfactant in (mainly) iodine-based teat sprays. All of these products have been reformulated and NPE replaced with alcohol ethoxylates. New Zealand should not protest too much about this change as it is just catching up to where parts of Europe, and later others, reached more than ten years ago. Both changes are symptomatic of a new era focussing on 'what is in milk should be in milk'. The next target is likely to be chlorhexidine with a potentially woeful future for a number of popular teat disinfectants.

It is important to know that teat disinfection in New Zealand so far has been primitive by best standards. Disinfectants are almost always sprayed. Some

good automatic spray systems are in use on rotary platforms but manually operated systems remain a lottery. There is much to be done in this area.

First, New Zealand has not had a decent new disinfectant for years partly because its approval system was based solely on the old NMC Protocol A – the excised teat system – which no self-respecting disinfectant manufacturer wanted to touch! The regulators have just issued a new approval system based on the NMC Protocol 3 – a positive control, non-inferiority field trial. It will also be possible to use international data to support an application for a product licence so now New Zealand should be able to get some of the modern international technologies, if they do not leave residues.

The disinfectants likely to be of most use will be peroxides breaking down to water, sodium chlorite from which chlorine will not be distinguishable, and lactic acid similarly. There will always be a role for iodophor disinfectants.

Only one pre-milking sanitiser is licenced in New Zealand, an iodophor. It must be used alone and not in combination with a post-milking disinfectant. If residue issues can be solved more pre-milking products are needed, if they can be used automatically.

Teat sealants

Bismuth subnitrate internal teat sealants for dry cows have been available for nearly fifteen years, or thirty years if you are Irish. They have revolutionised dry period protection and are especially useful in heifers.

There is always a but!... and that is black spot in cheddar cheese, a discolouration forming around the microscopic amounts of the salt in the cheese. Dairy farming needs these sealants so one proposal is to try halving the amount per teat to minimise residues. (For some reason no-one wanted to try my solution of not making cheese in New Zealand until November, three months after calving has finished.)

Sealant technology is still in its infancy. Variants have become available that include chlorhexidine (probably a non-starter for so many reasons), some that include 'natural' plant oils, some with a bacteriocin etc. Other test products include changing the sealant formulation to include a barium salt or titanium dioxide or zinc oxide. More will happen in this space and more intellectual property tussles should be expected

Antimicrobial resistance

Both the NMC and IDF have adopted a position that antibiotic treatment of clinical mastitis has not changed the amount of resistance. This refers essentially to intramammary treatment where the specific infection is targeted. This may not apply to parenteral treatment where significantly more antibiotic is injected and most is distributed outside the mammary gland thus subjecting non-target and mostly enteric bacteria to sub lethal

doses. The most developed dairy countries are applying the precautionary principle, bypassing but not avoiding scientific argument, and adopting the principle of prudent use of antibiotics. New Zealand has gone a big step further. The NZ Veterinary Association has a position that

“By 2030 New Zealand Inc will not need antibiotics for the maintenance of animal health and wellness.”

This does not mean that antibiotics will not be used to treat sick cows but they will become reserved for critical problems, the great unknowns of new diseases and the scaring thought of a biosecurity crisis.

This goal will become achievable as new technologies in immune modulation, immune enhancement and genetic resistance at least are adopted. More will come from what is still unknown and from education of veterinarians and farmers. The one certainty is that the solution will no longer come from the syringe.

Dry cow treatments

The immediate problem that New Zealand vets and farmers will face is exactly that of Europe: use of dry cow antibiotics will need to be justified.

The components of a selective dry cow strategy are fairly well known to all and used very successfully by some. The Udder Health Service can (will) work out the criteria for each farm (cow) to determine fate (cull, treat, seal or nothing). It will become beholden on each farmer to engage with his vet on this exercise as it is likely, following regulations on access to dry cow antibiotics and in meeting the NZVA target, that a clear audit trail will be required to allow supply of a dry cow prescription.

One tentative conclusion is that the growing use of non-antibiotic approaches to dealing with mastitis combined with the continuation of therapeutic uses for infected cows will likely allow farmers to maintain current levels of control. As a result, the dairy sector can probably restrict antibiotic use without a major economic impact. Early suggestions are that this will be cost neutral, the cost of advice will balance the saved cost of drugs.

A FINAL THOUGHT

By 2030, the global population is expected to grow to 8.3 billion, and the world will need 50 per cent more energy, 40 per cent more clean water, and 35 per cent more food. Much of the food protein will come from milk produced to even more exacting standards. New Zealand is working hard to supply the very small proportion of increased demand it can achieve whilst meeting system and quality targets already understood and will be working even harder to lead new targets. The aspirations in minimising antibiotic use will be achieved, but there is a lot to do to succeed.

NOTES

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A METHOD TO SIGNIFICANTLY REDUCE THE USE OF INTRAMAMMARY ANTIBIOTICS AT DRYING OFF IN DAIRY COW PRODUCTION

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Antibiotic use creates a selective pressure on bacterial populations and contributes to the development of antimicrobial resistance. In this context, some countries around the world advocate a cautious and rational antibiotic use in agriculture. As part of mastitis control and prevention at drying off, most dairy cow producers in North America and in many European countries treat all quarters of all cows with an intramammary antibiotic therapy at the end of lactation. An alternative approach to blanket dry cow therapy would be to target antimicrobial treatment only at infected mammary quarters.

Milk Amyloid A (MAA) has been suggested in several studies as a biomarker of both clinical and subclinical bovine mastitis. We conducted a field study to evaluate the efficiency of the measurement of MAA when used to make selective antimicrobial treatment decisions at mammary quarter level on cows at drying off. Mammary quarter milk samples from 112 cows, originating from low bulk tank somatic cell count (SCC) (<250,000 cells/mL) dairy herds, were collected prior to drying off and after calving. All milk samples were cultured for bacterial detection and were analyzed for MAA concentration and for SCC.

We performed a selective dry cow therapy at quarter level based on MAA results. The mammary quarters from cows with an MAA concentration ≥ 1 $\mu\text{g/mL}$ (n=257) were treated with an intramammary antibiotic therapy and were infused with a teat sealant. The other quarters (MAA < 1 $\mu\text{g/mL}$) were only infused with a teat sealant and were not treated with an antibiotic therapy (n=94) or they were treated by antibiotic therapy and infused with a teat sealant (n=92).

We developed an algorithm to identify an intramammary infection (IMI) at mammary quarter level at the end of lactation based on MAA and SCC results. The test characteristics of our algorithm, called the MAA-Biotecklait test, were calculated and its negative (NPV) and positive (PPV) predictive values were estimated using bacterial culture as a gold standard. Our test was compared with the SCC recording prior to drying off.

