SELECTIVE DRY COW THERAPY IMPLEMENTATION GUIDELINES

INTRODUCTION

Although intramammary antibiotics account for less than one percent of all antimicrobials sold for use in food-producing animals as of 2021, the American Association of Bovine Practitioners advocates continuing efforts to optimize antimicrobial stewardship wherever possible. In dairy cattle, selective dry cow therapy (SDCT) is a tool that can be implemented in certain instances to achieve this goal in dry cows.[1] The beginning of the dry period is a high-risk time for intramammary infections in dairy cattle. The lag between cessation of milk harvest by the human and the cessation of lactation by the cow results in increased udder pressure. This udder pressure combined with a delayed or absent keratin seal formation in the teat end can result in milk leakage allowing entry of mastitis-causing pathogens. Additionally, if a subclinical infection is already present in the udder when a cow is dried off, the infection may not be cured, as the affected milk is no longer being flushed from the udder. Finally, high-producing dairy cattle experience slower mammary involution than their lower-producing counterparts, resulting in a lower concentration of immune cells and factors to fight new and existing infections.[2]

To cure intramammary infections that may be present at dryoff, dry-cow therapy (DCT) (i.e., a long-acting intramammary antibiotic), may be infused into the teats after the last milking. DCT, along with a teat sealant, can also prevent new infections from arising in the beginning of the dry period. In the past, there was a high prevalence of subclinical mastitis in dairy cattle, especially due to contagious mastitis organisms. For this reason, the practice of blanket dry-cow therapy (BDCT) was recommended to cure these infections during the dry period. However, the dairy industry has made great strides in reducing the prevalence of subclinical infections including those by contagious pathogens, and many farms may be able to move away from BDCT and employ selective treatment of cows at dry off (SDCT) by determining which cows have, or are at the highest risk of having, subclinical infection at dry off, and which cows are at a low risk, thereby only needing a teat sealant. It is important to note that not all farms may benefit from SDCT, and in some cases, SDCT may produce negative outcomes in herd health. Furthermore, cessation of dry-cow therapy altogether is not recommended in any herd.

Considered a prophylactic use of antimicrobials in some areas, BDCT is no longer a legal practice in the European Union.[3] For these reasons, it is important that a farm makes the decision to employ either BDCT or SDCT under the guidance of their veterinarian with a valid veterinarian-client-patient relationship (VCPR) and following geographically appropriate antimicrobial legislation. The aim of this document is to provide veterinarians with guidance on how to implement SDCT programs in dairy herds. Topics covered include a review of proper dry-off techniques, selection of herds suitable for SDCT programs, approaches to selecting cows or quarters for antimicrobial therapy, the role of teat sealants in SDCT, and monitoring outcomes after implementing an SDCT program.

DRY-OFF TECHNIQUE

Regardless of dry-off protocol used, proper technique and cleanliness are the keys to success. Dry off may occur in the milking parlor or in other loca-

SELECTIVE DRY COW THERAPY IMPLEMENTATION GUIDELINES

tions such as a free stall or hoof trimming chute. The milking parlor is ideal as it increases the safety of the employee, is often already clean, and can decrease the time between milking and dry-off if the cow has just been milked. Clean gloves should be worn and the intramammary products should be located in a clean, dry location that is easy to reach. Tubes should not be stored in water, and instead the ambient temperature of the dry-off location should be kept in a range according to the label of the product. A standard pre-milking routine of applying a pre-dip and wiping the teat barrel and end must be completed to prepare the teats for insertion of dry-off products. Next, the teat ends must be sanitized with an alcohol wipe, using a new wipe for each teat. Teats that are furthest away should be sanitized first followed by the teats closest to the worker to avoid soiling recently cleaned teat ends. Each wipe step should be repeated until the wipe comes back visibly clean.

