# IDF Animal Health Report

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International Dairy Federation IDF · 70/B Boulevard Auguste Reyers · Brussels 1030 · Belgium
info@fil-idf.org · http://www.fil-idf.org

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## From the Editor

Dear Reader,

First of all, for my first preface, I would like to acknowledge my predecessor Ylva Persson for her work. This edition of the International Dairy Federation Animal Health Report will take you on a worldwide journey in the field of health and welfare within the dairy sector. This publication is produced by the IDF Standing Committee on Animal Health and Welfare (SCAHW). In this issue, you will learn more about diverse subjects, ranging from biosecurity and the health status of dairy cows, to bovine and camel mastitis, antimicrobial resistance, recent advances in animal welfare and the importance of coagulase-negative staphylococci.


Louise Winblad (SE)
Editor
louise.winbladvonwalter@vxa.se


## Message from the SCAHW Chair

The International Dairy Federation (IDF) Standing Committee on Animal Health and Welfare (SCAHW) remains active in many areas, and continuous to work with other IDF committees and IDF Task Forces. The work of SCAHW is important for IDF because there is much interest from international organizations (WHO, FAO, OIE, Codex and others), stakeholders and consumers in animal welfare, antimicrobial resistance (AMR) and sustainability. Healthy animals are an important issue in these areas.

As a committee, we represent very diverse expertise within the dairy industry. I would like to take this opportunity to thank you all for your contributions to the development and activities of the committee and welcome new members in our Standing Committee.

This Report gives us a flavour of important developments in animal health and welfare throughout the world. Thank you to the new editor and the IDF secretariat for compiling another interesting publication.


Dr Olav Østerås (NO)
Chair of the IDF Standing Committee on Animal Health and Welfare
olav.osteras@tine.no

# PhD Reports

## Reducing subclinical mastitis in camels in Kenya to improve food security

From a global perspective, the camel is the fifth most important dairy animal. The largest concentrations of one-humped camels (*Camelus dromedarius)* in the world are found in the drylands of the Horn of Africa [1]. Camels are well suited to the harsh conditions of that region and can continue to produce milk when access to feed and water is limited. Milk is a crucial source of nutrition and sustenance for the inhabitants of the arid and semi-arid lands of East Africa. The majority of the camels in the Horn of Africa are kept under traditional conditions and managed by pastoralist communities. The people of these communities adhere to a migratory life style and survive mainly on their livestock [2]. In a survey carried out in 2006, mastitis was named as the main constraint for milk production. Clinical mastitis is known in camel herding communities. However, previous studies indicate that the prevalence of subclinical mastitis might be as much as eight to twelve times higher than reported and is almost never recognized by the herdsmen. Nevertheless, subclinical mastitis can have severe implications for milk production, animal health and food security. One pathogen frequently isolated from milk samples from subclinically infected udders in camels is *Streptococcus agalactiae*, which significantly reduces milk yield in infected animals [3, 4].

The issue of subclinical mastitis in pastoralist camels in Kenya is the focus of a PhD project conducted as a collaboration between the National Veterinary Institute (SVA), the Swedish University of Agricultural Sciences (SLU) and the Kenya Agriculture and Livestock Research Organisation (KALRO). The aim of the project is to develop a control strategy to reduce subclinical mastitis in camels adapted to pastoralist conditions, with the overarching goal of reducing hunger and improving food security. The research team consists of scientists from Sweden, Kenya and Germany with varied backgrounds in mastitis research, camel research and epidemiology.

The project investigates the prevalence, causative agents and risk factors of subclinical mastitis in camels and especially investigates the epidemiology of *S. agalactiae*. In addition, the qualitative data collected will help to increase understanding of what interventions are feasible in a pastoralist setting.

Prior to milking, milk let down is normally induced by suckling of the calf

Camels browsing in Isiolo country Kenya

D. Seligsohn
National Veterinary Institute, 751 89, Uppsala, Sweden
dinah.seligsohn@sva.se

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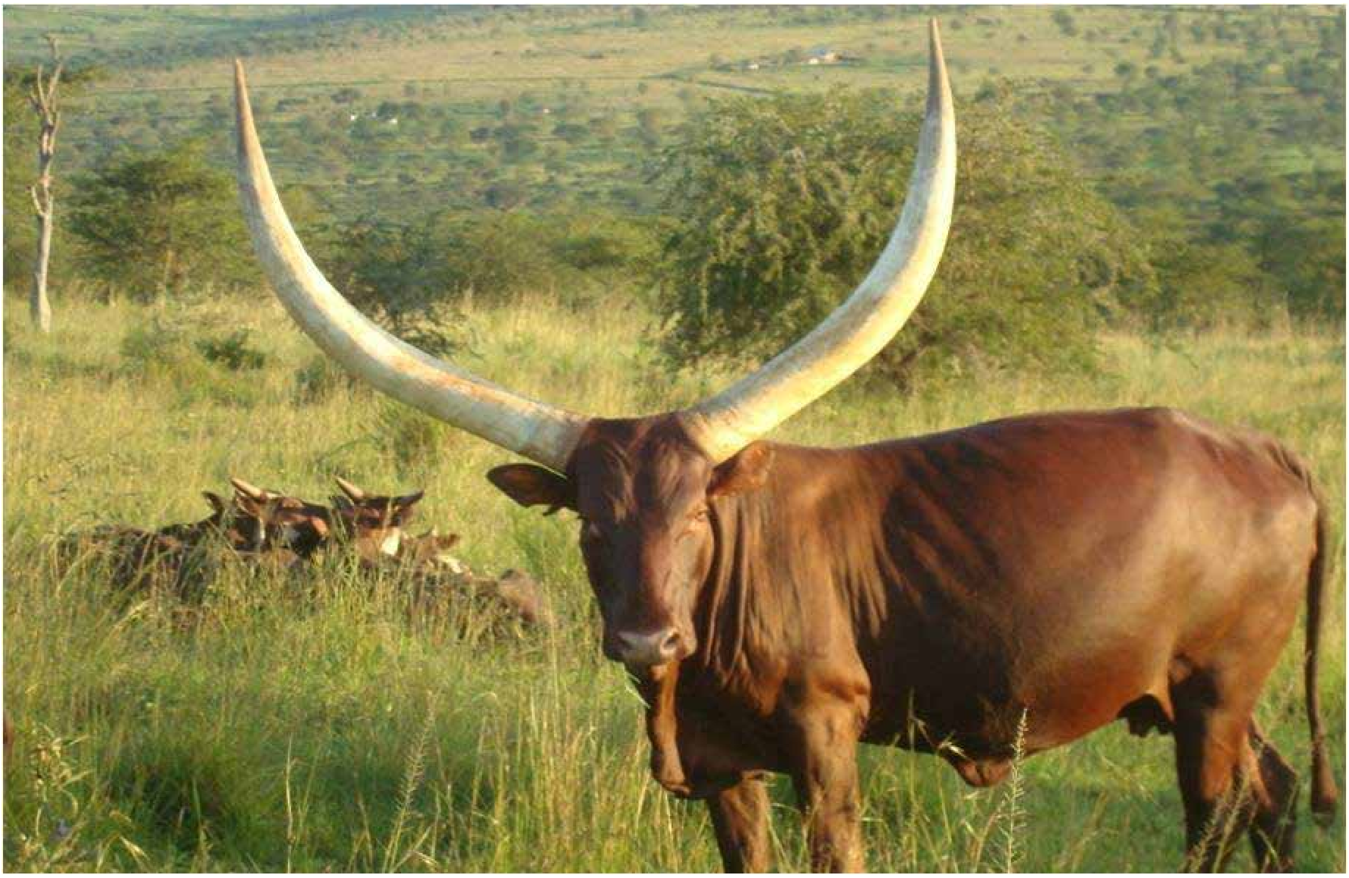
# Bovine mastitis and milk quality in Rwanda

The dairy cow is a very important part of Rwandan culture, and milk production contributes to the fulfilment of nutritional needs for many people. “Girinka Munyarwanda” [1] and “One Cow per Poor Family” [2] are national programmes that distribute dairy cows, mainly Holstein–Friesian and Holstein–Friesian/local crossbreed cows, to poor rural households with the aim of improving a household’s food and nutritional security, as well as income. These programmes have contributed to an increase in cattle population and milk production. Milk production in Rwanda has not yet reached a level that satisfies the needs and requirement of the population. FAO estimates that the per capital milk consumption in Rwanda is 50 kg of milk per year and the deficit to reach a recommended level is 120 kg of milk per year. Along with the increase in dairy cow population, there is a need for updated research at different levels of the milk chain, including prevention practices against pathogens causing udder inflammation (mastitis), improved post-harvest milk handling practices and milk storage.

The aims of this PhD research project are first, to evaluate the prevalence of subclinical mastitis and its aetiology, the prevalence of antimicrobial resistance of the causative pathogens and the associated risk factors for subclinical mastitis in dairy cows in Rwanda. Together with other mastitis pathogens characterization procedures, this study is expected to evaluate the aetiology of mastitis in Rwanda using matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS), a method that can identify bacterial species with high confidence. Accurate identification of mastitis pathogens can help in the design of a proper mastitis control strategy. Second, the study will assess the quality and safety of raw milk in Rwanda from farm level to milk collection centres (MCCs) through the evaluation of milk spoilage bacteria, somatic cell counts (SCC) and the prevalence of zoonotic bacteria. Last, the project will train dairy farmers, MCCs managers/technicians, veterinarians, district veterinarians and students in best practices for good udder health and milk quality.

