Putting research to the test: Implementing selective dry cow therapy on farms across New York State

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Abstract

Selective dry cow therapy (SDCT) has been shown to be an effective way of using antimicrobials judiciously on dairy farms while decreasing treatment costs and maintaining herd health. However, adoption of the practice has been slow in the U.S. In order to improve the adoption of this practice in New York State, we formed a team of veterinarians to help interested dairy producers and their herd veterinarians to implement SDCT successfully. Not all farms are a good fit for SDCT. An in-depth discussion between the herd veterinarian and farm stakeholders before adoption is necessary. This discussion should include current practices, data available to make the selection process, best practices for dry off and dry-pen management, and how to monitor progress going forward. Our team enrolled 24 farms over the course of a year. Seventeen out of 24 farms are still using SDCT at the time of publishing. A variety of SDCT methods were used, and on average, herds decreased dry cow antibiotic use by 53%. The metrics we used to monitor herd infection dynamics before and after SDCT included average monthly somatic cell count, fresh cow mastitis incidence, average herd prevalence of a high first test, average herd prevalence of subclinical infection, average new infection risk, and cure risk. For all but a few herds, 95% confidence intervals overlapped for all outcomes before and after starting SDCT and differences were relatively small. In our experience, SDCT, if employed on the right farm, is an effective way to use antibiotics judiciously at dry off without disrupting herd health.

Key words: SDCT, dry period, mastitis, algorithm

Introduction

Selective dry cow therapy (SDCT) involves administering antimicrobials at dry off to only those cows that are at risk of having a subclinical infection at time of dry off as opposed to blanket dry cow therapy (BDCT) where all quarters of all cows are treated. SDCT has been adopted by farms worldwide recently for numerous reasons. Judicious antimicrobial use not only reduces risk of antimicrobial resistance, but is also an important tool on farms for decreasing risk of residues and decreasing costs of production.[1] Public perception has also played a role in on-farm practices. In a recent survey, 90% of 1,000 survey respondents in the U.S. believed that antibiotic use on dairy farms posed some level of threat to human health.[2] More recently, supply chain disruptions around the globe made SDCT a necessity when many areas were unable to obtain dry cow intramammary tubes.[3] Producers in New York State have a new reason to consider SDCT. In 2021, legislature was introduced in the NYS Senate that, if passed, would ban practices using antimicrobials in a preventive manner in food animals, including BDCT.[4]

Numerous studies have shown SDCT does not negatively impact herd health, udder health and milk quality, and has positive economic benefits when implemented in qualified herds.[5-11] Between these neutral herd and individual health outcomes and an average savings of $2.14 to $7.85 per cow dry off depending on method used, one would think SDCT would be quickly adopted by all qualified farms.[8] However, adoption has been slower than expected. In order to encourage more widespread adoption in NYS, the New York Farm Viability Institute (NYFVI) partnered with veterinarians from Cornell University and a local veterinary clinic to guide New York herd veterinarians and their producers through implementation of SDCT. A grant from NYFVI reimbursed herd veterinarians for their time and travel associated with implementation and therefore eliminated additional costs to the producer. The goal of this paper is to detail how to implement SDCT from farm selection to monitoring outcomes, as well as share data from the farms we enrolled, and what we learned during the process. It is our hope that veterinarians and producers can use our experience as a guide for future adoptions of SDCT.

Setting up for success

Selecting the right farms

Perhaps the most important key to success with SDCT is selecting the right farm. Not all farms are ready to remove blanket dry cow therapy from their practices, and instead, efforts should be made on those farms to improve other areas before taking this step. A list of herd selection guidelines, shown in Table 1, were created to help guide veterinarians and producers in making this decision. Though not all items in these guidelines are necessary for success, it is our experience that the closer a farm is to meeting all of them, the higher their chance of success will be. The farms that we worked with met a variety of these criteria and only a few met all. One of the most unexpected challenges when enrolling herds was poor recording of disease and treatment events for mastitis. While some farms were diligent about recording all mastitis treatments, mastitis events that did not receive treatment were often not recorded. This created a problem when using an algorithm that included "mastitis events in the last lactation" as a criterion for considering a cow "high risk" of subclinical infection at dry off. Other farms were highly inconsistent about recording both events and treatment which creates both a lower sensitivity algorithm and makes monitoring outcomes inaccurate as cows go through the dry and fresh period.

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 protocols
	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

Discussion points for SDCT implementation

Implementing SDCT is not a change that should be taken lightly. Adoption of SDCT may expose management weakness in the system previously masked by BDCT. An in-person meeting between the veterinarian of record who is responsible for antibiotic use and involved parties on the farm is important to discuss what SDCT will look like on the farm, what risks are present, and how they should be addressed. This discussion should include a clear description of what SDCT is, current research findings involving SDCT, and the potential economic benefit from implementation. Whenever making a change on a dairy, it is important that stakeholders have clear expectations of what they are getting into. Following should be a general discussion of herd size and the number of animals dried off each week and when. Does dry-off day mean 40-50 animals are getting dried off in the 30 minutes between milkings, or is only one animal getting dried off per week? These different scenarios present different opportunities and challenges. In the herd drying off only one cow per week, it would be realistic to perform a California Mastitis Test (CMT) on each cow at dry off to confirm absence of subclinical infection, whereas in the former herd, this would be unrealistic.

Another important question is if the farm knows what types of mastitis pathogens are present on the farm. The best-case scenario is a farm that is already treating mastitis based on culture results. These types of farms seem to fare the best on SDCT. This is most likely because culturing clinical cases of mastitis also means that cases are being recorded and some other action is taking place on cows that culture contagious pathogens like *Streptococcus agalactiae* and *Staphylococcus aureus*. If individual cultures are not being done, how often is the bulk tank sampled for culture? At a minimum, a farm should know whether they have contagious pathogens or not and preferably they should know at what levels.