Next, the intramammary product can be infused, starting with the dry cow antibiotic, if applicable, followed by the teat sealant. Infuse teats closest to the worker first, followed by the teats furthest away. To avoid teat end damage, the tube should only be inserted as much as necessary to direct the product into the teat cistern. When infusing the teat sealant, it is important to pinch the base of the teat barrel to occlude entry of the sealant into the gland cistern of the quarter. Finally, a post-dip can be applied, or alternatively, an external teat sealant, using a clean applicator. Helpful videos in English and Spanish to demonstrate these techniques are available from Michigan State University's Qual-

TABLE 1. HERD SELECTION CRITERIA FOR SELECTIVE DRY COW THERAPY

Farm stakeholders involved in decision to adopt SDCT	All members of ownership and management should be in favor of adoption.
Strong relationship with veterinarian of record	Veterinarian has knowledge of and has observed dry-off procedure. Veterinarian has access to farm data to provide guidance.
Ability to implement new management tactics	Written and/or digital antimicrobial use protocol. Written or digital treatment documentation. Data required to make the selective use determination is captured in herd health record system.
Good control of milk quality on farm	Bulk tank SCC regularly less than 250,000 cells/mL. No *Streptococcus agalatiae* in the herd. Control of *Staphylococcus aureus* infections. Routine detection of visually abnormal milk. Consistent recording of abnormal milk as a mastitis event. Regular DHI testing or other form of routine individual SCC.
Appropriate dry-off procedures in place	Use of systematic dry-off lists. Written SOP and routine employee training program. Appropriate use of teat sealants.

Proceedings of the 55th AABP Annual Conference https://doi.org/10.21423/aabppro20228605

SELECTIVE DRY COW THERAPY IMPLEMENTATION GUIDELINES

ity Milk Alliance website (https://topmilk.msu.edu/Quality-Milk-Alliance/Dry-Cow-and-Mastitis-Treatments). Employee training resources and employee skill assessment tools for dry-off technique are available from Quality Milk Production Service's website (https://dairyroutines.jimdo.com).Clean dry-off technique is critical regardless of protocol used; however, it is essential for the success of SDCT.

HERD SELECTION

Not all herds are ready to adopt SDCT. These herds should instead focus on improving other aspects of milk quality before considering a change. A list of herd selection guidelines, shown in the following table, was created to help guide veterinarians and producers to make this decision.

Though not all items in these guidelines are necessary, the more a farm meets, the higher their chance of success. The overarching themes of these guidelines are cleanliness, communication and quality data. Quality data is achieved through routine SCC testing (such as DHI monthly test) and consistent disease detection and recording. If quality data is not present, cows at high risk of infection during the dry period are likely to get missed when using an algorithm-based protocol. Quality data also allows for early detection of problems associated with dry-off protocol.

COW OR QUARTER SELECTION

The type of milk quality data present on a farm will determine the type of SDCT protocol used. If a farm has routine individual cow somatic cell data, an algorithm-based SDCT protocol may work well and be the most cost effective.[4,5] Research has shown that an algorithm-based protocol performs equally against culture-based SDCT in terms of udder health.[5,6] Algorithm-based protocols use several criteria to determine a cow's risk of intramammary infection at dry off. Usually these include mastitis events in the last lactation or SCC tests above 200,000 cells/mL in the last lactation. Users of DairyComp (Valley Ag Software, Tulare CA) can use an automated algorithm to accomplish this quickly on dry-off day (https://vas.com/blog/2022/01/07/how-to-set-up-selective-dry-cow-therapy-with-dairycomp/). Algorithm-based systems without the use of individual SCC data have been used with success, but using this method should be approached with caution, as they have not been validated with research trials.