Before embarking a full study on udder health and milk quality in Rwanda, a pilot study was carried out to evaluate SCC, total bacterial count (TBC), *Staphylococcus aureus*, and antimicrobial residues in bulk milk samples from 20 MCCs located in the north, east and south of Rwanda [3]. The mean SCC for all MCCs was 1048 x $10^3$ cells/ml and 60% of the samples had an SCC above the EU cut-off value of 400 x $10^3$ cells/ml. The study showed variation in SCC among MCCs in the studied regions, ranging from 65 x $10^3$ cells/ml in the south to 7120 x $10^3$ cells/ml in the north. The mean TBC was high (3.8 x $10^6$ CFU/ml), which indicates possible contamination of the milk during milking, transport and/or at MCCs. The study also indicated that *S. aureus* was isolated in 20% of the samples. One sample tested positive for antimicrobial residues.



Local breed at Rwanda Agriculture station

Aetiology and risk factors associated with subclinical mastitis (SCM) and milk spoilage during the chain from farm level to MCCs are currently being evaluated. We hypothesize that the prevalence of SCM in dairy cows in Rwanda is high, that best practices in udder health applied on dairy herds in Rwanda differ and are associated with the prevalence of SCM. Moreover, we hypothesize that factors associated with the handling of milk at the farm and at MCCs affects the quality of milk. We have developed questionnaires for use at animal, herd and MCC levels to acquire information on practices that may be associated with levels of udder health and milk quality in Rwanda. We intend to develop training materials according to gaps identified and train dairy farmers, MCC managers/technicians, veterinarians, district veterinarians and students in best practices for good udder health and milk quality.

In conclusion, the pilot study showed that mastitis is prevalent in dairy cows, as indicated by high SCCs. Furthermore, the high bacterial content in raw milk could lead to milk spoilage. The good news is that it is possible to produce milk in Rwanda with very low SCC and no antimicrobial residues. There is a need to establish knowledge on udder health and raw milk quality in Rwanda and to promote good hygiene practices in pre-harvest, harvest and post-harvest of raw milk. Such information is also needed to ensure the availability of nutritious milk on the Rwandan market, especially for the government intervention programme "One Cup of Milk per Child'' [4]. Ultimately, such information will be used to train farmers and others involved in the milk chain if high quality milk is to be produced in Rwanda and satisfy current and future milk supply needs in Rwanda.

Jean Baptiste Ndahetuye at the University of Rwanda, food microbiology laboratory

J.B. Ndahetuye
Swedish University of Agricultural Sciences (SLU), Department of Clinical Sciences, Division of Reproduction, 756 51 Uppsala, Sweden
jean-baptiste.ndahetuye@slu.se

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# Salmonella in Swedish cattle: Epidemiology and aspects of control

During the last few decades, increasing efforts to prevent the presence of salmonella in the food chain have been made in the EU. In Sweden, all herds in which salmonella is detected are put under restrictions and measures aiming at on-farm eradication [1, 2]. The overall aim of these studies was to provide a knowledge base for government decisions on modifying salmonella control in Swedish cattle herds, and for advising Swedish dairy farmers on how to reduce the risk of introduction and persistence of salmonella infections in their herds. Information was obtained by investigating the occurrence of salmonella in dairy herds, studying potential risk factors for salmonella, describing costs for on-farm salmonella control, and investigating the efficiency of different sampling strategies at the herd level.

Results from a bulk milk screening were used to investigate seroprevalence of salmonella and to study associations between salmonella status and geographical location, animal density, number of test-positive neighbouring herds, animal trade and herd size. Additional information on potential risk factors for salmonella was collected via a questionnaire [3]. The bulk milk screening confirmed a low prevalence of salmonella in Swedish dairy herds. Results showed that 3% ($n$ = 142) of the herds tested positive in the Bovine ELISA test (primarily detecting herds infected with *Salmonella Dublin*, *Salmonella typhimurium* and other serotypes

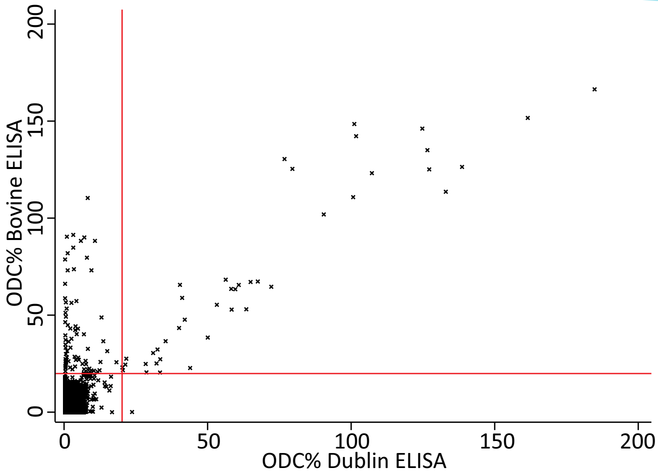


**Figure 1:** Results from a bulk milk screening in 2013 including all Swedish dairy herds ($n$ = 4683). Two tests were used, the Dublin ELISA (primarily detecting herds with *S. Dublin* infections) and the Bovine ELISA (primarily detecting herds with *S. Dublin* and *S. Typhimurium* infections). The results for each herd in these two tests are shown (*ODC* corrected optic density). The *red lines* represent a cut-off value of 20 ODC%.

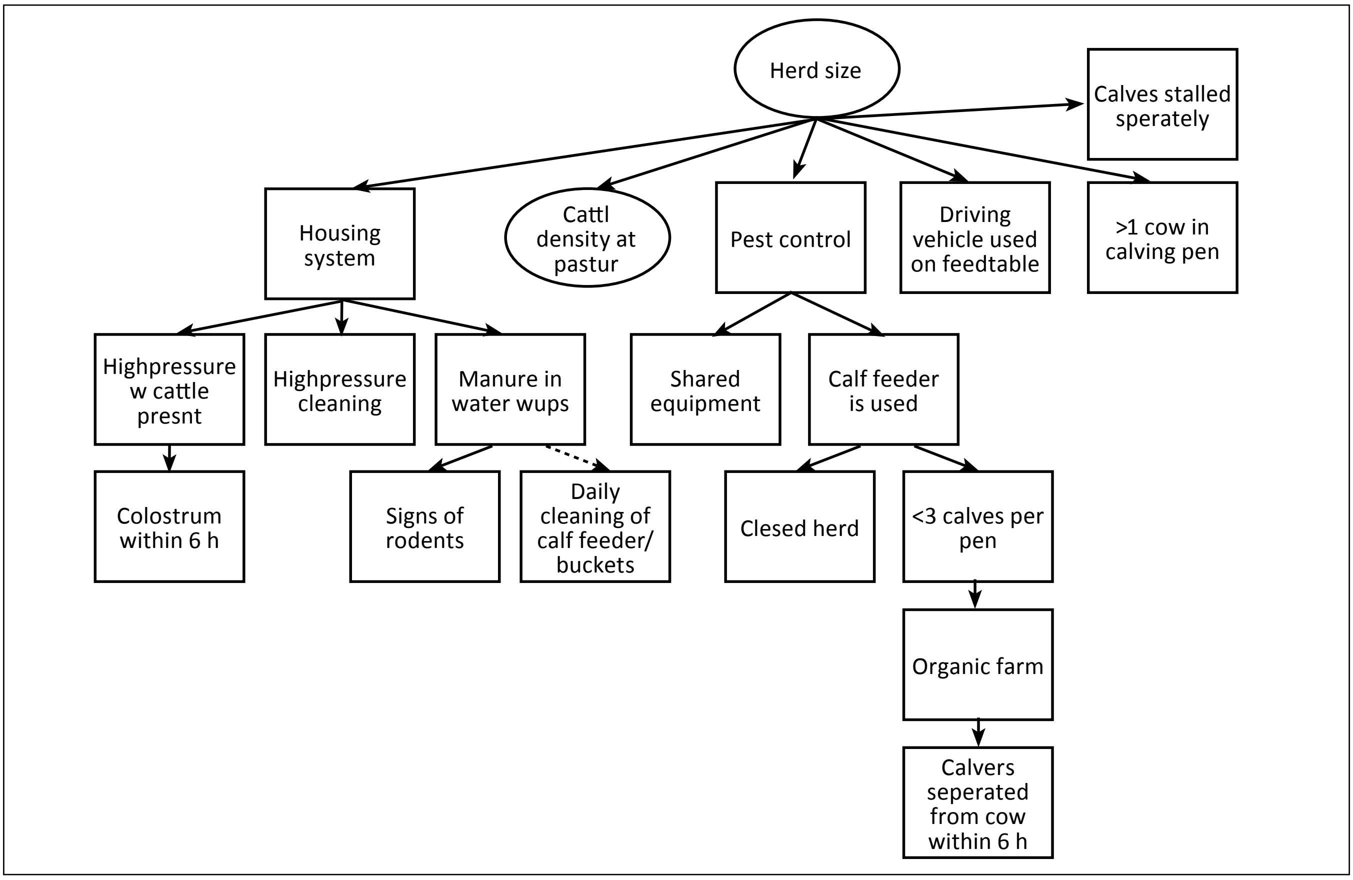


**Figure 2:** Results of a multivariate analysis on questionnaire data showing associations between herd size and other variables [3]. The results are shown as a directed acyclic graph with *squares* representing binary variables and *ovals* representing continuous variables. *Arrows* between variables indicate direct associations between these variables, but contain no information on causality. *Arrows with a continuous line* indicate a positive association (e.g. larger herds were more likely to have calves stalled separately). *Arrows with a dashed line* indicate a negative association (e.g. daily cleaning of calf feeding buckets is less commonly reported in herds where manure in the water cups is seen frequently).

