Designing effective reproductive management programs for lactating dairy cows: Matching strategies to farm needs and resources

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Abstract

A proactive, systematic, and consistent reproductive management program conducted by committed personnel that prioritizes attention to detail usually leads to successful reproductive performance of the dairy herd, regardless of the approach and the level of technology utilized. Programs aimed at maximizing the insemination of cows after a detected estrus can be successful; however, they should be coupled with a synchronization of ovulation protocol for timed artificial insemination (TAI) to assure timely insemination of all cows. Synchronization of ovulation protocols to increase the fertility of first as well as second and subsequent TAI services are available, and can be successfully implemented by dairy farms. Dairy farms seeking to optimize reproductive performance of their herds need to carefully evaluate the resources, personnel, and time available to implement a reproductive management program.

Key words: dairy, reproduction, breeding, TAI, synchronization

Résumé

Un programme de régie de la reproduction proactif, systématique et cohérent mené par du personnel engagé et pointilleux permet souvent d'augmenter la performance de reproduction dans un troupeau laitier peu importe l'approche et le niveau de technologie utilisés. Les programmes dont le but est de maximiser l'insémination des vaches après la détection de l'œstrus peuvent avoir du succès. Toutefois, ces programmes devraient se faire en parallèle avec un protocole de synchronisation de l'ovulation pour l'insémination artificielle sur rendez-vous afin d'assurer l'insémination en temps voulu de toutes les vaches. Des protocoles de synchronisation de l'ovulation sont disponibles pour accroître la fertilité après le premier de même que le second service d'insémination artificielle sur rendez-vous et peuvent être déployés avec succès dans les fermes laitières. Les fermes laitières qui veulent optimiser la performance de reproduction dans leurs troupeaux doivent évaluer avec soin les ressources, le personnel de même que le temps disponible pour mettre de l'avant un programme de régie de la reproduction.

Introduction

Optimizing reproductive performance of lactating dairy cows is paramount to dairy farms because reproductive efficiency has a major impact on farm profitability. Because of the significant variation across farms in type of facilities, cows, and personnel, a thorough evaluation of the resources and conditions of a particular farm should be conducted before selecting a reproductive management program. Producers should work with their farm personnel, veterinarian, and consultants to select the strategy that optimizes reproductive performance while maximizing the profitability of the herd. Given the vast array of strategies available, it may be challenging for producers to identify the program that best fits the needs of their farm. In many cases a proactive, systematic, and consistent reproductive management program conducted by detailed oriented and committed personnel leads to successful reproductive performance regardless of the approach and the level of technology utilized. This paper attempts to summarize recent research data generated to evaluate the implications of various reproductive management strategies that favor AI either at detected estrus (**EDAI**) or timed artificial insemination (**TAI**) for first as well as for second and subsequent AI services in lactating dairy cows.

Practical considerations for the design and implementation of a reproductive management program for lactating dairy cows are also provided.

Strategies for First Service Post-partum

Maximizing AI after a detected estrus

Maximizing insemination of cows after a detected estrus is the goal of numerous dairy farms, in particular for those that are successful identifying cows in estrus and those that utilize an automated activity monitoring (**AAM**) system for detection of estrus. Some farms may also prefer to reduce their reliance on TAI programs.

Because AAM systems for detection of estrus are a feasible alternative to replace traditional methods of estrus detection and avoid some of the challenges associated with traditional methods (e.g., protocol drift, subjectivity of the method, inconsistent definition of estrus), many studies focused on the incorporation of AAM systems for detection of estrus into reproductive management programs for lactating dairy cows. Although these experiments provided valuable information about the implementation of reproductive management programs using AAM systems, their results directly apply to farms that are successful with any other method to identify cows in estrus.

Fricke et al evaluated potential strategies to incorporate an AAM system for first AI service postpartum only.[8] In this study, a limited hormone intervention program that combined ED based on activity (**EDAI**) and the Ovsynch protocol for cows not inseminated in estrus was compared to the Presynch-Ovsynch protocol with (combined EDAI and TAI) or without (100% TAI) detection of estrus based on activity after the Presynch portion of the protocol. Despite differences in the rate at which cows were inseminated for first service, there were no differences in the rate at which cows became pregnant up to 300 days-in-milk (DIM). The initial difference in the proportion of pregnant cows in favor of the 100% TAI program after first AI was compensated by the limited hormone intervention program and the combined Presynch-Ovsynch and ED program as DIM progressed (cows managed equally for subsequent AI services). An interesting finding of this study was that cows detected with increased activity after Presynch but not inseminated (all received TAI) had greater P/AI than cows AI on activity after Presynch. As expected, due to the very similar reproductive performance during lactation (up to 300 DIM) there were no major economic differences between the 3 programs. The differences observed ranged from \$8 to \$4 per cow per year in favor of the 100% TAI program with Presynch-Ovsynch and the combined Presynch-Ovsynch and ED program, respectively. In this study, however, the comparison only included different programs for first-service management without any specific interventions for cows failing to conceive after first service.

More recently, Stevenson et al conducted a study to compare the reproductive performance of dairy cows managed with a program that relied on detection of estrus with an AAM system, induction of estrus with $PGF_{2\alpha}$ (hereafter PGF), and TAI for cows not detected by the AAM system.[23] This program consisted of a combination of induction of estrus with a PGF treatment if cows were not inseminated 4 d after the end of a VWP of 50 DIM (91% of cows received PGF), were enrolled in a CIDR-Synch protocol if not AI by 75 DIM (7% of the cows) and, received TAI after resynchronization if failed to conceive after a third service (% of cows not reported). This program that combined ED and TAI was compared to a 100% TAI program with Presynch-Ovsynch and Ovsynch for the first 3 AI services postpartum. As expected, the strategy that included the AAM system resulted in reduced days to insemination for first AI service (12 d for primiparous and 7 d for multiparous) because of a VWP of 50 DIM versus 71 DIM for cows enrolled in the TAI strategy. Fertility of cows was affected by a treatment by parity interaction with no difference for primiparous cows, whereas greater P/AI was reported for multiparous cows receiving TAI than those inseminated in estrus. On-farm records (values obtained from PCDart and not analyzed statistically) also showed a numerical difference in favor of the TAI program for P/AI (44 vs 35%) across all 3 first services, but a greater estrus detection rate (74 vs 42%) and percentage of cows pregnant by 150 DIM (68 vs 52%) in favor the program that used the AAM system.

In summary, the majority of recent research studies seem to indicate that AAM systems (and maybe any other efficient and accurate method of estrus detection) can be successfully used by dairy farms to inseminate cows for their first AI postpartum. Nevertheless, due to physiological limitations presented by lactating dairy cows or technical limitations of these systems that lead to inaccuracy of detection of estrus, it seems clear that AAM systems should be used in combination with synchronization of estrus and ovulation protocols for TAI.

