Issue N° 12 - September 2018

IDF

ANIMAL HEALTH REPORT

Research progress | Global insights | Expert opinion

CONTENTS

PREFACE

MESSAGE FROM THE IDF DIRECTOR GENERAL

This International Dairy Federation (IDF) Animal Health Report comprises 24 articles which provide a glimpse of noteworthy topics on member countries and current research within the field of animal care, antimicrobial resistance and farming practices. It offers an opportunity for those involved in the field to present their findings through innovative research and providing an update on progress achieved and lessons learned.

IDF's work on animal health and welfare aligns with the efforts of international organizations (the World Health Organization, the Food and Agriculture Organization of the United Nations, the World Organisation for Animal Health and Codex), stakeholders and consumers. Healthy and productive dairy animals can contribute towards the provision of a safe, sufficient and nutritious food supply at a time of a rapidly increasing global population.

We extend our thanks to the authors, whose written contributions have helped to add value to this scientific report through their insights and analysis.

Wishing you a great reading,

Caroline Emond
IDF Director General

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MESSAGE FROM THE CHAIR OF THE IDF STANDING COMMITTEE ON ANIMAL HEALTH AND WELFARE

The objective of our report is to inform the dairy sector about new developments in the field of animal health and welfare and their implications on disease prevention by considering aspects related to farm economics, food safety, human health and dairy technology.

Thanks to the expertise of our committee members, the IDF Guide on Good Animal Welfare Practices in Dairy Production is now revised to be in line with the latest standards by the OIE and ISO TS 34700 and will be published soon. International guidance on this topic is important, not only to educate and inform the reader about measures for animal health and welfare, but it also serves as a practical guide to facilitate continuous improvement in animal welfare, and secure safe and for fair international trade, as compliance with international standards can help to facilitate cross border fair trade and avoid unnecessary technical barriers.

Fostering good animal health is a driver which can help to reduce the need for antimicrobials. Healthy animals do not need antibiotics. Prudent use of antibiotics and minimising antimicrobial resistance (AMR) is important as diseased animals need proper treatment to secure good animal welfare. Several pieces of IDF work underline their reduction and optimal use and thus, the prevention of resistant microbes. Apart from contributing to minimising antimicrobial use in the international sphere, IDF also monitors AMR in mastitis and other relevant pathogens. The IDF gathers information on antimicrobial usage, provides guidance on mastitis detection and recommends good management practices on milking machine settings. The proper use of modern sensors is part of this work. The IDF supports restricting antimicrobials to prevent infection and not to promote growth. Antimicrobials should only be used to treat diseases when proper indications exist. In addition, IDF's work on food safety is crucial to guarantee consumers' health and in decreasing the risk of the spread of AMR into the human population. Biosecurity is overall important to avoid the spread of pathogens and AMR between both herds and animals, but also from human reservoirs to animals.

Finally, I would like to encourage you to attend the next IDF Mastitis Conference from 14–16 May 2019 in Copenhagen. It is a platform for experts to share their knowledge and insights on udder health and milk quality.

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MESSAGE FROM THE SCIENTIFIC EDITORS

Dear Reader,

It is an honour to present the 12th edition of the IDF Animal Health Report. In this issue, we present articles on a wide range of subjects concerning animal welfare programmes, mastitis, use of antimicrobials and resistance, milk quality, reproduction and fertility. We wish all readers an interesting and informative read.

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NEWS FROM IDF MEMBER COUNTRIES

United States: National Dairy FARM Animal Care Program Accredited to International Standards Organization Animal Welfare Technical Standard


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The International Organization for Standardization's (ISO) Technical Specification 34700 - Animal Welfare Management/General Requirements and Guidance for Organizations in the Food Supply Chain [1] was developed to evaluate animal welfare programs' conformance to international standards for animal care established by the World Organization for Animal Health (OIE) [2]. ISO, an independent, international standards-setting body, worked with the OIE to assist farmers and animal welfare programs in implementing the OIE species-specific animal welfare standards. The OIE, the World Trade Organization-recognized body for setting animal health and welfare standards affecting international trade, adopted dairy cattle welfare standards in 2017 [2].

In the United States, the U.S. Department of Agriculture's Agricultural Marketing Service [3] offers a voluntary marketing program which ensures independent welfare programs meet the specifications of the ISO Technical Specification 34700. In 2017, the National Dairy FARM Animal Care Program (administered by National Milk Producers Federation in conjunction with Dairy Management Incorporated) applied to USDA-AMS for accreditation with the ISO Technical Specification 34700 [4].

The USDA-AMS has developed species-specific audit tools to assess animal welfare programs for compliance with the ISO Technical Standard 34700 including QAD 1060A ISO TS Animal Welfare Management Checklist [5] and QAD 1060C Animal Welfare and Dairy Cattle Production System Checklist [6]. The National Dairy FARM Animal Care Program

Program materials evaluated
FARM Animal Care Reference Manual
FARM Animal Care Self-Assessment
FARM Animal Care Third-Party Verification
FARM Dairy Cattle Ethics and Training Agreement
FARM Comprehensive Emergency Action Plan
FARM Veterinarian Client Patient Relationship Form
FARM Herd Health Plan
FARM Employee Training Resources
FARM Proper Care for Non-Ambulatory Animals Poster
FARM Emergency Contact Poster
FARM Top 11 Considerations for Culling Dairy Cattle Poster
FARM Milk & Dairy Beef Residue Avoidance Reference Manual

Table 1 – National Dairy FARM Animal Care Program materials evaluated for ISO Technical Specification 34700.

submitted all program materials, standards and guidelines to USDA-AMS (Table 1). USDA-AMS used these materials to audit the standards and program execution to the OIE requirements as outlined by ISO Technical Standard 34700. Additionally, an on-site audit of program implementation was conducted.

On 14 February, 2018, USDA-AMS affirmed that the FARM Animal Care Program is ISO Technical Standard 34700 compliant (Figure 1) which validates the design and implementation of the program [6]. The National Dairy FARM Program is now the first livestock animal care program in the world to be recognized internationally for its industry-leading animal welfare standards.

In achieving this compliance, US and international dairy customers can be assured that the dairy products coming from FARM Animal Care Program participants meet the stringent, internationally recognized animal welfare standards set by the OIE.

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”In the US, the National Dairy FARM Program is now the first livestock animal care program in the world to be recognized internationally for its industry-leading animal welfare standards.”

Jamie Jonker

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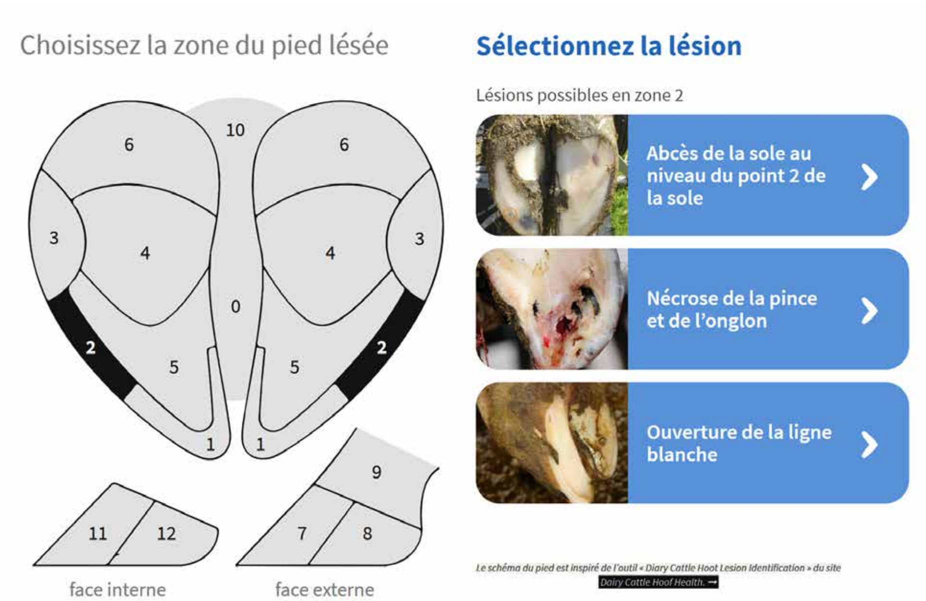
7. United States Department of Agriculture (USDA) Agriculture Marketing Service (AMS) (2018) Official Listing of Approved USDA ISO Technical Specification 34700 Animal Welfare Assessment Programs. https://www.ams.usda.gov/sites/default/files/media/OfficialListingofApprovedISOTS34700AnimalWelfareProgram.pdf. Accessed 2 July 2018.

Official Listing of Approved USDA ISO Technical Specification 34700 Animal Welfare Assessment Programs			
Company	**Program Name**	**Program Scope**	**Approval Information**
National Milk Producers Federation 2107 Wilson Blvd. Suite 600 Arlington, VA 22201 Phone: (703) 469-2372 Contact: Emily Meredith Email: emeredith@nmpf.org	*National Dairy Farm Program*	Animal Welfare and Dairy Cattle Production Systems • QAD 1060C Animal Welfare and Dairy Cattle Production Systems Checklist • QAD 1060A ISO TS Animal Welfare Management Checklist	Approval No. TS7286BAA Effective Date: February 14, 2018

Figure 1 – The National Dairy Farm Program as officially approved by the USDA ISO TS 34700 Animal Welfare Assessment Programs.

France: an information website for dairy farmers on hoof health and lameness management in dairy herds



"Designed for dairy farmers and their advisors, the website synthesizes all the current knowledge on lameness to help farmers prevent, recognize and manage lameness in their herds as quickly as possible. To ensure correct treatment and prevention of hoof lesion, a specific tool has been developed in order to help farmers identify the type of lameness."

Eloise Modric

Lameness is, by its frequency and its economic importance, the 3rd disease in French dairy herds, after mastitis and reproductive issues. On the initiative of the CNIEL (French Dairy Board) and in collaboration with lameness experts* (veterinaries, hoof trimmers, technical advisors and experts from technical institutes), a French reference website on lameness has been developed. Online since September 2017, more than 13,000 users have already connected to the website.

Designed for dairy farmers and their advisors, the website synthesizes all the current knowledge on lameness to help farmers prevent, recognize and manage lameness in their herds as quickly as possible: from the hoof anatomy to the lameness identification and treatment, through recording lame cows. The website is very educational, based on many photos and didactic videos, for example, on the fragility of the hoof or on lameness scoring (thanks to our colleagues at the VetSuisse, university of Zurich and Dairy NZ).

The key issue of reduction of antibiotics in dairy farms and antimicrobial resistance is also addressed. It is accepted that each lesion is different and must be treated with appropriate treatment. The injection of an antibiotic is often useless (except for the interdigital phlegmon).

To ensure correct treatment and prevention of hoof lesion, a specific tool has been developed in order to help farmers identify the type of lameness. Based on a hoof diagram, the user selects the area affected by the lesion and identifies, using photos, the lesion on their cow. After recognition, farmers can learn more about the lesion selected: risk factors, treatment and prevention adapted to the lesion.

This information website is not intended to replace training for farmers on identifying lame cows and functional trimming, or the advice of lameness professionals (hoof trimmers, veterinarians ...).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Norway: the Animal Welfare Index

An example of application of OIE and ISO standard using the animal recording system

Animal welfare has had a great deal of attention over the last decade, both from consumers, retailers, the international community and farmers. National regulators and International organisations like the International Dairy Federation (IDF), the World Organization for Animal Health (OIE) and the International Organization for Standardization (ISO) have put a lot of effort into producing regulations and guidelines on animal welfare and the focus is ever-increasing. The Norwegian government published their first official act and regulation on animal welfare in 1935, revised in 1974 and again in 2009 [1]. The IDF published the 'Guide for good animal welfare in dairy production' in 2008 following the OIE principles established in 2006 [2], with expert participation from the OIE and the Food and Agriculture Organization of the United Nations (FAO). The OIE adopted their standard on 'Animal welfare in dairy cattle production systems' in May 2016 [3] and ISO followed with the ISO standard 'Animal Welfare Management – General Requirements and Guidance for Organizations in the Food Supply Chain' in December 2016 [4]. The ISO TS 34700:2016 reflects the OIE standard and aims to facilitate the implementation of the animal welfare principles of the OIE Terrestrial Animal Health Code by the private sector.

Norway has a long tradition in animal recording systems, such as milk yield, animal information (culling and death) and health and mortality records, both in dairy cattle and calves. Approximately half of the variables indicated as output variables in the OIE welfare standard [3] are included in the Norwegian Dairy Herd Recording System (NDHRS) [5]. Using the NDHRS, it is possible to apply a statistical algorithm by calculating the normal standard deviation (the number of standard deviations) for each herd on each variable. This herd specific normal standard deviation is thus the number of standard deviations away from the national mean, supposing a normal distribution, or a Poisson distribution for discrete events like disease. Using this index, many of the parameters described on OIE welfare standard can range from +3 to -3. Figures above or below those are truncated to +3 or -3 respectively. Finally, these figures are added up to a herd animal welfare index which is adjusted so that the mean is around 100. The main area included in this index are variables within; claw health services, calf disease and mortality, mortality in dairy cows, dehorning routines in calves, young stock health (mortality, disease, growth rate and age at first calving), fertility (number of days from first to last insemination and calving interval), udder health (clinical mastitis and cell count), metabolic diseases, culling reasons and longevity, milk production difference between 1st, 2nd and above 2nd calving. One example of the distribution of this welfare index is illustrated in Figure 1.

> "The animal welfare index is a good, objective tool to document and improve the animal welfare of dairy cattle in Norway. As the welfare index is available on the internet, the farmer and advisor can easily concentrate on what is important."
>
> **Olav Østerås**

This index could be presented to the farmers and advisors and could also be broken down into sub-indexes according to the main areas mentioned above. The point is that farmers and advisors could work on improvements within those areas.

Some of the key areas are not included in this index. This might be aspects such as emotional areas and 'natural life', freedom to move, pasturing, fright indicators, cleanliness, play, access to water and feed, wounds and so on. These variables could be gathered yearly during farm audits. As the welfare index is available on the internet, the farmer and advisor can easily concentrate on what is important.

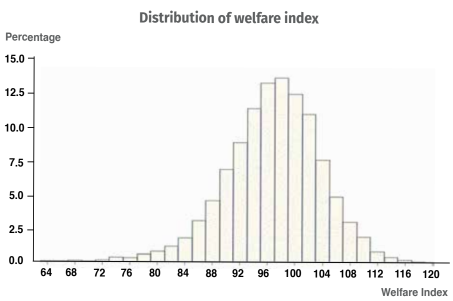

Figure 1: Distribution of the Norwegian animal welfare index.

Currently, the Norwegian dairy industry is building up some advisory services based on this index. This service might be part of the industries ISO TS 34700 standard. At present, the Norwegian dairy industry is working on providing information to the farmers and building up awareness and changing attitudes to increase the importance and understanding of good animal welfare in dairy production. Traditionally, Norway has very good records on health and cell count, but there is always variation, as Figure 1 illustrates. And, as long as there is variation there is also room for improvement. The key with the index is to document the status, provide a tool for improvement and measure the improvement.

To conclude, the animal welfare index is a good, objective tool to document and improve the animal welfare of dairy cattle in Norway. The tool is devised to improve the standard in all herds and can give specific professional advice to help farmers with even the lowest standard to progress, change their attitudes and inspire to be better. The index is combined with an obligatory herd audit at least once a year.

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Australia: promoting prudent use of antibiotics when drying off cows in Australian dairy herds

Antibiotics play an important role in dairy animal health and it is vital that farmers have continued access to effective medicines in order to protect the health, welfare and productivity of their herds. However, there is worldwide concern about the growing incidence of antimicrobial resistance (AMR) in both human and animal pathogens. Sustainable and responsible use of antimicrobials is critical to mitigate AMR and contribute to the 'One Health' strategies for AMR.

Although there is relatively low usage of antibiotics on our dairy farms, the Australian dairy industry is keen to play its part in ensuring that there will be a range of effective antimicrobial treatments available for future generations. Antibiotics used at drying off make up a large proportion of total dairy antibiotics used in Australian milking herds, so the dairy industry is encouraging farmers and dairy veterinarians to re-evaluate how antibiotic dry cow therapy is prescribed and used.

Since the early 2000s, Dairy Australia's Countdown extension project has been promoting best practices for milking and drying off cows to prevent and limit the impact of clinical and subclinical mastitis. The key activities include the flagship publication the Countdown Farm Guidelines [1] and the two-day Cups On Cups Off accredited training course for farm milking personnel. Instructional videos and waterproof visual guides [2] are also included as part of the extension resources to enable farmers to use these for on-the-job training and induction of new milking staff. These extension activities complement other Dairy Australia projects to enhance whole farm planning to manage biosecurity risks.

Countdown has recently developed a structured interview process which improves veterinary engagement with dairy farmers about the prescribing, dispensing and application of dry cow products. The Dry Cow Consult [3], a web-based tool, is designed to be used by farmers in conjunction with their veterinarian once a year. The farmer identifies the key risks for mastitis in their herd during the dry period and the veterinarian provides support for mastitis prevention and control with guidance levels for selective treatment of cows with antibiotic therapy. Planning the drying off process well in advance is a key element, to enable farmers to get all the following aspects right: cow identification and selection, milk production level, timing of drying off, product choice (internal teat sealant or antibiotic therapy), aseptic technique for product application and maintaining a low risk environment post drying off.

To further promote farmer adoption of the Dry Cow Consult, Countdown recently hosted a live webinar attended by over 140 people, where the recommended approach to planning selective dry cow therapy was discussed, including the practical implications on farm. A recording of the webinar is now available for viewing here[4].

These new resources are underpinned by a series of technical reviews, the Countdown Technotes, based on a review of the scientific evidence, expert opinion and practical observations of the Australian dairy farming environment. Technotes 15, 16 and 17 are currently undergoing revision to reflect advances in our understanding of mastitis risks and management strategies during the dry period and post calving period. This suite of new Countdown resources aims to improve the confidence of farm veterinarians to advocate for more selective use of antibiotic dry cow therapy by dairy farmers at the time of drying off and will soon be published on the Dairy Australia website.