with similar antigens) and 1% ($n$ = 41) were also positive in the Dublin ELISA (Fig. 1). In Öland, an island in the southeast, the prevalence of Dublin-positive herds was considerably higher (15%) than in other parts of Sweden (0–1.2%). There was a strong association between Dublin-positive herds and presence of test-positive herds within 5 km (OR 22.4, 95% CI 9.1–54.9). Herds infected with serotypes other than *S. Dublin* were more evenly distributed throughout the country (0–5.5%). However, there was still an association between these herds and the number of test-positive herds within 5 km (OR 1.6, 95% CI 1.04–2.56). The results indicate that local spread is an important component in transmission of salmonella between herds. Based on the questionnaire study, no additional factors of major importance were identified, suggesting that broad external biosecurity is the best approach for preventing salmonella. This suggests that local efforts focusing on occasional herds within a cluster region might not be as useful as a collective local effort aiming to involve most dairy farmers in a cluster region.

The effect of animal trade was tested using several measures but, in contrast with several other studies, no significant associations with salmonella status were found [3]. This result was most probably because the test status of selling herds not was available and, in a low prevalence region, the probability of infection is very low for any selling herd or purchased animals. Tracings from infected herds have shown that purchase of animals is an important route of infection, in Sweden also.

Large herds were more likely to be Dublin-positive (OR per 100 animals was 1.2, 95% CI 1.1–1.4), and the effect of herd size was larger for *S. Dublin* infections than for other serotypes [3]. A multivariate analysis revealed associations between herd size and many management factors. Conditions and management routines more common in large herds were free-range housing, group pens for calving, driving of vehicles on the feed table, and higher density of cattle on pastures (Fig. 2). These might create preconditions for persistence of salmonella infections. Organic herds were more often test-positive (OR 2.5, 95% CI 1.2–4.9), and it is possible that some management procedures that are regulated in organic herds (e.g. longer time between birth and separation of a calf from the cow) increase the risk of within-herd circulation of salmonella.

Costs for implementation of the required measures in restricted herds during the years 1999–2013 were on average 0.49 million euros per farm, with a median of 0.11 million euros, and a range of 1080 euros to 4.44 million euros. Large herds and long restriction periods were associated with higher costs [4].

Efficiency of different sampling strategies was evaluated at the herd level [4]. The study highlights the importance of considering a herd's risk of having salmonella when deciding on sampling strategies for different purposes (e.g. surveillance of pre-purchase testing). The added value of testing a herd differs, depending on a herd's prior probability of infection (Fig. 3). In a low prevalence region, the added value of testing might be marginal. These results can be used to support interpretation of herd test results and decisions on testing for different purposes.

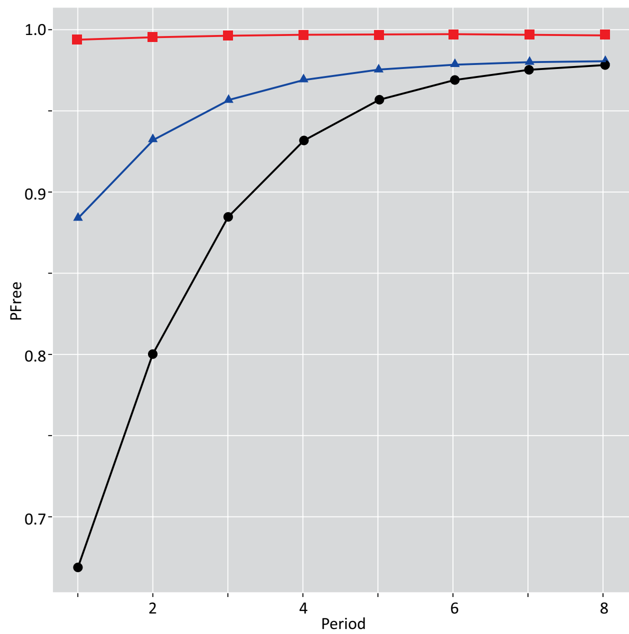


**Figure 3:** A herd's probability of freedom from salmonella after repeated testing PostPFree ($y$-axis) based on sampling of bulk milk (herd sensitivity0.53). *Squares* represents results for herds in a low prevalence region (prior probability of infection; PriorPInf = 0.01; probability of introduction; PIntro = 0.003). *Triangles* represent herds in a high prevalence region (PriorPInf = 0.20, PIntro = 0.02). *Dots* represent herds with completely unknown salmonella status (PriorPInf = 0.50, PIntro = 0.02). Each data point represents the discounted PostPFree after each new sampling every three months (period, $x$-axis).

E. Ågren
Swedish National Veterinary Institute, Department of Disease Control and Epidemiology, 751 89 Uppsala, Sweden
estelle.agren@ sva.se

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## Assessment of cattle welfare at stunning in commercial abattoirs

In the European Union, abattoirs must take measures to avoid pain and minimize distress during the slaughter process [1]. To fulfil such requirements properly, animals must be rendered unconscious (stunned) before sticking, which is a process to drain the body of blood and ensure death. If deep unconsciousness is not present after stunning (in practice, detected by observation of certain behavioural symptoms), there is potential for the animal to experience pain and suffering. This study aimed to develop and implement an assessment method for stun quality for use in commercial cattle and pig abattoirs relevant to protecting animal welfare. It also aimed to discuss how animal welfare can be safeguarded. This article only discusses the results relevant to cattle.

Most major slaughter plants in Europe stun cattle with two types of captive bolt stunners. The cartridge bolt stunner (CB) is a handheld device that, when triggered, fires a spring-loaded retractable bolt by means of gunpowder-filled cartridges. The pneumatic bolt stunner (PB) uses compressed air to propel a retractable bolt. To assess stunning, a protocol was designed to describe and evaluate behavioural signs seen after animals were stunned. Behavioural signs (symptoms) were rated from 0 to 3 to indicate the stun quality level (SQL) and risk of inferior animal welfare. Animals with SQL0 showed signs of a deep stun with no risk of recovery, but those with SQL3 indicated recovery and the highest risk of inferior animal welfare.

Using this protocol (Table 1), routine slaughter of 1000 cattle was assessed for stun quality and shot accuracy. Of the 585 bulls looked at, 98 (16.7%) were inadequately stunned compared with 27 of 413 cows (6.5%) ($p < 0.0001$). Bulls showed high-risk symptoms (SQR3) more frequently ($p = 0.0011$) than other cattle (6.9% compared with 2.1%). The incidence of inaccurate shots was 8.0%, with 16.7% of bulls requiring re-shooting compared with 6.5% of cows. Of the bulls showing inadequate stunning, 79% were shot accurately. Furthermore, 14 bulls aged over two years were shot more than three times. One example was a Holstein needing five shots before signs of recovery were eliminated. No cows, steers or calves were shot more than twice. A combination of poor maintenance of the stunner, inaccurate shooting, and use of a power range too low for the size of animal (0.22 calibre stunner) were considered the major factors in causing such a high frequency of inadequate stunning in this abattoir.

In the second study, 1725 cattle in six abattoirs were surveyed, five of which used CB stunners and one that used PB. The brains of 12 cattle were also macroscopically examined to assess brain damage in association with signs indicating inadequate stunning.

The proportion of CB-shot bulls inadequately stunned was 9.5%, 15.9%, 13.8%, 6.0%, and 6% compared with 1.3% for PB-shot bulls. For CB stunned cows, it was 4%, 0.4%, 2.3%, 0% and 0% and 1% for PB. Only the abattoir using PB stunning reported no bulls showing high-risk recovery signs. Risk factors identified as contributing to a higher frequency of inadequate stunning included use of cartridge/fired stunners that were too low in power for bulls, poor maintenance of stunners, and the lack of neck restraints to prevent inaccurate shooting. Stun quality appeared to be optimized by the use of a Jarvis® pneumatic stunner in combination with neck restraints. In two bulls that showed recovery signs (corneal reflex, blinking and breathing), shot with a 0.22 CB stunner, the bolt failed to penetrate the brain and there was little haemorrhaging of the brain compared with bulls that were well stunned. The bulls were more than two years old (Charolaise and Angus breeds) and had the thickest of the 12 skulls investigated (3.2 and 3 cm, respectively); the thinnest skull was 0.5 cm. The Angus bull was shot five times, but still had a low level of brain haemorrhaging, indicating a probable malfunction of the stunner. Re-shooting may have had no effect because of a reduction in impact energy due to absorption by fractures in the skull [2]. Another possible cause could be the extremely muscular necks present in some older bulls, which could reduce the acceleration forces primarily responsible for destroying the brain during stunning. Bulls were generally more nervous at restraint than cows or steers, indicating a lack of exposure to handling and restraint experience. Furthermore, in five of the six abattoirs studied, the pen where animals were restrained for stunning was located close to where carcass processing occurred, exposing animals to high noise and activity levels. This appeared to cause some animals to struggle during stunning, which is a probable factor in reducing shot accuracy and stun quality.