Although submitting healthy cows for insemination is critical for the success of every reproductive management program, it may even be more critical for programs that rely heavily on insemination after a detected estrus. Because the goal is to inseminate as many cows as possible in estrus, farms should strive to have cows that resume cyclicity and are physically sound to express estrus (i.e., do not present lameness, impediments to normal locomotion, injuries) by the end of the voluntary waiting period. This is relevant because mounting evidence is linking health during the early postpartum period to estrus expression and overall reproductive success.

Increasing fertility through timed AI

In general, strategies aimed at increasing the fertility of TAI services entail more complex synchronization of ovulation protocols that require more treatments during 1 or more days of the week. Therefore, such strategies might be a good resource for dairy farms with dairy management software available and/or for farms in which cows are less likely to express estrus due to biological limitations or management constraints (e.g., tie-stall facilities, poor flooring, others). Also, these more complex protocols may be an excellent resource for dairy farms that want to increase fertility of AI services after failing to do so through estrus-based inseminations. Due to the increased complexity of these programs, it is paramount that farm personnel critically examine the feasibility of running such programs and whether this type of program is the best alternative for the herd.

Although many other synchronization of ovulation protocols have been examined in research studies, the most common protocols used to increase fertility of TAI for first service are the Presynch-Ovsynch[18] (used exclusively for TAI), Double-Ovsynch,[21] and G-6-G.[1] Although these protocols vary in complexity and the type of hormone treatments used, in general they have all been designed with the goal of improving the overall response of cows to each hormonal treatment through presynchronization of the estrous cycle before the initiation of the Ovsynch-56 protocol (sometimes referred to as Breeding Ovsynch) for TAI (Figure 1). These protocols

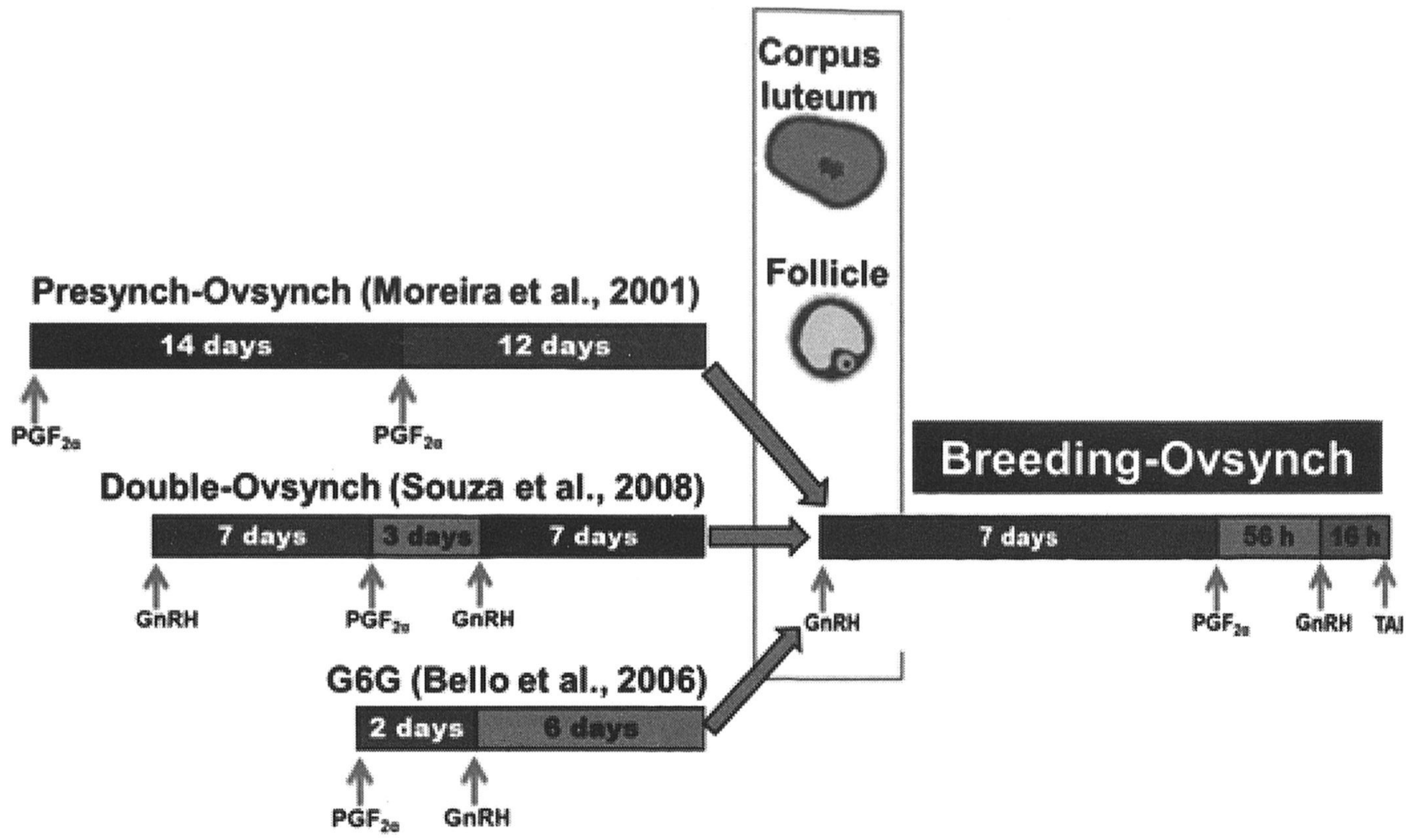

Figure 1. Schematic representation of 3 different protocols that include presynchronization of the estrous cycle before the Ovsynch-56 protocol for first AI service postpartum.

work by synchronizing estrus (Presynch-Ovsynch) or ovulation (Double-Ovsynch and G-6-G) so that cows are approximately on day 6 to 9 of the estrous cycle at the initiation of the Ovsynch-56 portion of the protocol (Figure 1). Cows at that stage of the estrous cycle should have a growing corpus luteum (**CL**) and an ovarian follicle (≥ 10 mm) responsive to the first GnRH treatment Ovsynch-56 (Figure 1).

Numerous research studies have confirmed that these protocols improve P/AI when compared to the Ovsynch protocol without presynchronization of the estrous cycle. When these programs are correctly implemented, the expectation is to observe a 7 to 15 percentage point gain in P/AI as compared to the Ovsynch protocol alone. Thus, producers using protocols that include presynchronization of the estrous cycle before Ovsynch-56 for first service TAI should expect P/AI in the range of 40 to 55%.

Some studies also suggest that the Double-Ovsynch protocol results in greater fertility than the Presynch-Ovsynch protocol[13] when cows receive TAI at the same range of DIM. Likely this is because the Double-Ovsynch protocol resolves anovulation more effectively than the Presynch-Ovsynch protocol which depends largely on the enrollment of previously cycling cows to successfully synchronize ovulation.[13,19] It is worth noting that the greatest differences in fertility between these protocols have been observed for primiparous and not for multiparous cows. Indeed, observations from numerous dairy farms using the Double-Ovsynch protocol confirm that primiparous cows can achieve very high P/AI, often times ≥50 to 55%.