Next, the dry-cow facilities should be observed. Inquire about the stocking density of the pen, bedding type and frequency, and cleaning frequency. Also discuss heat abatement and air quality. Factors affecting cleanliness and stress will all impact a cow's risk of intramammary infection and general health during the dry period and beyond.[12,13] Discussion of and observation of the dry-off procedure is equally important and is discussed below.

Selecting the right cows

What data or resources are available for making the selection process of high versus low-risk cows? In other words, how will the farm decide which cows receive a dry-cow antibiotic and which cows will receive a teat sealant only. This will most likely determine if the farm pursues culture-guided SDCT or algorithm-guided SDCT. All of the farms we worked with decided to use algorithm-guided SDCT. For these farms, it is necessary to find out what data is available to create the "algorithm." The best-case scenario is a farm that has in-line somatic cell count (SCC) readers and is diligent about recording mastitis events. This will provide the highest sensitivity in an algorithm-guided approach for determining a cow's risk of infection at dry off or during the dry period. The next best scenario, and most common, would be monthly Dairy Herd Improvement (DHI) SCC tests combined with mastitis event records. Farms that have this data, along with Dairy Comp software, can use an automatic algorithm available in the most recent (December 2021) versions of the software. Users can visit the Valley Ag Software page for a webinar on how to use this tool (**https://vas.com/blog/2022/01/07/how-to-set-up-selective-dry-cow-therapy-with-dairycomp/**). If Dairy Comp software is not available, written

mastitis records and printed DHI reports can be used to accomplish the same function. Based on research models, the most common SDCT parameters used in this type of algorithm would be an SCC cut point of 200,000 cells/mL, more than one mastitis event in the last lactation, or any recent mastitis event.[6,7] This means if a cow had a milk test greater than 200,000 cells/mL at any point in her current lactation, had more than one mastitis event in her last lactation, or had one mastitis event in the last 30 days, she would receive a dry cow antibiotic at dry off.

If SCC data is not available, other data can be used as a proxy for subclinical infection risk, though this is less ideal and not supported by published research. These data points could include milk yield at dry off, lactation number, CMT score, teat end condition, or udder conformation. An example of how an algorithm like this could work is that a cow would only receive dry cow therapy (DCT) if she is greater than first lactation, is producing more than 75 pounds at dry off, has a positive CMT at dry off, has hyperkeratosis present at any teat end, or had mastitis at any point in the last lactation. A decision-making flowchart used on one of the enrolled herds is shown in Figure 1. These types of algorithms tend to be more conservative by nature resulting in a higher percentage of cows being dried off with dry cow therapy (DCT) than in herds using a traditional algorithm that uses mastitis events and SCC over the lactation.

As previously mentioned, adoption of culture-guided SDCT was not popular with the farms enrolled in New York. Theoretically, culture-guided SDCT would be the most accurate way to detect a cow at risk of mastitis before dry off, however when compared to algorithm-guided SDCT and a control (BDCT) in a research trial, all 3 methods performed the same, with algorithm-guided SDCT showing the greatest economic benefit.[8] However, in a farm that lacks quality data to use for an algorithm, but still wants use dry cow antibiotics more judiciously, or in a farm already performing on-farm culturing, culture-based therapy may be a reasonable option. Several different options for culture-guided SDCT have been described and will not be detailed here.[6,9,14] Based on this discussion of management constraints, risk factors, and data available, a decision can be made if the farm is truly ready to move forward with SDCT and which type, algorithm-guided or culture-guided, would work best for the farm.

Dry-off day

If the date of the initial SDCT discussion does not fall on a day when the farm is drying off cows, a follow-up visit should be scheduled to perform a dry-off evaluation and training. First, what is the current protocol for dry-off technique, and what is the owner or manager's perception of how it is currently being performed? They may have already identified areas for improvement or may not even know current best practices for dry-off technique. As dry off is observed, note how many people are involved. The more people participating, the larger the space for procedural drift. This will especially be true when multiple languages are involved. Also, take note of the conditions in the parlor and along the exit pathway to the dry pen during dry off. Are cows dried off in a parlor or does the procedure take place in a free stall or trim chute? These areas should be cleaned of excess manure prior to dry off. How long have the cows been waiting since they were milked last? Do they get milked with their normal pen and sorted out to return to the parlor after milking or are they sorted out prior to milking? Logically, the longer a cow is waiting, the more time she has to make milk, and therefore would have more pressure against the dry-off products being inserted allowing for a higher risk of leakage.

Observe the procedure performed by all employees involved. A resource for objective evaluation of dry-off procedure was created by veterinarians at Quality Milk Production Services (QMPS) in New York and is a useful tool in monitoring employee performance over time **(https://www.dairyroutines.com/)**. This resource, among others, describes correct dry off procedure and step-by-step technique and will not be described here. However, general principles include wearing clean gloves and cleaning or changing them frequently, performing teat-end cleaning and tube insertion in an order that reduces the risk of forearm or sleeve contact with a clean, unprotected teat, and inserting tubes in a way that protects the teat end and gets the product to the area it is supposed to be. This means dry-cow antibiotics are ending up in the gland cistern and teat sealants stay in the distal end of the teat canal. Take note of if teat sealants are used at all and if they are external or internal teat sealants. Research has been convincing that using an internal teat sealant reduces the risk of new intramammary infection during the dry period.[15,16] Be advised that these research findings may not prove true in the face of poor insertion technique. In fact, some producers decided that they could not rely on consistent insertion technique and instead chose to use only an external teat sealant on cows not treated with a dry-cow antibiotic. In all cases, but especially the aforementioned, extreme care must be used when managing dry-cow pen cleanliness.