The sensitivity and specificity of the MAA-Biotecklait method were both high, respectively 94.5% and 93.0% and the PPV and NPV when estimated in our study population were respectively 96.3% and 89.9%. The predictive values were both above 90% in populations where the proportion of mammary quarters with an IMI at drying off ranged from 40% to 65% (Figure 1). By contrast, the sensitivity and the NPV of the SCC were low, respectively 68.7% and 62.8% (threshold of 100,000 cells/mL for primiparous cows or of 150,000 cells/mL for multiparous cows).

We concluded that the use of the MAA-Biotecklait method in a selective dry cow therapy programme at the quarter level would allow a significant reduction in the use of intramammary antibiotics at drying off with a low risk of missing infected udder quarters. In our study, its application would have reduced the use of antibiotic treatments by 29% and also would achieve the quantitative objectives of reducing antibiotic use in veterinary medicine by 25%, advocated by the French “ecoantibio 2017 plan”. Moreover, we didn’t observe a clinical mastitis six weeks after calving for quarters with a negative MAA-Biotecklait test that were not treated with antibiotics and were only infused with a teat sealant. These quarters have achieved success in the treatment and prevention of IMI over the dry period.

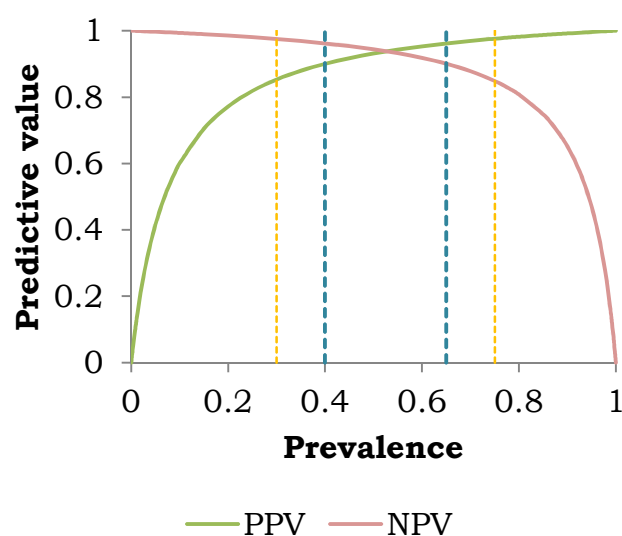


Figure 1. Positive predictive value (PPV) and negative predictive value (NPV) of the MAA-Biotecklait method when used to diagnose an IMI at mammary quarter level at drying off in cows from herds with low bulk tank SCC (<250,000 cells/mL) and for prevalence of IMI ranging from 0 to 100%. The vertical blue dashed lines indicate the prevalence range (40-65%) for which the PPV and the NPV both are above 90%. The yellow lines indicate the prevalence range (30-75%) for which the PPV and the NPV both are above 85%.

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MILKING MACHINE TEST RESULTS – AN UPDATE

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More than 95% of dairy farms in Great Britain assessed under the Red Tractor Farm assurance standards. These standards are updated periodically and have always included the need for an annual milking machine test. This poster reports the results from a sample of milking machines in England and Wales tested between September and October in 2012 (300 machines) and 2014 (340 machines). The results are compared with previous surveys carried out in and 1997 (1,000 test results) and 2004 (2,500 results). While there are significant improvements in the overall compliance of milking systems there are still room for improvements. The same problems are still occurring, suggesting there is still a significant amount of complacency over milking machine operation. There is also a failure by many to comply fully with the purpose of testing in the standards and to realise the full benefits of a correctly operating milking machine.

This survey was a review of static milking machine tests and further tests such as dynamic or wash cycle assessments may highlight additional faults. A milking machine test is included in all mastitis and milk quality plans but it is essential that this is not only carried out but any faults are rectified.

Vacuum reserve, incorrect vacuum due to a faulty regulator or gauge, overmilking and poor set up of ACR can all contribute to poor teat conditions and an increase in mastitis. In addition excessive airline leakage results in turbulence during milk transfer thereby increasing lipolysis and formation of free fatty acids and affects keeping quality and flavour of the milk collected.

It is discouraging that producers are still failing to invest and continue with milking machines which do not operate properly in areas that can have major effects on animal health and welfare, especially teat condition and mastitis. Farm economics and confidence in the industry may be factors for this apparent lack of investment (and interest!).

“STARTCHECK® HIPRA’S DIAGNOSTIC TOOL FOR THE DETECTION AND QUANTIFICATION OF PATHOGENIC BACTERIA (*Staph aureus*, *E.coli*, CNS And COLIFORMS) IN BOVINE MILK SAMPLES FROM DAIRY FARMS IN UK”

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STARTCHECK® is a reliable diagnostic tool that uses a new methodology to collect milk samples and detect the major mastitis causative agents. STARTCHECK® can be used to complement Somatic Cell Count (SCC) and Bacterial culture to monitor mastitis at a herd level(1). STARTCHECK® has been used worldwide since 2009 and milk samples from 44 different countries have been analysed. The aim of this study is to show the results obtained in UK dairy farms.

METHOD AND MATERIAL

A total of 366 Bulk Tank Milk (BTM) and Mastitis Pool samples were collected from different dairy farms in UK. The samples were taken according to the STARTCHECK® instructions [Impregnating the designated areas (BTM and Mastitis Pool) on the FTA card with 250ul of the respective milk sample](2) and sent by ordinary mail to DIAGNOS (HIPRA) in Amer, Girona, Spain. (Fig. 1).

Figure 1. STARTCHECK® kit (Instructions, FTA card, pipette, plastic bag with desiccant and envelope).