More recently, some experiments explored different alternatives to maximize the fertility of TAI with protocols that include presynchronization of the estrous cycle. One feasible alternative is to increase the proportion of cows with complete CL regression (<0.5 ng/mL) before TAI by giving an additional PGF treatment 12 or 24 h after the PGF that triggers luteal regression before TAI.[2,23] Obviously, there will be an increased labor demand and cost of the program, but recent studies have shown an increment of ~4 to 5 percentage points in P/AI. Whether this strategy is suitable for all dairy farms and worth economically should be carefully evaluated by each dairy operation.

An important consideration at the time of selecting GnRH-based presynchronization programs such as Double-Ovsynch and G-6-G is that a relatively low proportion of cows will display estrus during the treatments (probably <30 to 40%). Therefore, it will not be possible to inseminate a high proportion of cows at a detected estrus. In fact, these programs will result in a majority of cows receiving TAI.

Strategies for Second and Subsequent AI Services

Considerations for management of second and subsequent AI services

Because a substantial proportion of cows may fail to conceive after a previous AI service, maximizing fertility and minimizing the interval between inseminations remains a main objective of reproductive management programs. Indeed, recent economic evaluations of the value of reducing the interbreeding interval demonstrated substantial gains in cow profitability when the interbreeding interval was reduced, in particular for herds with poor detection of estrus.[10]

Likely, the major impact of implementing a systematic resynchronization protocol for TAI in a commercial dairy operation is to assure the insemination of cows within a predefined time frame after the previous AI service. In dairy farms that use solely detection of estrus or choose not to use a resynchronization program after the previous AI, the pattern of re-insemination is characterized by a large variation among cows and long interbreeding intervals for a significant proportion of cows (Figure 2A). Although a majority of cows can be re-inseminated at detected estrus within 30 d of the previous AI in farms with good estrus detection efficiency, it is typical to observe that 30 to 40% of cows will not receive AI for up to 50 to 70 d after their previous AI. In fact, some cows may not be re-inseminated for as long as 70 to 80 d. Such a pattern of re-insemination for second and subsequent services is detrimental to the overall reproductive performance of the herd because the over-extended interbreeding interval for some cows will reduce the 21-d service rate, hence, the rate at which cows become pregnant.

Conversely, dairy herds that implement a systematic resynchronization of ovulation program to re-inseminate cows not detected in estrus will benefit by a major reduction of the interbreeding interval. For example, when estrus detection is combined with resynchronization initiated on a weekly basis at 32 ± 3 d after a previous AI, the pattern of re-insemination is characterized by a reduced variation of the interbreeding interval. More importantly, all cows will be re-inseminated by 45 d after TAI (Figure 2B).

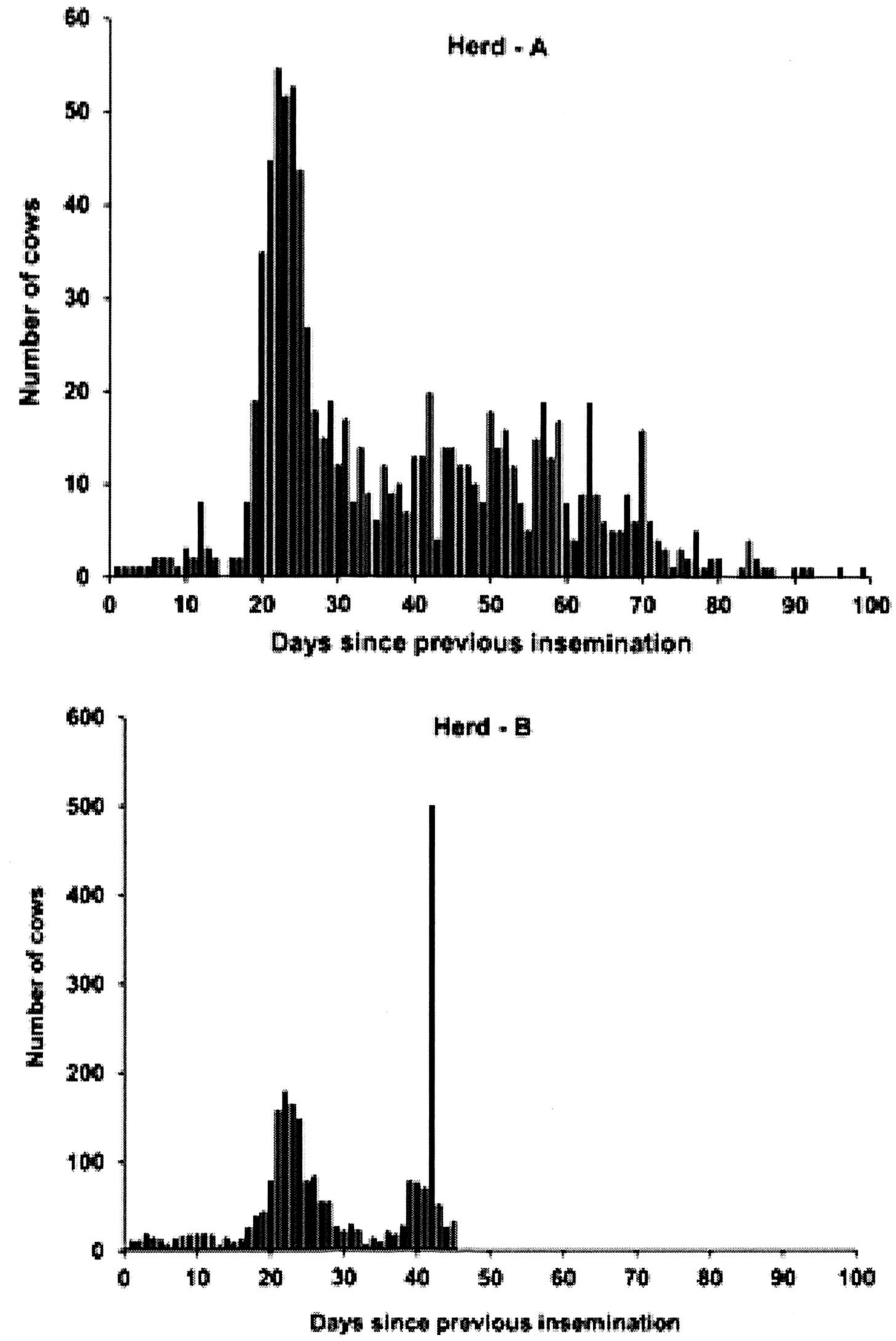

Figure 2. Distribution of re-inseminations for cows failing to conceive to a previous AI service in dairy herds using different management strategies for second and subsequent AI services. In Herd A, the majority of cows are AI after detection of estrus and no systematic use of resynchronization of ovulation is used. In Herd B, a combined approach is used with detection of estrus and TAI. All cows not detected in estrus and inseminated after their previous AI begin the resynchronization protocol 32 ± 3 d after AI to receive TAI 42 ± 3 d after the previous AI. Note the substantial number of cows not re-inseminated beyond 42 d (2 21-d cycles) of their previous AI in herd A as opposed to herd B.

