What is New in Dairy Reproduction?

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Has the reproductive performance in your herd improved, remained the same or declined over time? If your herd is typical for the Southeast, reproductive performance has declined over time. A study that evaluated reproductive performance from 1976 to 2002, in Florida and Georgia dairy herds, showed that days to first service, days to conception, and calving interval increased significantly over time (de Vries and Risco, 2006). Further, average pregnancy rates decreased from 22% to 11%. Although, causes for this decline is multifactorial, attenuation of estrus expression in high producing cows, embryonic mortality, energy metabolism early postpartum and its interactions with immune function play a major role (Wiltbank et al., 2006; Santos et al, 2007; Hammon et al., 2006). Further, the trend for larger herds has resulted in new challenges with compliance of reproductive programs, namely inseminating cows on a timely basis at the end of the voluntary waiting period (VWP).

The purpose of this manuscript is to review recent findings in reproductive management of dairy cows and how they may be applied to enhance reproductive efficiency in dairy cattle. The discussion centers on management considerations related to time specific events from parturition to the end of the VWP to accomplish the economic goal of pregnancy within 80 to 120 days after calving.

Periparturient and Postpartum Periods

Just prior to parturition, a depression in feed intake occurs in dairy cows, and after calving they mobilize fat as well as protein reserves. Consequently, many dairy cows are in a negative energy balance and at risk to develop ketosis during early post partum. As a result of the compromised energy balance, uterine health is affected predisposing cows to uterine infections. It is well accepted that uterine infection during post partum reduces the risk for pregnancy at the end of the VWP. Energy balance near calving was associated with uterine health disorders and fever in Holstein cows **(**Hammon et al., 2006). Cows with fever (days 1 to 10 post partum) and endometritis (cytology at 4 wks), experienced lower dry matter intake from -1 wk to + 5 wk, were ketotic from -2 to 4 wk post partum and neutrophil function was suppressed. The authors concluded that uterine infections are preceded by negative energy balance prior to calving and extend into early lactation. Further**,** ketosis has been associated with an increased risk to develop puerperal metritis (Markusfeld, 1984 and 1987), displaced abomasum (Geishauser et al., 1997) and mastitis (Syvajarvi et al., 1986).

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A reduction in blood calcium concentration or hypocalcemia, is common after calving and appears to suppress immune function which predisposes cows to retained fetal membranes, mastitis and uterine infections. The response of immune cells is complex; a recent study showed that hypocalcemia at calving interferes with the activation of immune cells (Kimura et al., 2006). Furthermore, hypocalcemia acts as a stressor to the cow and cortisol is considered a major contributor to immune suppression. Typically, cows have a 3-4 fold increase in plasma cortisol as a component of the calving process. However, sub clinically hypocalcemic cows can have a 5-7 fold increase in plasma cortisol on the day of parturition and cows with milk fever may exhibit plasma cortisol concentration that are 10-15 fold higher than pre-calving plasma cortisol concentration (Horst et al., 1982). Because immune suppression has been reported to begin 1-2 weeks pre partum (Kerhrli et al., 1998; Horst et al, 1982) and the surge of cortisol is confined to the day of parturition, cortisol probably plays more of a contributing than a causal role in immune suppression.

The challenge in transition cow management is to implement feeding strategies before calving that enable the fresh cows to achieve optimal dry matter intake and recover quickly from hypocalcemia and ketosis. It is the opinion of the author that in many dairy herds, attention to transition cow management occurs after health problems occur. Therefore, periodic evaluation of prepartum transition cow management is recommended to determine whether or not there is an increase risk for calving related disorders to occur due to inappropriate management. The parameters in the checklist below can be used as a guide to determine whether or not management of transition cows is appropriate. These items should be evaluated periodically:

- Is the ration balanced for energy, fiber content (including effective fiber), protein, dietary cationic anionic difference (DCAD), minerals and vitamins?
- Is there enough feed bunk space (at least 2 feet per cow)?
- Is there adequate shade (50 square feet per cow)?
- Are there clean, well - designed calving facilities?
- Are urine pH's evaluated to ascertain compliance of appropriate DCAD diet feeding?
- Is pre and postpartum energy status evaluated in selected groups?
- Is there ample clean water available for all cows?

Calving Management

On many dairy farms, veterinarians continue to observe inadequately trained employees when performing obstetrical procedures which results in calving trauma. Producers should make an effort to work with their herd veterinarian to design a herd health protocol that emphasizes first – aid calving assistance to get producers away from using improper techniques for delivering calves.