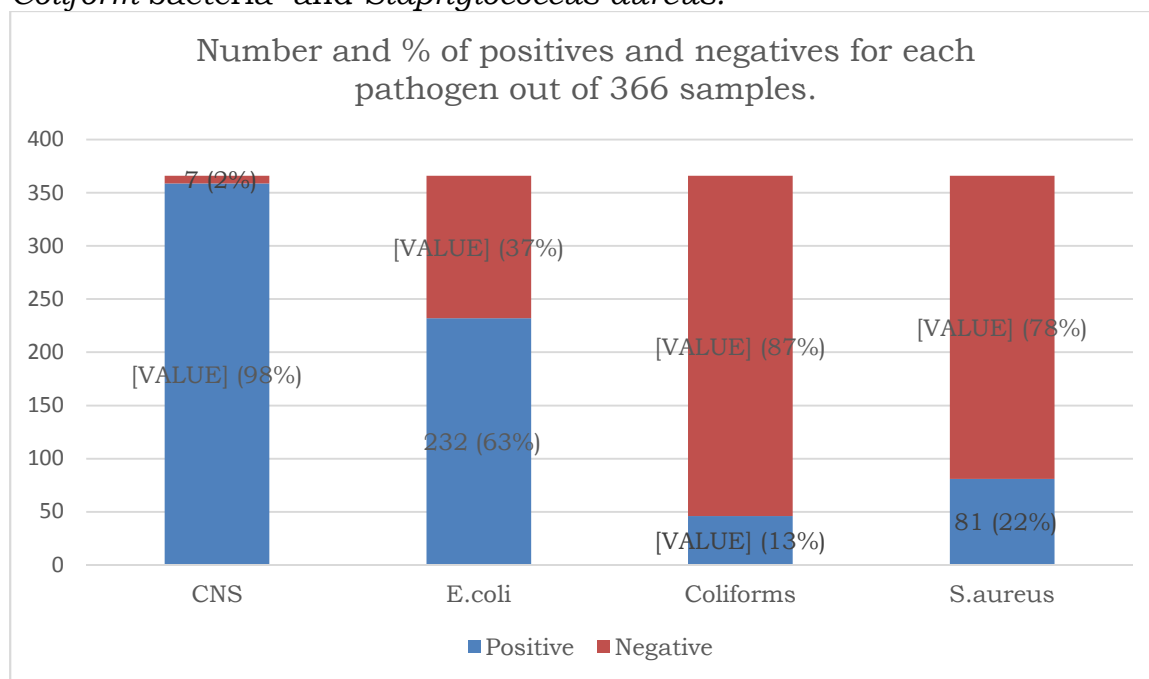


The samples were processed and tested using the Real-Time Multiplex PCR assay as previously described (2), to detect the presence of *Staphylococcus aureus*, *Escherichia coli*, *Coagulase Negative Staphylococci* (CNS) and Coliform bacteria. The results were determined as positive or negative based on Cycle threshold (Ct) values, with Ct values below 37 being considered as positive.

RESULTS

Results for each specific pathogen are showed in figure 2.

Figure 2. Number and percentage (%) of samples with positive or negative PCR results to *Coagulase Negative Staphylococci (CNS)*, *Escherichia coli*, *Coliform* bacteria and *Staphylococcus aureus*.



DISCUSSION

STARTCHECK® is a good diagnostic tool to identify pathogenic bacteria present in milk samples. The high specificity and sensitivity circumvents limitations experienced with bacteriology (1). Compared with worldwide data, it should be noted that the presence of *Staph. aureus* in UK samples (22%) is higher than samples obtained from other countries (6-10%) (2) Further data will be discussed in more detail during the BMC conference.

ACKNOWLEDGMENTS

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THE PREDICTION OF DRY PERIOD INTRA-MAMMARY INFECTION STATUS FROM LIFETIME COW RECORDS

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The dry period is of exceptional importance for optimising udder health and milk quality. The aims are to cure existing intra-mammary infections (IMI) and prevent the acquisition of new IMI [1]. New IMIs in early lactation have a significant economic impact due to deleterious effects on milk yield, quality and dairy cow welfare [2]–[4].

The probability that individual cows will succumb to a new IMI during the dry period, or if infected, will fail to cure is not well established. Some cow level risk factors for cure and new IMI have been reported [5], [6]. No studies would appear to exist using lifetime cow records to estimate the probability of failure or success of dry period outcome. The purpose of this study was to investigate whether lifetime data, available through routine on-farm recording, could be used to predict changes in intra-mammary infection status across the dry period for individual cows using somatic cell count (SCC) as a proxy for infection.

A large sample of milk recording data collected by Quality Milk Management Services (QMMS, Westbury – sub – Mendip, UK) between September 1994 and July 2014 was used for the analysis. The selected data set included records of 46,257 lactations from 24,660 cows in 114 herds. Dry periods were classified as eligible for new infection i.e. SCC < 200,000 cells/ml and eligible for cure i.e. SCC > 199,000 cells/ml. Further classification of dry periods occurred based on outcome as either new intra-mammary infection (nIMI) or cure of intra-mammary infection (CureIMI).

CureIMI and nIMI rates have been estimated and distributional characteristics described. A multi-level model was constructed and two outcome variables (nIMI and CureIMI) were modelled to explore the association with historical cow level variables. Explanatory covariates analysed included milk yield at last test day, lactation length, dry period length, parity, proportion of test days infected in previous lactation(s) and SCC prior to drying off.

Results will be presented to illustrate the relationships between the probability of nIMI or CureIMI and historical farm data. Further analysis will be presented to demonstrate the extent to which outcomes can be predicted for individual cows. Prediction of risk profiles are of particular interest because appropriate management practices can then be targeted towards

specific animals such as alteration of the environment [7], [8], changing dry cow therapy [9], [10] or culling animals with a remote likelihood of cure.

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IN VITRO GROWTH INHIBITION OF BOVINE INTRAMAMMARY STREPTOCOCCI AGAINST BETALACTAMS

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INTRODUCTION

Determining the causative agents of intramammary infections in dairy cows and testing its susceptibility to antimicrobials is a first step in justified treatment. In Flanders, streptococci are identified as the most prevalent pathogens isolated from milk from intramammary infections. For streptococci, as for some other pathogens, the availability of veterinary clinical breakpoints for classifying pathogens as resistant or susceptible is a bottleneck. Also, little is known on epidemiological cut-off values of (all) veterinary pathogens. This work aims at providing an epidemiological insight in the growth inhibition of the two major bovine intramammary streptococcal species against antimicrobials of the betalactam group.

METHODS

Streptococcus uberis and *Strep. dysgalactiae* isolated from routine milk samples of bovine clinical and subclinical intramammary infections were subjected to susceptibility testing by disk diffusion between January 2013 and September 2015 in the laboratory of Flanders Milk Control Centre. Antimicrobial molecules tested were amoxicillin/clavulanic acid, ampicillin, cefquinome, cephalonium and oxacillin. The epidemiological profile was visualized by histograms of the inhibition zone diameters.