Reproductive management programs to reduce time to pregnancy after first service

Improving the P/AI of cows without a corpus luteum in a resynchronization protocol. A very well documented problem with lactating dairy cows enrolled in the Ovsynch protocol for resynchronization of ovulation is that cows that lack a functional CL at the time of the PGF treatment will have reduced P/AI when compared to cows with a CL.[7] In general, this problem affects ~10 to 30% of all cows resynchronized with Ovsynch, and the reduction in P/AI is in the order of 15 to 20 percentage points (50 to 60% reduction). Because in many dairy farms the day of the PGF treatment coincides with the day of non-pregnancy diagnosis (**NPD**), re-assigning cows with no CL (as determined by transrectal ultrasonography) to a new treatment that improves P/AI is an alternative to improve overall performance of second and subsequent AI services. Therefore, we conducted an experiment to test 2 different treatments for cows with no CL at the time of NPD and the PGF treatment of the Ovsynch-56 protocol initiated 32 ± 3 d after AI (i.e., most typical program used by dairy farms that resynchronize cows; usually known as D32-Resynch).[12] In a preliminary study including 872 cows, we first determined that a cutoff of 15 mm or less was the best size to separate cows with or without a functional CL (i.e., from a response to TAI perspective and not based on progesterone concentrations) at the time of the NPD 39 ± 3 d after AI and 7 d after receiving the first GnRH treatment of the Ovsynch protocol. We confirmed that for cows without a CL or a CL of <15 mm in diameter, P/AI were 14% as compared to 33% for cows considered to have a CL ($P < 0.001$). For the follow-up randomized controlled study, cows without a functional CL were enrolled in the experimental treatments as follows: 1) Ovsynch+Progesterone (P4): re-initiation of the Ovsynch protocol with progesterone supplementation via a CIDR device[a] from the time of the GnRH to PGF treatment of Resynchronization, and 2) PreG-Ovsynch: presynchronization of the estrous cycle with a GnRH treatment 7 d before the initiation of the Ovsynch protocol. Interestingly, both treatments restored fertility of cows without a CL and resulted in similar time to pregnancy during lactation. Overall

P/AI were similar between the groups (34.4 and 37.0% for Ovsynch+P4 and PreG-Ovsynch; Table 1), but much greater than that observed in the preliminary study for non-treated cows without a CL (10 to 15% P/AI).

Thus, dairy producers have the option of using either one of these treatments to improve the P/AI of cows with no CL. Farms that prefer to use the Ovsynch+P4 protocol will have the added labor required to use the P4 releasing devices, but will re-inseminate cows 1 week earlier than if the PreG-Ovsynch program is used. A slightly greater proportion of cows might be inseminated after a detected estrus with the PreG-Ovsynch protocol.

Reducing time to pregnancy through the Short Resynch plus CIDR-Synch program. An ideal strategy for submitting cows for re-insemination minimizes the interbreeding interval and maximizes pregnancy per AI (P/AI). Many dairy farms reduce the interbreeding interval by combining re-insemination of cows at detected estrus and TAI after resynchronization of ovulation.[3,7,19] Re-insemination of cows at detected estrus with resulting P/AI similar to or better than that observed after TAI benefits herd profitability by reducing the overall interbreeding interval and reproductive program cost.[9,11,12] On the other hand, incorporating a resynchronization of ovulation protocol for TAI is essential because it ensures timely re-insemination of nonpregnant cows not detected in estrus. Although this combined approach can be effective to reduce time to pregnancy, new programs that favor earlier re-insemination of cows that receive TAI may benefit reproductive performance even further.

For farms that enroll cohorts of cows in a resynchronization of ovulation protocol on a weekly basis, an effective strategy to minimize the interbreeding interval of TAI services is to initiate the Ovsynch protocol 25 ± 3 d after AI (D25-Resynch). This program results in an interbreeding interval of 35 ± 3 d. A caveat of this protocol is that the GnRH treatment 25 ± 3 d after AI may reduce estrus expression. Indeed, it has been shown that fewer cows are detected in estrus when GnRH is given to cows 17 to 32 d after AI.[2,5] Another inconvenience associated with the D25-Resynch protocol is that because the pregnancy status of cows is unknown 25 ± 3 d after AI, a substantial proportion of the cows that receive the GnRH treatment are pregnant. These unnecessary treatments increase the cost and burden (i.e., labor and cow disruption) of the reproductive management program. Thus, removing the first GnRH treatment of the D25-Resynch protocol may be an alternative strategy to reduce the interbreeding interval without disrupting re-insemination at estrus and eliminating the treatment of pregnant cows. A caveat of removing the first GnRH of a resynchronization of ovulation protocol is the potential reduction in P/AI. Therefore, we first conducted an experiment to evaluate the Short Resynch protocol (PGF-24 h later-PGF-32 h later-GnRH-16 to 18 h later TAI) initiated 32 ± 3 d after AI.[26] Of note, cows without a CL at NPD received the CIDR-synch protocol because they are not expected to have reasonable P/AI after Short Resynch. As expected, P/AI for cows with a CL at NPD that received Short Resynch was reduced as compared to cows that received GnRH on Day 25 ± 3 after AI (D25-Resynch with 2 PGF treatments). Nevertheless, we concluded that P/AI (33%; 62/189) was reasonable to be used by commercial dairy farms. When compared to traditional programs that re-inseminate cows at 42 ± 3 d after AI, the reduction in P/AI for Short Resynch would be compensated by earlier re-insemination of cows that have CL at the time of NPD 32 ± 3 d after AI (usually ~70% of non-pregnant cows).

To determine the potential value of the Short Resynch protocol, we recently evaluated this program in commercial dairy farms. The Short Resynch protocol (PGF-24 h later-PGF-32 h later-GnRH-16 to 18 h later TAI; Figure 3) was used for cows with a CL at NPD 32 ± 3 d after AI, whereas the CIDR-synch protocol (GnRH + CIDR-7 d-CIDR removal + PGF2α-24 h-PGF2α-32 h-GnRH-16 to 18 h-TAI; Figure 3) was used for cows without a CL at NPD. This program, which we refer

Table 1. Pregnancies per AI for cows enrolled in an Ovsynch+P4 or a PreG-Ovsynch protocol after non-pregnancy diagnosis 39 ± 3 d after AI (Giordano JO, Thomas MJ, Catucuamba G, Curler MD, Masello M, Stangaferro ML, Wijma R. Reproductive management strategies to improve the fertility of cows with a suboptimal response to resynchronization of ovulation. *J Dairy Sci* 2016; 99:2967-2978. doi:10.3168/jds.2015-10223).

