Heat Detection: Trends and Opportunities

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Introduction

The ovsync breeding protocol was developed over 10 years ago. Many other timed breeding programs have been developed in recent years. Efforts to improve reproduction over the last decade has been focused on implementing time breeding protocols.

Heat detection has historically been an important component of a successful reproduction program. Today, a reproduction program with no heat detection is a common goal of many reproduction programs. Heat detection is barely mentioned in current reproduction management courses.

Are we ready to throw all out heat detection knowledge and tools out the window? I'm not. I'm convinced heat detection can still be a vital part of a successful breeding program. Many heat detection technologies are being developed to work with the dairy farms of today.

Why Heat Detect Today?

Timed breeding programs have been developed by great researchers doing outstanding research. The programs work. There is a place for a timed breeding program on every dairy. Have we seen significant enough improvements in reproduction benchmarks over the last decade to justify the trend away from heat detection?

In a survey of large herds across the country, (Caraviello et al., 2006) reported that 87% of herds used some type of timed breeding protocol. Unfortunately, heat detection effort usually decreases with an increased effort in timed breeding. Some dairies have seen significant reproductive improvements using a timed breeding program, but not all. The 1998 pregnancy rate in California was 14-15%. The 2008 pregnancy rate in California was 16%. 90% of dairy herds today still have a pregnancy rate <20%. Timed breeding alone or with minimal heat detection effort is not getting the job done on many dairies.

Several reproductive traits were compared from 1996 – 2006 for AI services only (Norman et al., 2009). Days to first breeding dropped 6 days. This is most likely due to the increased use of timed breeding programs. Conception rate dropped 1-2%. Days from 1st to last breeding increased 18 days and days to last breeding increased 11 days. The increase in breeding interval could be attributed to a decrease in heat detection or delayed enrollment in a resync program.

Insemination interval is also an important reproduction benchmark. Many herds have average insemination intervals over 50 days. New timed breeding programs target rebreds at 28d, 35d, or 42d. An on cycle rebred is 21 – 23 days on average. Why do so many dairies ignore this? When a dairy does no 21d heat detection, palpation pregnancy rates can range for 30 -50%. Palpation pregnancy rates of 65 – 70% are obtainable with a basic heat detection program.

Heat Detection Game Has Changed

There is a myth in the industry today that cows do not come into heat anymore. Dairy farming has changed significantly over the last decade. More herds are milked 3x. Milk production per cow is higher. TMR's are more common with more cows in freestall facilities. Dairy cow estrus expression has also changed drastically over the last decade. Historically, dairy cows estrus duration was 12-15 hours. USDA / University of Wisconsin research has shown high producing cows (>87# milk) have an average heat duration of 6.2 hours, total mounts 6.3 and 21.7 seconds total mounting time. Another study showed the average dairy cow had an average 8.5 mounts/estrus, 24% of the cows have estrus of low intensity (<1.5 stands) with a duration less than 8 hours, 30% of Holsteins were in heat less than 4 hours (Nebal et al.,2000).

Research was recently completed that looked at the risk factors for the resumption of estrus by 65 days postpartum (Santos et al., 2009). Cows had their estrous cycle presychronized with 2 injections of PGF2 14 days apart. 75% of cows were cycling by 65 DIM on ¾ study farms. 10% more multiparous cows were cycling by 65 DIM compared to primiparous cows. I believe this is primarily due to the growth requirements for 1st lactation animals. BCS at 65 DIM, BCS change and season also affected cycling. 85% of the cows were cycling with a BCS of > 3.75 at 65 DIM. Only 70% of the cows cycling with a BCS <3 at 65 DIM.

A Canadian study looked at the prevalence of anovulation in 1341 cows from 18 herds (Walsh et al., 2007). The prevalence of anovulation was 19.5% with a herd specific range from 5 -45%. My benchmark for % anovulation by VWP is < 25%. Only 1 of 8 freestall herds in this study did not make this benchmark (Figure 1).