RESULTS AND DISCUSSION

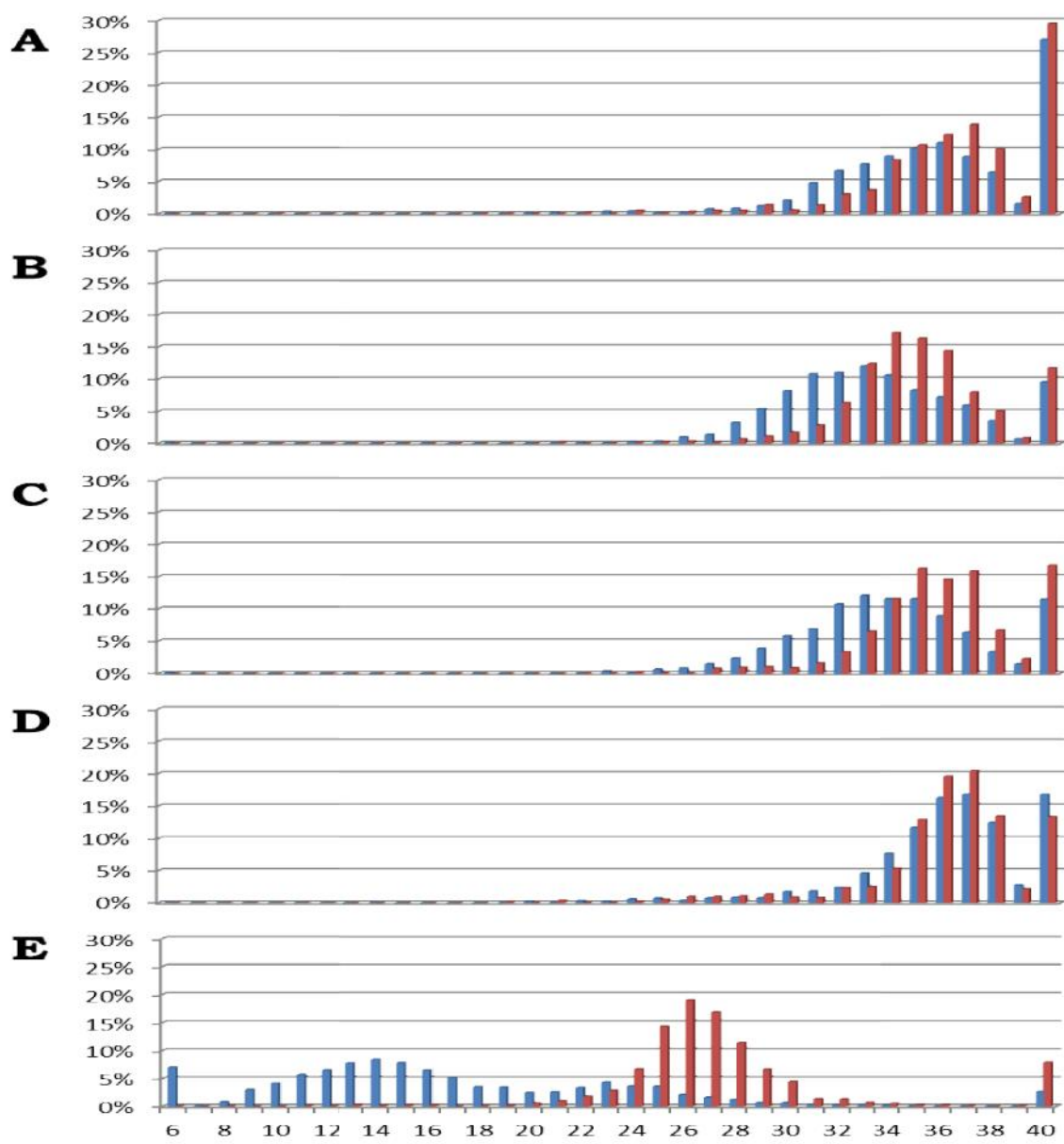
Inhibition zone diameters of 3,038 *Strep. uberis* and 1,299 *Strep. dysgalactiae* were included. Comparison of the distribution of strains over the inhibition zone diameters for amoxicillin/clavulanic acid, ampicillin, cefquinome, and cephalonium showed high similarity between the two streptococcal species (Figure 1) but with different medians of the curves.

For *Strep. dysgalactiae*, a Gaussian curve was also displayed for oxacillin, but with a lower median than the other betalactams. *Streptococcus uberis* in combination with oxacillin, on the contrary, displayed a totally different pattern as it was a bimodal curve widely distributed with most strains located at the lowest diameters (Figure 1). This indicates that, regarding oxacillin, the “non-wild type” population *Strep. uberis* is large compared to the “wild type”. These data are in agreement of the findings of Schwarz et al. using MIC methods (1).

The data point out that (at least) epidemiological cut-off values of streptococcal growth inhibition in the presence of betalactams are species specific, and especially the growth inhibition to oxacillin needs to be

clarified. Additional study is needed to elucidate the cause of the peculiar profile of *Strep. uberis* against oxacillin. Because epidemiological cut-off values are not per se linked to response to treatment in the field, the availability of veterinary clinical breakpoints for different antibiotic-bacterium combinations should be enhanced.

Figure 2: Comparison of distribution over inhibition zone diameters (as % of strains) of *Streptococcus uberis* (blue bars) and *Streptococcus dysgalactiae* (red bars) against amoxicillin/clavulanic acid (A), ampicillin (B), cefquinome (C), cephalonium (D), and oxacillin (E).



ACKNOWLEDGEMENT

The authors want to thank all lab technicians for their excellent work.

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EFFECTIVENESS AND SAFETY OF A NOVEL FLUNIXIN MEGLUMINE TRANSDERMAL POUR-ON SOLUTION IN THE TREATMENT OF BOVINE MASTITIS

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Anti-inflammatory drugs are commonly used as adjunct therapy to antibiotics to treat clinical mastitis to control the inflammatory response to infection.

Flunixin meglumin is the active ingredient of a NSAID commonly used for the relief of pain and control of inflammation and pyrexia associated with diseases of different origin and nature. A novel 50 mg/mL flunixin transdermal formulation was developed by MSD AH (Finadyne[®] Transdermal) and is now the first NSAID registered for both BRD and mastitis to be administered as a pour-on product along the dorsal midline in cattle (Fig.1).

The objective of the study was to demonstrate the safety and effectiveness of flunixin transdermal in the treatment of clinical mastitis in dairy cows. A total of 133 cows, showing severe signs of mastitis, were randomly assigned to treatment with either the test product, flunixin transdermal (3.3 mg/kg flunixin; 1ml/15kg) or the negative control product, a red dye saline solution (to preserve masking), both administered topically once. All animals received intramammary antibiotics and systemic antibiotics starting at 6 hours post-treatment. The animals were observed for clinical signs for 6 hours post-treatment and daily for 5 days.

The decrease in rectal temperature 6 hours post-treatment was greater in the flunixin group (-1.8°C) compared to the control group (-1°C). This difference was statistically significant ($p < 0.0001$) and the superiority of the flunixin transdermal to the control was confirmed.

The alleviation of pain, firmness and swelling of the udder was also significantly greater at 6 hours ($p < 0.0001$) and at 24 hours ($p < 0.05$) after treatment initiation in the flunixin group compared to the negative control group. Rectal temperature and clinical index (general attitude and udder clinical signs) improved over time in both groups.

The health status of the animals in the flunixin group as well as those in the control group was not negatively impacted after treatment, confirming that flunixin transdermal is safe.