Dr. Maarten Drost from the University of Florida, College of Veterinary Medicine, has developed a web based visual guide titled the Drost Project Visual Guide, that enables producers and veterinarians train and educate employees on reproductive

management that includes; AI, Pregnancy diagnosis, and management of obstetrics. These topics and others are available and can be accessed free at: www.drostproject.vetmed.ufl.edu.

Moving Fresh Cows through Pens Before and After Calving

Observations made by Dr. Ken Nordlund and colleagues from the University of Wisconsin, College of Veterinary Medicine suggests that cow behavior and social factors has emerged as the primary risk factor for ketosis, fatty liver and displaced abomasums. These investigators have pointed out that where poorly formulated rations and inaccurate delivery systems were once the primary risk factors for these conditions, they increasingly see poorly stage pen moves and overstocking as key risk factors. The mechanism appears to be a disruption of dry matter intake for vulnerable cows, leading to ketosis followed by the cascade of related diseases. To simplify labor, dairy farms create a grouping system of cows for specialized management which commonly includes:

- Far off dry cows: -60 to -20 day from calving
- Close up dry cows: -21 to -3 days from calving
- Maternity pen
- Fresh pen: 3 to 14 days after calving
- Sick pen: variable days after calving
- Various lactation and pregnant groups

In the above scenario, cows are often moved multiple times during the 3 weeks periods before and after calving, a time when cows are most vulnerable to develop ketosis. With each movement to a new pen or group, cows experience stress and must establish her rank within the social order of the pen and feed intake is reduced. It is well known that cows form dominance hierarchies, strongly associated with age, body size and seniority in herd (Dickson, 1970). In general, cows resident in a pen tend to maintain their rank compared to new arrivals (Scheim and Forhman, 1955). It has been reported that early lactation cows were more affected by regrouping than mid lactation cows (Kongaard and Krohn, 1978). Cows that are losing weight loose social rank within a group, while those gaining weight gain dominance. These observations suggest that too many cow movements early post partum may have an impact on fresh cow health as the early post partum period is a period of significant weight loss.

The sick pen in some dairy farms may have daily entries of new cows, and Dr. Nordlund describes it as a state of constant social turmoil as each new cow attempts to establish her rank within the social order of the pen. It should also be kept in mind that sick pens have been reported to be contaminated with bacterial pathogens that include Salmonella (Peek et al, 2004); thus, presenting a substantial risk to cows that are stressed and immunosupressed. In some dairies fresh cows are moved through the sick pen until colostrum is cleared to group “non – salable” milk, this is a high risk practice. Another group of cows that often are moved to the sick pen are cows with metritis that require antibiotic treatment. With the availability of Excenel RTU® (Pfizer

Animal Health) labeled for metritis, that do not require milk withdrawal, cows with metritis can be treated with this antibiotic and remain in the milk herd to avoid the social turmoil that reduces feed intake. I have often wondered, that if cows could talk, they would say “I can live with the disease but not the movement to a new pen “.

Health Monitoring During Post Partum

Postpartum health monitoring strategies have become popular in many dairies because it allows the opportunity to identify sick cows early and provide supportive therapy. In general, as discussed in a previous Dairy Road Show Seminar by the author, monitoring postpartum health involves the examination of all cows early post partum by trained farm personnel. Parameters commonly used to evaluate health include rectal temperature, attitude, milk production, uterine discharge, and urine ketones.

A study was conducted in Florida that described the rectal temperature of cows with metritis before diagnosis and documented the association between metritis, and reproductive performance in dairy cows (Benzaquen et al., 2006). Cows experiencing an abnormal calving had greater odds to develop metritis than cows with normal calving. Heifers had greater odds of metritis in the cold season and multiparous cows showed no seasonality in the occurrence of metritis. Evaluation of daily rectal temperature distinguished cows with metritis with or without fever (Temp. > 103). A high proportion of cows did not have fever (58%) at the time metritis was diagnosed. Prior to diagnosis, daily increases in rectal temperature on 2 consecutive days prior to the actual diagnosis could serve as a predictor of metritis in cows that subsequently develop a fever at the time metritis is diagnosed. In cows diagnosed with metritis and treated, first-service conception risk and cumulative pregnancy risks by 150 d postpartum were comparable to cows that did not experience metritis. The take home message from this study when monitoring uterine health in fresh cows is:

- Because cows with metritis may not present with a typical fever > 103. 0, diagnostic and treatment consideration for metritis should include attitude of the cow, the condition of the uterus and not rectal temperature alone.
- Identification of cows with metritis early and prompt treatment may ameliorate the effects of metritis on reproduction.
- Cows that experience an abnormal calving such as retained placenta or dystocia are more likely to develop metritis. Therefore, cows with these conditions should be monitored carefully.