	Treatment		
Item	**Ovsynch+P4**	**PreG-Ovsynch**	***P*-value**
P/AI at 39 d			
EDAI*	41.4 (12/29)	29.3 (12/41)	0.42
TAI	33.3 (61/183)	39.1 (59/151)	0.37
Overall	34.4 (73/212)	37.0 (71/192)	0.57

*Cows AI after a detected estrus after enrollment at 39 ± 3 d after AI

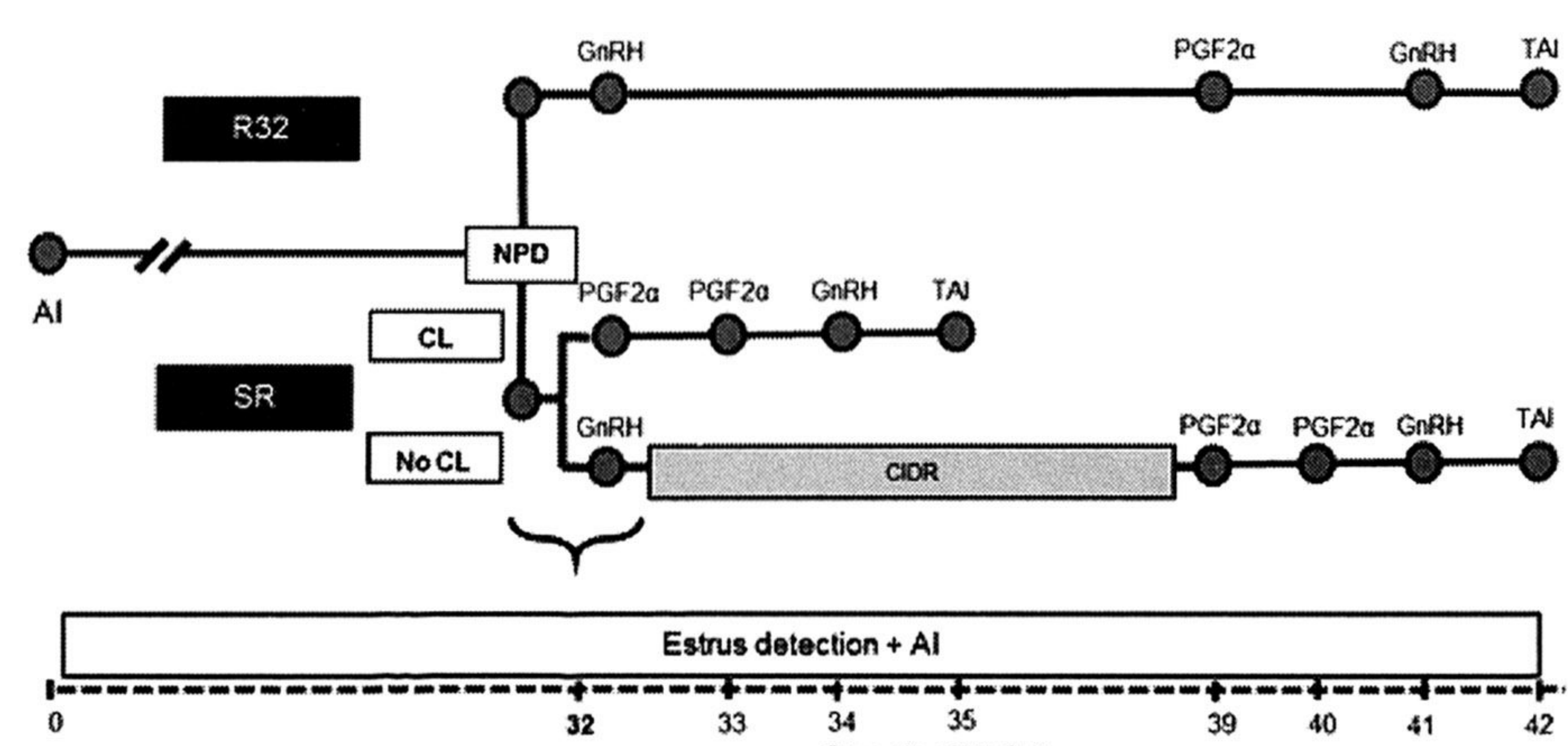

Figure 3. After first service postpartum, cows received the D32-Resynch (R32; n = 1,010) or Short Resynchronization (SR; n = 1,000) treatment. At NPD 32 ± 3 d after AI, cows in R32 received the Ovsynch protocol, whereas cows in SR were resynchronized based on the ovarian structures. Cows with at least one CL≥ 15 mm received PGF2α, 24 h later PGF2α, 32 h later GnRH, and TAI 16 to 18 h after GnRH. Cows without a CL received the CIDR-Synch protocol with 2 PGF2α treatments. NPD = non-pregnancy diagnosis, CL = corpus luteum, TAI = timed AI.

to as Short Resynch + CIDR-synch or simply Short Resynch (**SR**), was compared to the D32-Resynch protocol (GnRH-7d later-PGF-56 h later GnRH-16 to 18 h later TAI; Figure 3). The expectation was to reduce time to pregnancy after first service because of a shorter interbreeding interval for cows with a CL and improved P/AI for cows with no CL at NPD. These 2 effects were expected without disrupting insemination of cows at detected estrus before NPD because the GnRH treatment on Day 25 was not given. In support of our hypothesis, cows in the SR program had fewer days to pregnancy after the first service (Figure 4) because the hazard of pregnancy was greater ($P = 0.03$) than for the R32 treatment (HR = 1.18, 95% CI: 1.01 to 1.37). As a result, mean time to pregnancy was 111 ± 3 and 100 ± 3 d for the R32 and SR treatment, respectively. Another benefit of the SR treatment was a reduction in the proportion of non-pregnant cows at the end of experimental period (6.9 percentage points; $P = 0.01$).

Thus, the SR treatment may benefit dairy herds when compared with blanket use of the D32-Resynch protocol through a reduction in both time to pregnancy during lactation and the proportion of nonpregnant cows removed from the herd at the end of lactation. Of note, the reduction in interbreeding interval for cows with a CL at NPD in the SR treatment was possible without the GnRH 25 ± 3 d after AI. Removing the GnRH treatment eliminated 2 unintended consequences: (1) interfering with estrus expression before NPD and (2) unnecessary treatment of all pregnant cows with GnRH.