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"The Dry Cow Consult [3], a web-based tool, is designed to be used by farmers in conjunction with their veterinarian once a year."
Susannah Tymms

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Israel: Unusual Outbreak of Mastitis Caused by Methicillin-Resistant *Staphylococcus aureus* (MRSA) in a Dairy Herd in Winter 2018

Staphylococcus aureus is a leading cause of contagious bovine mastitis in many countries. In Israel it accounts for 2% of sub-clinical mastitis isolates and ~3% of clinical mastitis isolates, originating from bovine milk sent for bacteriological diagnosis to the Laboratory for Udder Health & Milk Quality (UHL). During 2017, 62,300 milk samples were admitted to UHL for bacteriological diagnosis, and the results of clinical samples (25% of all samples) are presented in Figure 1.

Methicillin-Resistant *Staphylococcus aureus* (MRSA) is an emerging threat both to human and farm-animal industry health [1]. The prevalence of MRSA in milk samples originating from individual cows as well as from bulk-tanks has been monitored by bacterial culture on MRSA-selective chromogenic agar since 2011. The results from 2012 to 2018 are presented in Table 1.

The number of MRSA isolates has changed dramatically since February 2018, when an increasing number of MRSA-positive milk samples originating from a specific farm were noted. This is a cooperative farm, with 1,050 lactating cows, using a 60-point rotary milking-parlour, exhibiting relatively high mean DHI SCC (350,000 cells/mL). Results of diagnosis of milk samples originating from this farm are presented in Figure 2. By the end of June 2018, 13% of the cows (n=142) were infected with *S. aureus*, and 98% of these isolates were diagnosed as MRSA.

> ”Methicillin-Resistant *Staphylococcus aureus* (MRSA) is an emerging threat both to human and farm-animal industry health. In Israel, by the end of June 2018, 13% of the cows (n=142) were infected with *S. aureus*, and 98% of these isolates were diagnosed as MRSA.”
>
> **Falk Rama**

Antimicrobial susceptibility tests using the disk diffusion method indicated that all MRSA isolates were resistant to penicillin, oxacillin, cefoxitine, cefalexin/kanamycin and marbofloxacin; and susceptible to cefquinome, spectinomycin/lincomycin and rifaximine. Representative isolates

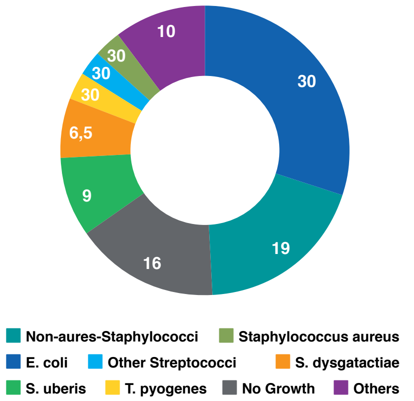

Figure 1 – Distribution of pathogens isolated from milk clinical samples, 2017.

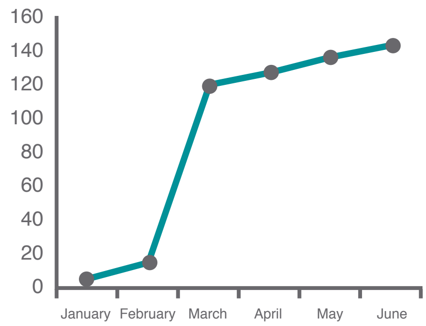

Figure 2 – Accumulating number of cows diagnosed as MRSA-positive in milk samples originating from farm ‘M’ in the north of Israel, 2018.

Year	No. Tested Milk Samples	No. *S. aureus* Isolates	No. MRSA Isolates	No. infected herds
2012	54,600	628	1	1
2013	56,600	590	14	7
2014	53,000	632	2	2
2015	57,000	600	2	2
2016	54,000	747	4	2
2017	62,300	1,010	15	7

Table 1 – Total number of MRSA isolates from bovine mastitis in Israel, 2012–2017.

were genotyped by PCR and sequencing and assigned to spa type t011, multi-locus sequence type (MLST) CC398 and confirmed to be positive for mecA. These characteristics are typical to 'livestock-associated MRSA' (LA-MRSA), a major cause of disease in a variety of livestock and humans, especially in Europe [2]. In addition to cows, two of the 12 farm workers were diagnosed as LA-MRSA nasal carriers by bacterial culture.

Here we report an exceptional outbreak of bovine mastitis caused by *S. aureus* in general, and specifically by MRSA, in Israel, where *S. aureus* prevalence in bovine mastitis is low. In this outbreak, LA-MRSA was detected in 142 cows. During 2018, LA-MRSA was diagnosed in another five farms in Israel; however, the records of diagnosed cows were much lower, ranging from 1–11 MRSA positive cows from herds ranging from 55 to 300 cows.

Full molecular characterization of these isolates is on the way.

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New Zealand: Update on *Mycoplasma bovis* situation on August 2018

BACKGROUND

On 21 July 2017, samples taken from a dairy herd in the South Canterbury region of New Zealand tested positive for Mycoplasma bovis *(M. bovis*), a bacterium which causes disease in cattle, is widespread internationally, and has never been identified before in New Zealand. By causing untreatable disease in cows, *M. bovis* can mean significant and ongoing losses to dairy and beef producers and have severe disease management and animal welfare implications. The outbreak was diagnosed in non-lactating cows. Clinical symptoms observed were predominantly mastitis involving multiple quarters with approximately 40% of animals within the cohort affected. In a limited number of cows, lameness with arthritic lesions localised in the fetlock was observed. Subsequently at the time of calving calf illness was observed with premature calves born. Affected calves showed limited ability to feed and these either died or were euthanized.

The investigation undertaken by the New Zealand Ministry for Primary Industries (MPI) confirmed the diagnosis of *M. bovis* by culture, PCR and DNA sequencing [1]. Previous industry surveillance undertaken in 2009 had demonstrated that the organism was considered to not be present in New Zealand. Based on this information and results from the initial investigation of the current outbreak, the decision was made to undertake a national response with the following objectives (Table 1.)

CURRENT SITUATION

The response initially involved standard epidemiological procedures of identification of likely infected properties based on tracing followed by testing and confirmation of infection status. Additionally, surveillance using bulk and mastitic milk samples by PCR testing was undertaken for all dairy herds nationally during late 2017 and early 2018. This milk surveillance is being currently repeated

Response Objectives	Aim of Objective
1. Contain *M. bovis* to its known distribution in NZ	Ensure that all feasible control options are maintained
2. Assess feasibility of eradication	Ensure eradication options are considered to the fullest possible extent
3. Determine and track distribution of *M. bovis*	Inform decision making for this response
4. Engage industry partners, stakeholders and Iwi and work with them to effectively manage this outbreak	Work with, and through partners and stakeholders to achieve response objectives
5. Maintain confidence in New Zealand's biosecurity system and protection of conservation values	Identify all partners and stakeholders in this response to effectively coordinate efforts
6. Ensure that the welfare of affected farmer(s) and their livestock is effectively managed	Minimise business disruption and emotional distress.

Table 1 – Response and aim of the objectives.

Number of active confirmed Infected Properties	37
Number of properties under Restricted Place Notice	58
Number of samples received by AHL	195,746
Number of tests completed	181,971
Number of traced properties	5,137

Table 2 – Response statistics to 26 September 2018.

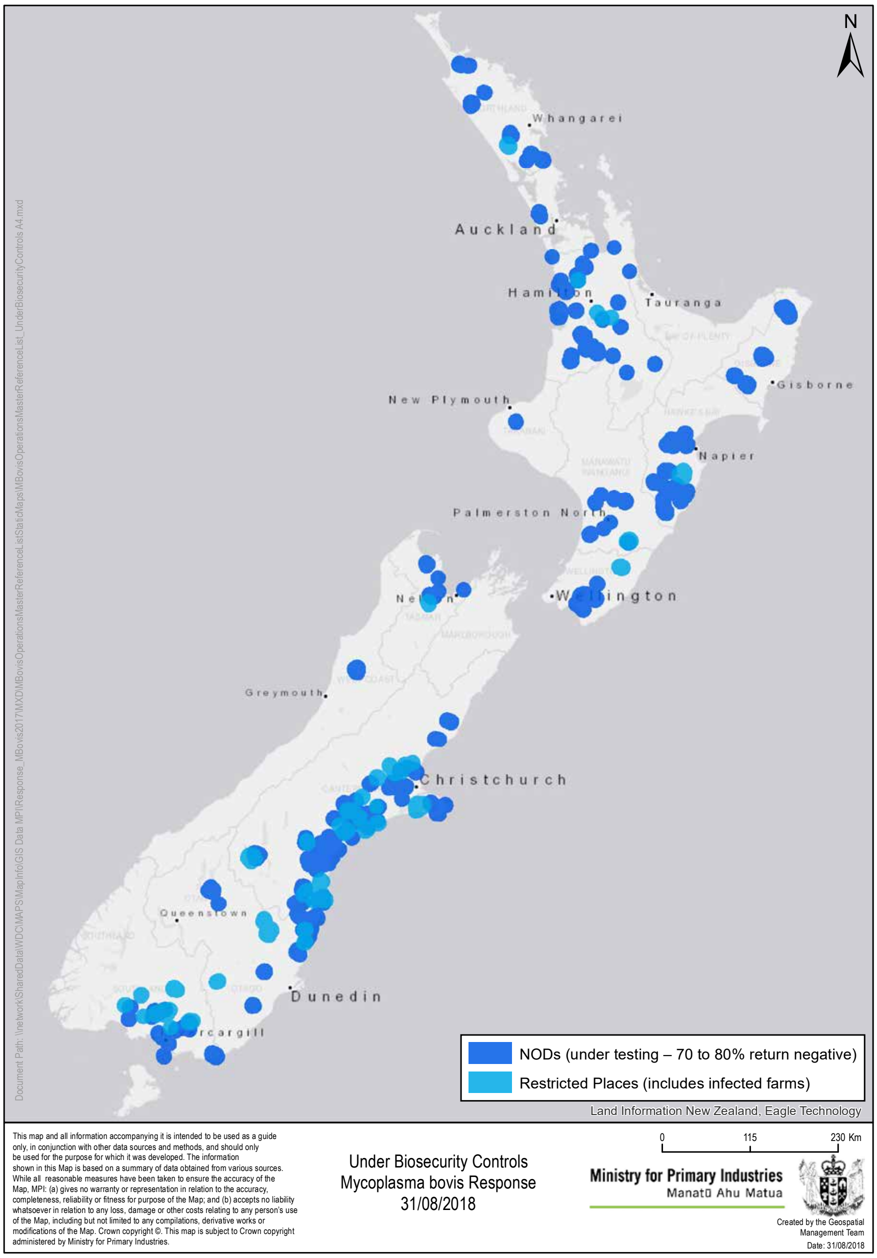

Figure 1 – Location distribution map

with all dairy herds being testing during the Spring calving period, six tests repeated every two weeks using PCR and Elisa, to identify any herds not already detected. Testing of meat animals at slaughter premises is also being undertaken. The decision to continue to undertake eradication will be reviewed in late 2018 based on the results of the current testing programme.

To date all properties that have been identified as infected have occurred as a result of animal movements occurring from the index property or properties subsequently infected as a consequence of purchase of infected stock from the index property. All evidence suggests a single point of entry of the disease which occurred in late 2015 – early 2016 (Table 2). The pathway has not been established.

All properties identified (Figure 1) as infected are being depopulated, subject to cleaning and disinfection and then repopulated. The activities that are being undertaken are using the powers of the Biosecurity Act. This includes compensation for losses incurred for affected farmers.

CONCLUSION

The eradication of *M. bovis* from the New Zealand cattle population will continue until there is either technical evidence that it is not feasible and/or there is not economic justification to support current controls. To date the spread of disease and the control measures adopted support continuation of the existing response.

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Argentina: Training veterinarians through the Milk Quality Programme

With the aim of improving the competitiveness of the dairy chain, the Ministry of Agroindustry of the Nation through the Direction of Dairy, has developed the Argentine Milk Quality Programme. The Programme is a public-private initiative, promoted by the Ministry of Agroindustry as part of a true State policy aimed at continuous improvement of milk quality. To do this, the first list of milk reference parameters was established, with the aim of establishing a criterion of comparability and valorising quality.

The programme aims at training veterinarians. The following institutions participate in the programme: Ministry of Agroindustry, National Service of Health and Agro-Food Quality (SENASA), National Institute of Agricultural Technology (INTA), National Institute of Industrial Technology (INTI) and Pro Quality Milk Association and its derivatives (APROCAL).

The Argentine Milk Quality Programme is inspired by the vision of an Argentina which has to project itself to the world and offers products of high quality from healthy animals (Figure 1).

For the first time, the Reference Milk is established at national level:

- Fat Content: 3.5 g / 100 cm3.
- Protein content: 3.3 g / 100 cm3.
- Somatic Cell Count: less than or equal to 400,000 cells / cm3.
- Total Bacteria Count: less than or equal to 100,000 colony forming units / cm3.
- Brucellosis: officially free.
- Tuberculosis: officially free.
- Cryoscopic index: less than - 0.512 °C.
- Temperature in dairy farm: less than or equal to 4 °C.
- Residues of inhibitors: negative.

Mastitis is one of the most prevalent and costly diseases affecting dairy cows worldwide. In addition, mastitis is one of the major animal welfare and economic problems in dairy cattle production. The losses due to mastitis are not just about economics: issues like animal health and welfare, quality of milk, antibiotic usage and the image of the dairy sector are also important reasons to focus on a mastitis control programme. Hence, the actions of the Argentine Milk Quality Programme concerning milk quality, disease control and animal welfare.

"The Argentine Milk Quality Programme is inspired by the vision of an Argentina that has to project itself to the world and offers products of high quality from healthy animals. The actions of the Argentine Milk Quality Programme concern milk quality, disease control and animal welfare."

Alejandro Sammartino

The programme aims at the accreditation of veterinary professionals in:

- Implementation of milk quality plans
- Milking machines
- Animal welfare and milking routines
- Economic losses due to milk quality problems
- Antibiotic treatment protocols
- Plans for prevention and control of mastitis

The Programme can be used as training for dairy farmers and milkers in:

- Good management practices
- Economic losses through reduction in milk quality
- Records and information management
- Animal welfare

This training programme will take place during the second half of 2018 in Ataliva, Santa Fe, Argentina.

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INTERNATIONAL PROJECT OUTCOMES

The World Organisation for Animal Health (OIE) and the Annual Collection of Data on the Use of Antimicrobial Agents in Animals

"Combatting antimicrobial resistance is a priority issue for the OIE, recognizing the vital role played by antimicrobials in human health, animal health and animal welfare."

Elisabeth Erlacher-Vindel

The OIE is an intergovernmental organisation with a mandate from its 180 Member Countries to preserve animal health and animal welfare worldwide. Within its mandate, the OIE has developed standards and guidelines for animal health, including those on the responsible and prudent use of antimicrobial agents in veterinary medicine, and on monitoring antimicrobial resistance and antimicrobial use in animals.

Combatting antimicrobial resistance is a priority issue for the OIE, recognizing the vital role played by antimicrobials in human health, animal health and animal welfare. In order to ensure sustainability of livestock production, the efficacy of antimicrobials must be preserved through the principles of responsible and prudent use, and monitoring use allows countries to follow trends in its implementation.

Following Resolution No. 26: Combating Antimicrobial Resistance and Promoting the Prudent Use of Antimicrobial Agents in Animals, adopted by the OIE World Assembly during the 83rd General Session in May 2015 [1], the OIE launched an annual collection of data on the use of antimicrobial agents in animals. The first phase of this new OIE activity is also in line with the Global Action Plan on AMR, and with the recently published OIE Strategy on Antimicrobial Resistance and the Prudent Use of Antimicrobials [2].

FIRST PHASE OF OIE DATA COLLECTION

The template used to collect data was designed to allow all OIE Member Countries to participate, regardless of whether or not a national data collection system exists in their countries. The OIE template includes administrative information and provides three options for reporting antimicrobial usage in animals, with various levels of detail depending on the data available at the national level.

In the first phase, 130 Member Countries (72% of the 180 OIE Member Countries) participated. A total of 89 of 130 OIE Member Countries (68%) submitted data specifying quantities of antimicrobial agents used in their animals for years ranging from 2010 to 2015.

The first report, OIE Annual report on the use of antimicrobial agents in animals: Better understanding of the global situation, can be found on the OIE Website [3] in English, French and Spanish. This report presents the findings of the first annual collection of data on the use of antimicrobial agents in animals, providing a global and regional analysis based on data ranging from 2010 to 2015.

SECOND PHASE OF OIE DATA COLLECTION

For the second phase, participation has increased with 144 responses: 141 from OIE Member Countries (78% of 180 Member Countries) and 3 from non-OIE Member Countries. Moreover, more Member Countries are now able to report specifically on the classes of antimicrobial agents used in their animals from 2013 to 2016 (102 or 72% of 141 Member Countries).

For this second phase, the OIE has also included a question on the obstacles countries face in order to provide quantities of antimicrobial agents in animals. When the analysis of this phase is complete, this section will inform the needs of OIE Member Countries to collect antimicrobial use data.

OIE REGION	Number Member Countries who submitted templates by OIE Region	Number of OIE Member Countries by OIE Region	Proportion of Proportion of responses by OIE Region by OIE Region
AFRICA	44	54	81%
AMERICAS	19	29	66%
ASIA	26	32	81%
EUROPE	36	53	68%
MIDDLE EAST	5	12	42%

Table 1 – OIE Member Countries that submitted templates in 2015, by OIE Region.

WORK TO DEFINE A DENOMINATOR (ANIMAL BIOMASS)

Data collected to this point have been measured by amounts of different antimicrobial agents used in animals by country (in kg). To provide a more detailed interpretation, it is necessary to analyse the weight of antimicrobial agents consumed relative to the number of animals consuming them. Towards this goal, concurrent to the second phase of data collection, the OIE is developing calculations for animal biomass in its regions to use as a denominator in its analysis of the antibiotic usage database. This denominator will also facilitate a deeper understanding of use of antibiotics in animals, including trends in use over time, and comparisons of consumption patterns between regions and countries.

In order to determine animal biomass, the OIE will use a variety of sources, including published databases, literature review, and the OIE World Animal Health Information System (WAHIS), which collects census data on animal populations of Member Countries. Further work will be conducted to develop WAHIS in order to quantify the most accurate possible denominator over the long-term. Simultaneously, it is expected that Member Countries will improve the quality of their data on their use of antimicrobial agents in animals and allow refinement of the analysis over time.