Use of a standardized protocol and scoring of stun quality allows a more accurate and standard comparison of animal welfare between abattoirs. The study revealed that there is a wide range of animal welfare standards at slaughter, with inadequate stunning affected by many environmental risk factors, most of which can be minimized through good management procedures. This study highlights the importance of external monitoring as a safeguard for animal welfare. Abattoirs should be externally assessed, with at least a full day being spent assessing stun quality. If ≥ 5% of cattle display recovery signs, the stun system and management should be immediately reviewed.

| Stun quality /inferior animal welfare level | Symptoms |
|---|---|
| SQS 3 High risk | |
| Inadequate stunning at the highest risk of recovery and compromised animal welfare. Re-stunning necessary to prevent suffering | Failure to drop<br>Groaning/vocalization<br>Respiration<br>Corneal/palpebral reflex<br>Spontaneous blinking<br>Pain reflex<br>Attempt to regain posture or raising of the head |
| SQS 2 Moderate risk | |
| Inadequate stunning, but with a moderate recovery risk and compromised animal welfare.<br>Re-stunning necessary to eliminate recovery risk | Nystagmus<br>Full rotation of eye (mostly sclera seen)<br>Gasping |
| SQS 1 Unknown risk | |
| If shown, animal is closely monitored and tested for reflexes | Tongue up in mouth at sticking<br>Excessive struggling at sticking<br>Ears up at sticking<br>Partial rotation of the eye (iris is partially seen) |
| SQS 0 No risk | |
| Animal is deeply stunned and there is no concern of recovery or reduced animal welfare | Immediate collapse<br>Tonic and clonic phase of spasms<br>Involuntary limb movements<br>Fixed eyeballs<br>Dilated pupils<br>Glassy appearance over iris and pupil |

**Table 1:** Stun quality protocol describing symptoms from 0 (no recovery risk) to 3 (highest recovery risk)

S. Atkinson
The Department of Animal Health, Faculty of Veterinary Medicine, SLU, Uppsala, Sweden
info@smartanimalhandling.com

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# Other Research

## Reverse vaccinology approach for the prevention of mycobacterial disease in cattle

Vaccination is a cost-effective means of preventing the transmission of infectious diseases in animals. These diseases cause direct economic loss to livestock producers and to the economy at large [1]. The use of vaccines by the livestock industry is still limited, although vaccination could reduce the use of antibiotics in the treatment of disease and decrease the risk of transmission of zoonotic diseases to humans. One of the greatest barriers to success is discovering appropriate antigens to induce effective immunity [2].

A Canadian team of scientists under the co-leadership of Dr Andrew Potter of VIDO-InterVac at the University of Saskatchewan and Dr Robert Hancock of the University of British Columbia is undertaking the development of vaccines against cattle tuberculosis and paratuberculosis. The four-year project initiated in October 2015 is sponsored by Genome Canada through their Genome Prairie and Genome BC centres, and benefits from the collaboration of scientists from four Canadian research institutes, namely VIDO-InterVac and the Johnson Shoyama Graduate School of Public Policy at the University of Saskatchewan, the University of British Columbia and the University of Calgary.

The major deliverables of the project are two new vaccines for significant mycobacterial diseases such as tuberculosis and Johne's disease, which affect livestock worldwide, and the development of a companion diagnostics allowing the differentiation of infected animals from immunized animals. The Canadian team of scientists is using a genomics-based approach called reverse vaccinology, which allows them to identify and track in parallel every possible candidate protein as a potential vaccine for cattle diseases.

To determine which proteins are expressed during infection and which antigens can cause an immune reaction, the response of cattle and bacteria during infections is monitored. The process of reverse vaccinology provides an efficient and effective method of developing vaccines using the parallel identification and expression of every possible antigen, and screening them for vaccine potential. This information assists in determining the vaccine potential of bacterial components, while supporting the rationale for the development of novel vaccine formulations and immunization strategies. Scientists use the cloning of genes for hundreds of antigens to produce a harmless expression vector in bacterium Escherichia coli, which enables inexpensive production of each antigen [3]. The antigens are tested in appropriate natural animal infection models to see which can cause immune responses that trigger protection against bovine tuberculosis and Johne's Disease.

In parallel, a team of economists are assessing the level of competitiveness of a genomics-based vaccine with respect to existing animal culling strategies and new practices involving immunization [4]. The study involves investigating public perceptions, readiness of the livestock industry, appropriate commercialization strategies and implementation of the relevant regulatory framework and policies. The outcome is the production of comprehensible information dedicated to consumers, producers, the livestock industry and governments on options and strategies for dealing with the mitigation of two important infectious cattle diseases, namely tuberculosis and paratuberculosis.

R. Bouchard
Vaccine and Infectious Disease Organization - International Vaccine Centre (VIDO-InterVac), Saskatoon, SK S7N 5E3, Canada
info@vido.org

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## Good recovery after penicillin-treated acute puerperal metritis

Acute puerperal metritis affects cows during the early postpartum period and causes fever, fetid vaginal discharge and general depression. Cows with dystocia, twin births and retained foetal membranes are particularly at risk of developing metritis. The disease is considered to be severe, often requiring treatment with antimicrobials and anti-inflammatory drugs.

In an observational field study, we followed 79 Swedish dairy cows with acute puerperal metritis. Clinical cases were assigned by participating practitioners, who examined the cows, performed uterine swab sampling, decided treatment and provided information about cow health and calving conditions. Bacteria from the uterus were conventionally cultured and their susceptibility to penicillin studied. Fertility and culling data were collected from the Swedish official milk and health recording scheme. Recovery from disease was defined in four levels: survival for 1 month, survival for 4 months, insemination and pregnancy. Intervals from dates of first and latest calving to insemination date were studied.

The most common bacterial findings were a mixed culture of *Escherichia coli* and bacteria such as Gram-positive cocci, *Fusobacterium necrophorum*, *Clostridium* spp. or *Trueperella pyogenes*. Gram-negative bacteria were present in 90% of the samples and 45% of the samples contained at least one Gram-positive bacterial species. Of the isolated *E. coli*, 18% had haemolytic properties. Anaerobic bacteria were found in 39% of the samples.

The Gram-positive cocci *Pasteurella* spp. and *F. necrophorum* were generally susceptible to penicillin. The majority of cows (70%) were treated with penicillin in accordance with the Swedish antibiotic policy on treatment of metritis, whereas 19% were treated with tetracycline and 8% were not treated with any antimicrobials. Although this was not designed as a proper treatment study, and the number of animals in the different treatment groups was low, we noticed that recovery rates were similar between treatments. We advocate further studies to confirm this observation, with untreated controls included.

Recovery after acute disease was high. Survival rates at 1 and 4 months after parturition were 89% and 80%, respectively. Death associated with acute disease was low (6%), but the culling rate within 300 days after parturition was high (57%) compared with the national mean of 33%. Reported reasons for culling were mainly low milk production and mastitis. The results imply that the cows recover well from acute disease but that farmers are, for some reason, less prone to inseminate them again. The cows that survived and were inseminated performed well and 70% of the inseminated cows became pregnant. Of the pregnant cows, 74% had been *E. coli*-positive, and most had been treated with penicillin. The “calving to last insemination interval” was 5 days shorter (i.e. better) than the national mean. In addition, fertility was slightly reduced compared with the national mean. “Calving to first insemination interval” was 4 days longer than national mean (92 versus 88 days) and the number of inseminations per cow increased from 1.9 to 2.1. *E. coli* culture-positive cows did not become pregnant to the same extent as cows without *E. coli* in the uterus ($p < 0.05$).

Individual cows seem to cope with bacterial contamination after calving, even when it develops to uterine disease. The self-cure rate is reported to be high, but the difficulty lies in distinguishing which cows need antibiotic treatment and which do not. A clinical sign that may be indicative of severity of disease is the body temperature. A tendency was seen for cows with fever ≥ 40.0°C not to become pregnant to the same extent as cows with rectal temperatures of 39.5–39.9°C, regardless of antimicrobial treatment and the time of year. Rectal temperature ≥ 40.0°C could indicate a bad prognosis for recovery.

In conclusion, *E. coli* was the most common bacterial pathogen isolated from cases of acute puerperal metritis in this Swedish study [1]. Although this bacterium is inherently resistant to penicillin, and most cows were treated with penicillin, death caused by acute disease was low. Recovery and final fertility results in surviving cows were acceptable. In times of emerging antimicrobial resistance and demand for prudent antimicrobial use, we suggest that penicillin is a “good enough” choice if antimicrobial treatment of acute puerperal metritis is needed.