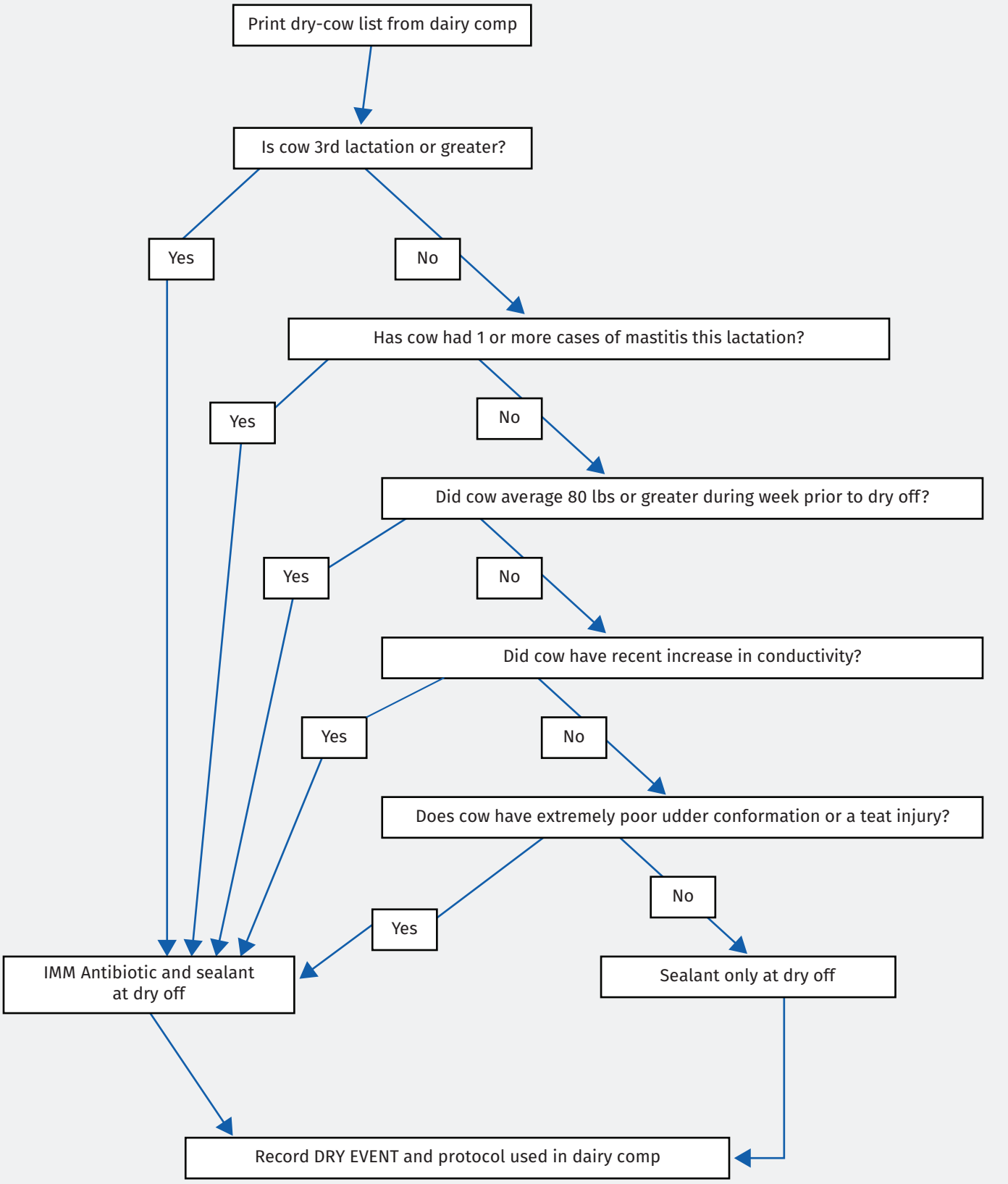
Using the information gathered from observation of dry off procedure and discussion with the herd managers, a written standard operating procedure (SOP) should be created if one was not present already. Included in the SOP should be a description of how cows will be visibly marked so that employees can immediately tell which cows are to receive antibiotic DCT and which are to receive teat sealant only. In some systems with poorer record keeping or algorithm compliance, it may be helpful to visibly mark and record all cows, regardless of dry off therapy used, as having a milk-and-meat withhold in the record keeping system. This would provide another safeguard against mistakes and accidental residues. The SOP can then be used to conduct a formal "dry off day" training. Ideally this training would take place on the day of dry off for hands-on instruction and should be given in the first language of the employees involved. Regularly scheduled dry-off procedure evaluations should take place in the future to evaluate procedural drift.

After drying off the first cohort of cows using SDCT, review how protocols used for each cow are to be recorded. If DairyComp is being used, create new protocols for "treated cows" that get a dry-cow antibiotic and teat sealant and "no treat" cows that receive sealant only. This will allow monitoring of these 2 separate populations in the future.

Continuous monitoring

Once SDCT is set up on a farm, maintain an open dialogue about how dry off goes each week. About one month after beginning SDCT, review herd records to ensure there have been no increase in cases of mastitis during the dry period. If there was an increase, have a discussion about possible reasons. Was there a bedding change, has stocking density in the dry pen changed, is correct dry off technique being followed, or was there a weather change? Be aware that this time will be when a farm is most critical of SDCT. Two farms discontinued SDCT one month or less after starting because they felt they were losing more cows in the dry period than was acceptable to them. It was

Figure 1: Below is an example of a decision-making flowchart that could be used on a dairy that does not have SCC data but would like to pursue algorithm-based selective dry-cow therapy.



discovered later that the increase in dry mastitis events on one of those dairies was part of a much larger spike in clinical mastitis cases that just happened to be the month after starting SDCT.