The new product flunixin transdermal demonstrated a strong anti-pyretic effect and anti-inflammatory properties, providing a convenient and suitable

adjunct therapy to antibiotics used in clinical mastitis in dairy cattle.

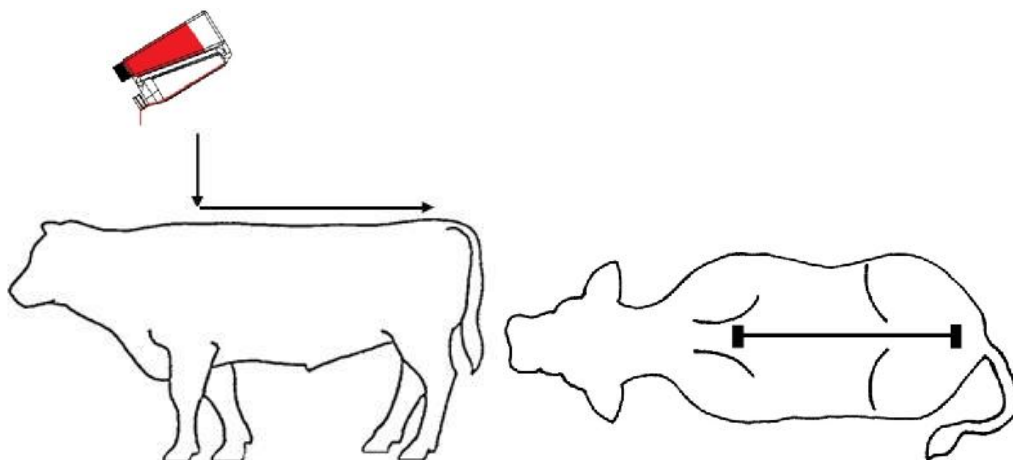


Fig. 1: Recommended pour-on location

INFECTION DYNAMICS ACROSS THE DRY PERIOD AND THE IMPACT ON A DAIRY COW'S PERFORMANCES THROUGHOUT THE SUBSEQUENT LACTATION

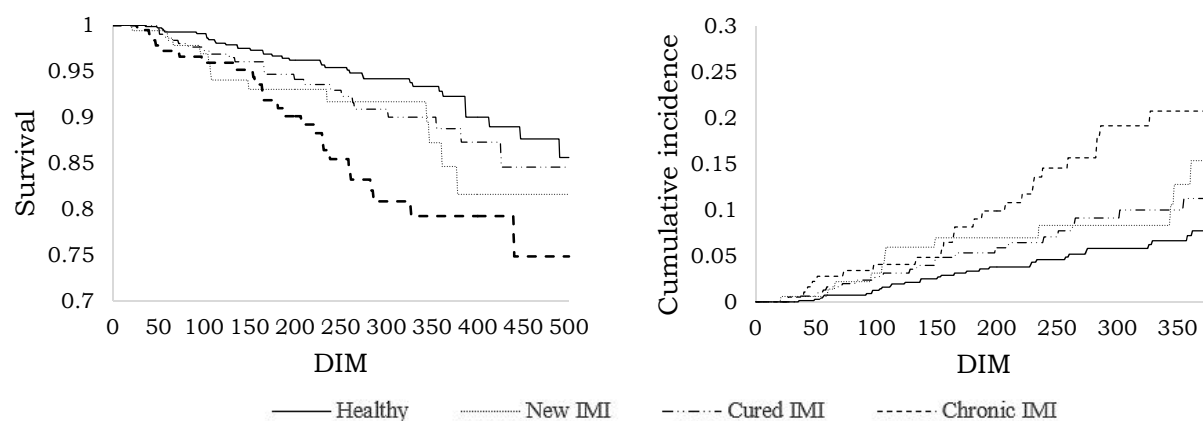
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The dry period is an important period for the udder health in a cow's lactation cycle. On the one hand, many dry cows cure from intramammary infections (IMI) present at dry-off while on the other hand many dry cows acquire new IMI (1). Milk somatic cell count (SCC) is often used as a proxy for IMI (2). In contrast to culture results, SCC data can be easily obtained from Dairy Herd Improvement (DHI) records. The cut-off value generally suggested in literature to distinguish between infected and non-infected cows with is 200,000 cells/mL (3). In this study, infection dynamics across the dry period were pictured using composite SCC at the last DHI record before (<43d) dry-off and the first DHI record after (<43d) calving. Following definitions of infection dynamics were used: *Healthy*: composite milk SCC < 200,000 cells/mL before and after the dry period; *New IMI*: composite milk SCC < 200,000 cells/mL before and \geq 200,000 cells/mL after the dry period; *Cured IMI*: composite milk SCC \geq 200,000 cells/mL before and < 200,000 cells/mL after the dry period; and *Chronic IMI*: composite SCC milk \geq 200,000 cells/mL before and after the dry period.

The objectives of this study were (a) to estimate the infection dynamics across the dry period on randomly selected Flemish commercial dairy farms and (b) to analyze the relevance of the infection dynamics across the dry period on the incidence rate of clinical mastitis and the culling rate in the subsequent lactation.

In total, 1,803 dry periods of 1,553 dairy cows housed on 33 commercial dairy herds, geographically spread over the 5 provinces of Flanders, were enrolled. The database consists of data collected between January 2012 and



October 2013 through questionnaires, observations and DHI records.

Clinical mastitis data were producer-collected between September 2012 and October 2013 (4).

Ninehundred-and-thirtyseven cows (52.0%) remained *healthy*, 224 (12.4%) acquired a *new IMI*, 411 (22.8%) *cured* and 231 (12.8%) remained *chronically infected* across the dry period.

The *new IMI rate* was 19.3% (224 out of 1161 cows with a low SCC before dry off) whereas the *cured IMI rate* was 64.0% (411 out of 642 cows with a high SCC before dry off). In total, 116 cows suffered from clinical mastitis in the subsequent lactation. The hazard of clinical mastitis was substantially higher in cows with new, cured and chronic IMI compared to healthy cows. In total, 108 cows were culled in the subsequent lactation. The culling hazard tended to be associated with parity and was significantly associated with the infection dynamics across the dry period. The hazard of culling was higher in cows with new and chronic IMI compared to healthy cows.

Since the infection dynamics across the dry period has an impact on the performances throughout the subsequent lactation, picturing the infection dynamics based on composite milk SCC data is a practical tool to monitor and improve the udder health across the dry period and thereafter. As almost 20% of the cows were estimated to acquire a new IMI across the dry period in Flanders, prevention is key: dry cows should be managed in as optimal conditions as lactating cows.