If individual cow somatic cell data is not available, or a system with higher sensitivity and specificity is desired, culture-based SDCT is an option. An advantage of a culture-based SDCT protocol is the ability to make decisions at the quarter-level; however, algorithm-guided and culture-guided SDCT programs both show a similar reduction in dry cow therapy antibiotic use.[5] There is no difference in effectiveness between the two methods in terms of significant cow health or production outcomes according to a multi-herd, multi-state study.[5] Collecting and culturing a composite milk sample before dry off is a method that can also be employed. An advantage to utilizing composite milk samples is greater ease and convenience. Cultures can be performed on-farm or sent to a laboratory depending on the distance to the laboratory and employee skill sets on the farm. Research has supported the use of Petrifilm® systems and rapid culture plates (Minnesota Easy® 4Cast plate, University of Minnesota, St. Paul, Minn.) for on-farm culture.[5,7,8] In all culture-

SELECTIVE DRY COW THERAPY IMPLEMENTATION GUIDELINES

based SDCT systems, specific pathogen detection is not necessary and non-selective growth media can be used to determine if DCT or teat sealant alone is indicated. Cow or quarter selection method should be chosen based on the quality of data available on a farm and the level of sensitivity and specificity desired when detecting the presence of intramammary infection at dry off.

TEAT SEALANTS

Regardless of method used, the use of teat sealants for all cows is imperative for the prevention of new intramammary infections during the dry period.[9] Both internal sealants and external barrier dip products are available. Internal products are generally longer lasting, providing protection for the entirety of the dry period. However, as with all intramammary products, clean insertion technique is critical for their success (see dry-off technique, above). External products have a shorter duration but can be used as a second layer of protection during the high-risk early dry period, or as a sole product in systems where insertion technique is inconsistent.

MONITORING OUTCOMES

After SDCT has been implemented on a farm, monitoring of its success must begin. The first animals dried off on this protocol will not freshen for about two months, and monitoring efforts during this time should focus on the health of animals in the dry pen as well as monitoring for dry cow mastitis. If an increase in dry-cow mastitis is noted, reevaluation of dry-off technique and environmental management must take place.

As SDCT animals start their new lactation, monitoring efforts should continue to focus on udder health outcomes related to a change in dry-off procedure and employee compliance with the change. These outcomes can include the following (calculations for each can be found in the appendix):

- Prevalence of subclinical infection in the herd at each monthly test
  - Monitoring the percent of the cows tested over 200,000 cell/mL month-to-month can be helpful in monitoring the level of subclinical infections in the herd.
- Prevalence of cows with a high first test at each monthly test
  - This metric gives an estimate of the proportion of cows entering lactation with a subclinical infection and can be affected by dry period changes.
- New infection risk each month
  - While new infection risk applies to all lactating animals, it is still an important metric when monitoring udder health of the herd.
- Clinical mastitis incidence each month
  - Similarly, clinical mastitis incidence applies to all lactating animals and should be interpreted along with dry and fresh cow mastitis incidence, below.
  - Culturing of milk from clinical mastitis cases is encouraged to detect potentially contagious pathogens.
- Dry cow clinical mastitis incidence each month
  - While useful in assessing changes made at dry off, dry cow clinical mastitis incidence may not be useful or accurate, as dry cows are not usually monitored for mastitis as closely as lactating cows. Regardless, a significant uptick in cases of severe mastitis in the dry period is reason for a closer look.

SELECTIVE DRY COW THERAPY IMPLEMENTATION GUIDELINES

- Fresh cow (< 30 days in milk) clinical mastitis incidence over time
  - Fresh cow clinical mastitis incidence is a useful metric to calculate as these cases are more likely to be related to dry cow udder health than overall mastitis cases during lactation. Fresh cow mastitis is defined as any clinical case within 30 days in milk.
- Bulk Tank SCC over time
  - Bulk tank SCC is not directly related to dry cow management, but it is necessary to monitor this to get the full picture of udder health on the dairy. The most accurate bulk tank SCC will come from the reports received from the milk co-op. SCC reports from DHI testing in on-farm management software programs may not be as accurate, as they do not reflect the weighted average SCC on a day-to-day basis.

It is important to interpret these outcomes in the context of other changes on the dairy. Changes in the dry matter of bedding material or a new employee, for example, can affect udder health just as much as a change to the dry-off protocol. When investigating the cause of a negative udder health outcome, it can be helpful to view the outcome in first lactation animals versus second- and greater-lactation animals. Changes in the dry-off protocol will not affect first lactation animals given these animals did not experience a dry-off event. Responsible antimicrobial use does not equate to simply eliminating use. Appropriate antimicrobial stewardship also monitors outcomes of the decisions made.

