156 Milk quality challenges and opportunities in robotic milking systems. D. Kelton*, Department of Population Medicine, University of Guelph, Guelph, ON, Canada.

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or at risk of acquiring one during the dry period. Conversely, blanket dry cow therapy (BDCT) consists in the treatment of every quarter of every cow at dry off. BDCT has been widely adopted in the last decades and led to an important success in the reduction of contagious mastitis. However, recent studies report a low prevalence of intramammary infections at dry-off in many herds. This, in addition to the recent introduction of rapid on-farm diagnostic tests, and the availability of teat sealants, may allow development of successful SDCT strategies. Although the number of clinical trials with adequate internal validity evaluating the efficacy of SDCT is limited; it appears that farm selection is key for the success of SDCT strategies. Bulk tank SCC, as well as intramammary infection prevalence and etiology at dry off have been used to select herds benefiting from SDCT. Thereafter, the accurate identification of cows or quarters benefiting from antimicrobial treatment is the cornerstone for the implementation of SDCT. Strategies followed vary from use of cow records (e.g., SCC records, clinical mastitis history), culture results, cow-side diagnostic test results (California Mastitis Test, milk leukocyte differential count, etc), or a combination of them. The economic returns of SDCT include savings on antibiotics and milk withholding after parturition. However, even with no differences in health or performance for not treated cows or quarters, there are associated diagnostics and labor costs. In conclusion, the current epidemiology of mastitis in addition to the availability of new technologies make SDCT a logical step to reduce antibiotic use in dairy cows. However, there is still a need to large multi-herd randomized controlled studies to investigate whether SDCT programs will be effective under diverse management conditions.

**Key Words:** selective dry cow therapy, mastitis, antibiotics

### 160 Selective dry cow therapy to control mastitis and reduce antimicrobial use

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Blanket dry cow therapy is a common preventative measure of mastitis control. However, concerns over antimicrobial resistance, may lead to concerns over blanket therapy as an unnecessary use of antimicrobials. Selective dry cow therapy involves only administering antimicrobials to those cows that require them at dry-off to cure existing infections. This research was conducted at 3 Irish research herds between 2015 and 2017. Prior to dry-off, weekly milk recording data were used to identify cows which had not exceeded 200,000 somatic cells at any point in lactation and to randomly assign them to 1 of 2 treatments: (1) antibiotic plus teat seal (AB&TS), or (2) teat seal only (TS). SCC was analyzed as (1) average, (2) minimum, and (3) maximum animal SCC across lactation, and as (4) test-day SCC. Analyses were conducted using records from the first 3 wk and first 120 d of lactation. The effect of treatment was quantified using a repeatability model accounting for concurrent experiment treatment level, breed (proportion of Holstein, Jersey, or Norwegian Red), heterosis, recombination, month of calving, parity (n = 4; 1, 2, 3, 4+), year (n = 3). For SCC traits with a single lactation value animal was repeated across years of the study. Animal was repeated across lactation week when the dependent variable was test-day SCC. The likelihood of having an SCC reading ≥ 200,000 was quantified using logistic regression adjusted for the same fixed effects as the linear model. Up to 56% of cows in the research herds (n = 364 lactations) were eligible for inclusion in the analyses. The minimum, maximum, and test-day SCC of TS only cows was greater than those cows that received AB&TS both in the first 3 wk and 120 d of lactation (P < 0.05). TS only cows were 2.9 times more likely to have an SCC reading > 200,000 within the first 120 d of lactation. However, the majority of cows (>80%) in both treatments maintained SCC < 200,000. Administering TS only to cows that have not had high SCC throughout lactation may offer a viable method to reduce on-farm anti-microbial use while not affecting herd-level SCC.