ACKNOWLEDGEMENTS

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ADDITION OF METACAM® (MELOXICAM) TO THE TREATMENT OF CLINICAL MASTITIS IMPROVES SUBSEQUENT REPRODUCTIVE PERFORMANCE

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SUMMARY

This study demonstrates that addition of the non-steroidal anti-inflammatory drug Metacam (meloxicam, 20mg/ml) to antibiotic treatment of mild to moderate clinical mastitis improves reproductive performance and bacteriological cure rate.

INTRODUCTION

Mastitis is a very common and costly disease of dairy herds worldwide which has also been shown to have negative effects on reproductive performance (1, 2, 3). Addition of Metacam to antibiotic therapy resulted in cumulative culling rate reduced by 42% ($p < 0.001$), particularly associated with failure to conceive, relative to antibiotic therapy alone (4). 45 weeks after enrolment, culling rate was 16.4% in the Metacam treated group vs 28.2% in the placebo treated group.

The primary objective of the current study was to assess if the combination of Metacam and Ubrolexin® (cefalexin and kanamycin) antibiotic therapy of mild to moderate cases of clinical mastitis would improve cow fertility compared to antibiotic therapy alone.

METHOD, DATA COLLECTION AND ANALYSIS

509 cows were sourced from 62 herds, across 10 sites, in six countries (UK, France, Belgium, Netherlands, Spain, and Italy). Data collection and randomisation of treatment was performed using a purpose built database on a tablet. Balance of treatment groups were compared by one way ANOVA and X^2 analysis for continuous and categorical variables, respectively.

Cows were recruited if they were up to 120 days calved, not confirmed pregnant and suffering from a mild to moderate case of clinical mastitis in one quarter for the first time in the lactation, without having received NSAIDs, antibiotics or corticosteroids in the previous 14 days.

Recruited cows were treated with 2-4 tubes of Ubrolexin and either Metacam OR placebo, and milk sampled for bacteriology. Further milk samples were taken at days 14 and 21 to assess bacteriological cure and fate of the animal with regard to service dates, pregnancy checks or culling was recorded up to day 300 post-recruitment.

RESULTS

502 cows were eligible for reproductive analysis. Treatment groups did not differ other than cows in the Metacam group were enrolled on average eight days later in lactation than the placebo group, which was adjusted for in the statistical analysis.

Table 1. Results demonstrating that addition of the non-steroidal anti-inflammatory drug Metacam (meloxicam) to antibiotic treatment of mild to moderate clinical mastitis improves reproductive performance and bacteriological cure rate

Result	P value	Metacam treated group	Placebo treated group
Increased first service conception rate	<i>P</i> <0.01	31% (SE=2%)	21% (SE=2%)
Reduced number of inseminations required to conceive	<i>P</i> <0.01	2.4 (95%CI=2.2-2.7) inseminations per conception	2.9 (95%CI=2.7-3.2) inseminations per conception
Increased proportion of cows pregnant 120 days after calving	<i>P</i> <0.001	40% (SE=1%) pregnant	31% (SE=1%) pregnant
Increased bacteriological cure rate	<i>P</i> <0.05	66% (SE=4%) cure	50% (SE=6%) cure

DISCUSSION

This study demonstrates that addition of Metacam to antibiotic treatment of mild to moderate clinical mastitis results in an increased first AI conception rate, a reduced number of inseminations to conceive and an increased proportion of cows pregnant by 120 days after calving.

It appears that NSAID treatment ameliorates some of the negative effects of mastitis on reproductive performance and may have a protective effect on luteal function by reducing PGF2 α concentrations, amongst other effects.

The increased bacteriological cure rate of Metacam treated cows may be due to reduced inflammation leading to improved distribution of the antibiotic. However further study is necessary to investigate these findings.

ACKNOWLEDGEMENT

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COST-EFFECTIVENESS OF SPECIFIC MASTITIS INTERVENTIONS

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INTRODUCTION

With the limited resources available to a commercial dairy farm, it is important that potential mastitis interventions are prioritised not only according to their proven efficacy, but also on the likely return on investment. There are very few studies that have measured the clinical efficacy of specific mastitis interventions within a cost-effectiveness framework so there remains a large degree of uncertainty about the impact of a specific intervention and its cost-effectiveness.

Bayesian methods are widely adopted by the human medical field for the analysis of cost-effectiveness (Claxton, 2008). A key feature of such studies is that Bayesian analysis of decision making requires model parameters to be specified as probability distributions to capture the uncertainty in their true values; this uncertainty is then propagated through the model. The aim of this study was to investigate the cost effectiveness of mastitis control interventions to reduce intramammary infections during the dry period. An integrated Bayesian cost-effectiveness framework was used to construct a probabilistic decision model that could be used to inform clinical decision making.

MATERIALS AND METHODS

Data were assimilated from 77 UK dairy farms that participated in the British national mastitis control scheme during 2009-2012 and that had an epidemiological herd diagnosis of 'environmental' pathogens causing intramammary infections during the dry period. The data consisted of clinical mastitis (CM) and somatic cell count (SCC) records, herd management practices and details of interventions that were implemented by the farmer as part of the control plan.

The outcomes used to measure the effectiveness of the interventions were i) changes in the incidence rate of clinical mastitis during the first 30 days after calving (IRCM30) and ii) the rate at which cows gained new infections during the dry period (measured by SCC changes across the dry period from <200,000 cells/ml to >200,000 cells/ml (HighSCC)). A Bayesian one-step microsimulation model was constructed such that posterior predictions from the model incorporated uncertainty in all parameters. The incremental net benefit (saving – cost) was calculated across 10,000 Markov chain Monte

Carlo iterations, to estimate the cost-benefit (and associated uncertainty) of each mastitis intervention. The resulting posterior distributions were used to make predictions about expected return on investment from implementing each intervention.

RESULTS

A total of 112 interventions were evaluated in the analysis and the number of farms implementing each of the interventions ranged from 2-15. The interventions could be broadly grouped into three categories; management of the dry cow environment, management of the calving cow environment and the selection and application of dry cow therapy. The interventions likely to be cost-effective in most circumstances included selecting dry-cow therapy at the cow level, dry-cow rations formulated by a suitably qualified nutritionist, use of individual calving pens, milking cows within 24hrs of calving and spreading bedding evenly in dry cow yards.

DISCUSSION

The results of this study highlight the efficacy of specific mastitis interventions in UK conditions which, when incorporated into a cost-effectiveness framework, can be used to optimise decision making in the field of mastitis control. This intervention study provides an example of how an intuitive and clinically useful Bayesian approach can be used to form the basis of an on-farm decision support tool.