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One Welfare – a complement to One Health supporting a sustainable dairy industry approach

'One World, One Health' was developed as a concept to achieve fully comprehensive approaches in support of global sustainable development. A set of principles (i.e., The Manhattan principles) were agreed following an event in 2004 organised by the Wildlife Conservation Society and hosted by The Rockefeller University. The concept of 'One Welfare' complements these by emphasizing the interconnections between animal welfare, human wellbeing and the environment. Integrating 'One Welfare' with 'One World, One Health' helps strengthen and better integrate stakeholder liaison by capturing all relevant issues involving animals and our society in a holistic way [1].

ONE WELFARE FOR ALL

To date there has been a lot of progress towards developing and implementing the concept of One Health in relation to how animal disease interconnects with human disease and productivity, among other aspects. However, the interconnections go beyond health and extend to wellbeing, environmental and conservation aspects. These are captured more explicitly by the concept of One Welfare. "One Welfare" describes the interrelationships between animal welfare, human wellbeing and the physical and social environment [3]. Recognising the links between animal welfare, human wellbeing and the environment represents a step forward in the implementation of animal welfare standards and policies, with the aim of integrating animal welfare with other relevant areas for the benefit of all [2]. This concept has the goal to help improve global welfare and achieve gains in development.

Health and welfare are inextricably linked within dairy cattle and partially overlap when we talk about their 'quality of life'. 'Health' most often refers to the state of being free from disease, while the terms 'welfare' and 'wellbeing' more often relate to mental and emotional states. Generally, you cannot have positive welfare without good health. In a similar way, good welfare will support and be connected to good health [3]. Evidence shows that improved animal welfare leads to herds with stronger immune systems, less prone to disease and, as a result, less likely to need antimicrobials.

The Dairy Sector is subject to production pressures, relying heavily, not only on management and farm resources, but also on natural resources such as land availability, water availability, feed quality or climate conditions (i.e., dry/wet seasons), all of which are interconnected with human society and our planet. This makes the

"Recognising the links between animal welfare, human wellbeing and the environment represents a step forward in the implementation of animal welfare standards and policies, with the aim of integrating animal welfare with other relevant areas for the benefit of all. One Welfare describes these interrelationships"

Rebeca García Pinillos

concept of One Welfare very relevant to the current farming and dairy herd management approach.

Life Cycle Assessment that evaluate carbon or water footprints are key to measuring natural resource impacts which we can then correlate to other parameters such as animal welfare improvements. These allows us to better understand how animal welfare improvements, both animal and resource based, as well as changes at management level, can impact the wider environmental issues. There is a holistic interconnection between the welfare of the animals, humans and the environment, thus we can apply a One Welfare Approach and aim to maximize benefits for all.

The role of the dairy sector in society by using a One Health, One Welfare approach is consistent with the United Nations Sustainable Development Goals in animal-related areas by helping to 'build economic growth and address a range of social needs including education, health, social protection and job opportunities, while tackling climate change and environmental protection' [4].

THE ONE WELFARE FRAMEWORK

The One Welfare Framework includes five key sections that capture the overarching themes of One Welfare including: the Connections Between Animal and Human Abuse and Neglect; the Social Implications of Improved Animal Welfare; the connection between Animal Health and Welfare; Human Wellbeing; Food Security and Sustainability within the farming sector; Assisted interventions Involving Animals, Humans and the Environment and the more holistic aspect of Sustainability, including the interconnections between biodiversity, the environment, Animal Welfare and Human Wellbeing [3].

Each section is linked to the dairy sector. For instance, the interconnection between dairy cattle welfare and productivity; between farmer wellbeing and herd welfare or natural resource; the impact of conflict or environmental disasters on dairy farmers and their herd or the use of sustainable management through silvopastoral systems in dairy farming.

By expanding One Health into One Welfare, the dairy sector can make more explicit the recognition between the interconnections of animal welfare, human wellbeing and the environment. This is a step forward in the implementation of animal welfare standards and policies, with the aim of integrating animal welfare with other relevant areas for the benefit of all, and the overarching society.

For further information on One Welfare see: www.onewelfareworld.org.

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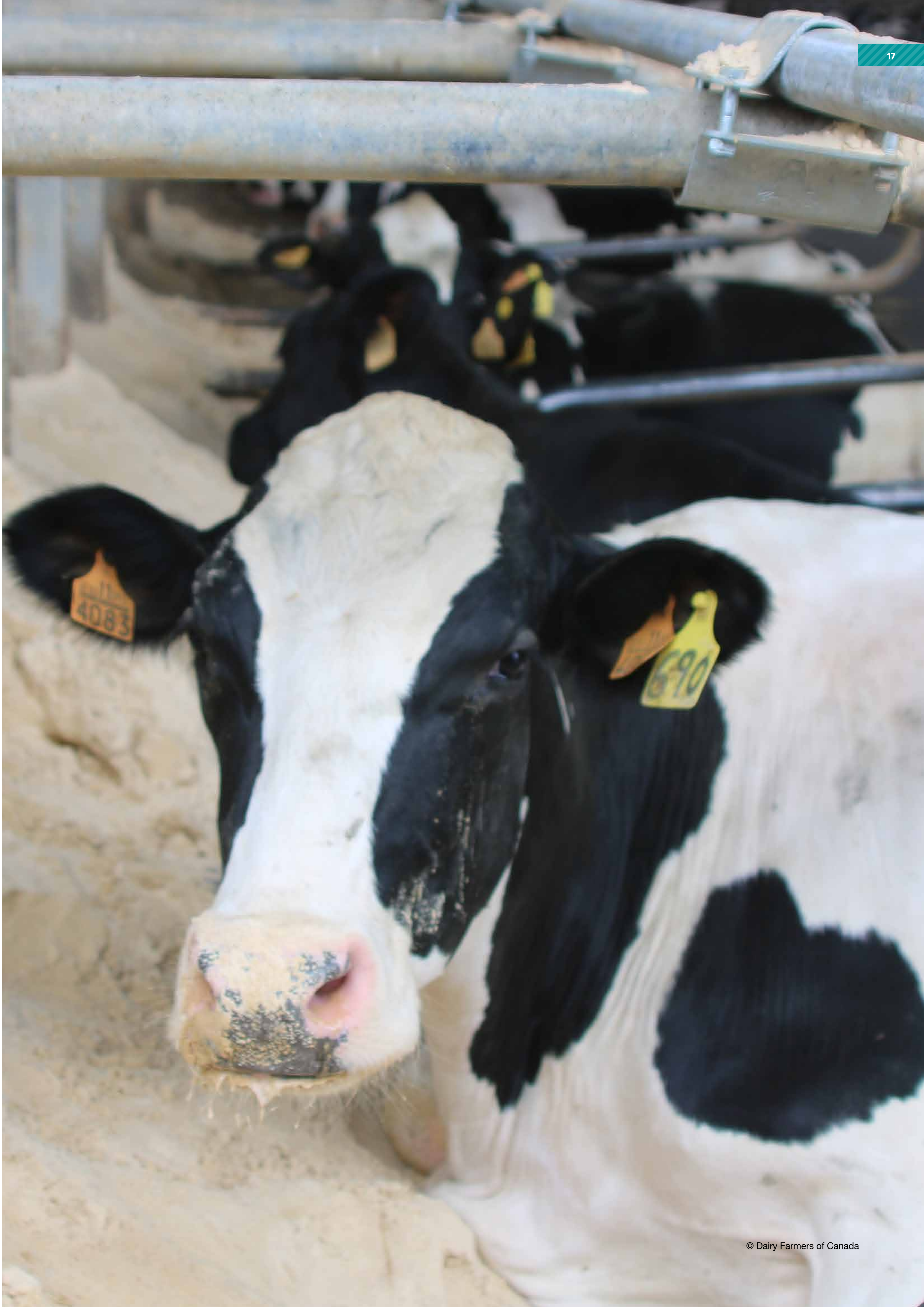

RESEARCH

Animal health and welfare: Results of the IDF questionnaire

Data obtained between 2014 and 2016

AIM OF IDF WORK

The results presented are from a questionnaire sent to all members of the International Dairy Federation (IDF) Standing Committee on Animal Health and Welfare (SCAHW) in 2014. The goal of the questionnaire was to map the health status and other items of interest on animal welfare in different countries. The specific aims were: 1) to identify the most important diseases for dairy farmers; 2) to identify the most important diseases for dairy processors; 3) to identify the most important issues on animal welfare; and 4) to map the feature of ongoing mastitis control in different countries.

The questionnaire was not focused on OIE-listed diseases, but on everyday production and infectious diseases with an economic or quality impact on the dairy industry.

The final purpose of this project is to help the SCAHW members determine the priority topics for the programme of SCAHW's work. Seventeen countries responded to the questionnaire. Some of the questions were not possible to be answered because of the lack of national data. The following countries responded: Belgium, Canada, Chile, Denmark, Finland, France, Germany, Iceland, Ireland, Italy (Lombardia), the Netherlands, Norway, South Africa, Switzerland, Sweden and the UK.

THE MOST IMPORTANT DISEASES

The countries were asked to name the top five most important diseases for dairy farmers. Mastitis was listed as one of the most important in 16 countries and as the most important in nine countries. Reproduction was mentioned by 12 countries and as the most important area of disease in three countries. Table 1 illustrates all diseases listed.

"Most countries reported a large reduction in rate of clinical mastitis over the last ten years. There has been a large improvement in udder health, with the largest reduction in clinical mastitis."

Olav Østerås

ANIMAL WELFARE

Countries were asked about the current and future issues for animal welfare in the country. The results are shown in Table 3.

DAIRY CATTLE POPULATIONS

The structure of the dairy population is very diverse and has an impact on the management and on health parameters. The number of farms in the countries surveyed varied from 600 to 76,000. However, most countries had from 1,000 to 20,000 farms. The number of cows within the country ranged from 30,000 to 4.3 million, most having between 230,000 and 650,000 animal heads.

Diseases of importance for dairy farmers	Number of countries where the disease was listed as the most important	Number of countries where the disease was listed as one of the top five most important diseases
Mastitis	9	16
Reproduction	3	13
Lameness	1	11
Bovine tuberculosis	1	2
Bovine ephemeral fever (BEF)	1	1
Bovine herpes virus (HV-1)	1	0
Bovine virus diarrhoea (BVD)	0	8
Calf diseases	0	5
Ketosis	0	2
Stillborn	0	2
Insect transmitted diseases	0	2
Metabolic diseases	0	2
Bovine digital dermatitis (BDD)	0	1
Tick-borne diseases	0	1
Johne's disease	0	1
Milk fever	0	1
Bovine leucosis virus (BLV)	0	1
Infectious diseases	0	1

Table 1 – Diseases of importance for dairy farmers listed on the IDF questionnaire.

Disease of importance for dairy processors	Number of countries where the disease was listed as the most important	Number of countries where the disease was listed as one of the top five most important diseases
Mastitis	6	9
Johne's disease	2	8
Salmonellosis	1	3
Campylobacter	1	0
Arbovirus	1	0
Bovine tuberculosis	1	0
Infertility	1	0
Claw diseases/Lameness	0	4
E. coli (EHEC)	0	2
Metabolic diseases	0	2
Listeriosis	0	1
Lumpy skin disease	0	1
Foot and mouth disease (FMD)	0	1
Tick borne diseases	0	1
Bovine virus diarrhoea (BVD)		1
Bovine respiratory syncytial virus (BRSV)	0	1
Blue tongue	0	1
Insect transmitted viruses	0	1
Infectious diseases leading to antibiotic usage	0	1
Calf disease	0	1

Table 2 – Diseases of importance for dairy processors listed on the IDF questionnaire.

Issue	Number of countries that listed this issue
Pasture	8
Lameness and injuries	7
Housing (tie-stalls, slatted floors)	5
Separation mother – calf	5
Pain control during dehorning	4
Mastitis	3
Dead cows	1
Cow comfort	1
Bull calf export	1
Education of farmers	1
Welfare and quality in AMS	1
Heat stress	1
Breeding goals	1
Slaughtering pregnant cows	1

Table 3 – Diseases of importance for dairy farmers listed on the IDF questionnaire.

Results originate from the existing animal recording system data at national level. Thus, the data presented is limited by the existence of animal recording programmes in the countries surveyed. The number of herds included in the recording systems usually varied between 20% and 95% of herds, although in most countries this included 80% to 90% of the herds. The number of cows included varied from 12% to 95% whilst most programmes had between 80% and 90% of cows.

Herd size mean varied between 25 and 350 cows, being in most countries between 40 and 100. The percentage of cows in first lactation varied from 16% to 45%, with most herds having around 35% to 38%. A closer look to the distribution of herd size shows clusters from 20 to 500 animals in most countries. There were only a few herds above 500 and below 20 (Figure 1).

"This questionnaire covered 17 countries with a total of 279,000 herds and 18 million cows.The outcomes presented in this document might help the IDF SCAHW to prioritize the work needed to improve animal health and welfare in the dairy sector."

Olav Østerås

The proportion of herds having cows in free-stalls or cubicles varied between 35% and 100%. In some countries, this distribution varied from 35% to 40% while in others from 60% to 90%.

The proportion of herds using automatic milking systems (AMS) varied from 3% to 23% and many had around 20%.

The milk yield per cow varied from 5,100 to 12,041 kg. In most countries this ratio was between 8,000 and 10,000 kg (Figure 2).

UDDER HEALTH

Udder health can be expressed in different ways. One is the mean somatic cell counts (SCC) in bulk milk. The recommended figure is the geometric mean as the distribution is generally skewed to the right and the arithmetic mean will, therefore, be higher. The geometric mean varied from 106,000 to 218,000. The arithmetic mean varied from 131,000 to 257,000. Most countries had a geometric mean around 200,000 (Figure 3).

CLINICAL AND SUBCLINICAL MASTITIS

Eight countries have a national register on treatment rate of clinical mastitis. The estimated rate of cases per one hundred cows per year varied from 8.1 to 48. Most countries had around 30. Subclinical mastitis is estimated as a proportion of milk analyses at cow level with 200,000 somatic cell counts or above. Only six countries gave figures on subclinical mastitis. These figures varied from 19.4% to 40%. Most countries have figures from 20% to 25%.

The frequency of dry-cow therapy was given from five countries. These figures vary from 4.9% to 64.8%. The rate variation on clinical mastitis, subclinical mastitis and dry-cow therapy is given in Figure 4.

There was a striking difference between countries. Scientific literature illustrates a large difference from 25–28 cases per cow and years in the Netherlands (Barkema et al. 1998). Schukken et al. (1989) found ten herds with low SCC with a rate of clinical mastitis of 2.2 cases per 100 cows, while ten other herds with the same low SCC had a clinical mastitis rate of 53.6 cases per 100 cows. In New Zealand, 19 cases per 100 cows - 305 days in milk were reported (Petrovski et al. 2009). This illustrates a huge variation between farms and between countries.

Figure 5 illustrates the distribution of clinical mastitis rate and geometric mean SCC between herds in Norway as well as the lack of correlation between clinical mastitis rate and bulk milk somatic cell count (BMSCC).

Most countries reported a large reduction in rate of clinical mastitis over the last ten years. The reduction varied from 5.4% to 61%. There was also a reduction in BMSCC in most countries, but a few countries had an increase in BMSCC. Three countries reported an increase in BMSCC (5.5–7.8%) and four countries reported a decrease (3%–40%) (Figure 6). The figure illustrates a large improvement in udder health over the last ten years, with the largest reduction in clinical mastitis. This is a good trend as there is a goal to reduce and improve the prudent use of antibiotics. It also illustrates that this reduction can be done without detrimental effect on BMSCC.

Eight countries gave feedback on the distribution of different bacteria as cases of mastitis both clinical (Figure 7) and subclinical (Figure 8). The most frequent agents in clinical mastitis are *Staphylococcus aureus*, *Escherichia coli*, *Streptococcus uberis*, *Streptococcus dysgalactiae* and coagulase negative staphylococci (CNS). For subclinical mastitis CNS was the most prevalent, followed by *S. aureus*, *Corynebacterium bovis*.

Sensitivity to penicillin for *S. aureus* was given by five countries. The percentage of sensitive isolates varied from 86.3% to 98.8% for clinical mastitis and 96% to 98.6% for subclinical mastitis. The conclusion was that most of the *S. aureus* isolates are sensitive to penicillin in those countries with available data.

Concerning coagulase-negative staphylococci (CNS), a much lower percentage of sensitive isolates to penicillin were reported. Isolates from clinical mastitis varied from 57% to 91% and isolates from subclinical mastitis around 65%. Scientific research demonstrated that there is a huge difference between different species of CNS.

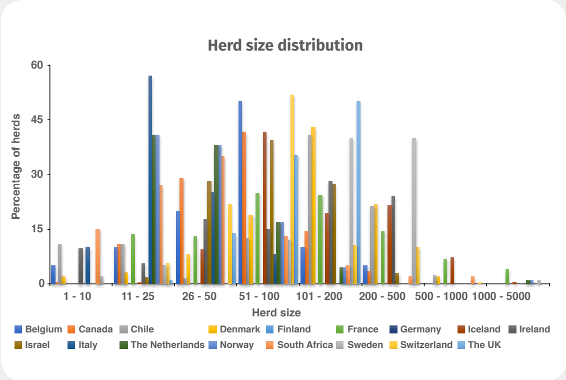

Figure 1 – The distribution of herd sizes in different countries.

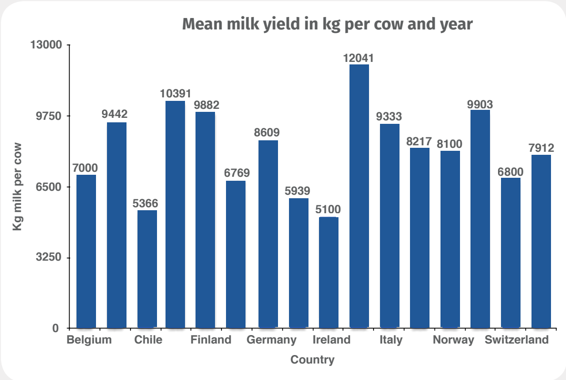

Figure 2 – Mean milk yield in kg per cow and year.