Strategies to Maximize Pregnancy Rate at the End of the Voluntary Waiting Period

It is well accepted that the most economical strategy to improve pregnancy rate (PR) is the use of timed insemination protocols such as Ovsynch. Pregnancy rates increases when the protocol Ovsynch is initiated during days 5 to 12 of the estrous cycle (Moreira et al., 2001). This can be accomplished by pre-synchronizing cows with prostaglandin (PGF2α) 12 days before the initiation of Ovsynch or more effectively two

treatments with PGF2α 14 days apart and initiation of Ovsynch 12 days after the second prostaglandin injection (Presynch-Ovynch; Moreira et al., 2001). Studies conducted in lactating dairy cows indicate that PR improved by 6 to 18 percentage points when the Presynch – Ovsynch protocol was employed (Moreira et al., 2000; EL-Zarkouny et al., 2004).

A meta-analysis study of various breeding programs examined 71 treatment and control comparisons extracted from 53 research papers (Rabiee et al., 2005). Programs evaluated included Ovsynch, Natural Service, prostaglandin injection, (and modifications of the Ovsynch protocol Select Synch, Heat Synch and modified Ovsynch). Pregnancy rates for Ovsynch programs did not differ significantly from those with natural breeding programs. Results of Ovsynch vs. PGF2*α* programs showed that the risk of conception and pregnancy rates did not differ significantly. Comparisons between Ovsynch and SelectSynch demonstrated that the risk of conception and pregnancy rates did not differ significantly between these groups. Examination of Ovsynch vs. modified Ovsynch programs showed that the risk of pregnancy in cows synchronized with modified Ovsynch was similar to those treated with Ovsynch.

Meta-analyses identified that the conception and pregnancy rates obtained with the prostaglandin, SelectSynch, and modified Ovsynch (including Presynch and CoSynch) programs were comparable with the Ovsynch program. Modifications to the Ovsynch program such as pres-synchronization and timed artificial insemination at the time of second GnRH injection (CoSynch) may be an alternative for reproductive management of dairy herds where detection of estrus is less than optimal. The findings of this study demonstrate that the Ovsynch program could benefit dairy operations because it allows for timed artificial insemination of lactating cows without detection of estrus. There was, however, little or no significant improvement in pregnancy rates using Ovsynch over other programs.

Economics of Timed Insemination Programs

The economic value of the use of Ovsynch depends on the estrus detection rate of the herd. In those herds with high estrus detection rate the value of Ovsynch is lower. This concept was illustrated in a study that reported the value of a pregnancy based on insemination at detected estrus or Ovsynch in two herds (Tenhagen et al, 2004). One half of each herd was inseminated at detected estrus, the other half was inseminated with Ovsynch. In one herd with poor estrus detection, the cost of a pregnancy was reduced significantly with the use of Ovsynch compared to insemination at detected estrus. In the second herd, which had higher estrus detection rates, the cost of a pregnancy was slightly more for Ovsynch, despite improved reproductive performance. The greatest costs attributed to lower PR from insemination at detected estrus were higher culling rates and excessive days open.

A study conducted in Florida, modeled potential net returns per cow by comparing use of Ovsynch in winter and summer compared to insemination at detected estrus (Risco et al, 1998). The greatest impacts on net returns were obtained when

Ovsynch was used during summer compared to winter. This finding was attributed to lower estrus detection rates observed during the summer months. The authors concluded that use of a timed AI program such as Ovsynch is an economical alternative in reproductive management of dairy herds with poor estrus detection.

Embryonic Loss

An important consideration of low PR is embryonic loss before 40 days of gestation and can account for 15% to 25% of failed pregnancies (Roche, 1986). It was concluded by J. Santos and coworkers that lower fertility of lactating dairy cows appears to be due to both a lower conception rate and greater early embryonic (i.e., 28 d; 20%) and late embryonic losses (i.e., 24 to 42 d; 12.5%). Total losses from fertilization to birth are up to 60% with a final conception rate at birth of 28%. These total losses appear to be associated with lactation because similar rates are not seen in nonlactating heifers or multiparous cows that are nonlactating. However, milk production per se does not appear to be a risk factor for increased pregnancy losses. Higher producing herds may be better managed regarding nutrition, health, and reproduction such that milk production associations are difficult to detect. What appears to be associated with high milk production and lower fertility is that an increased milk yield is accompanied by an increase in both feed intake and overall metabolic rate, decreasing estradiol and progesterone concentrations in blood. These alterations in steroid balance are thought to reduce early embryonic development.