Based on this experiment and others from our laboratory,[25,26] the Short Resynch + CIDR-synch program is a new management strategy for second and greater AI services with the potential to improve reproductive performance of dairy herds, particularly, for herds that currently implement programs like D32-Resynch. Removing the GnRH treatment to induce a new follicular wave in the SR treatment not only helped reduce the interbreeding interval for a majority of cows without disrupting estrus expression, but also reduced unnecessary treatment of pregnant cows with GnRH.

Ongoing research in our laboratory is comparing time to pregnancy during lactation for the Short Resynch + CIDR-Synch program as compared to the D25-Resynch + CIDR-synch protocol (i.e., includes GnRH on Day 25).

Maximizing AI after a detected estrus. Maximizing insemination of cows after a detected estrus for second and subsequent AI services may be the goal of numerous dairy farms, in particular for those that utilize an automated activity monitoring (**AAM**) system for detection of estrus or prefer to reduce their reliance on TAI programs. Therefore, we recently conducted a study at a commercial dairy farm in New York to evaluate the impact of a reproductive management program aimed at increasing the proportion of cows AI based on physical activity (**AIAct**) after non-pregnancy diagnosis (**NPD**) and the P/AI of cows reaching TAI after not being detected in estrus.[13] To maximize the efficacy of this program, nonpregnant cows were assigned to treatments according to their ovarian status at the time of NPD. Cows enrolled in the treatment group (**TRT**; n = 616) were eligible to receive AIAct any time after a previous AI and were enrolled in 2 different synchronization of estrus and ovulation protocols based on the ovarian structures present on their ovaries at the time of NPD. Cows bearing at least 1 CL (**TRT-CL**) of ≥ 20 mm in diameter received a treatment of PGF (32 ± 3 d after AI) to synchronize estrus and were AIAct during 9 d after the treatment (Figure 5). Cows not AIAct after the PGF treatment were enrolled in

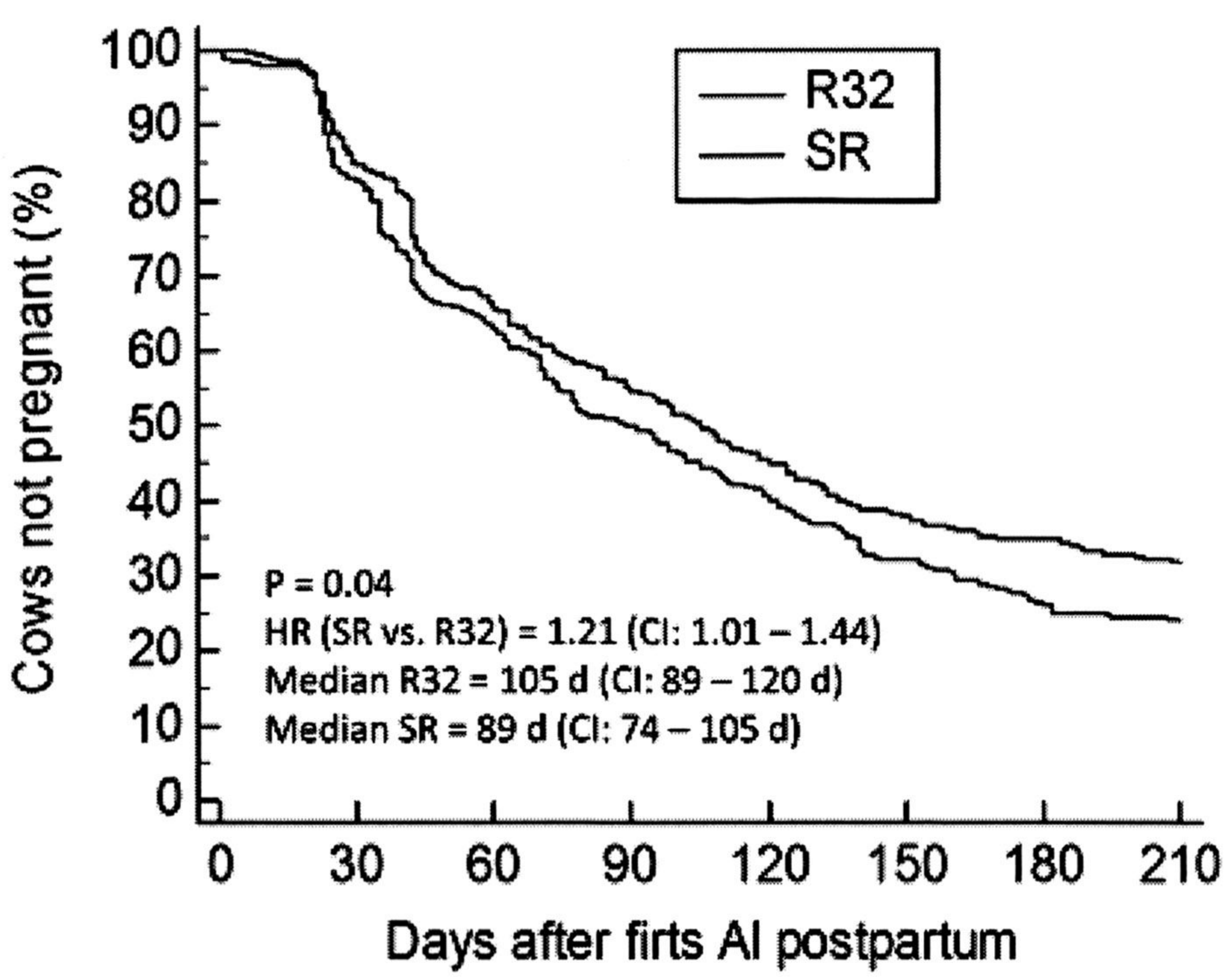

Figure 4. Kaplan-Meier survival curves for time to pregnancy from enrollment up to 210 d after the first service postpartum for cows in the D32-Resynch (R32) and Short Resynchronization (SR) treatments. The hazard of pregnancy was greater for cows in the SR than the R32 treatment ($P = 0.04$).