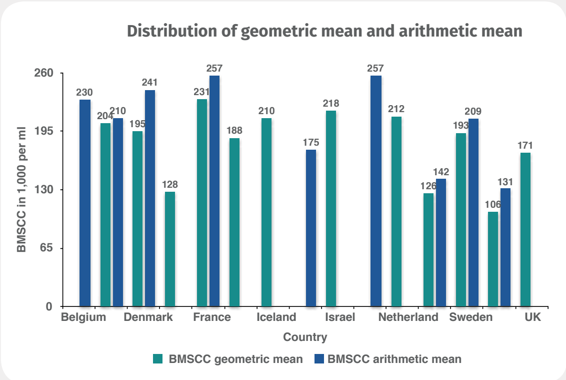

Figure 3 – Distribution of geometric mean and arithmetic mean in bulk milk somatic cell count in different countries.

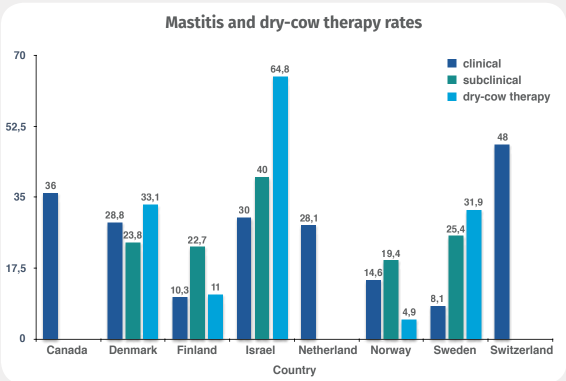

Figure 4 – Rate of clinical mastitis (cases per 100 cows), subclinical mastitis (percentage per analyses) and dry-cow therapy per 100 cows reported in the questionnaire.

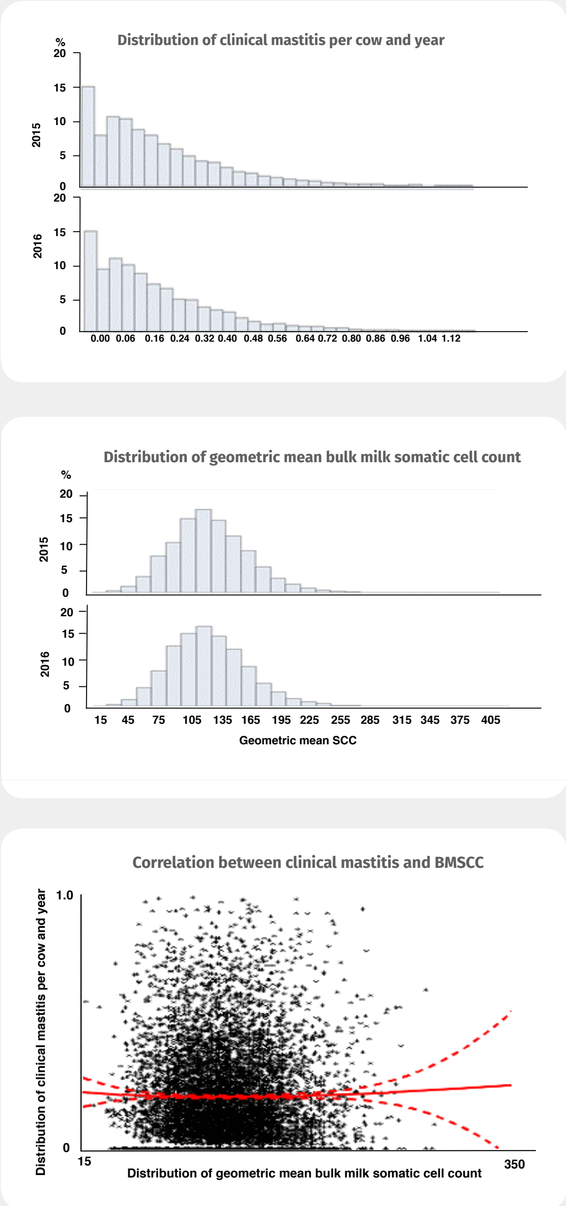

Figure 5 – The distribution of clinical mastitis, BMSCC and correlation between clinical mastitis and BMSCC.

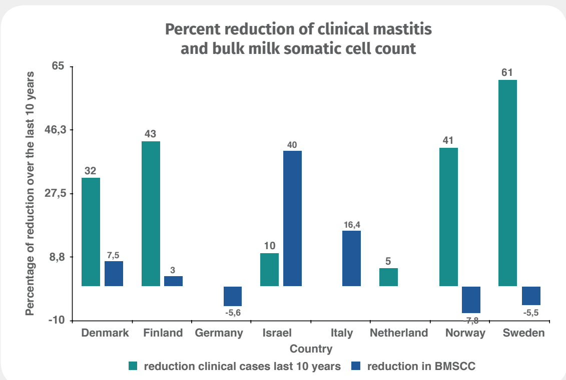

Figure 6 – Percent reduction of clinical mastitis and bulk milk somatic cell count (BMSCC).

BACTERIAL COUNTS

Bacterial count in milk was very difficult to measure because different units are used: some countries reported on colony forming units (cfu) while others used bactocount (bc). In addition to this, many countries used a different converting factor between cfu and bc. The reported cfu values varied from 5,500 to 30,000 and the bc reported values varied from 8,100 to 28,000. These figures must be taken as a weak indication on levels.

SAMPLING PROCEDURE

Quality sampling from each delivery was done in four countries, weekly sampling in five countries and twice a month sampling in three countries.

The frequency of obtaining data from the animal recording system at animal level varied between countries. It was done five times a week in one country, once a month in three countries, on a voluntary basis in one country, four times a year in one country, seven times a year in two countries and five to 10–12 times a year in another three countries.

QUALITY LIMITS

The quality limits given for BMSCC was for premium quality: < 100,000 (one country), < 200,000 (three countries), < 230,000 (one country), < 250,000 (one country) < 300,000 (one country) and < 500,000 (one country). Additional price was given as an increase in milk price from 0.64 to 10%.

First class milk was given limits of > 150,000 (one country), > 300,000 (four countries), > 350,000 (two countries) and > 400,000 (one country). The percentage adjusted price varied between 2 and 8 percent.

Second class milk was given limits of > 300,000 (one country), 380,000 (two countries), > 400,000 (one country) and > 500,000 (one country). Withdrawal in price was from 2 to 7 percent.

Third class milk was given limits of > 350,000 (one country), > 400,000 (one country), > 500,000 (one country) and > 800,000 (one country). Adjusting of the price was between 7 to 14 percent.

The stop limit was set at 400,000 for eight of the countries. This is the general limit for EU.

RECOMMENDED PREVENTIVE PROCEDURES

Post-milking teat dipping

Thirteen countries recommended post-milking teat dipping regularly, eleven for all herds and two for selected herds (those with a streptococcal problem).

Pre-milking teat dipping

Of eleven countries, eight recommended regular pre-milking teat dipping, two for all herds, eight for selected herds, one did not recommend pre-milking teat dipping and one had it forbidden. The criteria recommended where there was selective use of pre-milk dipping, were for environmental mastitis, poor teat hygiene or ‘severe’ outbreaks of *S. aureus* or salt-tolerant spores.

Dry-cow therapy

All eleven countries recommended some kind of dry-cow therapy. Three recommended total dry-cow therapy for all cows, ten only recommended it for selected herds, and eleven recommended dry-cow therapy for selected cows.

The selected criteria stated in different countries are given here:

- Cows with SCC > 150,000 or 100,000 for heifer and older cows respectively
- > 150,000 in BMSCC and cows > 100,000 and culture positive
- Proven infected
- Primiparous > 150,000 and multiparous > 50,000
- > 100,000 in geometric means DHI 2 or 3 samples and culture positive with *S. aureus* or Streptococcus spp.
- Eradication of *Str. agalactiae*
- SCC > 200,000 and previous CM
- SCC and infection status
- Includes herd mastitis history, bacteriology results, individual cow SCC and clinical mastitis records

The results suggest that selective dry-cow therapy is now implemented in most countries instead of total dry-cow therapy. There has been a shift over the last five years. This is also in accordance with IDF guidelines on antimicrobial agents (AA) use (only to be used to cure infections) (IDF, 2013 and 2017).

Teat sealant

Seven out of ten countries recommended teat sealant, three recommended teat sealant for all herds, six countries recommended teat sealant for selected herds and eight only for selected cows.

- The selection criteria were:
- Environmental bacteria
- Crowded deep bedding
- No high SCC last control
- Leaking cows
- Includes decisions made on dry-cow therapy, operator technique, herd mastitis history, bacteriology results, individual cow SCC and clinical mastitis records

Environment

- For housing, the recommendation was: ventilated, clean, dry areas, spacious, free-stalls and cow comfort.
- For milking machines: yearly check-up, regular control, control during milking (VADIA) and control every year by a certified specialist.
- For milking methods: Audit during milking every 3rd year, preparation time 60 to 120 seconds, take off at 400 ml/minute when two times milking a day, and 600 ml/minute when milking three times a day, udder preparation, dry, clean teats, milking gloves, wet and dry preparation, careful attachment, check if udder is empty and careful removal.
- For feeding: Check-up regularly, bunk space, total mixed ration always available, avoid fat cows, not extreme production at start of lactation, in one country (Switzerland) 40% of dairy farms are not allowed to feed on silage.

Rank 1 (15-30% pathogens)	Rank 2 (11-24% pathogens)	Rank 3 (9-18% pathogens)	Rank 4 (2-15% pathogens)	Rank 5 (2-15% pathogens)
S. aureus (5)	*E. coli* (3)	*S. dysgal* (3)	CNS (3)	*S. dysgal* (4)
E. coli (3)	*S. uberis* (2)	*S. agalac* (1)	*S. uberis* (2)	*S. uberis* (1)
	S. dysgal (1)	CNS (1)	Enterococ/*E. coli* (2)	*M. bovis* (1)
	CNS (1)	*S. aureus* (1)	*S. aureus* (1)	Prototeca (1)
	S. aureus (1)	*S. uberis*		

Figure 7 – Bacterial isolates from clinical mastitis grouped according to percentage of isolates. Number in brackets is number of countries given.

Rank 1 (5-70% pathogens)	Rank 2 (3-25% pathogens)	Rank 3 (9-18% pathogens)	Rank 4 (4-14% pathogens)	Rank 5 (0.4-5% pathogens)
CNS (4)	*S. aureus* (3)	*S. dysgal* (3)	*S. dysgal* (3)	*S. dysgal* (1)
S. aureus (2)	CNS (1)	*S. uberis* (3)	*S. aureus* (2)	*S. agalac* (1)
S. bovis (1)	*S. bovis* (1)	CNS (1)	*S. uberis* (1)	
	S. uberis (1)	Cor. spp (1)		

Figure 8 – Bacterial isolates from subclinical mastitis grouped according to percentage of isolates. Number in brackets is number of countries given.

Drug recommendation

The recommendations for the use of drugs from different countries were:

- Responsible use (not defined).
- Use drugs only if justified.
- Maximum six daily doses per animal per year, 3rd and 4th generation cephalosporines only in exceptions.
- Penicillin G only, sometimes sulfamides. Avoid broad-spectrum antibiotics to prevent AMR.
- Treatment of antibiotics or hormones only under veterinarian supervision. Performance enhancing drugs are forbidden.

SUMMARY AND CONCLUSIONS

This questionnaire covered 17 countries with a total of 279,000 herds and 18 million cows. This study would benefit from additional responses, in particular from countries with high dairy production. Yet, the results give an idea of the situation in the dairy sector. The intention is to redo this questionnaire and update it regularly; preferably before the regular IDF mastitis conference (the next one will be in Denmark in May 2019). The dairy structure is very diverse, and this will have an impact on the results for each country. The disease strategy might have to be adapted to each country. Also, the production and the quality payment system are diverse. Only five countries seem to have regular recording of disease (mastitis) treatment (Nordic countries and Israel). Some countries have some good information through good surveys on clinical mastitis. However, most countries do not seem to have any information of the situation. The same can be said for bacteriological isolates from mastitis.

A dramatic reduction in the treatment rate of clinical mastitis can be seen over the last ten years (reduction varied from 10% to 60%); yet BMSCC do not seem to be influenced by the reduction of clinical mastitis cases. Results on BMSCC show both an 8% increase and a 40% reduction at the same time.

Most countries have abandoned the total dry-cow therapy as a strategy and are on the way to implementing selective dry-cow therapy. There is a large discrepancy in the selection criteria used. No association between BMSCC, rate of clinical mastitis or rate of dry-cow therapy results was seen between countries. A few countries had already implemented a stringent and specific recommendation on drug usage, and most were implementing prudent use of AA.

The most prevalent bacteria in clinical mastitis were *S. aureus*, *E. coli*, *Str. uberis* and *Str. dysgalactiae*. The most prevalent bacteria on subclinical mastitis were CNS, *S. aureus*, Corynebacteriae spp., *Str. uberis* and *Str. dysgalactiae*. Most *S. aureus* were sensitive to penicillin. However, about 40% to 60% of CNS were not.

The questionnaire illustrated huge progress on udder health, at least in the countries that responded. The pressure to reduce the use of antibiotics is expected to increase. This questionnaire demonstrates that the use of antibiotics in the 1980s and 1990s was unnecessary in many countries, since antibiotic usage reduction has not led to an increase in BMSCC.

Reproduction, lameness, bovine tuberculosis, calf diseases and different virus diseases like bovine herpes virus and BVD remain important in many countries. The relative importance was slightly different for dairy farmers than for dairy processors. Dairy processors found mastitis the most important disease, followed by Johne's disease, salmonella, campylobacter, EHEC and listeria. On animal welfare, pasture, lameness, housing, separation mother-calf bovine tuberculosis, pain control by dehorning and mastitis were found to be important.

The outcomes presented in this document will help the IDF SCAHW to prioritize the work needed to improve animal health and welfare in the dairy sector.

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Rethinking definitions for mastitis detection: Leaving the paradigm of only clinical mastitis

IDF ACTION TEAM ON GUIDELINES ON THE USE OF SENSORS FOR ANIMAL HEALTH AND PRODUCTIVITY

Dairy Farmers worldwide have available several sensor systems, particularly to measure cow health and fertility. The work on sensors can be immensely broad since there is a wide range of animal health and fertility problems that could be addressed by using sensor systems. None of the systems currently available provides reliable automated decision support (Rutten, 2013). The IDF action team has decided to work on standards for the evaluation of sensor systems aimed at those areas of management (existing or novel) which support interventions by the dairy farmer.

> ”The IDF action team has decided to work on standards for the evaluation of sensor systems aimed at those areas of management (existing or novel) which support interventions by the dairy farmer.”
>
> **Henk Hogeveen**

Since the early 1990s, research has been carried out on automated detection of mastitis (Brandt et al. 2010; Nielen et al. 1992). Mastitis is associated with two aspects of milk quality which are used in most dairy producing countries: somatic cell count (SCC) and, if mastitis is clinical, visibly abnormal milk (in the remaining part of this article referred to as abnormal milk). Moreover, mastitis is the most prominent production disease in developed dairy producing countries. The development and use of on-line mastitis detection systems has received much attention following the introduction of automatic milking systems (AMS) in the mid-1990s (Viguier et al. 2009). On dairy farms working without an AMS, a well-established method to detect clinical mastitis (CM) is to strip before milking and check the foremilk for abnormalities. During milking, abnormal milk was detected using visual observations.

Since 1992, approximately 20 peer-reviewed papers have been published with a description and evaluation of CM detection models (Hogeveen et al. 2010). There is a large variation in the use of sensors and algorithms. All this makes these results incomparable. There is also a considerable difference in performance between the detection models, and a broad variation in time window used and little similarity between study data. Therefore, it is difficult to compare the overall performance of the different CM detection models. Thus, dairy farmers could make misguided investment decisions.

Until now, research on automated mastitis detection systems has been using methods from the visual mastitis detection era as the gold standard. For decades, on-farm clinical mastitis detection was based on a visual observation of milk, a clinical examination of the udder and the general condition of the cow and supported by semi-quantitative measurement of somatic cell counts, e.g., by CMT testing. Although the test accuracy of automated CM detection systems might be lower than trained clinicians of milking staff, repeated sampling at each milking has the ability to identify subclinical changes and monitor them over time for early detection of intramammary infections. Sensors for the automatic detection of abnormal milk defined as colour changes, deviating electrical conductivity or changes in other inflammatory markers are increasingly implemented in automated milking systems as well as in milking parlours, although they either do not meet the standards for test accuracy set years ago or their test performance is unknown [5].

The IDF has a leading voice on mastitis in the dairy industry. Therefore, guidance on the evaluation of test performance and use of data originating from sensors for udder health management should derive from the IDF. In consequence, an IDF action team is currently working on guidelines encompassing exactly what types of intramammary infections, clinical and subclinical, a sensor system should be able to detect, with a focus on the potential interventions by the farmer rather than on the old paradigms.

The IDF Action Team on sensors is working on the following areas based upon the potential interventions by the farmer:

- Cows needing immediate attention.
- Cows not needing immediate attention: subclinical signs and others.
- Cows needing attention at drying off.
- Udder herd health monitoring and management based on critical control points from herd specific sensor technology.

This work will be presented at the IDF Mastitis Conference 2019 in Copenhagen.

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Dry, clean and properly nourish cattle to diminish mastitis and limit antimicrobial use

CONCLUSIONS

The results presented during the 2018 International Bovine Mastitis Conference contribute to a better understanding of the onset of inflammation of the mammary gland of dairy cows. Improvement of immunity responses and adequate herd management are crucial to control mastitis in the absence of preventive antimicrobials.

DIMINISH MASTITIS TO LIMIT ANTIMICROBIAL USE

Livestock has been recognized as a main source of bacterial pathogens displaying antimicrobial resistance. This is likely due to the considerable amounts of antimicrobials used in this sector per kg of live biomass. There is concern that either pathogens or genetic materials coding for antimicrobial resistance could move from animals to humans. Incidents of humans being infected by methicillin-resistant *Staphylococcus aureus* and, especially, extended-spectrum beta-lactamase (ESBL) *Escherichia coli* originating from animals have led to plenty of media exposure.

In dairy herds, however, these arguments are less applicable because resistance levels are generally low, transmission of resistance genes to humans is assumed to be of minor importance, and all milk being delivered to dairy processor is tested for antimicrobial residues. Moreover, more recent studies based on precise sequence-based population level data indicate that little or no host transfer of ESBL genes of bacteria takes place between animal species or between animals and humans [1].