A study that evaluated factors affecting embryonic loss in dairy cattle indicated that 39% of cows pregnant on day 23 lost their embryo by day 27, and 18% of cows that were pregnant on day 27 or 28 were not pregnant on days 35 to 41 (Moore et al., 2005). The greatest risk identified for embryonic loss during both periods was insemination of pregnant cows, low progesterone concentration and cows with a linear somatic cell count > 4.5. The authors concluded that embryonic losses can be reduced by:

- Proper training of insemination technicians to improve accuracy of estrus detection. That is, to reduce the breeding of cows that are pregnant but incorrectly identified as being in estrus.
- Strive to reduce the incidence of both clinical and sub-clinical mastitis.
- Evaluate lactating cow nutrition to minimize postpartum negative energy balance and maximize postinsemination progesterone concentration. Administration of human chorionic gonadotropin (HCG) increases progesterone concentration (formation of accessory corpora lutea) and reduces pregnancy wastage (Santos et al, 2001). Treatment with 3,300 units of HCG, IM on day 5 after insemination resulted in multiple corpora lutea, higher progesterone concentration and higher conception rates on day 45.

Lameness and Reproductive Performance in Dairy Cows

A study conducted in Florida show that lameness delays resumption of cyclicity after calving and prolongs the calving to conception interval in dairy cows (Hernandez et

al., 2001). In lame cows, the effect of lameness on time to conception is greater in cows with severe lameness, compared to cows with mild lameness (Hernandez et al., 2005) and application of a screening and hoof trimming procedure reduced the incidence of lameness during late lactation (Hernandez et al., 2007). These studies suggest that producers should adapt lameness prevention practices that include evaluation of locomotion scores for early detection and management of lame cows, to obviate the effect of lameness on reproduction.

Early Diagnosis of Open Cows

The basic economical factor that influences the value of early diagnosis of open cows is the premise that a pregnant cow is more economical than an open cow. The most common parameter used to express the value of a pregnant cow is the cost of a cow remaining open. Therefore, the value of early pregnancy diagnostic is finding an open cow earlier coupled with a successful re-breeding to reduce days not pregnant.

Palpation is effective after day 33 to 35 and ultrasonography around day 28 to diagnose pregnancy. Pregnancy – specific protein B (PSPB) is present in cells of the developing trophoblast as early as day 21 of pregnancy in cows (Humblot et al., 1988). Detection of this protein in blood is a very good indicator of pregnancy as early as 30 days of gestation. Because of its long half-life, it remains in circulation for several months after parturition. Cows diagnosed for pregnancy less than 70 days, residual PSPB causes false positive results. Currently, blood samples for cows that are greater than 90 days in milk and 30 days post AI are shipped to the laboratory for analysis (BioPRYN®; Ag Health, Sunnyside, Wa., www.aghealth.com). The utility of this protein at the farm level will improve when on-the-farm diagnostic kits are developed and implemented for early diagnosis of open cows to manage reproduction.

Sexed Semen

A review on what is new in reproduction would be incomplete if the technology of sexed semen is not discussed. Increasing the number of heifers calves born would be a great advantage to the dairy industry. The bovine X chromosome – bearing sperm contain 3.8% more DNA than do Y chromosome -bearing sperm, allowing their separation after being stained with a fluorescent dye and sorted through fluorescent - activated cell sorter (Johnson, 1995). Because the female always contributes an X chromosome bearing egg, cattle AI with an X chromosome bearing sperm will result in a female calf with 95% reliability. At the present moment, there are two major drawbacks for used of sexed semen. The first is cost due to the labor and expense in producing sexed semen straws for AI. The second is the lower conception rates (35% vs. 55%) when compared to unsexed semen in virgin heifers.

Because of the low conception rates sexed semen is recommended in heifers AI at detected estrus. A recommended strategy is to use sexed semen to first service followed with unsexed semen in repeat breeding (Moore and Thatcher, 2006). This method results in $\geq$ 62.2 % female offspring at first calving. More heifers being born on

the farm is a fast way to grow a herd internally, while maintaining biosecurity. Additionally, heifer calves are usually easier to deliver than bulls, so calving ease is another benefit. However, while each pregnancy is important, so is genetic progress. Each calf born should be genetically superior to her dam. This applies to sexed semen as well as conventional semen. Don't buy sexed semen just for the fact that it's sexed, because you may not get the best quality of genetics.

Conclusions

The premise for the observed decline in reproductive performance in dairy cows is that genetic improvement for high milk yield has created a sub-fertile animal experiencing lower pregnancy rates and high embryo mortality. To combat this problem, research has focused on the cow, her environment and ovulation synchronization protocols. However, application of this new research or technology must be coordinated with sound management practices that optimize cow health to allow the opportunity for conception and pregnancy maintenance. Producers must also endeavor with their managers to assure compliance of these reproductive management strategies on a daily basis.

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Notes