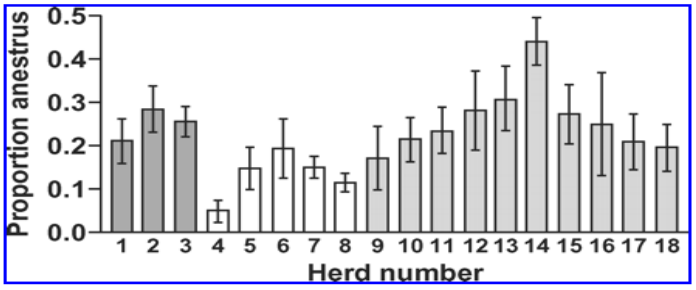

Figure 1. The prevalence of anovulation (mean ± SE), defined as skim milk progesterone concentrations < 1 ng/mL determined at 46 and 60 ± 7 DIM in 18 Ontario dairy herds between January 2004 and April 2005. Herd numbers 1 to 3 were in 3-row free-stall barns, herds 4 to 8 were in 2-row free-stall barns, and herds 9 to 18 were in tie-stall barns.

The bottom line is heat detection is harder today, but cows still come into heat. Old heat detection aids have new limitations. New technologies have been developed to help overcome the new heat detection challenges.

Uses and Limitations of Common Heat Detection Aids

Visual observation has been the most common heat detection program. If dairies heat detect like they did 10 years ago, heat detection may be sub optimal. A Wisconsin group (Lopez et al., 2004) correlated the heat detection rate for an 88 # cow with varying heat check intervals. When checking heat

once per day you have a 30% chance of catching this cow in heat. Check 2 times per day and the probability increases to 50%. Heat detect every 6 hours and the probability of catching this cow in heat increases to 65%

Tail head marking with chalk or paint is still a popular and economical heat detection aid, especially for larger herds. False positives can be a problem with both, but false negatives have become a bigger issue. Estrus duration is shorter; # mounts/heat has decreased resulting in less chalk or paint being rubbed off during a heat. Effectiveness of tail head markings as a heat detection aid has decreased significantly over the last 10 years. A 500 cow dairy cow could easily be seeing 1-2 false negative per day with tail head marking.

Tail head pressure sensitive devices, such as Kamar or Bovine Beacon, are also used for heat detection today. False positives and false negatives are also an issue with these aids. Shorter heat durations and less mounts can make it harder to interpret color changes. They can still be a valuable tool but with limitations.

Is Activity Monitoring a Viable Heat Detection Tool?

Activity monitoring systems have increased in popularity recently. Some dairymen are looking to decrease the number of timed breeding injections or others are looking to improve a timed breeding program. Activity systems collect data 24/7 and can efficiently find animals in heat, especially those with very short estrus duration. Activity monitoring has been around for 25 years. A strong correlation has been established between increased activity and low progesterone during estrus (Figure 2).

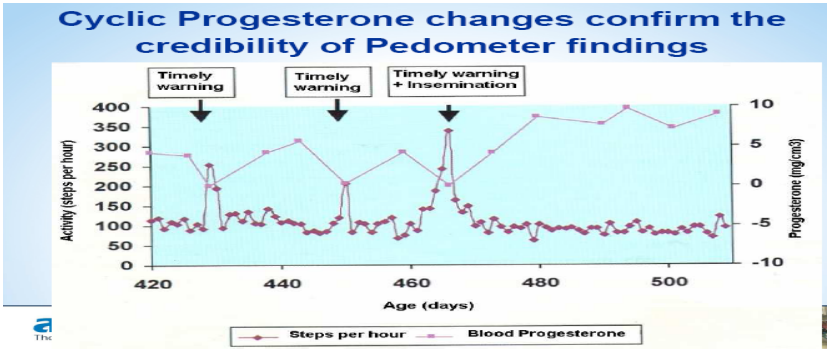

Figure 2. Graph provided by Afikim showing correlation between activity (steps/hr) and progesterone levels.