Up to 85% of antimicrobials used in the dairy sector aim at mastitis control [2]. Mastitis is the expression of a serious inflammatory response resulting from a dysfunction of the innate immune system, involving a combination of enhanced production of proinflammatory molecules and reduced levels of anti-inflammatory ones. This usually occurs in periparturient cows, due to the fact that the immune system is suboptimal at time of calving. The innate immune system of a cow's udder can mount a response to both infectious and non-infectious stressors. The elimination of an antibiotic shield does not necessarily have to result in a higher rate of new intramammary infections. By modifying the known risk factors and by optimising herd management, risk levels can be equally low as when prophylactic antimicrobials are used.

CONTROL OF INFECTIOUS STRESSORS

Infectious stressors are constituted by the different pathogens present in the udder, which might provoke relatively different inflammatory responses. For instance, *S. aureus* leads to an inadequate and somewhat weak inflammatory response because it incites a rather low bacterial recognition through toll-like receptors and a slower expression of inflammatory mediators. Because neutrophil functions are diminished, this pathogen evades mammary gland immune responses, leading to chronic subclinical disease. On the other hand, Gram-negative bacteria, such as *E. coli*, give rise to a more acute and exacerbated response due to delayed leukocyte response and rapid bacterial growth, resulting in increased endotoxin exposure [3].

Fostering the immune system for optimal responses can help cows resist the establishment of mastitis when infections occur. As a first option, one might try to control microbial pathogens by active immunization. Vaccines could include antibodies to bacterial toxins and/or bacterial secretion products (biofilms) which are able to reach adequate protective titers in the mammary gland. Proper protocols of immunization should not induce "dangerous" types of inflammatory response or cause tissue damage. To this end, adjuvants containing antibodies to mucosal addressin might sustain local, non-inflammatory IgA responses in the mammary gland. As a second option, induction of endotoxin tolerance in the mammary gland and innate immune memory could be exploited. This can be achieved by intracanalicular injections of low-dose bacterial pathogen-associated molecular patterns at dry-off [3].

Mastitis control is facilitated by early detection of cows and quarters which require attention. Specific and cost-effective diagnostic sensors can be used. Clinical mastitis treatments must then be decided upon on-farm culture. Selective dry cow therapy is the way forward, with no prophylactic use at dry off. An alternative novel diagnostic approach for accurate mastitis pathogens identification is provided by 16S rRNA gene sequencing of the 'milk microbiome' [4]. Cause and effect relationships between mastitis and the "milk microbiome" are still a little far-fetched and it is not fully clear yet whether the bacterial DNA found in milk represents a genuine and representative microbiome.

CONTROL OF NON-INFECTIOUS STRESSORS

Among non-infectious stressors, inappropriate nutrition can modulate the generation of inflammatory lipids [5]. After calving, imbalances in dietary nutrients or metabolic adaptations, such as a negative energy balance, can increase metabolic stressors, such as non-esterified fatty acids (NEFA) [3]. Interestingly, autochthonous cattle breeds have shown to possess better fundamental innate immune responses in the mammary gland and other crucial metabolic features [6]. For instance, high NEFA levels seem to be more likely to occur in high-yielding animal phenotypes, such as Friesian cows, when compared to, for instance, Brown Swiss cows [3]. Prevention of inflammatory lipids can be done by avoiding intense lipid mobilization after calving, optimizing inflammatory responses with diets rich in omega-3 fatty acids and appropriate micronutrient supplementation. Omega-3 fatty acids are known to have anti-inflammatory properties. Feeding cows with such omega-3 fatty acids, such as linseed or fish oil, improves lymphocyte function during negative energy balance, enhances immunity during high-ambient temperatures and improves milk production and reproductive performance in periparturient cows [7]. Omega-6 fatty acids, in contrast, generate pro-inflammatory responses.

> "The elimination of an antibiotic shield does not necessarily have to result in a higher rate of new intramammary infections. By modifying the known risk factors and by optimising herd management, risk levels can be equally low as when prophylactic antimicrobials are used."
>
> **María Sánchez Mainar**

Clean, dry and well-ventilated bedding material is the most appropriate means to reduce environmental stress. High bacterial counts in the bedding material relate to impaired udder health and depend on the type of material used. Organic material, e.g., recycled manure solids, seems to be more problematic than inorganic material, e.g., sand, because organic nutrients feed the bacterial load [8]. Therefore, content of organic-matter (best if less than 5%) and dry-matter (ideally more than 95 % respectively) are important [9, 10]. Longer lying times indicate better cow comfort and are associated with less lameness and higher milk yield. Yet, those cows have a higher risk of exposure to environmental udder pathogens [11].

Finally, milking machines and the way they are used can have an influence on teat condition [12]. Making milking a regular, gentle, rapid and appropriate quarter routine, reduces udder stress. Overmilking subjects the quarter to tissue stress and has an impact on udder health, with exacerbation of other milking machine faults. Automatic milking machines, now employed worldwide, milk quarters separately with quarter-specific take-off determination, thereby reducing the possibility of overmilking [13].

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A literature review of animal welfare outcomes by facility type in the United States

Standard operating procedures and recommended practices on dairy farms are constantly evolving, driven by measurable animal welfare outcomes and societal pressures about what is acceptable to customers and consumers.

In 2016, the U.S. dairy industry was presented with customer concern about tie stalls facilities due to the potential to limit freedom of movement. The National Dairy FARM Animal Care Program, administered by National Milk Producers Federation in conjunction with Dairy Management Incorporated, developed a task force to address the concern, as well as to develop Best Management Plans (BMP) for tie stalls facilities. A literature review was conducted to examine U.S. dairy farm demographics, animal welfare outcomes, and best management practices (BMP) for tie stalls facilities. Additionally, a comparison of animal welfare outcomes for tie stall facilities with other housing systems was conducted as well as the economic and societal impact of tie stall facilities.

The literature review concluded that tie stall facilities implementing BMPs provide equal opportunities of sound welfare for lactating dairy cattle compared to those housed in other facility types. Animal morbidity, mortality, BCS, hygiene, and locomotion score of 1 (Table 1) are similar in tie stall and freestall systems. Tie stalls tend to have a greater percentage of cows with a hock and knee score (Table 2; 7.2 vs. 2.1%) and hygiene score of 3 as (17.3 vs. 10%) compared with freestall systems. Approximately 50% of all tie stall facilities are operated by a plain sect community member representing more than 9,000 dairy farms with 21,000 employees.

More research is needed to evaluate the welfare of cows that are housed in tie stalls and compare these values to those in other housing systems. Results of this analysis will be used to enhance the BMP of the sector in the United States dairy industry which manages dairy cattle in tie stall facilities [2].

	Primary Housing Type							
	Tie stall or stanchion		Freestall[a]		Open/dry lot[b]		All operations[c]	
Locomotion score[d]	%	SE	%	SE	%	SE	%	SE
1	89.6	2.1	89.7	1.0	91.7	2.2	90.2	0.9
2	8.6	2.0	7.1	0.6	6.3	1.3	7.3	0.7
3	1.8	0.4	3.2	0.5	2.0	1.0	2.6	0.3
Total	100.0		100.0		100.0		100.0	

[a] Includes Freestall with no access to open/dry lot and Freestall with access to open/dry lot
[b] Includes Open/dry lot/multiple animal outside area without barn or shed (with or without shade structures) and Open/dry lot with open shed/loafing shed
[c] The All Operations category includes categories not presented in this table (those with Pasture and Other housing for lactating cows)
[d] Locomotion Scorecard 1 is sound, 2 is moderately lame, 3 is severely lame

Table 1 – Operation average percent cows by locomotion score, and by primary housing type used for lactating cows.

	Primary Housing Type							
	Tie stall or stanchion		Freestall[a]		Open/dry lot[b]		All operations[c]	
Hock lesion score[d]	%	SE	%	SE	%	SE	%	SE
1	69.8	5.2	88.8	2.4	96.1	0.8	82.5	2.4
2	23.1	3.9	9.1	2.0	3.8	0.7	13.9	1.9
3	7.2	1.7	2.1	0.5	0.1	0.1	3.6	0.7
Total	100.0		100.0		100.0		100.0	

[a] Includes Freestall with no access to open/dry lot and Freestall with access to open/dry lot
[b] Includes Open/dry lot/multiple animal outside area without barn or shed (with or without shade structures) and Open/dry lot with open shed/loafing shed
[c] The All Operations category includes categories not presented in this table (those with Pasture and Other housing for lactating cows)
[d] Hock and Knee Lesion Scorecard 1 is no hair loss/swelling, 2 is some hair loss; no swelling, 3 is severe swelling and/or abrasion through hide

Table 2 – Operation average percent cows by hock lesion score, and by primary housing type used for lactating cows.

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Road mapping ensures systematic empowerment of employees in the dairy farm

The road mapping tool provides a structure for stepwise employee development so that they continuously undergo a learning process and upgrade their skills in a simple and comprehensive way. One of the challenges in today's agriculture is ensuring that employees continuously develop their skills, thus raising the professional level of the farm. Most employees are interested in learning more. In an American survey, 174 people were interviewed on 14 farms [1]. Employees were asked whether they thought that their professional level met the demands of their work. They should respond to a scale of 1–5, where 1 was 'I know enough about my work' and 5 was 'I am interested in the farm and I want to learn more'. The average result was 4.73. In other words, there was a great deal of interest in learning more.

SEE EMPLOYEE POTENTIAL

The farm owners or managers were also asked about their views on the employees' interest in the work on the farm. Typically, they did not think that the employees were particularly interested apart from earning money. This result is food for thought since they completely ignore the enormous potential of their employees. Nevertheless, the author thinks there is a great potential in farm employees which is not being exploited, and many farms could create a win-win situation by being more systematic about employee education, as a higher level of knowledge results in greater understanding and better task performance. Vibeke Fladkjaer Nielsen is convinced that the employee's interest in learning more is the same all over the world. The trick is to do it in small steps; this is the way people learn most quickly.

DEVELOPMENT STEP BY STEP WITH ROAD MAPPING

The perfect tool for meeting this goal and ensuring skill improvement of employees in a systematic way is road mapping. Road mapping divides the development that the individual employee is going through into different levels ranging from 0 to 5. At level 0 the employee is aware of a (single) task while at level 5 the employee has all the skills that meet the farm goal. An example could be milking. Here, level 0 will typically be where the employee can wipe an udder and apply the cluster. At each subsequent level, new skills are added/required through which the employee can reach the next level. At level 5, the employee has a full understanding of the importance of proper milking and can make assessments in the milking parlour about the health of the cows. Road mapping is, in other words, a tool based on the level of employee competence. It provides a clear structure for stepwise development of employee skills, ensuring that the steps that are taken are not too big and yet providing sufficient development of particular skills. Thus, with a division into levels, the employee is guided through a learning process and upgraded in a simple and manageable manner. The content of each road map is, of course, dependent on the level of skills that the employee presently has at the farm as well as the level of skill he wants to achieve.

Below is presented an example of a road map for the milking parlour which is currently being tested by the author (Table 1).

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Level	Learning goals	Deadline	Responsible
5	• Can do all the milking routines in the milking parlour • Milking of cows treated with antibiotics and handling the milk correctly • Can train other milkers on level 1–4 • Can pass on information from the milking and the work of other milkers		
4	• Can do all the milking routines in the milking parlour, though with the support from a super-milker • Can service the whole milking parlour before and after milking • Can assess the cloths after wash		
3	• Can assess if cows have finished milking • Knows the action plan for what to do when you find a cow with mastitis • Can start the milking system • Can change the milk filter • Can handle the milking cloths when using them for milking		
2	• Can assess a cow with mastitis • Can do the right milking routine with the right interval of 90–120 sec • Can adjust the service-arm correctly after correct attachment of teat cups		
1	• Can strip the teats correctly using 3–4 strong squirts from each teat • Can prepare the cow with dip before and after milking • Can use the correct cloth-technique • Can attach the cluster without false air intake		

Table 1 – Road mapping: Training levels for milkers.

Antimicrobial resistance trends of *Staphylococcus aureus* isolated from bovine intramammary infections from 1990 to the present time in Argentina

Staphylococcus aureus is one of the most prevalent major mastitis pathogens in dairy herds worldwide [1]. Antimicrobial therapy is one of the bases of *S. aureus* mastitis control programmes, both for subclinical cases at drying off and clinical cases during lactation [1]. However, cure rates following antibiotic therapy are variable since several factors associated with host, pathogen and treatment regimen affect the probability of cure of *S. aureus* intramammary infection (IMI) [2]. Among pathogen factors, antibiotic resistance is an obvious reason for treatment failure, although selection of antibiotics based on in vitro susceptibility testing does not assure therapeutic success [3]. Despite this drawback, most authors agree that antibiotic susceptibility testing should precede antibiotic treatment, mainly in case of subclinical mastitis [2]. In addition, antimicrobial susceptibility testing is important for monitoring the spread of resistant strains among bacterial populations. Both determination of minimum inhibitory concentration (MIC) and disk diffusion test (DD), which is the most widely applied method in routine veterinary laboratories due to its simplicity and low cost, have been used for performing antimicrobial susceptibility surveys worldwide [4, 5]

The aim of this study was to review published research in Argentina on antimicrobial susceptibility of *S. aureus* isolated from bovine IMI. Searching for the survey included the words “mastitis”, “bovine”, “*Staphylococcus aureus*”, “coagulase-positive Staphylococcus”, “antimicrobial” “susceptibility” and “resistance”. Since previous reports indicated that the majority of coagulase-positive Staphylococci isolated from bovine milk are *S. aureus* [1] studies which characterized the isolates either as *S. aureus* or coagulase-positive Staphylococci were considered. The inclusion criteria were: studies performed in Argentina which evaluated antimicrobial susceptibility of *S. aureus* isolated from mammary secretion quarter and composite samples of cows with subclinical and clinical mastitis using MIC determination or DD test published in peer reviewed journals. Scopus, PubMed, and Academic Google databases were searched for scientific papers unrestricted by language and published from 1990 to 2018. A total of nine scientific publications which reported antimicrobial susceptibility of *S. aureus* isolated from bovine mastitis in Argentina is included (Table 1). Only those antibiotics included in at least three studies are shown in the table.

DISCUSSION

There is a growing concern about overuse and misuse of antimicrobial products for treating and preventing infectious diseases in cattle due to its contribution to the emergence and spread of antimicrobial resistant organisms. These organisms represent a great threat to human and animal health, and to the world ecosystem [15]. Bovine mastitis is the most frequent reason for treating both lactating and non-lactating dairy cattle [16, 17] There are no studies in Argentina and limited studies worldwide which compare resistance patterns before and after antibiotic usage throughout years using consistent procedures to evaluate the emergence of resistance due to antibiotic usage [16]. However, several studies have described occurrence of *S. aureus* resistance to antibiotics over time [5]. The antibiotics that were more consistently evaluated in Argentina were the beta-lactams and those of the macrolide-lyncosamide class. Penicillin is considered a first choice antibiotic for treating bovine mastitis. Resistance to penicillin has varied among studies showing the highest percentages during the first two decades (1990–2000) and lower percentages in studies conducted in the current decade. Only in one study, published in 2001, oxacillin-resistant coagulase-positive Staphylococci were detected, indicating that it could have been an isolated finding. However, since methicillin-resistant *S. aureus* have been detected in several countries [18], continuous surveillance is needed for early detection of emergence of this type of resistance.

Antibiotics from macrolide-lyncosamide class are frequently used in Argentina for treating bovine mastitis [17]. Erythromycin is the most commonly tested macrolide as representative of this group, using approved human interpretive criteria [19]. Resistance to erythromycin was low in most studies. Only in one study in the last decade did it exceed 20%, which is higher than percentages reported both in Argentina and other countries [5]. Pirlimycin was commercially available in Argentina during the 90s, and has recently been introduced again to the veterinary market. Susceptibility to this antibiotic was reported in studies published at the beginning of the 2000 decade using veterinary-specific interpretive criteria [19], showing variable resistance among studies and percentages comparable with previous reports in other countries [5].

In conclusion, although information is limited, there is no apparent emergence or progression of *S. aureus* resistance to the most commonly used antibiotics for treating bovine mastitis in Argentina. This finding is in accord with previous reports which included studies conducted in different countries [5, 16]. However, there is a need to extend these studies to other bovine mastitis pathogens, using a harmonized approach to allow measuring resistance trends over time [15]. This information, together with increasing knowledge about antibiotic usage in dairy farms in Argentina [17] will allow us to evaluate and propose actions for a more responsible and prudent use of antibiotics in our dairy farms.

Antibiotic	% Resistant								
Penicillin	14.81	77.5	55.89	40.3	47.6	48.4	14.3	28.12	33.85
Oxacillin	-	-	2.94	0	0	0	-	0	0
Erythromycin	-	-	5.6	11.6	2	2.1	22.2	3.12	7.69
Pirlimycin	-	-	14.71	7.7	4	-	-	-	-
N	33	79	34	206	101	95	63	96	65
Reference	1	2	3	4	5	6	7	8	9

Table 1 – Antimicrobial resistance of *Staphylococcus aureus* isolated from bovine mastitis in Argentina ([6, 7, 8, 9, 10, 11, 12, 13, 14].

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The reality and perceptions of the South African dairy farmer regarding mastitis in 2016

SUMMARY

The South African dairy industry shows immense diversity. There are mastitis management practices, if consistently executed, which might improve udder health and milk flow, but prioritizing these for the diverse segments might be a challenge.

As is the case globally, the South African dairy industry is aware of and actively addressing the issue of AMR. The funding of this survey by the producer organization reflects this on-going commitment.

In 2015, an industry-funded project, Resistance to Available Antibiotics in Lactating Cows with Mastitis, was initiated. An important part of the project was a survey of management practices applied to South African dairies as they pertain to mastitis treatment and prevention.

In South Africa, four dairy regions can be described, roughly equating to the provinces of the Western Cape (WC), Eastern Cape (EC), Kwazulu-Natal (KZN) and the remaining provinces combined into a Central region (Figure 1). Most of the milk is produced along the coastline with more than 50% of the milk produced by grazing dairies with seasonal calving from June through to August (Figure 2). The global trend of increasing milk production with fewer dairy farms is also occurring in South Africa (Figure 3).