About 2 months after beginning SDCT, those animals dried off without an antibiotic will begin to freshen in. On farms using Dairy Comp, parameters found in "Guide" under the "SDCT" tab can be used to evaluate success of the program. One of these shows a graph of herd infection dynamics over time which includes a metric called, "HiFresh," or the percent of the herd that had a first test greater than 200,000 cells/mL. Other graphs available are clinical mastitis incidence, and percent of the herd over time with a test greater than 200,000 cells/mL. The "Guide" feature also allows the veterinarian and producer to evaluate compliance with the algorithm. Are all the cows marked as "low risk" by the algorithm truly only receiving teat sealant and vice versa? Sending the farm regular reports with these findings is a good way catch problems early on and to improve herd health overall.

Demographics of farms enrolled

Over the course of a year, 14 veterinarians applied for funding for 26 farms to be enrolled in SDCT. Twenty-four of those 26 farms went on to start SDCT. Farms enrolled ranged in size from 65 to 3,774 mature cows with an average size of 985 mature cows. Twenty-one of the 24 farms that started SDCT used DairyComp. Four farms were robot dairies that used Lely's T4C software, 2 of which also used DairyComp for event recording. Two of the robot herds had in-line SCC readers to monitor daily SCC on each cow. In our experience, in-line SCC readers in robot systems are well worth the investment, especially for a robot dairy looking to start SDCT. Eighteen of the 24 herds were on regular monthly DHI test with SCC; however, 2 of those herds did not have access to on-farm DairyComp. Those herds created manual SDCT algorithms using Microsoft Excel to record mastitis events and high DHI tests for each cow across each lactation. This shows that even small herds with little access to technology, can be successful with SDCT.

Fifteen of the 24 herds consistently recorded clinical mastitis events. Some of the other herds began recording mastitis events when starting SDCT but again became inconsistent as time went on, making for an inaccurate SDCT algorithm and inaccurate herd health monitoring. This unfortunate trend is a prime example of why it is important that farms be consistent recording mastitis events before starting SDCT. If the farm is not, remind stakeholders that starting SDCT and mastitis recording at the same time will appear as though SDCT caused an increase in mastitis events. Fourteen of the 24 herds were already doing or began pathogen-based mastitis therapy (PBMT) of clinical cases when starting SDCT. It is our experience that herds currently using PBMT have an easier time transitioning to the practice of SDCT. These farms have more consistent clinical mastitis recording and therefore the data is more consistent. However, in our experience, herds following PBMT performed similarly to their counterparts. All of the farms enrolled elected to use algorithm-based SDCT instead of culture-based SDCT. Fourteen farms used the automated DairyComp SDCT algorithm, and 8 farms used a manual algorithm based on farm-selected criteria.

Herd health outcomes

On average, farms saw a 53% reduction in use of intramammary antibiotics and ranged from 32 to 78% reduction over the period observed when compared to previous blanket treatment (Figure 2). Figure 3 shows the compliance to the algorithm of the 14 herds that used the automated DairyComp algorithm. On average 81% of the cows labeled as low risk by the algorithms truly did not receive an intramammary antibiotic. This measure of compliance ranged from 32-100% across herds. In the herds where compliance to the algorithm was less than 100%, it was most often due to the herd adding some other level of criteria to sort out high risk cows, for example high milk production at dry off. For cows that were labeled as high risk by the algorithms, an average of 91% were actually treated.

Figure 2: Reduction in antibiotics used at dry off on selective dry-cow therapy compared to blanket dry-cow therapy.