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A NOVEL MILK PROTEIN BIOMARKER FOR DAIRY ANIMAL MASTITIS AND ITS IMPLEMENTATION IN THE ELISA FORMAT

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The milk somatic cell count (SCC), a routine parameter for monitoring udder health and milk quality in cows, is currently applied also in ewes and goats. Nevertheless, the reliability of SCC in small ruminants is still debated. In fact, adding to intramammary infections (IMI), a number of other factors impact on small ruminant SCCs more significantly than in cows. Therefore, for an earlier and sensitive monitoring of udder health in small ruminants, as well as for a better definition of thresholds, SCCs would benefit of the integration with additional markers. Adding to this, the applicability of protein inflammation mediators as mastitis markers also in cows would open the way to possible improvements in sensitivity and specificity of IMI detection also in these dairy animals.

A combined gel-based and shotgun proteomic study was carried out on milk from ewes affected by natural and experimental intramammary infections by different pathogens (1, 2). The study produced a number of candidates that were screened for their suitability to implementation in a diagnostic test. To this aim, 317 quarter cow milk samples, 705 half-udder ewe milk samples, and 549 composite goat milk samples were collected in the context of routine screening programs. All milk samples were subjected to SCC and bacteriological examination according to standard procedures, and a subset was tested for the candidate biomarkers by western immunoblotting. Then, the best performing biomarker was used for setting up a candidate diagnostic ELISA platform, which was tested on all cow, ewe, and goat milk samples. Statistical analysis was carried out with Medcalc and Prism.

Milk positivity for the candidate diagnostic ELISA was significantly associated with high SCCs in all animal species examined. In fact, ELISA-negative and ELISA-positive sample groups did always show a statistically significant separation in relation to SCC, with the significance of such association becoming lower from cows to sheep to goats, as expected. Specifically, SCC median (IQR) values for ELISA positives and ELISA negatives were as follows: for cows, 3 (1-34.5) *vs* 746.0 (374.3-1,508) cells/mL; for ewes, 144,000 (97,000-244,000) *vs* 2,327,000 (799,800-10,698,000) cells/mL; for goats, 260 (114-515.8) *vs* 883 (517-1,318)

cells/mL. In ELISA-positive samples, the ELISA OD value was directly correlated with the SCC. Concerning correlation with the bacteriological culture, most bacteriologically positive samples having high SCC levels were positive to the ELISA test. Most interestingly, however, numerous bacteriologically-positive milk samples having low SCC levels were positive to the proposed ELISA.

In conclusion, the novel biomarkers identified in the proteomic discovery study, especially the best performing one in the ELISA format, hold promise as novel mastitis markers, and open valuable perspectives for the development of diagnostic tools enabling a better monitoring of udder health and milk quality. In addition, the proposed ELISA can support the cross-validation of SCCs for monitoring small ruminant mastitis, as well as a better evaluation of SCC levels, dynamics, and reliability in these dairy animals. Further studies will be required in goats, especially with investigation of half-udder samples, to better elucidate the relationships among SCC, culture, and the proposed ELISA in this latter dairy animal.

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MILK YIELD - AN IMPORTANT RISK FACTOR AT DRYING OFF?

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SUMMARY

The dry period in dairy cattle is a high risk time for the acquisition of new intramammary infections (IMI). Increased yield at drying off has been associated with an increase in the risk of IMI at calving. Data collated over the last 16 years was reviewed, revealing, as expected, a rise in yields at drying off. More recently collected data demonstrated significant variation in yields at drying off, only a proportion of which could be explained by increased 305 day yields. Farmers should consider strategies to decrease yield at drying off so as to reduce the risk of new IMI during the dry period.

INTRODUCTION

The dry period in dairy cattle is a high risk time for the acquisition of new IMI, a risk that has been mitigated for many decades by the widespread use of antibiotic dry cow therapy. However, in an era of reduced antibiotic use and with the long overdue advent of the widespread uptake of selective dry cow therapy in the UK, it is timely to consider some of the risk factors for the acquisition of new IMI in the dry period. Milk yield at drying off has been associated with an increase in the risk of new IMI during the dry period (2) and this increase in risk has been associated with delayed formation of the keratin plug in the streak canal after drying off (1). Despite this link few producers make a concerted effort to reduce yield in the period immediately prior to drying off.

MATERIALS & METHODS

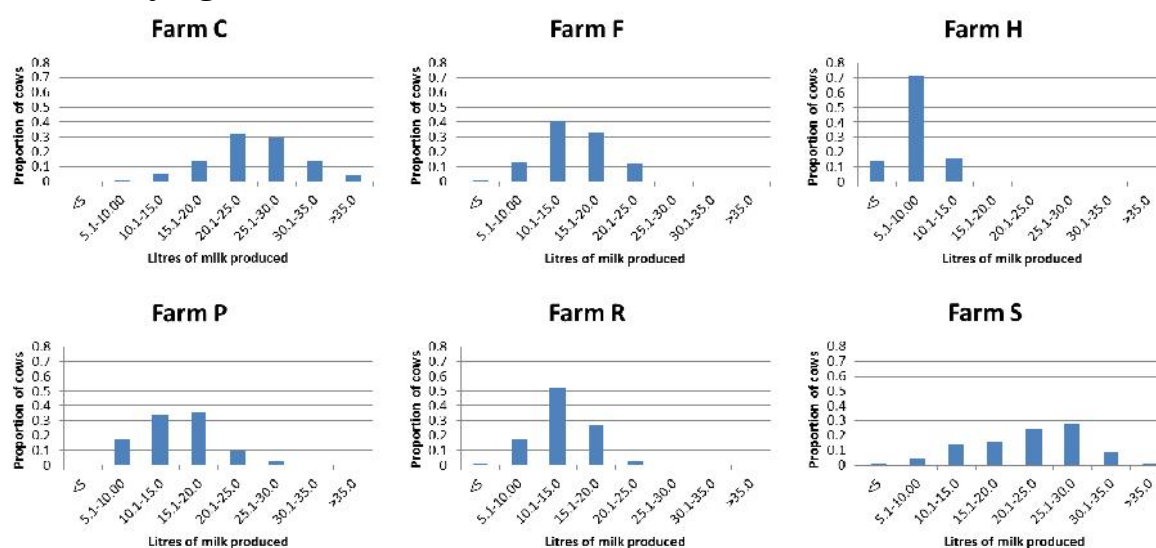
Data was collated from farms participating in clinical trials over a 16 year period in the south-west of England. Yields were recorded in the last 24 hours before drying off and, in a study conducted in 2014-2015, at the final milking. Data was analysed using appropriate statistical tests using Minitab 15.1 (Minitab Inc., State College, PA).