**Key Words:** selective dry cow therapy, antimicrobial use

### 161 Assessment of acoustic pulse therapy (APT), a non-antibiotic treatment for mastitis in dairy cows

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A new acoustic pulse therapy (APT) device developed specifically for treating dairy cows produces high power, deep penetration acoustic pulses distributed over a large treatment area. We show findings from a clinical assessment of the technology for treating dairy cows with (1) subclinical and (2) clinical mastitis. In study 1, overall, 116 cows of 3 herds were identified with subclinical intramammary infection and enrolled in the study with 78 cows assigned to the treatment group and 38 cows to the control. In the treatment group 70% of the cows returned to normal milk production compared with 18.4% of the control. Daily milk yield of treated cows increased significantly (P < 0.05) and the percentage of cows with SCC < 300 × 103 cells/mL was significantly higher (P < 0.001). Milk of the infected quarters appeared normal with lactose greater than 4.8%, but with no significant difference. Of the treated cows with identified bacteria, 52.6% of quarters were cured while in the control only 25% (P < 0.001). Specifically, all cows identified with *Escherichia coli* in the treatment group were cured, with only 60% cure with no intervention in the control. Spontaneous cure of glands infected with coagulase-negative staphylococci (CNS) and streptococci was low, while treatment successfully increased cure of CNS from 13% to 50% and that of streptococci from 18% to 36%. Of the 4 cows identified with *Staphylococcus aureus*, 3 were cured. In study 2, 29 cows identified with clinical mastitis were submitted either to antibiotic (n = 16) or APT treatment (n = 13). The antibiotic treatment cured 18.7% of the cows where SCC lowered to < 300 × 103 cell/mL and 52.6% were culled. The APT treatment cured 76.9% of cows with only a single cull (7.7%). Both studies were analyzed by SAS mixed procedure and GLM. Acoustic pulse therapy was found more effective than antibiotics or no-intervention in treating clinical and subclinical mastitis in dairy cows. In contrast to current treatment options of subclinical mastitis, which require early detection, APT is an easy to use confined treatment of cow’s udders. It does not require bacterial identification or discarding of milk after treatment.

**Key Words:** clinical mastitis, subclinical mastitis, acoustic pulse therapy

### 162 Diffusion of antimicrobial resistance across management niches on dairy farms

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Background: A challenge in efforts to mitigate the global impact of farm origin antibiotic resistance is a failure to understand dissemination patterns of resistance within the farm via animals or environmental flow. This study focuses on diversity of phenotypic antibiotic resistance within niches on the dairy. The goals were to identify niches where diversity is generated and maintained, identify niches connected by phenotype similarity, and identify niches that narrow diversity. The premise was that diversity is generated in niches with high antibiotic use and disseminate...
through the dairy system with animal movement or environmental flow. Twelve commercial dairy herds were sampled. Farm niches were defined by housing and function. Housing niches included areas with pre-weaned heifers, weaned and bred heifers, early lactation cows, lactating cows, pregnant nonlactating cows, antibiotic treated cows, and cows leaving the herd. Function niches include milk, waste, water, and feeds. For each sampling time, approximately 100 samples were collected across the niches. We used *E. coli* as our model and antimicrobial susceptibility tested 4 isolates from each sample against 13 antimicrobials. Latent class analysis (LCA) was used to organize isolate-based resistance patterns and clustered using K-means. Risk factors were assessed using multinomial logistic regression. Each farm was visited 3 times. More than 13,000 *E. coli* isolates were tested for antimicrobial susceptibility patterns. Based on LCA, 24 different patterns were observed. The most common pattern was pan-susceptible (68%) followed by a pattern with only tetracycline resistance (7%). The greatest diversity was observed in pre-weaned and weaned calves followed by treated animals. *E. coli* from adult cows were pan-susceptible (approaching 90% of isolates). *E. coli* from soil samples were pan-susceptible except for samples in pre-weaned housing areas. There were farm-specific patterns and between farm differences in diversity. There are niche-specific patterns of resistance that suggest there is little to no dissemination across niches. The between-farm patterns also suggest that resistance traits are farm-specific and driven more by local features rather than shared across spatially distinct farms.