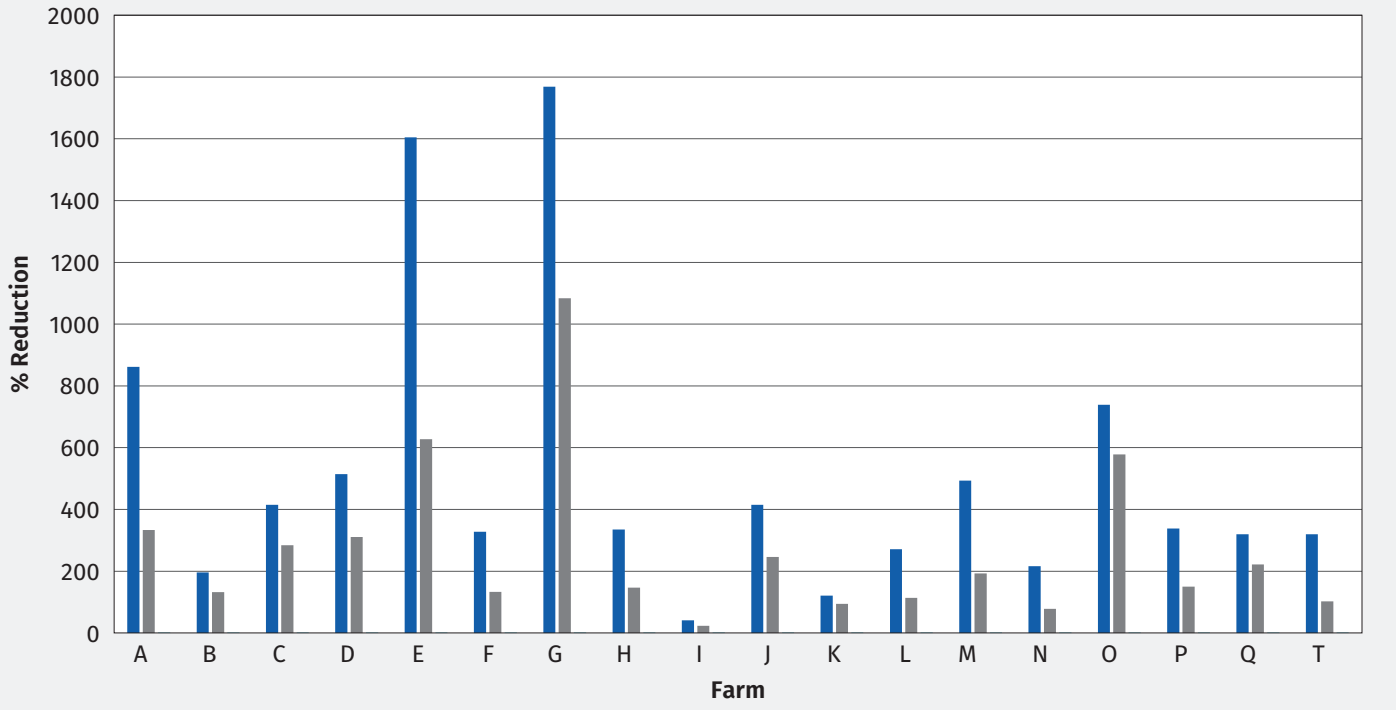


Figure 3: Compliance to the DairyComp algorithm.

The average SCC among participating herds before beginning SDCT was 199,000 cells/mL. The SCC before and after starting SDCT is shown in Figure 4. Of the 16 farms that had monthly SCC data, 12 farms had overlapping 95% confidence intervals (CI). Of the 4 that did not overlap, 1 showed a decrease in SCC and 3 showed an increase. It is important to note what is reported is the average of all cows' SCC on each test day and not a true weighted average that would be more reflective of bulk tank SCC. It is also hard to evaluate how much of these changes were impacted by, for example, seasonal variation as farms all began SDCT at different times of the year.

When evaluating clinical mastitis rates in response to a change made in the dry period, we focused on outcomes in fresh cow mastitis incidence. This was defined by clinical mastitis events that occurred less than 30 days in milk. We chose not to describe dry-cow mastitis incidence as it tends to be a low incidence with inconsistent findings as cows in the dry period are usually not monitored for mastitis like a lactating cow would be. While cases of clinical mastitis in dry cows did not seem to be a widespread problem in the herds that we enrolled, it is important to monitor these events, as 2 farms discontinued SDCT due to an increase in dry-cow clinical cases. Fourteen farms exhibited consistent mastitis recording in DairyComp. Figure 5 shows these farms' fresh cow mastitis incidences before and after beginning SDCT. Overall, the range of fresh cow mastitis incidence during SDCT on these farms was 0.4-8.1% with an average of 2.6%. The 95% CI of these incidences overlapped in all but one herd.

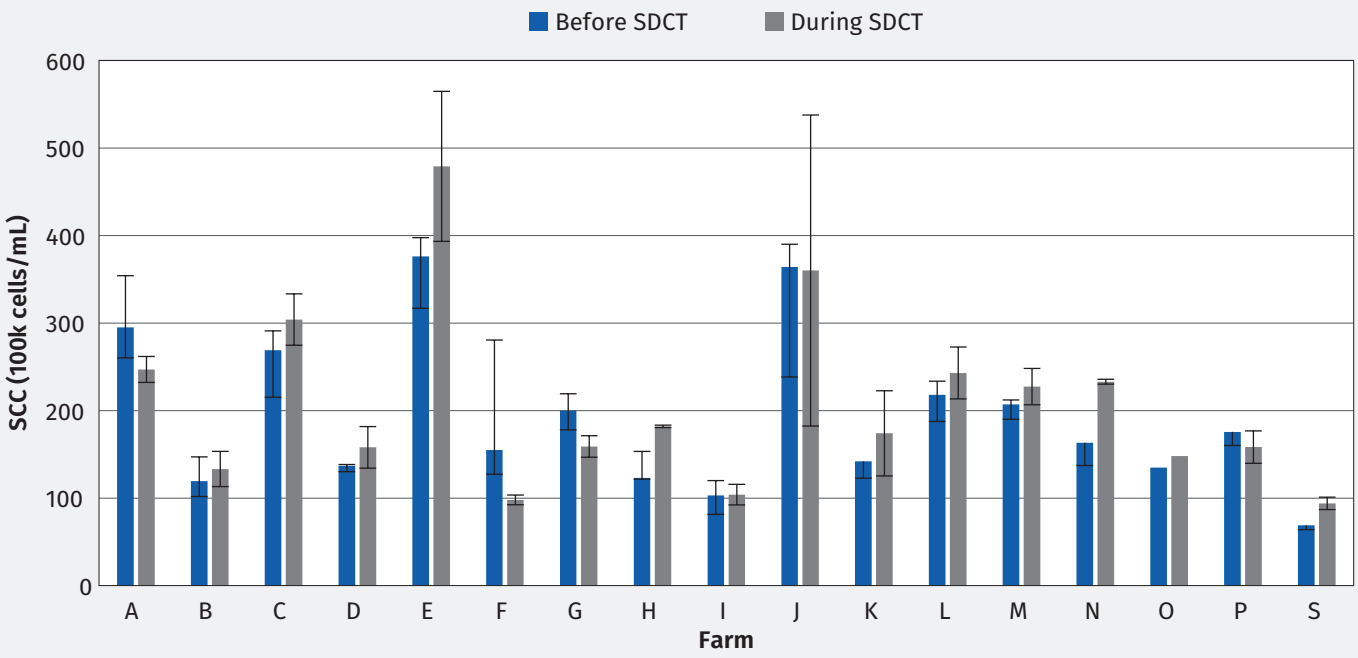
Another key metric to watch when evaluating a change made in the dry period is the percentage of the herd that has a first test greater than 200,000 cells/mL, or a high first test. This metric is shown in Figure 6 for the 16 farms that had DHI SCC data. The 95% CI for 15/16 farms overlapped before and after SDCT. Overall, the monthly percent of high first tests ranged from 8-33% across these farms with an average of 19% of the cows on each farm freshening in with a high first test.