SUMMARY

As previously mentioned, a close relationship between the veterinarian of record for a herd and the producer is a key part of SDCT success. The herd's veterinarian should advise the producer on initial adoption of SDCT, protocol development and implementation, routine employee dry-off training, and should be actively involved in monitoring outcomes related to SDCT. Ultimately, the decision to use antibiotics, and specifically dry cow intramammary antibiotics, should be left in the hands of the herd health veterinarian working with the herd owner under a valid veterinarian-client-patient relationship. SDCT is a practical way to employ judicious antimicrobial use on qualified dairy farms, though it may not be right for every farm. Quality data, clean dry-off technique, environmental management, and diligent monitoring of outcomes are necessary for success.

APPENDIX

- Prevalence of subclinical infection in the herd at each monthly test
  - *Prevalance of SC infection* = $100 \times \left(\frac{\text{\# of cows with SCC > 200k at last test}}{\text{\# of cows sampled at last test}} \right)$
    - DairyComp instructions In DairyComp, navigate to the GUIDE function. If the SDCT module has been activated, find the tab labelled "SDCT." Under the "Monitoring" section, click on the prompt, "Has the percent of infected cows increased over time for the entire herd while SDCT has been instituted?". The graph that follows shows what percent of the cows tested each month were above 200,000 cells/mL in red. Clicking on the tab, "Grid" at the bottom returns the table equivalent of the graph.
- Prevalence of cows with a high first test at each monthly test

SELECTIVE DRY COW THERAPY IMPLEMENTATION GUIDELINES

- *Prevalance of cows with high first test =* $100 \times \left(\frac{\text{\# of cows that had a first test >200k}}{\text{total \# of cows that had a first test}}\right)$
  - DairyComp instructions In DairyComp within GUIDE under the SDCT tab, "Monitoring" section, click on the prompt, "Are more cows in the herd becoming infected, based on monthly SCC, while SDCT has been instituted?". Clicking on the tab, "Grid" at the bottom of the screen returns the table format of this data. The row labeled, "HiFresh %" represents the percent of cows whose test was the first of their lactation that tested above 200,000 cells/mL. In other words, the percent of cows that freshened with a high first test.

DRY-OFF SCC AND CHANGE OVER DRY PERIOD

This can be used to monitor changes in dry period SCC over a longer period of time (six months of cumulative data) and is presented in both a graph and a 2x2 table. An increase in dry period infections over a six-month period from the point of implementation of an SDCT program, compared to the period prior to implementation, may also indicate the SDCT protocol may need be investigated.

- DairyComp instructions
  The 2x2 table and graph can be found by going to GUIDE, then MASTITIS, DRY-OFF SCC AND CHANGE OVER DRY PERIOD, then "Does the Pattern of of SCC Change (last six months) over the dry period indicate cows are becoming infected in the dry period?"
- New infection risk each month
  - *New infection risk =* $100 \times \left(\frac{\text{\# of cows that tested > 200k that tested <200k at their previous test}}{\text{total \# of cows tested}}\right)$
    - DairyComp Instructions Within the same table as above, the new infection risk each month is given in the row, "New Inf %".
- Clinical mastitis incidence each month
  - *Clinical mastitis incidence =* $100 \times \left(\frac{\text{\# clinical mastitis cases in the last month}}{\text{average \# of milking cows last month}}\right)$
    - DairyComp instructions In DairyComp, within GUIDE under the SDCT tab, the report "What has been the pattern of clinical mastitis events while SDCT has been instituted?" provides the recorded monthly level and risk per COW for the incident mastitis event and separate (repeat) mastitis events.
- Dry cow mastitis incidence each month
  - *Dry cow mastitis incidence =* $100 \times \left(\frac{\text{\# dry cow mastitis cases in the last month}}{\text{average \# of dryed off in the last month}}\right)$
    - DairyComp instructions Cows represented in the numerator may be currently lactating or dry, so two commands are needed:
      - Currently lactating: EVENTS\2SI ID FDAT PDDAT FOR LACT>1
      - Currently dry: EVENTS\2SI DDAT FOR DDAT>0
    - Denominator (Total cows dried off during that time period): EGRAPH -> DRY
- Fresh cow (< 30 days in milk) mastitis incidence over time
  - *Fresh cow mast incidence =* $100 \times \left(\frac{\text{\# fresh cow mast events in the last month}}{\text{\# of fresh events in the last month}}\right)$
    - DairyComp instructions In DairyComp, the numerator is found with the command, EVENTS\2SI ID FDAT by DIM for the selected date range. Cows that had mastitis less than 30 DIM are counted in the numerator. The denominator is found using the egraph function to find the number of fresh events for the selected date range.