RESULTS

Data was available from 4,295 lactations from 29 farms in the south-west of England, between 1999 and 2015. As might be expected over that period,

mean yields in the 24 hours prior to drying off had risen from 8.9 litres (range 1-25 litres) to 17.8 litres (range 1.8-40.1 litres). In a subset of data from 880 cows dried off between September 2014 and September 2015, yields at the last milking varied between 0.8 litres and 16.3 litres (mean 6.8 litres). Surprisingly, yields were significantly higher at the last milking in cows still being milked 3X daily compared to those being milked 2X daily (8.45 vs 6.79 litres, $p < 0.001$). As well as the absolute yields varying between farms, herds milking 3X daily (C and S) showed the widest range of yields at drying off (Figure 1). One farm (H) took measures to reduce yield prior to drying off.

Figure 1. An illustration of the variability in yields in the last 24 hours prior to drying off across 6 farms



DISCUSSION AND CONCLUSIONS

These data suggest that milk yields at drying off have risen significantly in recent times. The findings of Huxley *et al* (2) would suggest that, solely as a result of this increase in yield, on average, cows are now at 1.69 to 1.79 times the risk of acquiring a new IMI in the dry period compared to 1999. Whilst the factors affecting the risk of new IMI are many and varied, farmers should consider strategies to decrease yield at drying off as a way of reducing the risk of acquisition of new IMI during the dry period.

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THE USE OF MALDI-TOF MASS SPECTROMETRY FOR THE IDENTIFICATION OF BOVINE MASTITIS PATHOGENS

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SUMMARY

Bovine mastitis aetiology is complex. Arguably as the prevalence of contagious pathogens decreases, we are likely to see an increase in intramammary infections with a diverse range of opportunistic environmental pathogens. Conventional bacteriology techniques and organism identification can be slow and time consuming. MALDI-TOF mass spectrometry (MS) offers an opportunity for more rapid organism identification without loss of any ability to identify the diverse range of organisms known to cause intramammary infection.

INTRODUCTION

Bovine mastitis has a complex aetiology, with over 150 different organisms identified as potential causes of intramammary infection. Historically, the industry standard for identification of causal organisms has been bacteriology supplemented with biochemical tests; these methods are slow, labour intensive and prone to error in interpretation. More recently, PCR based techniques have offered more rapid screening, though at the expense of being able to determine more complex aetiologies. MALDI-TOF MS has shown promise in the field of human bacteriology (1) and potentially offers a more rapid and robust alternative to conventional techniques for the identification of organisms of bovine mammary origin.

MATERIALS & METHODS

Isolates were collated from both routine laboratory submissions and existing catalogues of isolates. Isolates were (or had already been) typed using routine laboratory techniques, encompassing growth characteristics (on selective agar), macroscopic and microscopic morphology, staining and biochemical tests. In addition some *Staphylococcal* isolates had been identified by sequencing of the *rpoB* gene (2) and some of the *Corynebacterium* spp had been typed by restriction analysis of a 16S rRNA gene fragment (3).

MALDI-TOF MS and species identification was compared with conventional biochemical techniques. In the absence of sequence data, conventional typing was treated as the 'gold standard' test to which MALDI-TOF MS was compared. Where sequence or restriction typing was available this was also used to compare the two different approaches. The sensitivity, specificity, negative predictive value, positive predictive value and accuracy were calculated; these were calculated on the basis of the ability of MALDI-TOF

MS to identify species within the genus *Staphylococcus*, genus *Streptococcus*, genus *Corynebacterium* and family *Enterobacteriaceae* respectively.

RESULTS

A total of 954 organisms were identified by conventional means and subjected to MALDI-TOF MS. A total of 101 different organisms were identified. The sensitivity and specificity of MALDI-TOF MS for species level identification for major and minor mastitis pathogens, compared to conventional laboratory and gene sequence techniques is summarised in Tables 1 and 2 respectively.

Table 1. The sensitivity and specificity of MALDI-TOF analysis for identification of key major mastitis pathogens when compared to conventional laboratory techniques

Pathogen	n	Sensitivity	Specificity	PPV	NPV	Accuracy
<i>Streptococcus uberis</i>	173	0.82	0.99	0.99	0.76	0.88
<i>Streptococcus dysgalactiae</i>	47	0.96	0.97	0.88	0.99	0.97
<i>Streptococcus agalactiae</i>	6	0.67	1.00	1.00	0.99	0.99
<i>Enterococcus spp</i>	15	0.88	0.94	0.60	0.99	0.94
<i>Escherichia coli</i>	166	0.98	1.00	1.00	0.92	0.98
<i>Serratia spp</i>	16	1.00	0.99	0.92	1.00	0.99
<i>Klebsiella spp</i>	7	1.00	0.98	0.69	1.00	0.98
<i>Staphylococcus aureus</i>	171	1.00	0.99	0.99	1.00	1.00

Table 2 The sensitivity and specificity of MALDI-TOF MS for identification of *Staphylococcus* spp isolates of bovine origin when compared to sequencing of a partial *rpoB* gene segment and *C. bovis* isolates of bovine origin when compared to restriction analysis of a segment of the 16S rRNA gene sequence

Pathogen	n	Sensitivity	Specificity	PPV	NPV	Accuracy
<i>S. aureus</i> (MALDI-TOF)	122	1.00	0.94	0.98	1.00	0.98
<i>S. aureus</i> (BIOCHEM)	122	0.99	0.89	0.96	0.97	0.96
CNS (MALDI-TOF)	122	1.00	0.98	0.94	1.00	0.98
CNS (BIOCHEM)	122	0.88	0.96	0.88	0.96	0.93
<i>C. bovis</i> (MALDI-TOF)	33	0.93	1.00	1.00	0.67	0.94
<i>C. bovis</i> (BIOCHEM)	33	1.00	0.50	0.93	0.50	0.88

Excluding *S. agalactiae* (for which there were only a small number of isolates available) the sensitivity of MALDI-TOF MS varied between 82% and 100% and specificity between 94% and 100% for the major mastitis pathogens. With respect to the *Staphylococcus* spp and *C. bovis* sensitivity varied between 93% and 100% and specificity between 94% and 100% when compared to DNA based techniques and outperformed conventional biochemical techniques.

DISCUSSION AND CONCLUSIONS

The single most significant constraint to this feasibility study was the need to compare to conventional methods for organism identification, which have their own inherent inaccuracies. Perhaps the best example of these shortcomings is with the major mastitis pathogen *S. uberis* which is often difficult to type definitively using conventional techniques. This may in part explain the apparently poorer performance of MALDI-TOF MS with respect to this pathogen. This would similarly apply to the *Enterococcus* spp. These results should therefore be interpreted in this light.

Unfortunately, we could only evaluate the use of MALDI-TOF MS against the true 'gold standard' of sequence data for the *Staphylococcus* spp and *C. bovis*. When sequencing data was available, MALDI-TOF MS outperformed conventional methods of identification.

This study has clearly demonstrated the utility of MALDI-TOF MS for the identification of organisms from bovine milk, offering the opportunity to increase both speed and accuracy of routine bovine mastitis diagnostics.

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