It is also helpful to monitor the percent of the herd with a subclinical infection at any given monthly test and this is shown in Figure 7 where 13/16 herd's 95% CI overlapped. Of the 3 herds with non-overlapping confidence intervals, 1 showed decrease in overall subclinical mastitis while 2 increased. The percent of the herd with a subclinical infection ranged from 9-32% in these 16 farms with an average of 16.8% As mentioned above, it is not realistic to interpret any of this as causation, but instead using these metrics as a monitoring tool. When looking at new infection risk (Figure 8), 14/16 herd's 95% CI overlapped where one herd had a decreased new infection risk and the same troubling herd (E) had an increased risk. New infection risk during SDCT ranged from 3-13% with an average of 6.8%.

Perceived factors associated with success and failure

As mentioned previously, 26 farms applied for our assistance with SDCT, and 24 actually began SDCT. One of the farms that did not start SDCT was determined to have milk quality issues that were non-compatible with SDCT success, namely, a bulk tank SCC of over 400,000 cells/mL and a large presence of contagious mastitis causing organisms including *Streptococcus agalactiae*. The other farm that did not start was due to ill timing during a change in herd management. Of the 24 farms that started SDCT, 17 farms are still using SDCT at the time of publishing. Three of the farms that discontinued cited seasonal challenges associated with warmer weather and would most likely return to the practice when cooler weather returned. Another farm that discontinued cited worsening milk quality in the herd unrelated to SDCT but felt they could not continue SDCT in the face of high bulk tank SCC and high mastitis incidence. Two others that discontinued experienced a higher number of severe mastitis cases early in the dry period. The final farm that discontinued had struggled with a *Staphylococcus aureus* problem historically which seemed to flare up when trying SDCT.

Figure 4: Average somatic cell count of farms before and after implementing selective dry-cow therapy.



These outcomes highlight the importance of selecting the right herd as described previously. Generally, higher milk quality, lower disease prevalence, and quality data are correlated with positive outcomes. However, there were a few specific factors that became recurring themes while working with farms. The first was the use of teat sealants. As mentioned earlier, research has been convincingly in favor of teat sealants, particularly internal sealants.[15,16] However, there has been anecdotal success with external sealants only on cows that do not receive intramammary antibiotics. Like most things of this nature, disease pressure and pathogen load of the environment will likely affect outcomes. But for herds that are worried about consistency of clean insertion of internal teat sealants, this is an option to consider. This project highlighted the need for more investigation into alternative dry-off techniques, like step-down methods to decrease milk production and perhaps milk leakage after dry off, and how they may affect herd health and how they would fit into current management systems. It would make sense that this would lead to improved udder health during the dry period, broadening the success of SDCT across farms.

Regardless, dry-off technique will continue to be an important area of attention. Formal, hands-on dry-off trainings and assessments must be performed at regular intervals as a milking routine training would be to ensure low risk of introducing infection at dry off and preventing infection upon entrance to

Figure 5: Fresh cow mastitis incidence before and after starting selective dry-cow therapy.

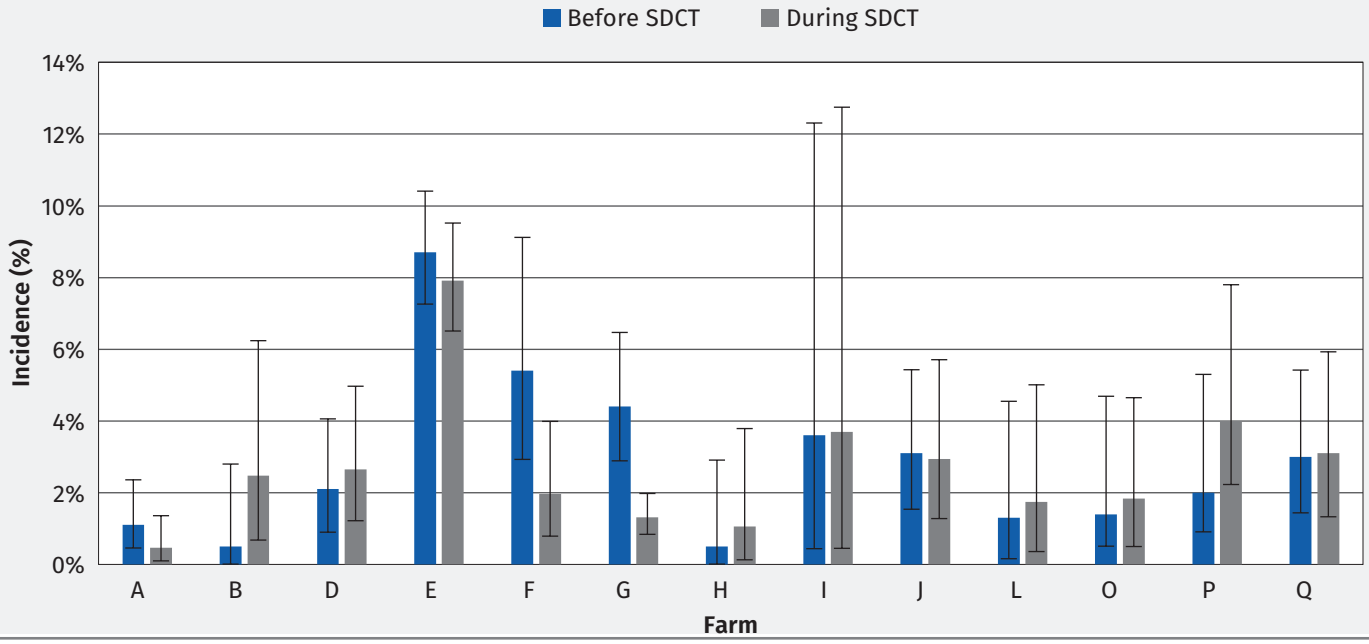


Figure 6: Average monthly prevalence of cows with a high (>200,000 cells/mL) first somatic cell test.