**Key Words:** antibiotic use

### 163 Antimicrobial resistance in non-*aureus* staphylococci isolated from milk is associated with systemic but not intramammary administration of antimicrobials in dairy cattle

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Emergence and spread of antimicrobial resistance (AMR) are major concerns for human and animal health worldwide. Consequently, there is increasing pressure to reduce antimicrobial use (AMU) in food-producing animals. In this project, we studied the association between AMU and AMR in non-*aureus* staphylococci (NAS) isolated from Canadian dairy herds. Distinct types of dry cow therapy (DCT), antimicrobials, and routes of administration were compared. The AMR profile was determined using a micro-broth dilution method against a panel of 23 antimicrobials for 1,702 NAS isolates obtained from 89 herds. A subset of these isolates was submitted to whole-genome sequencing and presence of AMR genes was determined using data from 4 databases. Antimicrobial use was determined for all herds using an inventory of empty drug containers and quantified for each antimicrobial as number of antimicrobial daily doses (ADD) administered. Data on management practices, including type of DCT, were obtained using questionnaires. Only systemic AMU was associated with prevalence of AMR in NAS, whereas intramammary or intrauterine use were not. Three drug classes, all of high or very high importance for human medicine, were associated with drug-specific AMR when administered systemically: penicillins, 3rd generation cephalosporins, and macrolides. Prevalence of tet, erm and *bla* genes in NAS was higher in herds that used more tetracyclines, macrolides, and 3rd generation cephalosporins, respectively. Mean AMU of antimicrobials administered as DCT was lower in herds using selective DCT in comparison to herds using blanket DCT. However, use of selective DCT was not associated with prevalence of AMR in NAS. The either weak or non-existent association between AMR and antimicrobials administered intramammarily suggest that a decrease in AMR of NAS following implementation of selective DCT would be minimal in comparison to reduced use of systemic antimicrobials.

**Key Words:** antimicrobial use, antimicrobial resistance, non-*aureus* staphylococci

### 164 Antimicrobial resistance patterns of bacterial isolates from cases of mastitis in dairy cows


Mastitis is the most prevalent disease of dairy cows mainly caused by bacteria. Antimicrobials are largely used in dairy farmers for prophylactic control of mastitis as dry cow therapy. The use of antimicrobials in dairy cows for treatment of mastitis has improved their health and productivity, but prophylactic usage is under scrutiny due to the risk of antimicrobial resistance (AMR). AMR is a threat to animal and human health due to rising reservoir of resistant population of pathogenic bacteria. The aim of this study was to determine sensitivity of bacterial isolates from cases of bovine mastitis to commonly used antimicrobials. In total, 174-quarter milk samples from 148 cows, 3 composite milk samples from 3 cows and 1 bedding sample were collected from 35 dairy farms in Tennessee, Kentucky, and Mississippi. We tested isolates for sensitivity with a panel of 10 antimicrobials by MIC using the Sensititre system. We used descriptive statistics and logistic regression for data analysis. Overall, we isolated 197 isolates, comprising of 34% *Staphylococcus aureus*, 21.3% *Streptococcus uberis*, 18.3% *Streptococcus dysgalactiae*, 17.8% *Escherichia coli*, 6.6% *Klebsiella pneumoniae* and 2% *Klebsiella oxytoca*. The most prevalent pathogen at cow level was *S. aureus* followed by *Str. uberis*, *Str. dysgalactiae*, *E. coli*, *K. pneumoniae* and *K. oxytoca*, whereas at the farm level *Str. uberis* was the most prevalent followed by *Str. dysgalactiae*, *S. aureus*, *E. coli*, *K. pneumoniae* and *K. oxytoca*. Cows infected with *E. coli* mainly had clinical mastitis, whereas those infected with *S. aureus* had subclinical mastitis (*P < 0.05*). Ceftiofur showed the highest efficacy on the most isolates followed by cephalexin, but *K. pneumoniae* isolates were resistant to most of the antimicrobials tested. Isolates from subclinical mastitis had higher MIC (P > 0.05) compared with isolates from clinical mastitis for some antimicrobials. The 197 isolates showed 32 different AMR patterns, which varied with farms and states. Compared with *S. aureus* and *Str. dysgalactiae*, *E. coli* and *Klebsiella* spp. had widespread resistance to pirlimycin and higher MIC for most of the drugs tested. These results suggested that confirmatory diagnosis and subsequent sensitivity testing would be a prerequisite to treat these mastitis pathogens effectively.

**Key Words:** antimicrobial resistance, dairy cow, mastitis pathogen