Studies have also established the sensitivity and specificity of activity monitoring (Figure 3). Estrus detection sensitivity using the Afikim/DeLaval Germania activity tag average 89% over 6 trials with a range from 80 – 100%. Activity monitoring can be an accurate tool for estrus detection. False positives can be seen with group changes, hoof trims or abnormal activity in a group. Estrus detection specificity using an Afikim / DeLaval Germania activity tag average 82% over 6 trials with a range of 73 – 92%. False negatives can also be a problem with activity monitoring systems today. Cows must have increased activity when they are in heat for an activity system to work. Lameness is a significant

problem on many dairies preventing some animals from increasing activity during estrus. Cook, (2003) estimates the prevalence of lameness in the US cows in commercial freestall housing at 25%. Nutritional and facility issues can also inhibit estrus expression.

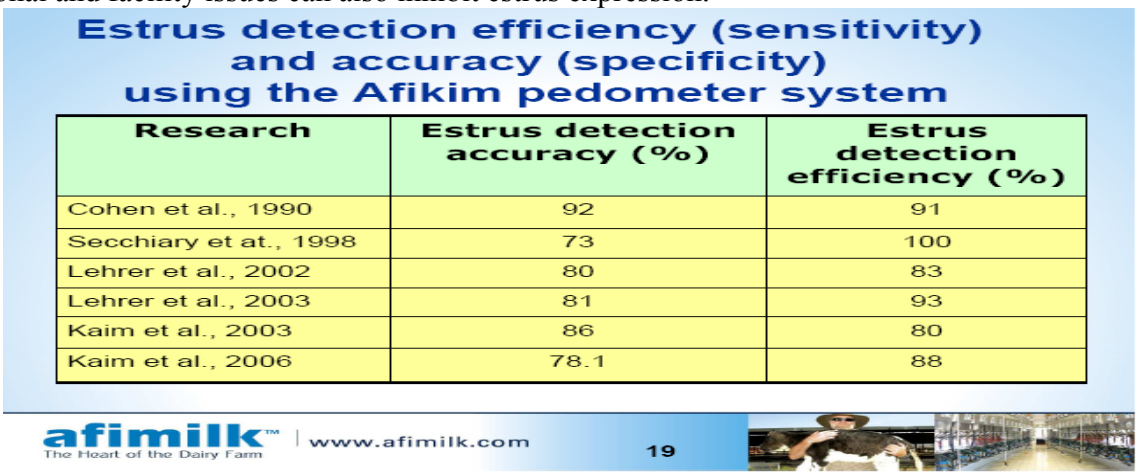

Figure 3. Sensitivity and specificity trial summary on Afikim pedometer system

Activity monitoring used in conjunction with timed breeding program can lead to excellent reproduction results. A 1700 cow herd in the U.S. using primarily activity monitoring with timed breeding has an average HDR of 66% with a 24% pregnancy rate (Figure 4).

Date	Heat eligible	Heat	Heat detection rate %	Pregnancy eligible	Pregnancy	Pregnancy rate %	Abortion
12/19/2008 - 01/08/2009	293	187	64	293	75	26	5
01/09/2009 - 01/29/2009	263	146	56	263	62	24	4
01/30/2009 - 02/19/2009	278	206	74	278	62	22	7
02/20/2009 - 03/12/2009	296	195	66	296	71	24	7
03/13/2009 - 04/02/2009	286	185	65	286	63	22	8
04/03/2009 - 04/23/2009	319	206	65	319	70	22	3
04/24/2009 - 05/14/2009	316	216	68	316	81	26	9
05/15/2009 - 06/04/2009	332	227	68	332	78	23	7
06/05/2009 - 06/25/2009	332	219	66	332	71	21	7
06/26/2009 - 07/16/2009	348	221	64	348	70	20	10
07/17/2009 - 08/06/2009	367	247	67	367	92	25	10
08/07/2009 - 08/27/2009	354	241	68	354	92	26	15
08/28/2009 - 09/17/2009	366	243	66	366	107	29	6
09/18/2009 - 10/08/2009	360	233	65	360	81	23	7
10/09/2009 - 10/29/2009	356	234	66	356	92	26	15
10/30/2009 - 11/19/2009	362	239	66	362	90	25	9
11/20/2009 - 12/10/2009	360	239	66	--	--	--	15
12/11/2009 - 12/31/2009	332	237	71	--	--	--	11
Sum	5920	3921	66	5228	1257	24	155

Figure 4. 12 month pregnancy rate report on 1700 cow U.S. herd.