METHODS

An online survey was deployed to the Milk Producers Organization (MPO) [1, 2] members of approximately 1,700 dairymen in April (autumn) of 2016. Twenty of the surveyed farms, milking ≥ 200 cows, were selected at random, 5 from each dairy region, for on-site visits where further data was collected. A software application (iPrep) was used to measure the timing between milking routine steps [3].

Results

Following vetting, 147 surveys (or 8.6% of the MPO) were eligible for analysis. Herd size for the survey averaged 448.5 ± 423.6 SD (Figure 4) and was similar irrespective of the management type – pasture only (49%), pasture with concentrate and/or total mixed ration (TMR) (35%) and TMR only (16%). Jersey's and Holsteins are equally popular.

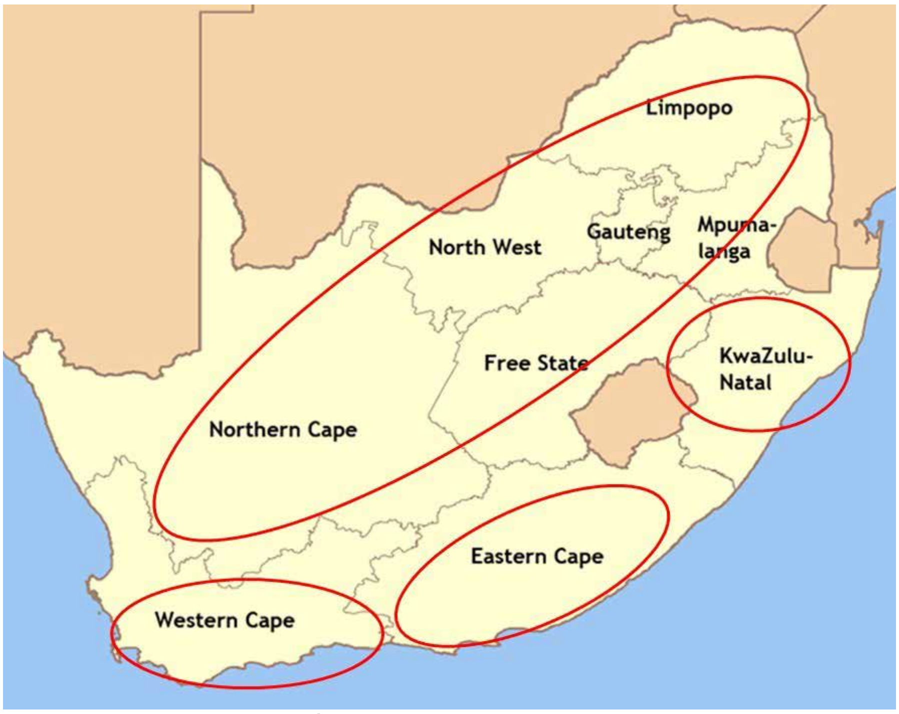

Figure 1 – The four dairy regions in South Africa.

When asked to describe their management style [3], an equal percentage of dairy farmers (± 45% each) considered themselves either low input, lower production or high input, higher production farms, relating to the intensity of their management. The average milk production was 18.2 L/cow/day (ranging from 7.0 to 40.0 L/cow/day), average butterfat 4.24% and average protein 3.54%.

Parlour

A wide variety of parlour types are in use, with swing-over, herringbone and rotary being the most common. Milking routine steps and parlour procedures [5] are compared with international data in Tables 1 and 2. Approximately 50% of dairy farms pre-dip, lower than in some other parts of the world and approximately a third of producers either do not strip or wipe and/or do not use gloves.

Besides the individual steps of a milking routine, the timing between them is important [6]. Timing was erratic within and between most of the dairy farms visited (Table 1). Allowing for an ideal stimulation time of between 60 to 120 seconds, only 11.1% of rotary and 18.2% of other parlours were in this range.

Udder health

The average bulk milk somatic cell count (BMSCC) was 287 ± 98 x 103 SD and were similar for the management types and regions (Figure 5). Fifty-three percent of farms participate in a milk recording scheme (Table 2), higher than that reported for the industry as a whole (± 20%). About two-thirds of dairymen routinely identify cows with an elevated somatic cell count (SCC) either testing individual cows and/or groups (Table 2). Of these, two-thirds consider cows with a SCC ≥ 500 000 cells/ml eligible for treatment.

Udder cleanliness reported in the survey was similar to that recorded on the herds visited. In contrast, in an earlier study, a greater number of teat-ends scored 3 and 4 on herds visited compared to the survey herds [7]. The regular trimming of tail switches is implemented on roughly two-thirds (65.2%) of dairies, yet only 1.0% reported clipping or flaming udders [8].

Mastitis

The mastitis incidence of 31.8% is higher than the median of 20% to 25% seen elsewhere in the world [9, 10] and ranged from 3.5% to 93%. The average cull rate due to mastitis was 6.9%, lower than the target upper limit of 15% [11] and ranging from 0.7 to 27.8%.

Milk samples for culture and microbial identification were collected on 29.2% of farms and 20.2% requested antimicrobial sensitivity. In contrast, in the USA, 68% of dairymen always submit samples for culture and identification or at the least some of the time [12]. In this study, the majority of dairymen treat mastitis with intramammary antibiotics (86.3%), of which half also use injectable antibiotics (49.3%) (Table 3).

The three most commonly isolated mastitis causing bacteria reported were, in decreasing order, *Staphylococcus aureus*, *Escherichia coli* and *Streptococcus uberis*. In contrast, bacteriology of high cell count, normal appearance milk showed coagulase-negative staphylococci, *Staphylococcus aureus* and Streptococcus agalactiae have been shown as the most common [13].

One-fifth of South African dairymen reported using antibiotics in an off-label manner (including higher dosage, shorter treatment intervals and/or an extended duration of treatment), not always doing so under the direction of a veterinarian (Table 3). The efficacy of using of injectable antibiotics, at 49.3%, must be questioned.

Dairy farmers' attitudes toward mastitis are shared in Figure 6, with only a third of dairy farmers feeling that they had enough knowledge regarding mastitis, a result similar to Jansen et al. [14].

Additional information, directly or indirectly, linked to mastitis is shown in Table 4, showing typical lengths of the dry and steam-up/close-up periods. There might be an opportunity to feed higher levels of Vitamin E during the steam-up/close-up period.

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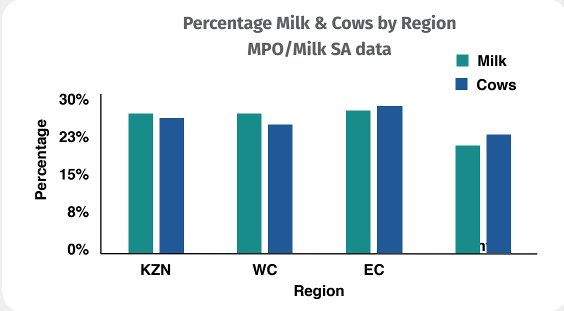

Figure 2 – The distribution of dairy cows in South Africa

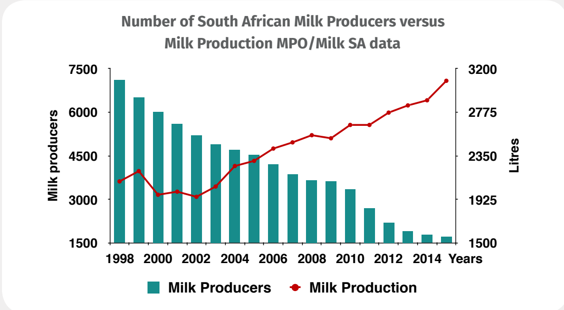

Figure 3 – The trend of dairy farm numbers and milk production in South Africa.

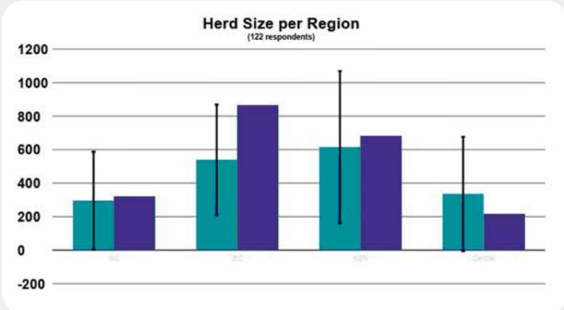

Figure 4 – Herd sizes in the different dairy regions in South Africa as compared to the Milk Producers' Organization census numbers.

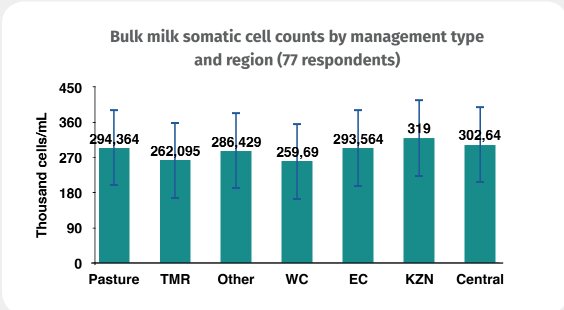

Figure 5 – Bulk milk somatic cell counts on South African dairy farms.

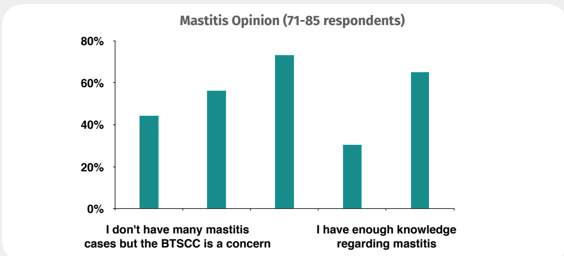

Figure 6 – South African dairy farmer attitudes regarding mastitis.

MILKING ROUTINE TIMING (sec ± SD)				
TIME	Survey only (24)	Farms (20)	Rotary (9)	Other (11)
Pre-dip kill time (30 sec)	22 ± 15	74 ± 51	54 ± 31	87 ± 58
Stimulation to attach (90 sec)	N/A	92 ± 77	77 ± 65	100 ± 85
Entrance to 1st touch (42-54 sec)	N/A	112 ± 99	73 ± 29	144 ± 127

Table 1 – The timing of the important milking routine steps on South African dairy farms.

SUBCLINICAL MASTITIS – SCC MONITORING	%
Individual cow or group (88 respondents)	67.1
As needed (58 respondents)	39.7
Twice or more per year (58 respondents)	60.3
By California Mastitis Test (63 respondents)	51.0
By milk testing agency (63 respondents)	49.0
Quarter samples (46 respondents)	50.0
Whole herd testing (83 respondents)	53.0
Frequency every milk test or more (44 respondents)	63.6
Routinely treat high SCC cows (52 respondents)	67.3

Table 2 – Findings related to subclinical mastitis in South Africa.

MASTITIS TREATMENT & PREVENTION	%
Routinely treat mastitis with antibiotics (79 respondents)	92.4
Use an intramammary antibiotic (73 respondents)	86.3
Use an injectable antibiotic (73 respondents)	49.3
Use an anti-inflammatory (36 respondents)	63.9
Use extra-label treatments (72 respondents)	19.4
Extra-label treatment is authorized by veterinarian (9 respondents)	33.3
Use dry treatment (114 respondents)	88.6

Table 3 – Findings related to mastitis treatment and prevention

SUBCLINICAL MASTITIS – SCC MONITORING	%
Dry period length in days (87 respondents)	61.6
Have a steam-up group (110 respondents)	69.1
Duration of the steam-up period in days (68 respondents)	23.3
Feed anionic salts (37 respondents)	51.4
Measure urine pH (27 respondents)	18.5
Feed additional Vit E (68 respondents)	11.8
Average days in the hospital (58 respondents)	6.4
Mastitis cows kept segregated (90 respondents)	58.9
Waste milk fed to calves (82 respondents)	36.6
Vaccinate for mastitis (83 respondents)	10.8
Use a veterinarian (106 respondents)	77.4
Veterinary visits monthly or more frequent (78 respondents)	64.1
Considers the veterinarian qualified (a dairy "specialist") (81 respondents)	82.7
Demographics	
Average number of years in the dairy industry (147 respondents)	23.6
Dairyman of age < 50 (143 respondents)	51.8%
Hands-on time owners spend with their cows every day (hrs) (144 respondents)	4.36

Table 4 – Other interesting mastitis-related findings, revealed by the survey.

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PHD REPORTS

Selective Dry Cow Treatment in Dairy Cows

Udder health is associated with mastitis management, of which blanket dry cow treatment (BDCT) has been an important part for decades. To prevent the udder from new intramammary infections during the dry period, the use of BDCT has been advocated for more than 50 years as the best dry cow treatment (DCT) practice and part of the five-point mastitis prevention programme to reduce the prevalence of intramammary infections by eliminating infections already present at drying off and by preventing new infections from occurring during the dry period. Since 2012, preventive use of antimicrobials in veterinary medicine is prohibited in the Netherlands. Therefore, BDCT has been replaced by treatment of infected cows only, known as 'selective dry cow treatment' (SDCT). Although selection of cows is an important part of SDCT and has a great effect on the consequences, not much research had been done in this field. Therefore, the effect of various approaches to select cows for DCT on parameters such as udder health, antimicrobial use (AMU) and economics was evaluated.

This PhD thesis quantified the effects of SDCT on clinical and subclinical mastitis, AMU, economic consequences of the use of antimicrobials and farmers' attitude. The effect of different somatic cell count (SCC) threshold-scenarios for selecting cows for DCT on these parameters were evaluated.

The effect of SDCT was evaluated in 1,657 cows in 97 Dutch dairy herds, that all had a low SCC at the last milk recording before drying off. A split-udder design was used in which two quarters of each cow were treated with dry cow antimicrobials and the other two quarters remained as untreated controls. Low SCC was defined

”Farmers' and veterinarians' mindset towards reduction of antimicrobials is crucial for successful implementation of a selective dry cow therapy strategy.”

Christian Scherpenzeel

as <150,000 cells/mL for primiparous and <250,000 cells/mL for multiparous cows [1].

The incidence rate of clinical mastitis was found to be 1.7 times higher in quarters dried off without antimicrobials as compared to quarters that were dried off with antimicrobials. *Streptococcus uberis* was the predominant organism causing clinical mastitis in both groups. SCC at calving and at 14 days in milk was significantly higher in quarters dried off without antimicrobials (772,000 cells/mL and 46,000 cells/mL respectively) as compared to the quarters dried off with antibiotics (578,000 cells/mL and 30,000 cells/mL respectively). Quarters with an elevated SCC or a positive culture for major pathogens at drying off had a higher risk for a SCC above 200,000 cells/mL at 14 days in milk, as compared to quarters with a low SCC and a negative culture for major pathogens at drying off. For quarters that were culture positive for major pathogens at drying off, a trend for a higher risk of clinical mastitis was also found [1].

Selective dry cow treatment, not using dry cow antimicrobials in cows that had a low SCC at the last milk recording before drying off, significantly increased the incidence rate of clinical mastitis and the SCC after calving. The decrease in AMU by not applying SDCT was not compensated by an increase in AMU for treating clinical mastitis. The total AMU related to mastitis was reduced by 85% in these quarters [1].

Although differences were small, BDCT was, from an economical perspective, not the optimal DCT approach. In herds with a lower bulk milk SCC, more dry cow antimicrobials can be omitted without economic consequences, thus leading to lower costs. The economic impact of reducing the percentage of clinical mastitis was found to be much larger than that of reducing the bulk milk SCC. The optimal percentage of cows to be dried off with antimicrobials depends on the udder health situation, indicated by the bulk milk SCC and the incidence of clinical mastitis. For all evaluated types of herds SDCT was economically more beneficial than BDCT, in particular, if bulk milk SCC and clinical mastitis incidences are lower. Therefore, there is no evidence that economically, a change in the BDCT routine to reduction of AMU by applying SDCT [3] is detrimental.

More insight into the level of implementation of SDCT in the Netherlands was obtained via a questionnaire. The main criterion indicated by the farmers to be used to select cows for DCT was the SCC history during the complete previous lactation. There were no significant differences in udder health parameters between herds that applied BDCT or SDCT, nor between SDCT herds with high or low use of dry cow antimicrobials. Overall, AMU was higher in herds which applied BDCT, although there were no significant differences in intramammary treatment with antimicrobials other than DCT [4].

CONCLUSIONS

This thesis showed that reduction of AMU at drying-off leads to an increased risk of mastitis at the individual level. The effect at the herd level was, however, very small. Criteria chosen to select cows for DCT had a limited effect on udder health, while the effect on the amount of AMU was large. Economics was found not to be an argument not to reduce the use of DCT by applying selective dry cow treatment, because in almost all scenarios SDCT was economically beneficial over BDCT.

Application of SDCT appeared to be associated with farmers' and veterinarians' attitude. Their mindset towards reduction of AMU is crucial for successful implementation of a SDCT strategy.

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Genetic evaluation of susceptibility to, and recoverability from, mastitis in dairy cows

Mastitis - an inflammatory response to infection of a cows' udder - is a prevalent disease and has considerable negative economic and animal welfare consequences for the dairy industry. Despite the many preventive efforts, it remains one of the most common diseases in dairy cows. In situations of any high disease prevalence, like mastitis, selection for the recoverability of animals should be, therefore, of interest. This PhD project explores ways to improve the genetic evaluation of udder health by introducing methods and models which can make use of the information contained in recoverability from mastitis in addition to the information contained in susceptibility to mastitis.

At the beginning of the PhD project [1], extensive simulation analyses were performed to develop a bi-variate model for joint genetic evaluation of susceptibility to - and recoverability from mastitis. Mastitis incidences measured via the number of somatic cells in a millilitre of milk (typically used as an indicator for mastitis), were simulated and a transition model was applied to define traits of interest. The somatic cell count (SCC)-based mastitic or healthy states were converted to two series of transitions indicators: one for healthy to diseased (HD, to define mastitis susceptibility) and the other for diseased to healthy (DH, to define recoverability). The traits were analyzed with a bivariate threshold sire model using the Bayesian statistics approach in DMU [2]. The study [1] demonstrated that both traits can be modelled jointly, and simulated correlations could be correctly reproduced.