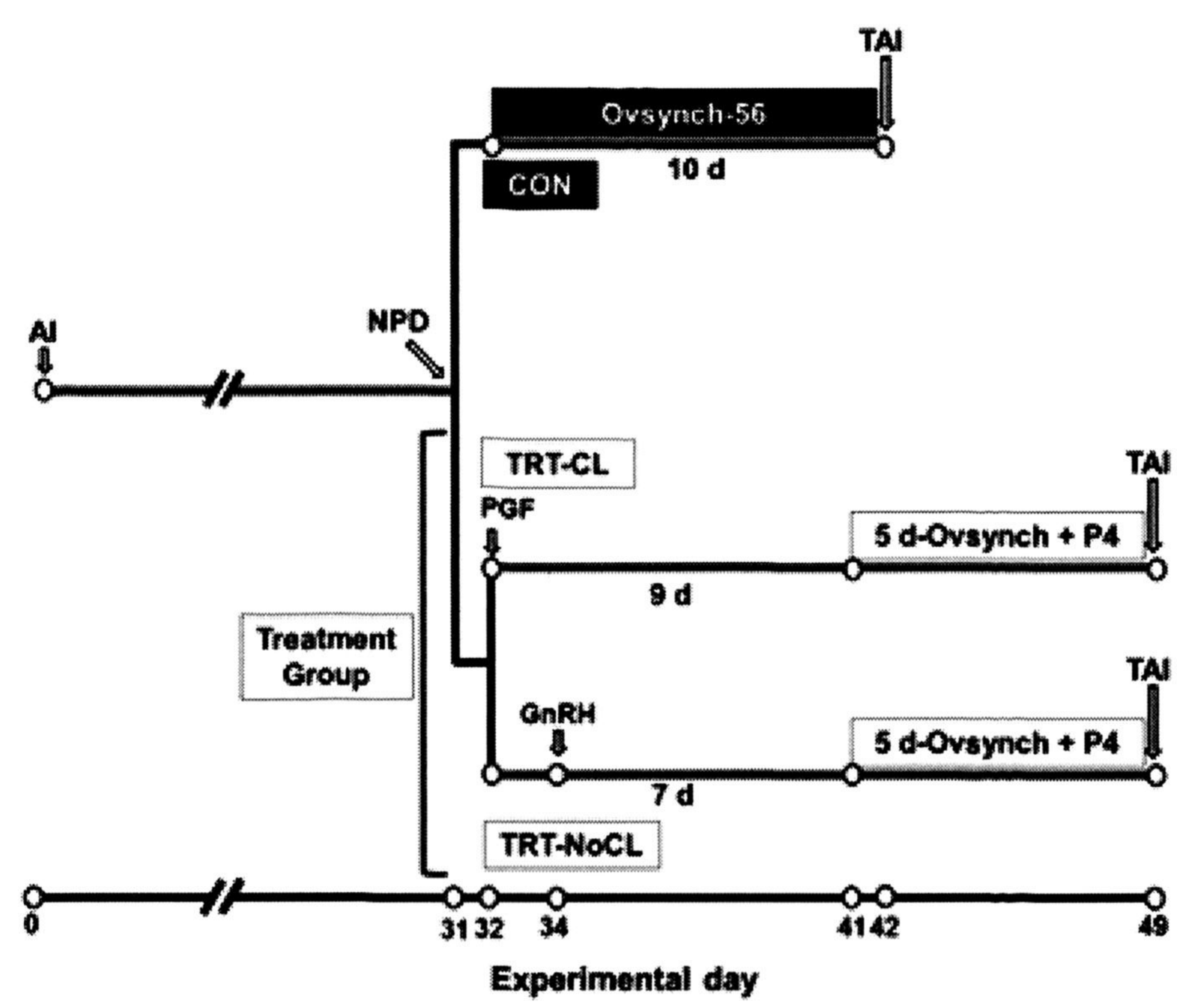

Figure 5. Schematic representation of experimental procedures for cows enrolled in the CON and TRT group (see text for details).

a 5d-Ovsynch protocol with progesterone supplementation (5 d-Ovsynch + P4; GnRH + CIDR insertion-5 d-PGF + CIDR removal-1 d-PGF-32 h-GnRH-16 to 20 h-AI) to receive their next TAI service. Cows not bearing a CL or a CL <20 mm in diameter (**TRT-NoCL**) were AIAct for 2 additional days after enrollment (Figure 5). Cows not AIAct received an treatment of GnRH for presynchronization (34 ± 3 d after A) of the estrous cycle and were enrolled in the 5 d-Ovsynch + P4 protocol 7 d later to receive TAI. The TRT program was compared to a very simple and typical strategy (**CON**) used by dairy farms which combines detection of estrus and resynchronization for TAI with the Ovsynch-56 protocol initiated 32 ± 3 d after AI. The main objective of this study was to evaluate whether our Treatment (TRT) strategy (Figure 5) would increase the proportion of cows inseminated after a detected estrus and reduce time to pregnancy during lactation.

The rate at which cows became pregnant up to 270 DIM was similar between the 2 groups (Figure 6). Therefore, the results of this study did not support the hypothesis that the more complex TRT strategy would be superior to the simple and widely adopted strategy used for cows in the CON group. Nevertheless, in support of our hypothesis, more cows received insemination after a detected estrus (AIAct) in the TRT group. Interestingly, the additional percentage of cows AIAct for this group was below our expectations with only ~20% more cows receiving AIAct in the TRT than in the CON group. A reason for this was that 65% (69.5% of the multiparous and 54.8% of the primiparous cows) of the cows met the criterion to be included in the TRT-CL group. This is not surprising for non-pregnant, previously inseminated lactating dairy cows, and is in agreement with previous studies that evaluated the presence of a CL at NPD around 30 d after AI.[5,10,17]