R. Båge
Division of Reproduction, Department of Clinical Sciences, Swedish University of Agricultural Sciences, Uppsala, Sweden and Växa Sverige, Development and Services for Farmers, Stockholm, Sweden
renee.bage@slu.se

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# Coagulase-negative staphylococci: friends or foes?

Coagulase-negative staphylococci (CNS) are frequently isolated from the mammary gland of dairy cows. CNS are often the most prevalent bacteria found in bovine milk samples [1] and in milk from other ruminants such as sheep and camels [2, 3]. As a result of colonization of the teat apex and teat canal, CNS may have a protective role against major mastitis-related pathogens. Nevertheless, CNS are mostly considered to be minor pathogens because they can cause intramammary infection in cattle and are able to cause both clinical and subclinical mastitis, which can result in reduced milk production [1].

CNS form a heterogeneous group. Phylogenetic relationships among CNS species can be determined on the basis of certain housekeeping genes, such as *rpoB* or *cpn60*. The use of whole-genome sequencing (WGS) can also give a wider view on the phylogeny and help to predict evolutionary relationships of bovine CNS species by using sequences from multiple genes. In addition, WGS can determine associations between phylogeny and many biological traits, such as virulence, antimicrobial resistance (AMR), environmental niche, geographical distribution, and host specificity. *Staphylococcus* species possess several worrisome virulence genes and may thus generate adhesins, biofilms, enterotoxins, and exotoxins, or transfer AMR factors. Based on WGS, *Staphylococcus agnetis* and *S. hyicus,* followed by *S. pasteuri, S. capitis* and *S. arlettae,* are the CNS with highest virulence potential [4]. This potential seems to be lowest within the species *S. fleuretti, S. epidermidis, S. hominis, S. succinus, S. nepalensis, S. equorum* and *S. xylosus.* However, based on the number of virulence genes, no CNS approximates the virulence potential of the coagulase-positive *S. aureus.* Time to evolve is required for the CNS species to gain prevalence or virulence by the acquisition of a few genes. Biofilm formation may play a crucial role in the evasion of host-defence mechanisms by CNS. However, there is no evidence in CNS of an association between biofilm genes such as *bap* and *icaP* and propensity to cause intramammary infection (in comparison with species primarily colonizing extramammary niches). Production seems to occur mostly in environmental CNS, a feature that could enhance their survival. With respect to transferable AMR genes, CNS may act as a reservoir and vehicle for commensal bacteria. Many of these genes are found on mobile genetic elements may lead to horizontal gene transfer and quick development of resistant populations. Even though a varied number of (multi) resistance genes (*ampA*, *fexA*, *cfr*, *str*, *blaZ, tetK)* can be found in CNS [4, 5], there are differences between species and even on strain level. Although resistance genes seem to be uncommon in some species (*S. arlettae*, *S. capitis*, *S. gallinarum*, *S. hominis*, *S. nepalensis*, *S. vitulinus*, and *S. xylosus*), the investigated strains of *S. epidermidis*, and *S. sciuri* had a high number of resistance genes [4, 6]. In this respect, the prevalence of *S. epidermidis* on human and animal skin, and the abundance of *S. sciuri* in dust and manure, may allow these species to come into contact with other organisms and to be prone to acquire resistance genes. Mapping of the AMR distribution in CNS can give better insights into the potential risks associated with an environment under constant antimicrobial pressure.

An improved understanding of phenotypic behaviour can be obtained by combining genomic data with in vivo studies. A mouse model of mastitis can be useful in predicting the presence and behaviour of certain CNS, for instance with respect to their ability to reduce major pathogens such as *S. aureus*. The *in situ* production of CNS bacteriocins (ribosomally synthesized peptides or proteins with an antagonistic activity against species that are closely related) was tested. CNS seemed to be a rich source of bacteriocins (belonging mostly to class I, also known as lantibiotics) and are a promising source of antibiotic alternatives [7]. A similar murine model was also successfully used to evaluate inflammatory markers that reflect subclinical CNS events, including infection by *S. chromogenes*. Quantifications of the bacterial load compared with the inoculation level were carried out, as well as measurement of histological and immunological parameters. Interestingly, a lower inoculum dose ($10^2$ versus $10^3$ CFU/100 µl) resulted in a higher bacterial load. Although no clinical signs of mastitis were evident, neutrophil formation in the mammary gland tissue could be seen for the inoculated quarters, and innate immunity markers increased with inoculum dose [8].

In addition to their involvement in animal health and dairy production, the metabolic activities of CNS are important for the production of fermented meats, such as fermented sausage [9]. Conventional use of CNS as meat starter cultures, besides acidifying lactic acid bacteria, usually leads to an appropriate cured colour development based on their nitrate reductase activity (formation of the red nitrosomyoglobin pigment). In addition, CNS metabolism contributes to flavour, although the precise effects are not always easy to estimate. There are reasons to believe that these basic technological features of CNS can be further enhanced by exploring their full metabolic potential. Non-negligible differences in metabolism between and within different species of CNS indicate that a rational selection of strains could lead to the development of novel starter cultures with enhanced functionality. Cured colour generation could be optimized to lower the amounts of curing salts needed, either by selecting for efficient nitrate-reducing CNS strains or by exploring potential alternatives based on nitric oxide synthase activity. Furthermore, CNS with specific aroma-producing abilities could help to accentuate certain flavours. The selection of wild-type strains from artisan-type fermented sausages seems attractive in the framework of innovation-through-tradition [10]. Bacteriocin-producing CNS strains may offer solutions for bioprotection against meat pathogens such as *Clostridium botulinum* or *Staphylococcus aureus*. Overall, making use of the metabolic interspecies and intraspecies heterogeneity of CNS is promising for the elaboration of healthier, tastier and safer fermented meats. However, the proposed strategies are still theoretical and speculative, requiring further proof of principle.

Overall, the results presented during the second CNS seminar contribute to a better understanding of the metabolic heterogeneity within the group of CNS. This is not only important to appreciate the ecological functioning of CNS in their diverse habitats, but also to identify new potential roles. The use of whole-genome sequencing can improve CNS identification and elucidate the relationship with their virulence potential, epidemiological characteristics and adaptation to different habitats. From an applied point of view, application of carefully selected CNS with specific functionalities could offer certain benefits within animal health applications, but also in relation to their potential for improving the quality and safety of animal products such as fermented meats.

M. Sánchez Mainar[1] and Ylva Persson[2]
[1]International Dairy Federation, Boulevard Auguste Reyers 70/B, Brussels, Belgium; [2]Swedish National Veterinary Institute, Department of Animal Health and Antimicrobial Strategies, 751 89 Uppsala, Sweden
msanchezmainar@fil-idf.org, ylva.persson@sva.se

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## Literature review of antimicrobial susceptibility in bovine mastitis pathogens

The emergence of antimicrobial resistance in bacteria has had profound effects on the management of therapeutic approaches to both human and veterinary diseases. Prudent use of antibiotics is a vital component in disease control and in assuring milk quality in most successful dairy management schemes. Therapy of bovine mastitis is the most common use of antibiotics in lactating dairy cows. Beginning in 2005, an annual comprehensive review of the scientific literature by the International Dairy Federation Standing Committee on Animal Health and Welfare (IDF SCAHW) has been prepared and reported to committee members. The specific goal was to determine whether scientific data demonstrate an emergence of antimicrobial resistance in mastitis pathogens after four decades of antibacterial drug use in dairy cows. Procedures for the survey include searching for the words “mastitis”, “bovine”, “antimicrobial” and “resistance” using the ISI Web of Knowledge©. Peer-reviewed publications of controlled trials and field surveys testing antimicrobial susceptibility of isolates taken from mammary secretion samples of individual cows were included in the literature review. A total of 249 scientific peer-reviewed publications from the years 2005 to 2015 that reported antimicrobial susceptibility of mastitis pathogens from 54 nations were included.

The use of antimicrobial drugs in treatment of bovine mastitis over the last 40 years has not resulted in an apparent emergence or progression of resistance in bacteria causing the disease. Impeding a definitive verdict is the fact that relatively few studies have been published that compare resistance patterns of isolates historically observed with those of isolates obtained at a later date using consistent technology and procedures. Trials that have compared antimicrobial resistance of bacteria isolated during different chronological periods have demonstrated similar patterns of resistance today as those recorded over the last 30 years. Despite a lack of empirical data demonstrating enhanced resistance, it is essential to use procedures and management strategies that assure prudent and justified use of antibiotics to minimize the possibility of facilitating emerging antimicrobial resistance in mastitis pathogens. This vigilant oversight of antimicrobial use is justified by the isolated reports of resistant strains and detection of resistance genes in bacteria associated with dairy cattle and dairy products. The IDF SCAHW will continue to monitor and report new research results, in comparison with historical data, to alert the dairy industry of confirmed changes in antimicrobial resistance within mastitis pathogens. Appropriate and coordinated responses to prevent and control spread of resistance by management of therapeutic regimes will be proposed by the IDF if an emergence of antimicrobial resistance among mastitis pathogens is confirmed.