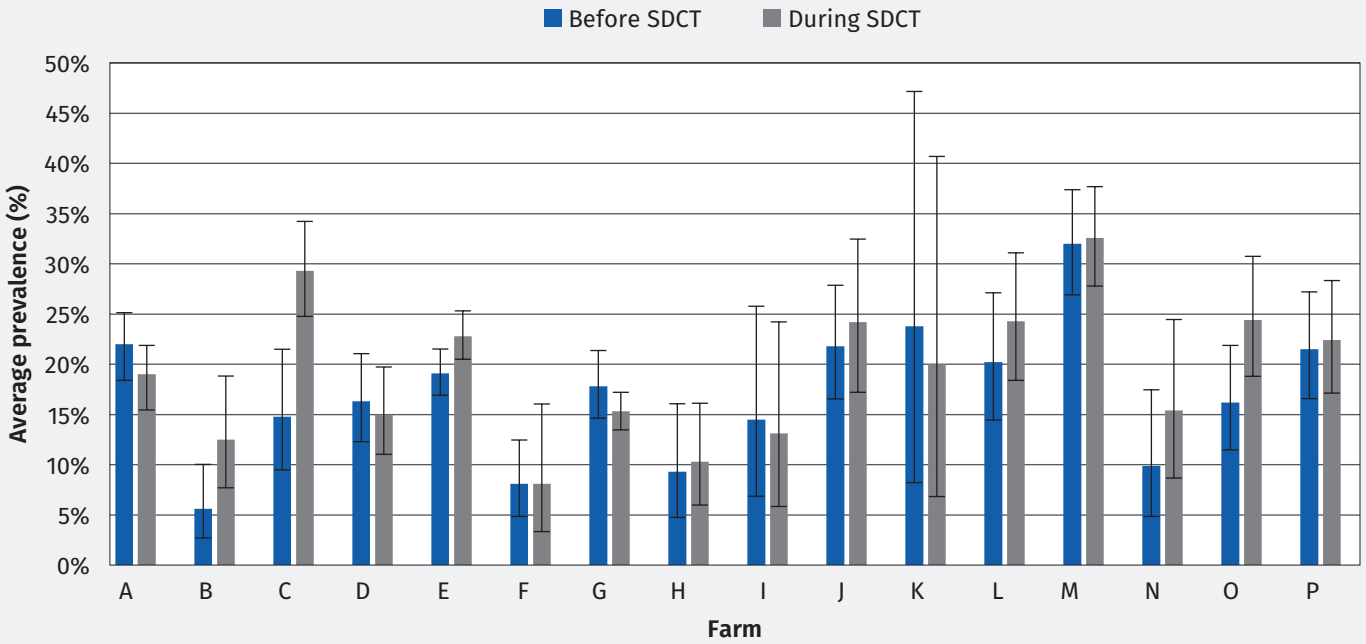


Figure 7: Average monthly prevalence of cows with a subclinical infection (somatic cell test >200,000 cells/mL).