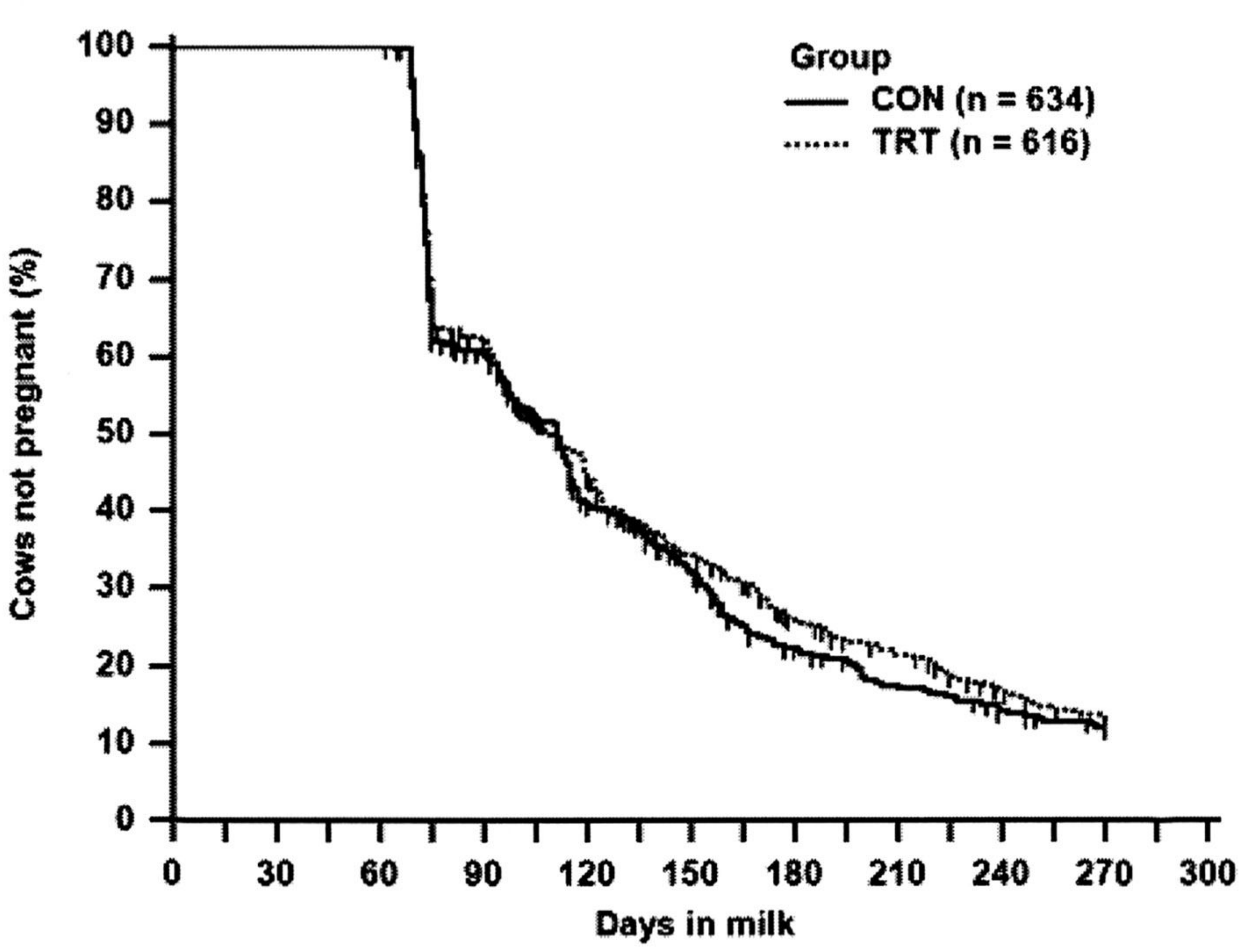

Figure 6. Survival curves for days to pregnancy from the end of the VWP until 270 DIM for cows in the CON (n = 634) and TRT (n = 616) group. The hazard of pregnancy was similar (P = 0.28) for cows in the CON and the TRT group (HR 1.07; 95% CI 0.95 to 1.21). Median days to pregnancy were 111 and 110 days for cows in the CON and the TRT group, respectively.

Because very few experiments evaluated time to pregnancy during lactation when implementing programs aimed at maximizing insemination of cows at detected estrus after NPD, we conducted another experiment at a commercial dairy farm to evaluate this type of strategy. Although final results are not currently available, our preliminary data suggest that time to pregnancy was similar for our program of interest (i.e., program aimed at maximizing EDAI after NPD) and the control group, which consisted of TAI after resynchronization of ovulation with the Ovsynch protocol initiated 32 d after AI and the CIDR-synch protocol for the small proportion of cows without a CL at the time of NPD.

In summary, the results of our research support the idea that dairy farms have the option to use a strategy that attempts to increase the proportion of inseminations at detected estrus after NPD or use a more aggressive resynchronization of ovulation strategy that results in TAI for all cows. When the former is used, it is imperative that a TAI protocol is included immediately after completion of the period intended to inseminate cows in estrus. This is even more relevant for farms that, due to biological limitations from the lactating dairy cow or the myriad of environmental and management factors that affect estrus expression and detection, are unable to detect a high proportion of cows in estrus after NPD.

Increasing P/AI of TAI services through presynchronization of the estrous cycle before initiation of resynchronization. Despite improving overall service rate and decreasing the interbreeding interval, pregnancies per AI (P/AI) for resynchronized services with Ovsynch are usually less than for first service. One reason for the poor P/AI to resynchronized services is that between 15 to 25% of cows lack a functional CL at the beginning of the resynchronization, and an overall poor response to the protocol. Indeed, only ~50% of cows will be correctly synchronized.[10] As a result, there has been interest in the development of new resynchronization strategies to improve P/AI of lactating dairy cows that receive TAI for second and subsequent services.

To improve the P/AI of resynchronized AI services, different strategies have been used to presynchronize the estrous cycle of cows before initiation of synchronization of ovulation protocols for TAI.[6,10,11,16,20] As for first AI service, a major goal of presynchronization is to have a functional CL and a follicle capable of ovulating in response to the first GnRH treatment of the resynchronization protocol. Moreover, presynchronization may also induce cyclicity in cows that become or remain anovular after the previous AI service.

A major limitation of using presynchronization of the estrous cycle before resynchronization is the potential lengthening of the interval between 2 successive AI services. This is relevant because a long interbreeding interval may decrease the overall reproductive efficiency of the herd if the P/AI of TAI services is not sufficiently high to compensate for the longer interval between AI services. As opposed to first service, the pregnancy status of cows after a previous

AI is unknown for a variable period of time, depending on the method used for NPD.

Several studies have tested the use of GnRH at different days after AI to presynchronize the estrous cycle before the initiation of Ovsynch for resynchronization. For example, Dewey et al reported an improvement in P/AI of about 8 percentage points when cows were presynchronized with GnRH 7 d before initiation of Ovsynch at 39 ± 3 d after a previous AI (i.e., known as GGPG or PreG-Ovsynch protocol).[6] In agreement, Lopes Jr. et al reported a 5-percentage point increase in P/AI in lactating cows resynchronized with GGPG initiated at either 25 or 32 d after TAI.[16] Likewise, Giordano et al reported a 4-percentage point increase in P/AI when 100% of cows received TAI after the GGPG protocol initiated 18 d after a previous AI.[11] Taken together, the results of these studies demonstrated that a single GnRH treatment 7 d before the initiation of Ovsynch could be an effective strategy to increase the P/AI of lactating dairy cows receiving second and subsequent AI services. The P/AI response to a presynchronizing GnRH treatment will likely be 4 to 5 percentage points.

The benefits and drawbacks of presynchronization of the estrous cycle before resynchronization should be carefully evaluated before protocol implementation. The improvement in P/AI may vary from 4 to 9 percentage points, depending on the agent used for presynchronization. Nevertheless, a reduction in estrus expression will be observed when presynchronization is started before the expected time of estrus expression after a previous AI. Reducing estrus expression by induction of ovulation will likely lead to frustrations if the farm goal is to inseminate cows in estrus. In fact, this type of strategy might be the most useful for herds that have difficulties detecting a high proportion of cows in estrus after a previous AI, and not for farms with a good estrus detection efficiency.

Final Considerations at the Time of Selecting a Reproductive Management Program

Because of the significant variation across farms in type of facilities, cows, and personnel, a thorough evaluation of the resources and conditions of a particular farm should be conducted before selecting a reproductive management program. Producers should work with their farm personnel, veterinarian, and consultants to identify a program that can be realistically applied by the farm to achieve specific reproductive goals. Oftentimes a proactive, systematic, and consistent reproductive management program conducted by committed personnel who prioritize attention to detail leads to successful reproductive performance, regardless of the approach and the level of technology utilized.

Endnote

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