Peer-reviewed papers searched by keywords “mastitis”, “bovine” “antimicrobial” and “resistance” in Web of Knowledge (ISI) 1990–2015. Papers were reviewed and only those including data from bovine-derived milk samples were included. See the scientific references on Annex 1.

J. Hogan
Department of Animal Sciences, The Ohio State University, Wooster, OH, USA
hogan.4@osu.edu

# Summaries of Other Projects

## The World Organisation for Animal Health and the annual collection of data on the use of antimicrobial agents in animals

The World Organisation for Animal Health (OIE) is an intergovernmental organization 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 (AMR) and antimicrobial use in animals.

Combatting AMR is a priority issue for the OIE, recognizing the vital role played by antimicrobials in human health, animal health and animal welfare. To ensure sustainability of livestock production, the efficacy of antimicrobials must be preserved through the principles of responsible and prudent use. Monitoring usage also 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 Antimicrobial Resistance", 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 the years 2010–2015.

The first report*, OIE annual report on the use of antimicrobial agents in animals: Better understanding of the global situation* [3], can be found on the OIE website 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 from 2010 to 2015.

### Second phase of OIE data collection

For the second phase, participation increased to 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 that countries face in providing quantities of antimicrobial agents in animals. When analysis of this phase is complete, this section will inform on what OIE member countries need in order to collect antimicrobial use data.

### Work to define a denominator (animal biomass)

Data collected to this point include measured amounts (in kilograms) of different antimicrobial agents used in animals by country. 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.

The OIE will use a variety of sources to determine animal biomass, including published databases, literature reviews and the OIE World Animal Health Information System (WAHIS), which collects census data on animal populations in 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 use of antimicrobial agents in animals and allow refinement of the analysis over time.

| OIE region | Number of member countries who submitted templates | Number of OIE member countries | Proportion of responses (%) |
|---|---|---|---|
| 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

E. Erlacher-Vindel[1], M. Raicek[2] and D. Góchez[2]
[1]Head of the Science and New Technologies Department, [2]Chargée de mission at the Science and New Technologies Department, International Organisation for Animal Health

[1]e.erlacher-vindel@oie.int

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# Summary of Scientific Opinion: Risk for the development of antimicrobial resistance due to feeding of calves with milk containing residues of antibiotics

Any use of antimicrobials, either in human or veterinary medicine, might result in the development of antimicrobial resistance (AMR) and, thus, has an impact on human and animal health, although the specific impact has not been quantified to date.

The treatment of dairy cows during the dry period and during lactation is common in EU member states. Penicillins, alone or in combination with aminoglycosides, and cephalosporins are most commonly used. In some member states, third and fourth generation cephalosporins are frequently used.

The level of residues in the waste milk depends on numerous factors, including the type of drug, dosage and timing of administration relative to milking and the route of administration. The type of drug and its chemical properties (among other factors) define its half-life in the animal and its transmission from the blood to milk via the blood–milk barrier and, hence, its potential concentration in the milk.

It is possible that calves are being fed with milk that potentially contains residues of antibiotics originating from the same farm. The two following sources can be differentiated:

- Colostrum of cows treated with long-acting antibiotics at the start of their dry period.
- Milk from cows that were treated with an antibiotic during lactation and were milked during the withdrawal period.

The feeding of waste milk can have other effects because of the microbial load of the waste milk and could contribute to calf disease. In addition, there may be an alteration of the calf gut microflora and an influence on cow health and metabolism. Further study of this topic is needed because it is outside the scope of this European Food Safety Authority (EFSA) study [1].

The feeding of calves with milk containing residues of antibiotics on the farm of origin is not harmonized and is subject to national rules.

The European Commission requested that EFSA assess the following risks:

- Development of AMR caused by on-farm feeding of calves with colostrum potentially containing residues of antibiotics.
- Development of AMR caused by on-farm feeding of calves with milk from cows treated during lactation with an antibiotic and milked during the withdrawal period.

Furthermore, EFSA was asked to propose possible options to mitigate the risk of development of AMR derived from such practices.

## Summary of report

*Request 1*:" Assess the risk for the development of antimicrobial resistance (AMR) due to feeding on farm of calves with colostrum potentially containing residues of antibiotics; focusing on colostrum and transition or post colostral milk (day 1 to 5)."

Residue levels of antimicrobials decrease with the length of the dry period. When the interval from the start of the drying-off treatment until calving is as long as or longer than the minimum specified in the summary of product characteristics of the antimicrobial, faecal shedding of antimicrobial-resistant bacteria does not increase when calves are fed colostrum from treated cows. When cows calve earlier than the minimum withdrawal period, levels may be higher but the available evidence is insufficient to quantify this risk. In one observational study, no effect was observed.

*Request 2*: "Assess the risk of development of AMR due to feeding on farm of calves with milk of cows treated during lactation with an antibiotic and milked during the withdrawal period."

Milk from cows receiving antimicrobial treatment during lactation contains substantial residues during the treatment and withdrawal period. This includes both systemic and/or intramammary treatment. Consumption of such milk leads to increased faecal shedding of antimicrobial-resistant bacteria by calves.

*Request 3*: "Propose possible options to mitigate the risk for the development of AMR derived from such practices."

A range of possible options are described in the literature. Targeting high priority critically important antimicrobials (HP CIAs) is one option. Depending on the lists used to categorize the HP CIAs, this could include β-lactams antibiotics such as penicillin and cephalosporins. These antimicrobials can be degraded by fermentation with specific β-lactamases. However, this leads to a higher load of other bacteria and is not practical on-farm. Increasing the pH of milk to 10 has the potential to reduce the concentration of certain antimicrobials (e.g. cefquinome), as shown in one study.

Options to mitigate the presence of resistant bacteria in raw milk or colostrum are mainly based on thermal inactivation. Non-thermal options (e.g. microfiltration, centrifugation) are less effective and are not easily carried out at the farm level.

## Recommendations

The following recommendations are given in the Scientific Opinion [1]:

1. "The feeding to calves of colostrum and milk containing residues of antimicrobials that could select for antimicrobial-resistant bacteria should be avoided, particularly those selecting for resistance to highest priority CIAs.
2. The contribution of resistant bacteria to the environment from faeces of calves fed milk containing antimicrobials should be compared to the contribution that would arise from other methods of disposing of milk that contains both antimicrobials and resistant bacteria.
3. Besides antimicrobial-resistant bacteria in calf faeces, attention should be paid to the presence of antimicrobials in calf faeces, which could also contribute to the development of AMR in the farm environment.
4. To perform further studies regarding:
    a. The concentration of antimicrobial residues in field colostrum and milk samples, and the thresholds at which selection for antimicrobial-resistant bacteria occurs in calves.
    b. The effectiveness of different mitigation options."

E. Berry
Animax Ltd., Bury St. Edmunds, IP31 2AR, UK
Elizabeth_Berry@bcva.co.uk

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# News from Member Countries

## Norwegian stakeholders' common action plan against resistant bacteria

Antimicrobial resistance is a concern to the world population. Today, about 700,000 people throughout the world die as a result of antibiotic-resistant bacteria. The number is increasing and, if the trend continues, it is estimated that about 10 million people will die because of such bacteria by 2050. This is why WHO has developed a "Global Action Plan on Antimicrobial Resistance" [1]. Other international organizations such as OIE, FAO, ISO and Codex are supporting the plan. The action plan includes a demand that all countries should prepare a national action plan by May 2017.

In Norway, such an action plan against antibiotic resistance has been put into place by the government [2]. Antibiotics are used both in human and animal populations. In Norway, about 80% of antimicrobials are used for humans and 20% for animals. The challenge is largest in human populations; however, there is also pressure to set up a strategy for use in animal production. The Ministry of Agriculture and Food has demanded that stakeholders reduce the use of antibiotics in animal production by 10% from 2013 to 2020.

In 1995, a strategy was introduced for Norwegian stakeholders to reduce the use of antibiotics by 25% over five years. The strategy was based on three main pillars: (1) change the attitude towards using antibiotics by information, (2) decrease the incidence of disease by a good prevention programme integrated with the use of data technology and the animal recording system, and (3) breed more disease-resistant cows by implementing health records in Norwegian breeding programmes.

This plan was a success; a 25% reduction in antibiotic use was reached in 1998, within three years. The reduction in mastitis treatment has continued until now, and is 60–70% lower than in 1994 (Figure 1). There was no increase in bulk milk somatic cell count (BMSCC) during this period.

The proportion of *S. aureus* resistant to penicillin in vitro was reduced from 16% to 2–3% in 2016 during the same period of 1994–2016. Data from 2003 to 2016 are presented in Figure 2.

Norway is one of the European countries with the lowest use of antibiotics per animal unit, together with Iceland and Sweden, according to a European Medicines Agency report published in 2016 [3]. This was also true when data on fish were withdrawn from the statistics.