Activity monitoring can be an effective heat detection tool. As with any tool, know the requirements for success and limitations. Cows in an activity monitoring system must show increased activity during estrus. Dairymen must be able to manage tags and the system must have an ID rate over 98%. Working systems must provide accurate lists to the breeders. There are several systems on the market today that will provide accurate high activity lists.

Be cautious when you see new activity monitoring tools on the market. Recently, activity monitoring via a bolus was released. You can identify high activity cows with this technology.

Unfortunately, experience from a large herd in the US showed a low sensitivity and specificity with this product. For every true heat cow on the list, 2 true heat cows were missed and 2 non heat cows were placed on the list. The results were not acceptable.

Improved Performance for Neck Mounted Activity Tag Monitoring

DeLaval has been the leader in neck mounted activity monitoring for 10+ years. Neck mounted activity tags are second generation activity tags. They are not a simple pedometer. They are motion detectors which measure a cow's movements. These movements include walking, lying, getting up and down and stationary head movements. Antennae are mounted in the cow's environment which record activity tag measurements every hour. A farm computer collects the activity every hour.

There are several advantages to collecting the data every hour in the cow's environment. Activity data is independent of milking times and up to date activity data is always available. With hourly data the system can predict activity patterns for the next day. This is the gray area on Figure 5. A kalman filter in the software calculates high activity cows which are labeled +, ++, +++ or a green, yellow or red triangle on the graph. +++ is a cow with the very highest activity. The system will also calculate heat start time for every high activity cow. This allows the breeder to inseminate at the appropriate time.

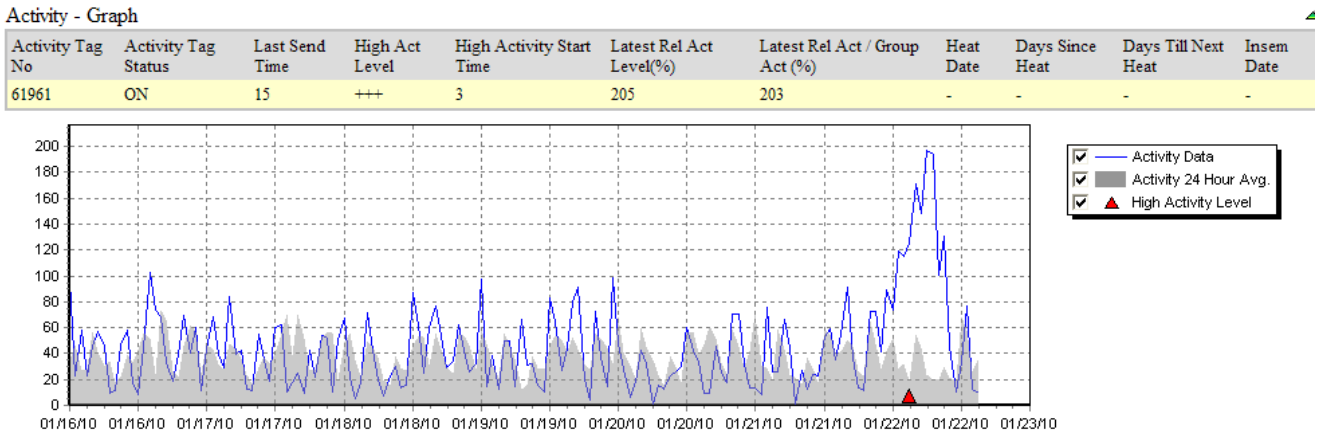

Figure 5. DeLaval Alpro activity system. Typical high activity graph.

This system does an excellent job of catching cows with high activity. A second filter was added to increase sensitivity further. The software now calculates the general high activity probability and general low activity probability for each cow every day. Example: A cow with a 99% probability of high activity will have a 1% probability of low activity. Relative activity and 24 hour average activity is also calculated. These secondary filters help breeders make a better decision on marginal high activity cows.

SCR is also now distributing a neck mounted activity tag. The data is collected when the cow passes below an ID station which are usually placed in the parlor exit lane. The data is recorded in 2 hour increments. I don't have enough experience with these systems to comment further.