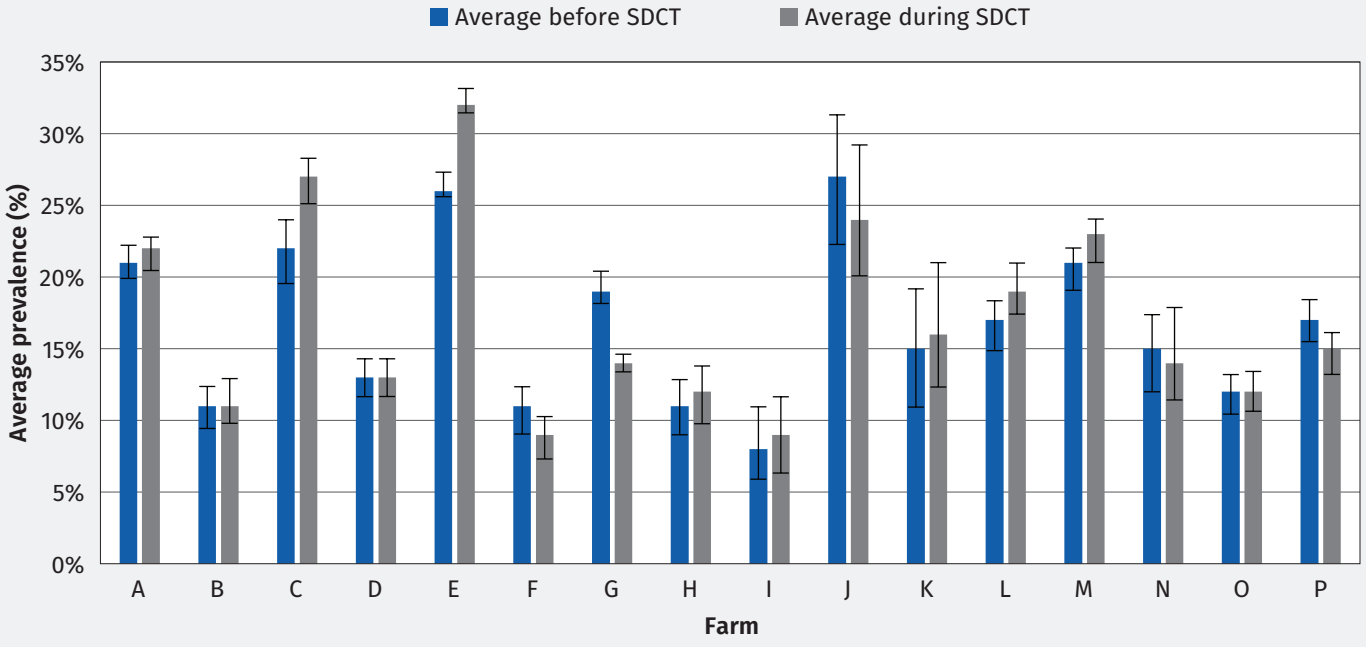
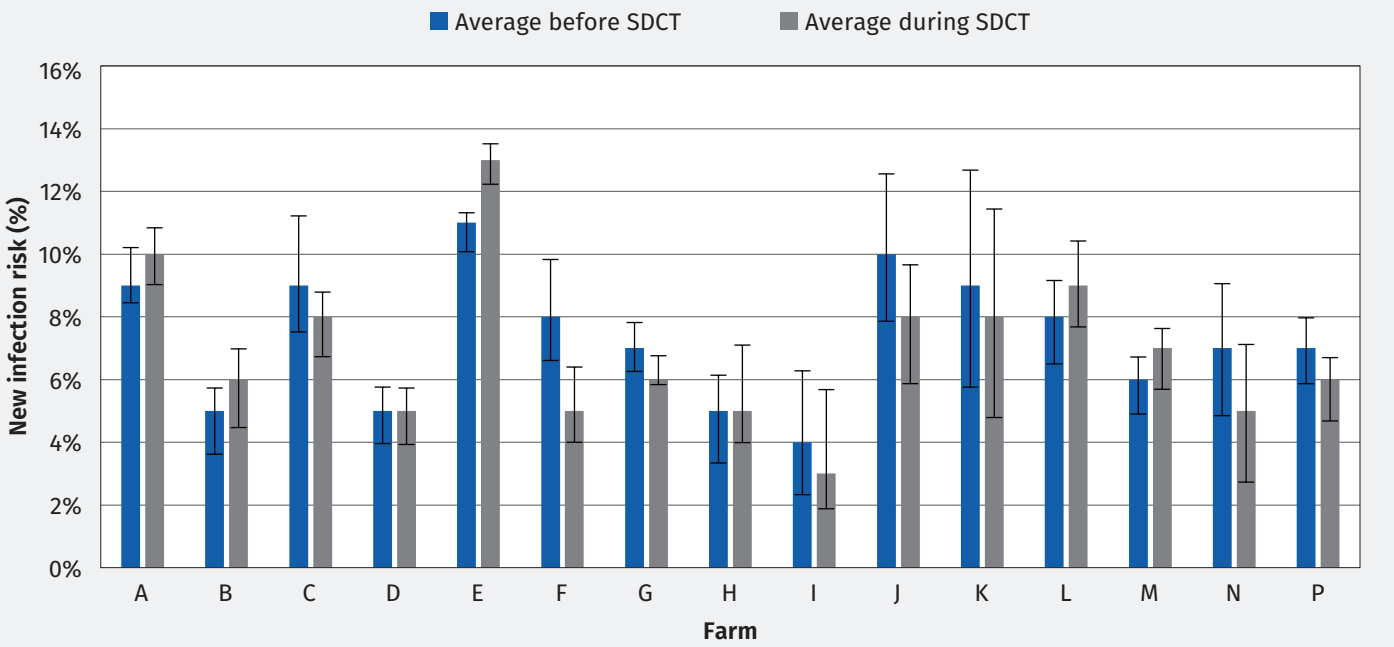


Figure 8: Average monthly new infection risk before and after selective dry-cow therapy.



the dry pen. Finally, although SDCT may not be right for every farm at present, it is a realistic and achievable goal for farms to reach a place in their milk quality and herd health journey in which SDCT is appropriate. In our experience, PBMT would seem a good place to start for many farms that are not ready for SDCT. With the most common reasons of "ineligibility" including a lack of consistent mastitis recording and control of contagious pathogens, PBMT is a logical next step to improve these factors.

Summary

Given the positive outlook research findings on SDCT had shown, we were encouraged to help other veterinarians and producers in our region adopt this method of selective antimicrobial use. This project showed that while SDCT is a practical way to employ judicious antimicrobial use on qualified dairy farms, it is not guaranteed to produce success on every farm. Many farms enrolled continue to have success and are expected to follow this new norm. However, there is a real possibility in few farms, as we experienced, for poor outcomes. Key factors to look out for before enrolling a farm are the data available to create an SDCT algorithm and to monitor its success, the current milk quality picture of the farm, dry-off technique, and dry-cow environment. Seventeen out of 24 farms enrolled continue to employ this method of dry off and if our cohort is representative of other farms across the nation and world, there exists an opportunity for many more farms to adopt this practice.

Acknowledgements

This project was partially financially supported by the National Institute of Food and Agriculture U.S. Department of Agriculture, under grant award number 2018-68003-27467. This work was also financially supported by New York Farm Viability Institute who provided the funds for veterinary reimbursement. We would also like to thank Aileen Randolph, with NYFVI, who was an excellent project coordinator for our team.

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