In the second study of the PhD project [3], the bivariate model developed through simulation with added systematic effects and a function of time was applied to real data extracted from Danish dairy herds database connected to VMS milking robots (Voluntary Milking System, DeLaval International AB, Tumba, Sweden). The SCC measured via cell counters attached to the milking robots, was analyzed in a novel way, using time-to-event

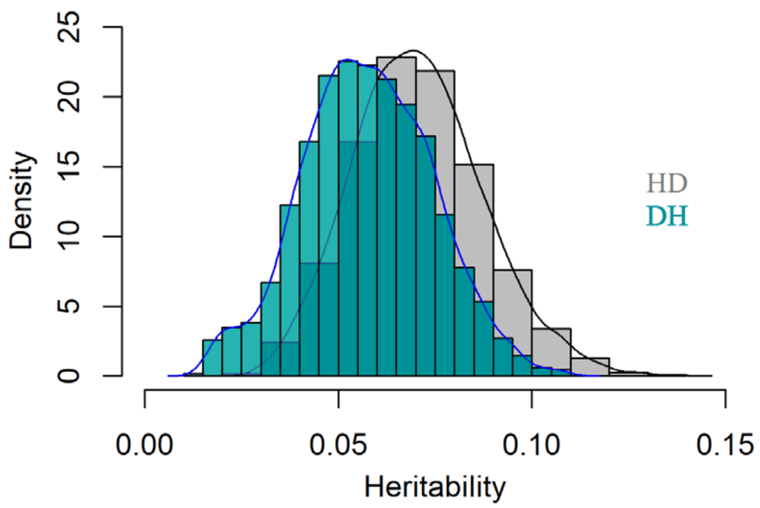

Figure 1 – Posterior distributions of heritability estimates from a Markov chain Monte Carlo sample size of 5,000 for susceptibility (HD, gray and overlapped area) to - and recoverability (DH, blue and overlapped area) from mastitis.

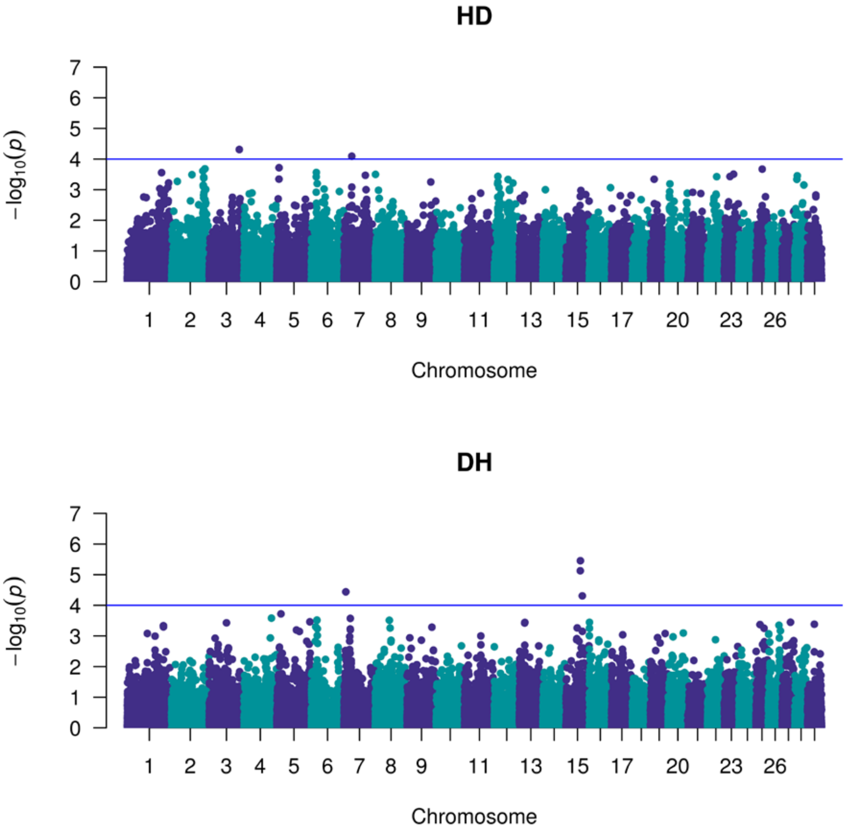

Figure 2 – Manhattan plot of genome-wide associations with susceptibility (HD) to – and recoverability (DH) from mastitis. The blue line represents suggestive significance level [–log10(P-value) = 4] [4].

analyses. Findings in this study indicate that recoverability is as heritable as susceptibility (Figure 1), suggesting that the trait can be improved by breeding. The genetic correlation between susceptibility to - and recoverability from mastitis was -0.83, implying that cows that are resistant to mastitis also recover faster.

In the third study [4], genome-wide association studies were conducted to find positions on the genome that affect HD and/or DH. Single SNP regression analysis was performed, and the substitution effect of each SNP was tested with a t-test. Contrary to the observed high negative genetic correlation in the second study, association signals were mapped in different locations, suggesting that the traits could be regulated by different genes. Moreover, complexity of the traits was manifested with the absence of strong association signals (Figure 2) suggesting that numerous genes with small effects could be involved in both directions of the disease.

"Somatic cell count measured via cell counters was analysed using time-to-event analyses. Findings indicate that recoverability is as heritable as susceptibility to mastitis, suggesting that the trait can be improved by breeding."

Berihu Welderufael

Towards the end of the PhD project [5], a more dynamic health classification, which took severity of possible infection into account, was introduced. Considerable genetic variance was detected for cows' presence in health classes defined for longer periods, whereas the variations in health classes defined for short-term and sudden changes (e.g., acute) were mostly attributed to environmental factors.

Although susceptibility to - and recoverability from mastitis are strongly negatively correlated, recoverability has a similar size of genetic component as susceptibility and could be considered a new trait for selection. Modelling and analyses of the genetics of recoverability could be of specific benefit in situations of high disease incidence. The PhD project has introduced a method for joint estimation of breeding values for susceptibility to - and recoverability from mastitis. With regard to introduction of recoverability or modelling both directions of mastitis, this thesis is novel in the area of genetic evaluation of udder health. This innovative modelling and approach, if adopted, should enhance the genetic evaluation of disease data through its ability to capture time-dependent and additional information not only from susceptibility to - but also from recoverability from a given disease, specifically mastitis.

The PhD project [5] was part of the Erasmus Mundus joint doctorate program 'EGS-ABG: European Graduate School in Animal Breeding and Genetics'.

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Testing of milk samples fails to detect on-going *Mycoplasma bovis* infections in dairy herds

Mycoplasma bovis (M. bovis) is a small bacterium capable of causing disease in cattle of all ages. It is part of the bovine respiratory disease complex and also associated with arthritis and otitis media in calves. In cows, the usual clinical presentation is mastitis and pneumonia, while arthritis is increasingly being reported. Since the first isolation in the USA in 1961, it has spread to many countries and is now endemic in many regions, including Europe. Over the last two decades, *M. bovis* has gained more attention due to its apparently increasing prevalence, intensified severity of the clinical signs and greater antibiotic resistance in recovered *M. bovis* isolates. The traditional way of diagnosing *M. bovis* has been bacterial culture of milk or other body fluids. However, easier and less expensive diagnostic test methods are requested for cows with arthritis or other systemic clinical signs of *M. bovis*-associated disease. In Denmark, serological assays such as ELISA are frequently used for testing dairy cows for other diseases, because they are relatively inexpensive per test and convenient, especially if applied to milk samples routinely collected for other purposes.

> ”The findings of these studies are important to the dairy sector, because they highlight the difficulties in diagnosing *M. bovis* in dairy herds, especially when using primarily milk samples.”
>
> **Mette Bisgaard Petersen**

A study of factors influencing the *M. bovis* ELISA optical density measure (ODC%)[1], which indicates the level of antibodies directed against *M. bovis*, in bulk tank milk (BTM) found that the prevalence of test-positive lactating cows was correlated with the BTM ODC%. For each 10% increase in the prevalence of milk-test positive lactating cows, the BTM OCD% went up by 9 ODC% on average [1]. However, it became obvious that clinical signs consistent with *M. bovis* were reported by farmers even in herds during periods with low ODC%-values measured in BTM (Figure 1). To pursue explanations for the observed dynamics of BTM ODC% and associations with underlying infection patterns, investigations of the antibody responses in individual cows with different clinical signs were warranted.

This was approached through an observational longitudinal study in four dairy herds with acute outbreaks of *M. bovis*-associated disease. The cows were divided into different disease groups based on the observed clinical signs, and the pattern in antibody responses in serum and milk were associated with the time since the clinical signs were first observed. The antibody response measured by the ELISA[2] was generally very dynamic, short-lived and dependent upon the observed clinical signs. Even in systemically diseased cows, the average estimated ELISA ODC% was below the recommended cut-off at 37 ODC% 60–70 days after clinical signs were observed for the first time (Figure 2). This makes the antibody response to *M. bovis* much more dynamic than seen for other diseases and means that frequent monitoring would be necessary to detect emerging *M. bovis* infection in the herd [2].

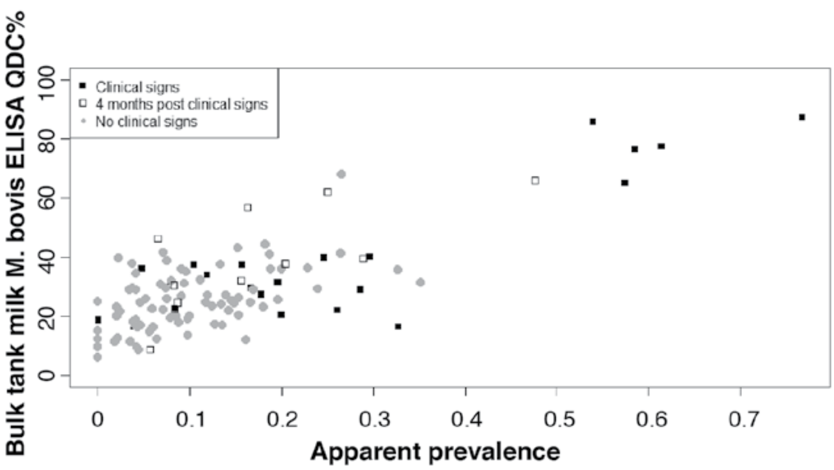

Figure 2 – Descriptive statistics showing the bulk tank milk *Mycoplasma bovis* ELISA optical density measurement (ODC%) plotted against the apparent milk prevalence of antibody-positive lactating cows. Modified from Figure 2 in Petersen et al. 2016, Factors associated with variation in bulk tank milk *Mycoplasma bovis* antibody-ELISA results in dairy herds. J. Dairy Sci. 99:3815–3823.

The ODC% in serum was primarily elevated in cows with clinical signs of systemic *M. bovis*-associated disease, while the ODC% in milk was mostly elevated in cows with mastitis and *M. bovis* PCR-positive milk samples. These findings suggest that secretion of antibodies against *M. bovis* in different fluids differ depending on clinical signs, making milk samples merely useful for detecting *M. bovis* udder infections [2]. In addition, differences were found when looking at the PCR results. Despite the fact that some cows with arthritis, or with non-specific or no clinical signs, were below the recommended PCR-cut-off at Ct-value 37, the cows with mastitis were, in general, clearly further below the cut-off (i.e., more clearly test positive) (Figure 3).

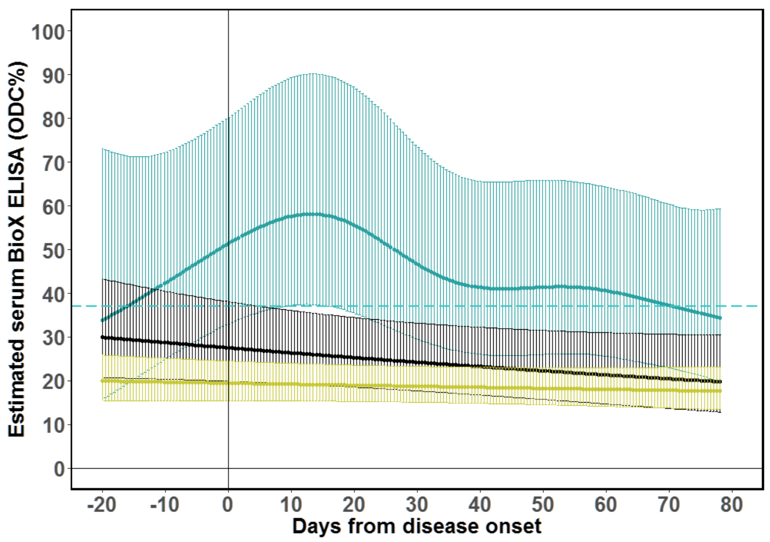

Figure 2 – Estimated mean antibody response in serum (solid line) and 95% confidence intervals (shaded area) as measured by the BioX ELISA Bio K302. Red represents the 'Systemic' group, blue is the 'None' group and black is the 'Non-specific' group. The dotted red line shows the recommended ELISA cut-off (37 ODC%). Modified from Figure 3 in Petersen et al. 2018: A longitudinal observational study of the dynamics of *Mycoplasma bovis* antibodies in naturally exposed and diseased dairy cows. J. Dairy Sci. https://doi.org/10.3168/jds.2017–14340.

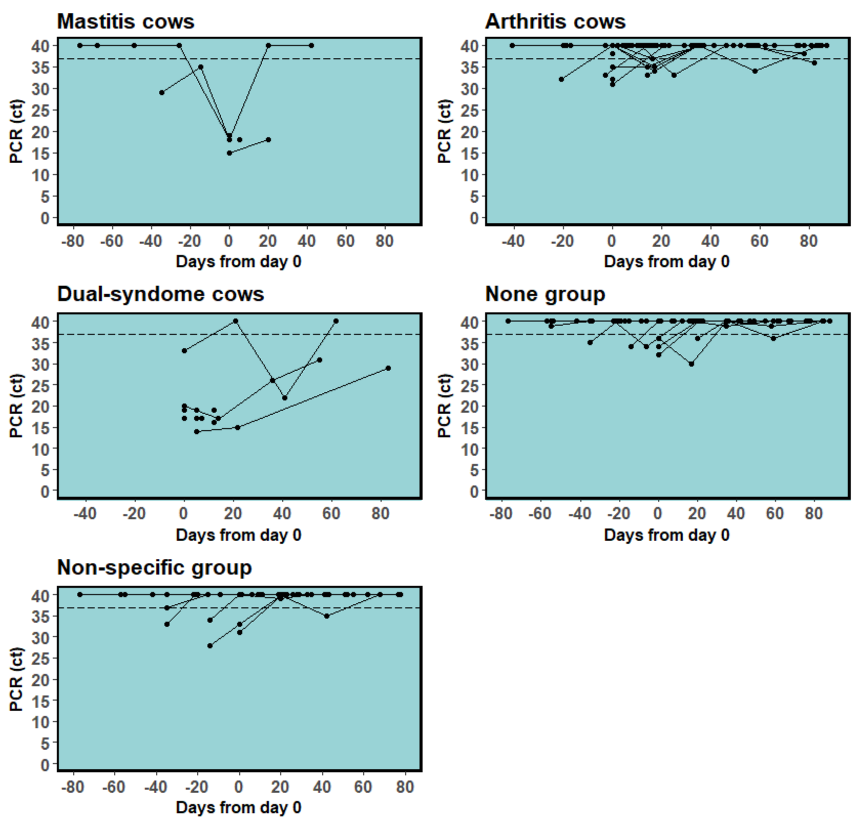

Figure 3 – Distribution of milk PCR cycle threshold (ct) values for *Mycoplasma bovis* divided into five disease groups of dairy cows from four Danish herds. Horizontal dotted lines show the recommended PCR cut-off (37 ct) under which a sample result is considered test-positive. Results from the same cow are linked by lines. 'Dual-syndrome' cows: cows with clinical signs of both arthritis and mastitis. 'None-group' cows: no clinical signs which are likely to be associated with *M. bovis*. 'Non-specific cows': clinical signs which are not typical for *M. bovis*, but where *M. bovis* could not be excluded.

This indicates that PCR in milk samples are also primarily suitable for detecting *M. bovis* udder infections and not *M. bovis*-associated disease or infection in general.

The findings of these studies are important to the dairy sector because they highlight the difficulties in diagnosing *M. bovis* in dairy herds, especially when using primarily milk samples. If only relying on milk samples, many cases are likely to be overlooked, because both individual and BTM samples reflect the presence of *M. bovis* udder infections among the cows and not all other clinical syndromes in cows. Hence, diagnosing *M. bovis* in dairy herds often requires assessment of udder infections as well as systemic infected animals, from e.g., antibody measurements in serum. The very dynamic nature of the antibody response to *M. bovis* and the clear difference related to different clinical signs were previously unclear and demonstrate the value of basic longitudinal studies. If a basic understanding of the diagnostic material or test is lacking, interpretation in different contexts and for different purposes challenging, and recommendations based on these might be incomplete or in the worst case, will be misleading.

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FOOTNOTES

1 BioX Bio K 302 ELISA kit, BioX Diagnostics, Belgium

2 PathoProof Major-3 PCR kit, Thermofischer Scientific, USA

A stronger oestrous improves the fertility in dairy cows

Dairy cow fertility is of great importance to the economy of the dairy industry. The cows have to show oestrous, become pregnant and keep the pregnancy, as well as, calve within a certain interval and produce milk to be economically sustainable. In the Nordic countries fertility has been included in genetic evaluation since the 1970s. Traditional breeding includes fertility traits measures derived from insemination - and calving dates, which in general are highly influenced by on-farm decisions. Unfortunately, the low heritability of these traits makes the genetic improvement slow.

Earlier studies have shown that fertility traits based on hormone levels, such as the progesterone level, have higher heritabilities compared to the classic fertility traits. Progesterone can be measured in milk, but tests and analyses are costly and labour intensive. This limits the opportunity to use these traits in a larger scale.

SWEDISH RED COWS HAVE BETTER FERTILITY COMPARED TO HOLSTEIN COWS

In Sweden, artificial insemination (AI) is used and would be unsuccessful much of the time without oestrous synchronization and timed inseminations. Expression of oestrous symptoms is important for finding a cow in oestrous and for the correct timing of insemination. Weaker oestrous symptoms together with larger herds and fewer working hours per cow can result in reduced possibilities to find cows in oestrous.

In the first part of her PhD project, Sofia Nyman looked at the oestrous intensity and duration, and the extent and pattern of pregnancy losses in the two main dairy breeds in Sweden, the Swedish Red and White (SRB) and Swedish Holstein (SH) breed [1]. The studies are based on ten different oestrous symptoms, progesterone measurements in milk and calving and insemination dates registered in 2,000 oestruses during 16 years at one of SLUs former research herds.