Revolutionary Changes in Proven Activity Tag

Afikim has produced an activity monitoring system for 25 years. In this system the activity monitoring is accomplished by an activity tag worn on the cow's leg. The tags are pedometers which register steps. When the pedometers are read the software calculates steps per hour and the system develops a 10 day average steps per hour for every cow. Most cows that are in heat have a 100% deviation from their average steps per hour. The cow in figure 6 is a typical example. She averages 100 steps/ hr at each milking. During milking 3 January 3 she had 700 steps per hour. This animal is in heat and should be bred the next morning.

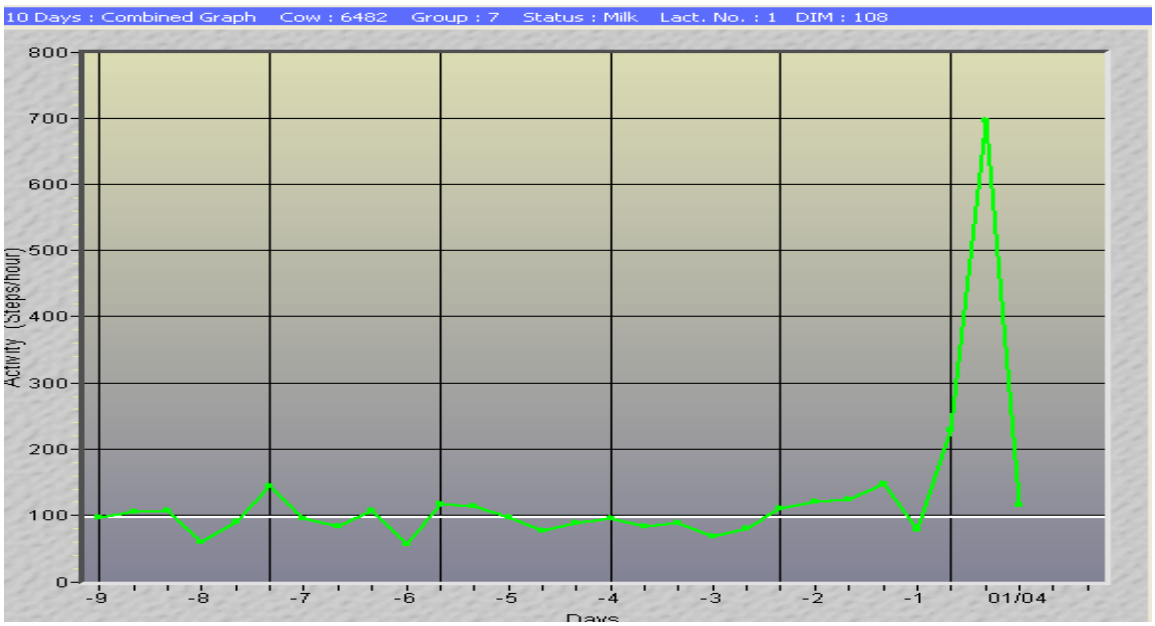

Figure 6. Typical high activity graph. Afikim / Delaval Germania activity system.

Many herds worldwide have achieved consistent pregnancy rates >20% using this technology. Group changes, hoof trimming or inconsistent cow handling can cause false positives with this technology. Management focuses and program features allow us to minimize false positives. Afikim has developed a new activity tag which will help eliminate false positive high activity cows.

This new tag still measures activity by steps per hour. Additional measurements includes rest bouts, rest duration and rest time per session. An average rest ratio for each session is also calculated from the data. A cow in a true high activity heat will show a decrease in rest time and rest ratio. The cow in figure 7 has normal lying durations between 20 – 45 minutes. On a day with spike in activity the average lying duration for the same day decreases to 5 minutes.