SELECTIVE DRY COW THERAPY IMPLEMENTATION GUIDELINES

REFERENCES

[1] 2021 Summary Report on Antimicrobials Sold or Distributed for Use in Food-Producing Animals. FDA USDA Center for Veterinary Medicine. December 2022. https://www.fda.gov/media/163739/download

[2] Silanikove N, Merin U, Shapiro F, Leitner G. Early mammary gland metabolic and immune responses during natural-like and forceful drying-off in high-yielding dairy cows. *J Dairy Sci* 2013;96(10):400-641. https://doi.org/10.3168/jds.2013-6740

[3] https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32019R0006&from=EN

[4] Rowe S, Nydam DV, Godden S, Gorden P, Lago A, Vasquez A, Royster E, Timmerman J, Thomas M, Lynch R. Partial budget analysis of culture and algorithm guided selective dry cow therapy. *J Dairy Sci* 2021 May;104(5):5652-5664

[5] Rowe S, Godden S, Nydam DV, Gorden P, Lago A, Vasquez A, Royster E, Timmerman J, Thomas M. Randomized controlled non-inferiority trial investigating the effect of two selective dry cow therapy protocols on antibiotic use at dry-off and dry period intramammary infection dynamics. *J Dairy Sci* 2020 Jul;103(7):6473-6492

[6] Rowe S, Godden S, Nydam DV, Gorden P, Lago A, Vasquez A, Royster E, Timmerman J, Thomas M. Randomized controlled trial investigating the effect of two selective dry cow therapy protocols on udder health and performance in the subsequent lactation. *J Dairy Sci* 2020 Jul;103(7):6493-6503

[7] Cameron M, Keefe GP, Roy JP, Stryhn H, Dohoo IR, McKenna SL. 2015. Evaluation of selective dry cow treatment following on-farm culture: Milk yield and somatic cell count in the subsequent lactation. *J Dairy Sci* 98:2427–2436. https://doi.org/ 10.3168/jds.2014-8876.

[8] Kabera F, Dufour S, Keefe G, Cameron M, Roy JP. 2020. Evaluation of quarter-based selective dry cow therapy using Petrifilm on-farm milk culture: A randomized controlled trial. *J Dairy Sci* 103:7276–7287. https://doi.org/10.3168/jds.2019-17438

[9] Rabiee AR, Lean IJ. The effect of internal teat sealant products (Teatseal and Orbeseal) on intramammary infection, clinical mastitis, and somatic cell counts in lactating dairy cows: A meta-analysis. *J Dairy Sci* 2013;96(11):6915-6931. doi:10.3168/jds.2013-6544

[10] Kabera F, Roy JP, Afifi M, Godden S, Stryhn H, Sanchez J, Dufour S. 2021. Comparing Blanket vs. Selective Dry Cow Treatment Approaches for Elimination and Prevention of Intramammary Infections During the Dry Period: A Systematic Review and Meta-Analysis. Front Vet Sci, https://doi.org/10.3389/fvets.2021.688450