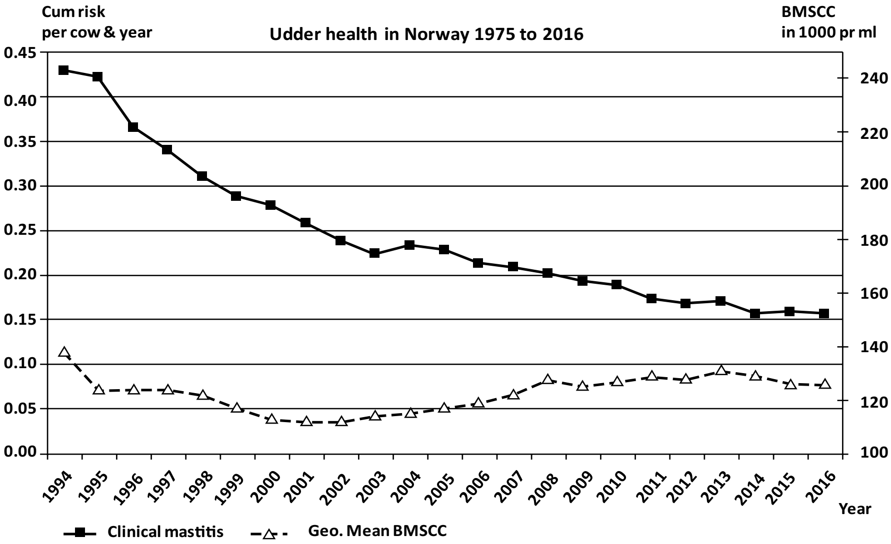


**Figure 1:** Risk of mastitis treatment per cow per year and bulk milk somatic cell count (BMSCC) in Norway from 1994 to 2016.

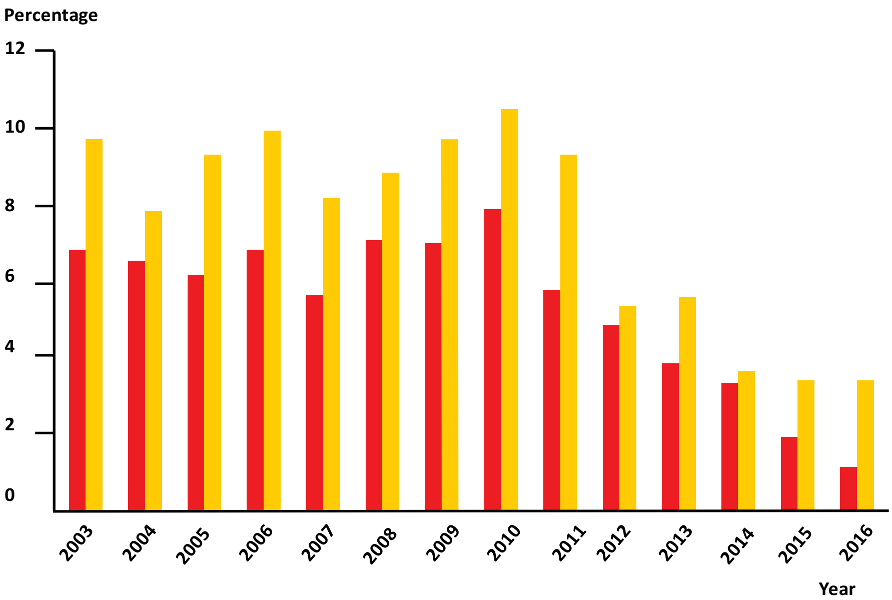


**Figure 2:** Proportion of penicillin-resistant *S. aureus* isolated from cases of clinical (in red) and subclinical mastitis (in yellow) during the period 2003–2016.

Despite the reduction in mastitis treatments from 1994 to 2016, it is possible to obtain further reduction. The stakeholder's new action plan from April 2017 has the following seven points:

1. Continue with good national biosecurity and prevent import of diseases and resistant bacteria.
2. Improve biosecurity between herds and within farms.
3. Reduce the incidence of disease in Norwegian food-producing animals.
4. Optimal and documented use of antimicrobials.
5. Document low use of antimicrobials, and further reduce prevalence of specific antibiotic resistance.
6. Generate new knowledge through research and development.
7. Strengthen cooperation between authorities, research institutions and other stakeholders.

Biosecurity is one of the most important tools because experience shows that import of live animals and contact with human societies with known high levels of antibiotic resistance are the highest risk factors for new introduction of resistance genes such as *MRSA* and *ESPL* into the animal population. Reduction in disease incidence is also important because healthy animals do not need antibiotic treatment, nor do they have a reservoir of resistant bacteria. Prevention of disease can also be achieved by breeding healthier animals. The task remains to optimize the use of antibiotics for animals that need treatment. This can be done by treating the right animal at the right time, and using the correct dosage and preparation. The present situation in Norway is that about 85–95% of antibiotics used for food-producing animals are penicillins. Estimates show that optimizing the dosage and treatment strategy in mastitis could reduce the use of antibiotics by 20–30% without any damage to animal welfare and food quality. There is no point in reducing the use of antibiotics, but in optimizing their use. Chronically infected cows (with continuous high somatic cell count) that cannot be cured should not be treated. The same is true for infections that cure by themselves. There is also a need for documentation of all usage of antibiotics and other medicines. This information will help optimize the usage and act as a basis for research and development. A FAO report pointed out that there are still some gaps in our knowledge on the development of resistance [4].

Finally, experiences from Norway and other countries show that reducing or optimizing the usage of antimicrobials can only be achieved when authorities, research institutions and stakeholders cooperate to accomplish the same common goal.

O. Østerås
TINE Advisory Services, Norway
olav.osteras@tine.no

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# Successful biosecurity programme for cattle farms in Sweden

A new biosecurity programme for cattle herds in Sweden, "Smittsäkrad besättning", was launched in 2015 [1, 2]. The aim is to increase the overall biosecurity of cattle herds, by enhancing farmers' knowledge of infectious diseases and prevention measures and providing tools for implementing on-farm biosecurity routines. Up to April 2017, there were 2800 herds enrolled in the programme, of which approximately 1900 were dairy (corresponding to 50% of all dairy herds), 500 suckler and 300 fattening herds (in addition to heifer hotels and buffalo herds).

The programme consists of the following three levels:

*First level:* This level consists of solely web-based activities, including a theoretical course in biosecurity and a risk assessment inquiry. The motive for a simple entry into the programme, without any veterinary inspection, is to reach as many herds as possible and thereby increase the base level of biosecurity awareness in Swedish cattle herds. The inquiry covers eight areas: animal contacts, visitors and staff, transport and shared equipment, stall hygiene, health monitoring, feed hygiene, manure routines and environmental risks. The aim is to increase interest in biosecurity and promote awareness of the herd's weak points.

*Second level:* This level adds a veterinary visit, which consists of a control part and an advice part. In the control part, the herd has to reach a base level in a number of biosecurity and hygiene check points, including biosecurity for visitors, animal contacts, feed hygiene and feeding routines, stall cleaning and stall hygiene. The advice part is adapted to each farm and is based on the results of the online risk assessment and the control check points.

*Third level:* This level consists of an on-farm practical course in biosecurity held by programme veterinarians. The staff develop a mutual plan, supported by the veterinarian, regarding the herd's internal biosecurity routines.

All veterinarians that carry out levels two and three are certified by a special education programme and are checked regularly to ensure the quality of the programme.

There are also regulations regarding animal contacts that apply to all levels of the programme. For example, joint pasture can only be used with herds enrolled in the programme, and there are rules for isolation before introducing new animals. A number of voluntary recommendations also exist, such as purchase animals only from herds that are on the same or higher level of the programme; fill out health forms provided by the programme; and enrol herds in "safe animal trade" sampling, whereby bulk tank milk is tested for *Salmonella* spp., *Streptococcus agalactiae* and *Mycoplasma bovis* four times a year by automatic subscription. These recommendations might become regulations in the future.

There are a number of measures, both economic and social, designed to nudge herds to join the programme. Herds enrolled in the programme are entitled to higher economic compensation from the Board of Agriculture in cases of salmonellosis. In Sweden, detection of salmonella in a herd implies the need for hygiene and eradication measures, which often are costly. Herds enrolled in the programme from level two get a sign "Smittsäkrad besättning" to put on the entrance as a signal that they are qualified at level two. Group pressure from neighbouring farms regarding status in the programme can arise regarding the ability to use joint pasture, and from herds that are purchasing animals.

The programme has an open-access web page with information on infectious diseases and biosecurity measures (smittsakra.se), which also includes animations and videos so that farmers can share lessons learned after having experienced an infectious outbreak.

The programme was developed by Växa Sverige in cooperation with the Swedish Animal Health Service (Gård & djurhälsan) and the National Veterinary Institute, and the development was financed by the Swedish Board of Agriculture. The yearly fee for herds in the programme is approximately 100 euro, not including the cost of the veterinary visit.

Previous programmes against specific agents such as bovine leucosis and bovine viral diarrhea virus (BVDV) have been successful in controlling the specific infection, but not as successful in terms of generally increasing the biosecurity level. Recent research has shown that Swedish cattle farmers in comparison with pig farmers have a lack of knowledge on the spread and prevention of infectious diseases, and also that there are large variations between herds regarding biosecurity. Structural changes with increased herd size, as well as public health concerns such as the development of antibiotic resistance, demand a higher level of biosecurity in cattle herds.