The first and most frequently observed oestrous symptoms in a coming oestrous, were red and swollen vulva, vaginal discharge and discharge colour and should not be neglected in the oestrous detection (Figure 1). To improve oestrous detection, automated registrations e.g., activity measures, together with visual observations could capture more oestrous symptoms. This could result in a better timing of the insemination. Generally, SRB cows, both tied and loose housed cows, had stronger and longer oestruses, better pregnancy results and lower early embryonic losses compared to SH dairy cows, irrespective of milk production levels.

Stronger oestrous intensity was found to decrease the amount of early embryonic loss from AI to day 24 after AI, but no effect was found after day 24 (Figure 2).

"Several fertility traits, such as start of luteal activity and oestrous intensity, could be used in genomic selection where we can choose the best animals by looking at their DNA. Genomic selection is beneficial for traits with low heritability such as fertility."

Sofia Nyman

One explanation for this might be that weak oestrous intensity results in the incorrect timing of insemination. Silent oestrouses, which are ovulations without visible oestrous symptoms, are common in the first cycle. Oestrous intensity was found to increase with increasing ovulation number, while early embryonic loss and total pregnancy loss was found to decrease at later ovulations. Even though later inseminations could benefit

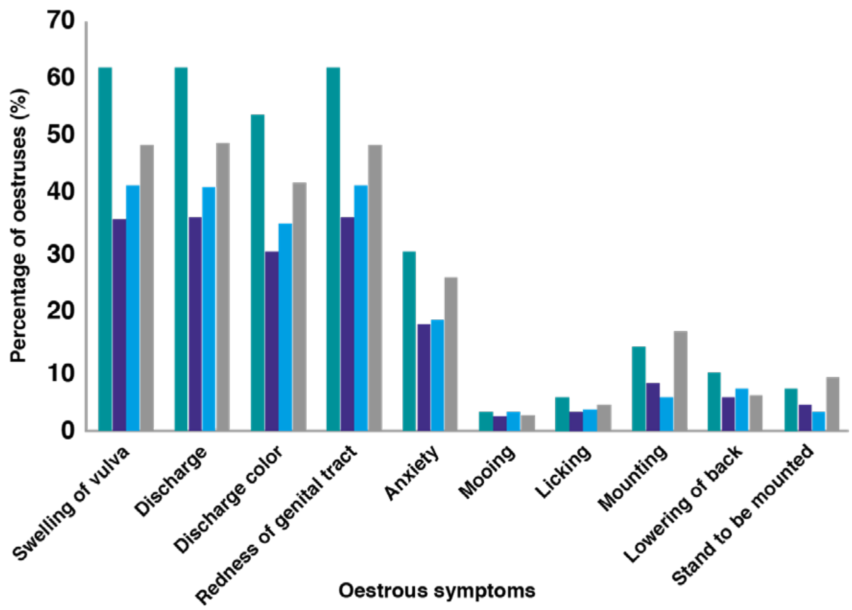

Figure 1 – The prevalence of oestrous symptoms out of total oestrouses per breed (Swedish Red and White, red bar, and Swedish Holstein, black bar) and housing system (tie-stall, vertical pattern bar and loose-housing, diagonal pattern bar).

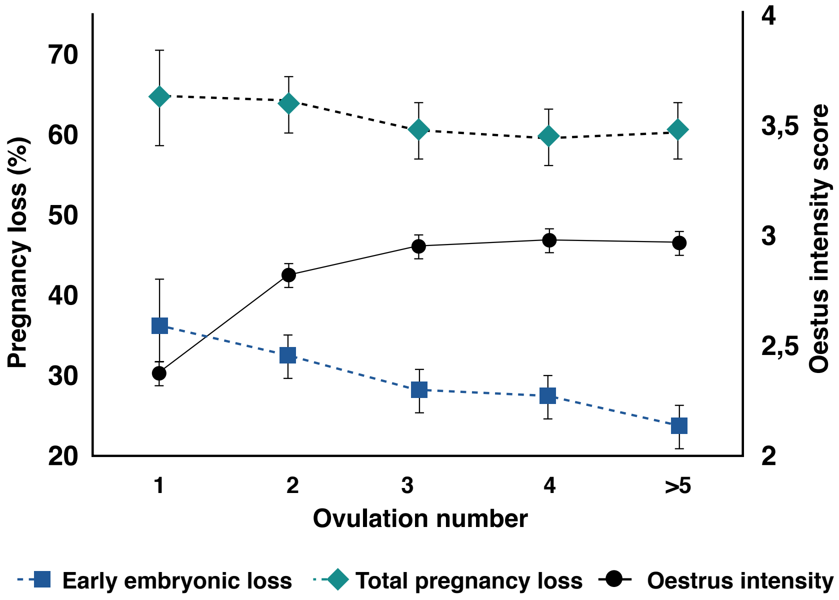

Figure 2 – Oestrous intensity (solid line; right hand y-axis, 2 = weak to 4 = strong), early embryonic loss in (dotted line and square markers; left hand y-axis) and total pregnancy loss (dotted line and triangle markers; left hand y-axis) by ovulation number for Swedish Red and White and Swedish Holstein cows.

the early embryonic survival it would be suboptimal in other aspects e.g., longer calving intervals.

A SEARCH FOR GENETIC MARKERS TO IMPROVE FERTILITY

Following this study, Sofia Nyman investigated the possibility of using progesterone profiles to provide information for a genetic evaluation of fertility [1]. By using information about the DNA (genome), the genetic background for the variation in progesterone profiles between cows can be identified. Holstein-Friesian cows from four different countries were used in this study.

The shape of the progesterone profile during the oestrous cycle was found to be important for the pregnancy result. Deviations from the normal oestrous cycle can result in later inseminations, more inseminations and longer calving intervals, which can result in a lower milk production and negatively affect the profitability.

Two progesterone-based fertility traits, start of luteal activity (CLA) and delayed ovulations, were found to have higher heritabilities compared to the classic fertility traits which are used in for example, the Nordic genetic evaluation. These measurements were also found to be negatively affected by increased milk production and could deteriorate if not considered in the breeding evaluation.

In the analysis of the genome, five interesting regions on three chromosomes with genes connected to reproduction functions were found. Several fertility traits, such as CLA and oestrous intensity, could be used in genomic selection where we can choose the best animals by looking at their DNA. Genomic selection is beneficial for traits with low heritability such as fertility. Genomic selection requires large reference populations of cows that are genotyped and have registered traits e.g., automated registrations of oestrous symptoms and progesterone samples.

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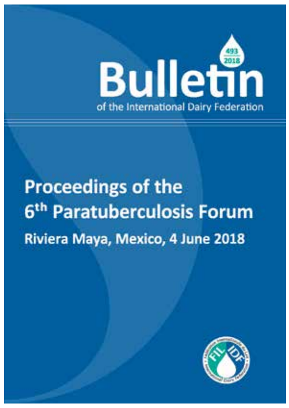
PAST & FUTURE IDF CONFERENCES



Takeaways from the 6th ParaTB Forum

> ”Countries with strong, active programmes are ones that are tightly linked to dairy processors and/or export markets. This level of interest among processors also serves to take a voluntary control and/or status programme and make it mandatory for farmers.”
>
> **David Kelton**

The 6th ParaTB Forum, promoted by the International Dairy Federation (IDF), was held on June 4th, 2018 at the International Convention Centre in Riviera Maya, Mexico. The Forum was comprised of more than 25 delegates, representing 13 countries (Germany, Italy, Spain, the Netherlands, Ireland, Czech Republic, Brazil, Colombia, Canada, Australia, Argentina, Slovenia, and the United Kingdom). The Forum presents an opportunity for delegates to discuss and report on the current state of paratuberculosis research and control programmes in their home nations. This paper reviews some of the common themes and takeaways which emerged from the presentations [1].

INTRODUCTION

Paratuberculosis, also known as Johne's disease, is a chronic, contagious bacterial disease of the intestinal tract which primarily affects sheep and cattle (most commonly seen in dairy cattle), goats as well as other ruminant species. Paratuberculosis is characterized by a slowly progressive wasting of the animal and increasingly severe diarrhoea. The disease is caused by a bacterium called Mycobacterium avium subsp. paratuberculosis (MAP)

There is no known treatment for the disease. Control involves good sanitation and management practices including screening tests for new animals to identify and eliminate infected animals and ongoing surveillance of adult animals.

CONTROL PROGRAMMES

The current status of paratuberculosis control programmes across the 13 represented countries is quite varied. Several countries currently lack a formal established control programme (e.g., Colombia, Argentina, Czech Republic, Slovenia, Spain, Brazil), though active regional control efforts and research are underway. Further variation exists among countries with established control programmes, both in terms of their stage of development/maturity and their goals and objectives. For example, Canada's voluntary control programme, though successful for many years during implementation, has waned in recent years due to reduced funding opportunities. However, Ireland has most recently developed and implemented a national voluntary control programme. Further still, control programmes in many other countries (e.g., Australia, the Netherlands and the United Kingdom) remain active and have matured over time.

Among those nations lacking a control programme, one of the primary barriers appears to be the national status of other important diseases of animal and/or human importance, such as FMD, Brucellosis, BSE and TB. Many of these diseases have warranted more attention and funding and as a result, regionally organized schemes for paratuberculosis control have been deemed lower priority. Researchers from these countries are taking steps to document the current prevalence and disease burden that Johne's disease presents to their nation's ruminant populations. These efforts are aimed at raising the collective industry awareness and knowledge of the issue, and there is hope that this will further motivate interest in establishing more formal programmes for control.

Key drivers for the implementation of regional/national control programmes appear to be related to growing industry concerns about the zoonotic potential of MAP, the desire to be proactive in control at both the farmer and processor levels, and/or to meet trade requirements. Countries such as Ireland and Canada have implemented programmes aimed at taking a proactive approach, but without a specific processor mandate or expectation. However, as documented, Canada has seen a decrease in investment and participation over time. Perhaps most interestingly, countries with strong, active programmes are ones which are tightly linked to dairy processors and/or export markets. For example, the Netherlands and the United Kingdom have seen strong processor interest in establishing herd status programmes, so they can differentiate their products. As a result, there appears to have been strong motivation to participate in the control programmes. This level of interest among processors also serves to take a voluntary control and/or status programme and make it mandatory for farmers. Other countries, such as Canada and Ireland, have not yet seen this sort of uptake.

TOOLS

The primary tools used for control across countries tend to revolve around a wide range of testing options, on-farm risk assessments, incentive programmes, education and awareness campaigns and vaccination (in a few instances). All countries recommend some form

Figure 3 – Attendants at the 6thParaTB Forum Meeting in Cancun, Mexico.

Figure 1 – Dr. David Kelton.

Figure 2 – Dr. Steven Roche.

of testing; from faecal culture or PCR of environmental samples to bulk tank milk ELISA tests, to the use of similar methods at the cow-level. More recent developments and variations exist in the use of a combination of tests (e.g., ELISA followed by direct faecal PCR for confirmation) and/or cut-off values (e.g., test label vs. cut-off for high shedding animals). Many nations supplement these testing schemes with the recommendation to complete a herd-level risk assessment. In certain cases, the risk assessment instruments are unique to Johne's disease, while industry's in other nations (e.g., Australia, Canada) are starting to adopt more general biosecurity risk assessments.

Most countries acknowledged that a primary programme challenge has been producer willingness to participate and/or adopt changes. The use of incentives and/or regulations are the most common tactics used to motivate participation and adoption. These represent the traditional industry 'carrot and stick' levers utilized to influence change, and while it is clear that these methods are effective for certain subsets of populations and regions, they are not wholly adequate. Certain nations are relying on other industry influencers, such as milk processors and/or herd veterinarians, to play a role. As discussed above, the role of the processor has been highly influential. The role of the veterinarian, and other herd advisors, is complex. Buy-in and support among these groups has led to enhanced participation in control schemes; however, a lack of buy-in among certain groups has created a significant barrier to participation. Certain nations have begun to focus on research and development of tailored education, awareness and training methods which seek to engage and motivate these advisors. Additional approaches have focused on the use of social science methodologies, such as peer-learning and participatory extension approaches, to understand producer and advisor mindset and their interactions, and use this information to motivate change.

A CALL TO ACTION

The Forum presentations and subsequent discussions clearly demonstrate that the current state of paratuberculosis control around the world is highly variable. The relative size and maturity of industry groups and the regional governments are important fixed characteristics which can act as motivators or barriers of control programme adoption. However, factors such as perceived priority, and the attitudes and knowledge of paratuberculosis as a problem, represent important variable characteristics which we have the power to influence.

If Johne's disease is ignored, there is clear evidence that the prevalence will increase; particularly in regions where there is significant animal movement. The good news is that many countries are demonstrating a decrease in herd and animal prevalence of paratuberculosis. Several nations have established status/control programmes and have engaged numerous industry stakeholders in the design, implementation and support of the programme - engagement which is crucial to the long-term sustainability of the programme. Furthermore, those without formal programmes are taking proactive steps to provide evidence of the problem and influence industry stakeholders towards adoption.

This Forum has presented a unique opportunity for the sharing of past, present and future perspectives on paratuberculosis control and serves as an incredibly important catalyst for engaging in meaningful international discussion about how to address this globally important issue. Much like our recommendations to producers to 'stay the course' and make Johne's disease control a long-term goal, we, along with our industry, government and academic partners, must adopt a long-term vision towards the prevention and control of Johne's disease.

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The next IDF Mastitis Conference will take place from 14 to 16 May 2019 in Copenhagen, Denmark. It will be hosted by the Danish farmers organization SEGES in collaboration with various research and development institutions.

The conference will gather experts from around the world, with knowledge and passion for udder health and milk quality. We expect around 400 participants from academia, research, general practice, farmer organizations, companies, state agencies and leading animal scientists working with the dairy industry.

The programme starts with a series of short courses on 14 May (limited number of seats available), followed by a welcome reception at Tivoli Gardens. On 15 and 16 May, there will be parallel scientific sessions comprising a broad range of topics such as milking management, diagnostics, social science and molecular epidemiology. Key note lectures will be provided by leading scientists in many aspects of mastitis. The preliminary programme is as follows:

Please visit our website www.idfmastitis2019.com for more information. Early bird registration opens on 15 December 2018 through the website. Information about accommodation will also be made available on the website by the end of the year. Participation fee will be around 400 Euro, half price for students and accompanying persons. For sponsorship opportunities, contact Michael Farre at mifa@seges.dk. There will also be a limited number of student awards, more information to follow.

Tuesday 14 May 2019			
Preconference course	Preconference course	Preconference course	Preconference course
Preconference course	Preconference course	Preconference course	Preconference course
Diamond sponsor industrial seminar			
Welcome reception at Tivoli Gardens			
Wednesday 15 May 2019			
Opening session: Mastitis management in an economic perspective			
Diagnostics		Udder hygiene	
Decision support tools, modelling & economics		Milk Quality	
Social sciences and antimicrobial usage		Small ruminants	
Conference dinner at Circus Building (Copenhagen)			
Thursday 16 May 2019			
Advice and management		Milking machines	
Microbiota and molecular epidemiology		Milking management	
The dry period		Mastitis manageme nt	
Closing session: Diagnostic methods for mastitis - Benefits for farmers and veterinarians			
Friday 17 May 2019			
Technical tour: Farm visit			

There will be plenty of opportunities to network and exchange ideas for all professionals with a core interest in milk. And there will be time to enjoy the great city of Copenhagen. **Please join us on 14 to 16 May 2019. We are looking forward to seeing you!**

Jaap Boes[1], *Chair, Organizing Committee and Morten Dam Rasmussen*[2], *Chair, Scientific Committee*
SEGES, Livestock Innovation, Denmark
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IDF WDS 2018: Session on Animal Health and Welfare

Under the main theme “Dairy for the Next Generation”, the IDF World Dairy Summit (WDS) 2018 will be held in Daejeon, South Korea, from the 15th to 19th of October 2018. Many emerging issues and key aspects of dairy farming and industry will be discussed in the IDF WDS 2018 and it provide a dynamic and interactive platform for all the participants; exchanging novel technologies and knowledge, identifying a common agenda in dairy society and sharing innovative experiences on dairy farming.

During the Summit, the Animal Health and Welfare (AHW) conference will focus on a one health concept to achieve one healthy dairy world. The first session of the AHW conference will cover some emerging issues on infectious diseases in the current dairy farming, including paratuberculosis and the newly developing mastitis vaccines. The second session will present the current problems on antimicrobial resistance (AMR) in dairy farms, animals and dairy workers and how the AMR issues are managed by different countries. The third and fourth sessions will provide various insights on the improvement of animal health and welfare from the viewpoint of dairy customers and farmers from different countries.

Nowadays, the world dairy sector is facing many challenges such as increasing productivity, improving supply and demand management systems, innovating distribution structures and increasing consumption. To successfully navigate such challenges, companies are investing in R&D and dairy farmers are paying greater attention to milk quality, eco-friendly practices and animal welfare. Government efforts also contribute to improving the dairy sector by focusing on collaborations and support rooted in a one health-based approach.

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To maintain good qualitative standards of milk and dairy products, dairy farmers and manufacturers should understand the complicated interactions between the human-animal ecosystems. In a recent study, for example, Lombardo et al. demonstrated how the development of an HACCP-like self-monitoring system with quantitative markers in critical points of the primary milk production chain, as well as in animals, is applicable for toxicant-related zoonoses in daily milk production with a simultaneous health benefit on the human-animal ecosystems (1).

Chronologically, the term “One Health” has been originated from “One Medicine” which was coined in the 1960s by C. Schwabe, a veterinary scientist and epidemiologist at the University of California, Davis, who died in 2006 (2). He emphasized the outcomes and potential benefits of “One Medicine” as added value to public health, which was incapable of being achieved through disciplinary approaches alone (2). However, this term “One Medicine” includes the general science of all human and animal health and diseases without the disciplinary specialization common in both human and veterinary medicine. Thus, the concept of “One Medicine” has been extended to the concept of “One Health” in the 1980s, for sustainable development and/or healthy production of the human-animal ecosystems, wherever they coexist. In 2008, the One Health Initiative Task Force has defined the term “One Health” as the collaborative effort of multiple disciplines working locally, nationally and globally to attain optimal health for people, animals and the environment (3)..

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