A. Ohlson and S. Andersson
Växa Sverige, Box 30204, 104 25 Stockholm, Sweden
anna.ohlson@vxa.se, sofie.andersson@vxa.se

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# Milk sustainability module in Germany

On behalf of the association for quality management in raw milk (QM-Milch e.V.) and in collaboration with other stakeholders, the Thünen Institute has developed a "Milk Sustainability Module" to meet the growing requirements on sustainability. The module is a scientifically based instrument to help dairies and milk producers meet the needs of market partners and society, substantiate facts and show that milk production is already sustainable and continues to develop. The module implements, for the first time, a system that is able to collect and map data on the complex issue of sustainability in German milk production at a reasonable cost.

In spring 2017, the pilot phase for the sustainability module began in Germany [1]. About 34 dairies are using the nationwide module as part of a collaborative project with Thünen Institute, the Association for Quality Management in Raw Milk (with the sponsoring associations of the German Farmers' Association, the German Raiffeisen Association and the Association of the German Dairy Industry) and Land & Market. The Federal Ministry for Food and Agriculture is supporting the project within the scope of a programme concerning promotion of innovation. For about three years, the sustainability module will be tested on-road and then re-designed to provide an industry solution for the sustainable development of German milk production.

Handing over the grant approval (*left to right*): Peter Stahl (Association of the German Dairy Industry), Dr Henning Ehlers (German Raiffeisen Association), Karsten Schmal (German Farmers Association), Parliamentary State Secretary Peter Bleser (Federal Ministry for Food and Agriculture), Dr Heike Kuhnert (Land & Markt), Dr Hiltrud Nieberg (Thünen-Institute), Ludwig Börger (German Farmers Association) (© Tanja Schnitzler)

R. Kröger and N. Pankow
QM-Milch e.V., Berlin, Germany
r.kroeger@idf-germany.com

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# United States: National Dairy FARM Program updates animal care standards

The largest dairy animal care quality assurance program in the USA, The National Dairy Farmers Assuring Responsible Management Program (FARM Program™), initiated version 3.0 of FARM Animal Care [1] on 1st January 2017.

The National Dairy FARM Program is managed by the National Milk Producer's Federation (NMPF) in partnership with Dairy Management, Inc. (DMI). The FARM Animal Care Program [2], which now encompasses 98% of the US milk supply is updated every three years by the FARM Program Animal Care Technical Writing Group. This group is composed of animal care experts, including dairy farmers, bovine veterinarians, animal scientists and industry personnel.

Recommendations for standards from the Technical Writing Group are approved by the NMPF Animal Health & Well-Being Committee and then the NMPF Board of Directors. The on-farm standards are then evaluated by trained second-party evaluators. Verification of the program is conducted on an annual basis through a third-party auditing service.

FARM Animal Care Version 3.0 has formalized additional on-farm accountability within the program by establishing three minimum participation requirements (priority one areas) and nine additional top priority areas for continuous improvement (priority two areas).

Priority one minimum participation requirements include the following: (1) The farm must have an established, documented relationship with a veterinarian through a veterinarian–client–patient relationship (VCPR). (2) All employees must complete and document annual employee animal care training. (3) Routine tail docking of animals is no longer permitted. Priority two continuous improvement areas include a multipart herd health plan written in consultation with a veterinarian, and conformance to key animal health observation measurements such as locomotion, body condition, and hock and knee scoring.

If an improvement need is identified, then a mandatory corrective action plan for priority one areas or a continuous improvement plan for priority two areas is developed in consultation with dairy professionals. A mandatory action plan must be resolved within 12 months and continuous improvement plans must be resolved before the next evaluation. If a priority one area is not resolved within 12 months, the farm risks probation and eventual suspension.

Since the inception of the FARM Animal Care Program, over 45,000 second-party evaluations have been conducted. As of 31st May 2017, just over 2500 version 3.0 evaluations were completed. Of evaluations that resulted in creation of an action plan, on average, mandatory corrective action plans and continuous improvement plans were resolved within 5.92 weeks.

The foundation of the FARM Animal Care Program is built upon continuous improvement. FARM strives to work with the entire dairy supply chain to raise the bar for dairy animal welfare. In doing so, FARM continues to engage and work with the entire dairy community.


National Dairy Farm Animal Care version 3.0 Minimum participation requirements

J. Jonker and B. Hampton
National Milk Producers Federation, USA
jjonker@nmpf.org; bhampton@nmpf.org

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# The Chilean Animal Welfare Committee for Dairy Cattle

The Animal Welfare programme of the Chilean Dairy Consortium seeks to put forth relevant topics for the dairy industry. These actions aim to improve productivity and longevity in Chilean dairy herds, thus increasing sustainability of the dairy sector.

The Chilean Dairy Consortium created the Chilean National Animal Welfare Committee in 2012. This Committee is formed by experts and specialists from different major areas concerned with the welfare of dairy cattle. The Committee's experts are not only from universities and the government´s Agricultural Research Institute and the Agricultural and Livestock Services, but also include dairy consultants, dairy processors, milk quality specialists and milk producers. By 2017, the number of Committee members has increased to 26. The Committee holds regular meetings, under the coordination of a programme officer. It is important to highlight the involvement of the Chilean government in the programme, in particular the Agricultural and Livestock Services (Servicio Agrícola y Ganadero; SAG). SAG is the official governmental service for monitoring, protecting, supporting and improving the development of agriculture, livestock and forestry. The Chilean government, through SAG, has also implemented a national regulation following the recommendations of the World Organization for Animal Health (OIE).

The tasks of the Chilean Animal Welfare Committee for Dairy Cattle include the revision and development of applied research in sustainability for the dairy industry and the validation of animal welfare protocols. These efforts have generated valuable material and documents, such as the "Protocol of Animal Welfare for the Dairy Sector" [1], the "Handbook of Udder Health and Animal Welfare" [2], "Hoof Health" [3] and "Heat Stress in Chile and Mitigation Options" [4]. All this material (and more) has been presented by the Chilean Dairy Consortium and introduced to the dairy sector using seminars, training courses, news media and outreach activities (Figures 1 and 2). The Chilean Dairy Consortium, by means of the Animal Welfare Committee for Dairy Cattle, looks forward to tackling future challenges and contributing to the improvement in animal welfare and sustainability of the dairy industry.

*Publications by the Chilean Animal Welfare Committee are printed in Spanish, but are also freely available in PDF format at www.consorciolechero.cl/chile/pags/libros-manuales.php

M. Muñoz Domon
University of Concepción, Chile
marcomun@udec.cl

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**Figure 1:** Training course on udder health and animal welfare

**Figure 2:** Field training course on lameness of dairy cattle and animal welfare

# Future Meetings

## Animal Health and Welfare Conference at the IDF WDS 2017

IDF WORLD DAIRY SUMMIT 2017
Belfast
29 October to 3 November
2017 making a difference with dairy

The UK dairy industry is bringing together the global dairy community to focus on how to make a difference with dairy at the International Dairy Federation (IDF) World Dairy Summit 2017 in Belfast. The Animal Health and Welfare Sessions will take place on Wednesday 1st November. The conference will deal with three topics: health and welfare, breeding technology and disease control, and conclude with a Leaders' Forum.

During the first session, Marie Haskell will give a talk on cow characteristics and herd health and welfare. Cow personality and behavioural traits have a direct impact on herd health and welfare. Marie Haskell will describe significant cow traits and how they can be selected and managed to achieve optimum health and welfare outcomes. Jennifer Walker will discuss animal welfare and the consumer. Consumer attitudes to animal welfare are becoming increasingly important in managing industry reputation and shaping consumption trends. She will examine the evolution of consumer attitudes, how they affect the industry and the types of strategies being developed in response. Luc Mirabito will discuss the application on-farm of the Animal Welfare Index, a powerful tool for demonstrating good animal husbandry.

The second session will focus on breeding technology. Trygve Solberg will discuss breeding and genetics for a sustainable and robust cow. These are important because they provide the industry with a variety of routes for improving the sustainability of dairy herds. Jason Osterstock will show how genetic data can help in developing the dairy cow of the future. Katie Olson will explain the technique of gene editing, the practical advantages it provides to dairy farmers and its potential benefits in the future.

During the last session, speakers will discuss disease control. Dr Matthew Stone will share the global view of the OIE on disease eradication, control and management. Ann Lindberg will present the strategy for control and eradication of bovine viral diarrhoea in Scandinavia. Jolanda Jensen will describe the use of social science techniques to obtain the best farmer participation in disease control.

The conference will conclude with a Leaders' Forum that will draw upon the speakers presenting throughout the day and provide an opportunity for delegates to engage in an interactive debate on the welfare of dairy cattle.

Organised by the UK National Committee of IDF (UK-IDF), the 2017 event will take place from 29th October to 3rd November 2017 at the Belfast Waterfront conference centre. Over 1000 dairy experts from across the globe are expected to gather in Belfast to share their in-depth knowledge of dairy and bring the audience up to speed on the latest developments in the industry.

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