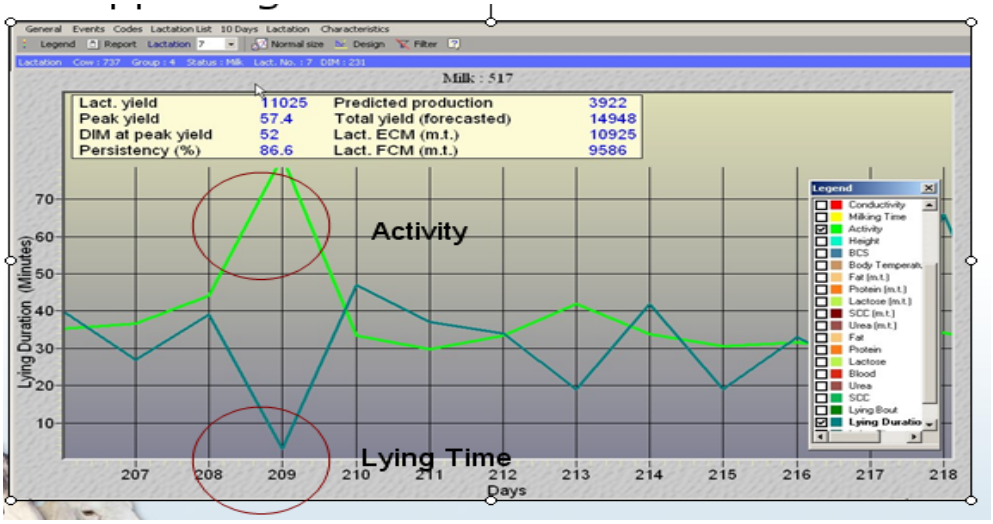

Figure 7. Afikim / DeLaval Germania activity graph showing decreased lying time for a heat cow.

The new activity measurements are going to make a good activity system better. They will allow early and reliable detection of cows in heat. The new activity measurements will also allow early detection of sick cows, calving and lameness alerts and new data for bedding management decisions.

New Gold Standard for Estrus Detection?

A joint venture between DeLaval, Foss and Lattec has developed an inline sampler which measures LDH (lactate dehydrogenase), progesterone, urea, and BHB (beta hydroxybutyrate). Daily milk progesterone measurements could be the new gold standard for estrus detection. An inline sampler collects a cow sample. The sample intake unit processes the milk samples into the analyzer. The Analyzer sends the data to a central data processing center and/or a local user interface (Figure 8).

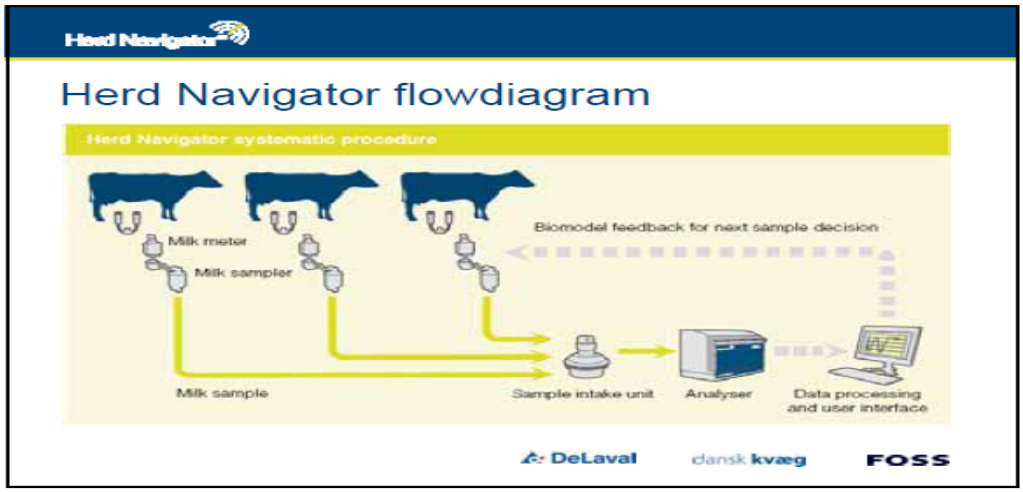

Figure 8. Herd Navigator flow diagram.

6 major hormones are associated with the bovine estrus cycle: LH, FSH, GnRH, PgF2, estrogen and progesterone. Measurement requirements and practical farm use makes progesterone a great hormone to monitor the bovine estrus cycle. During the luteal phase of the estrus cycle milk progesterone levels should fall between 12 – 20 ng/ml (Byrem, 2010). Cows in heat should have milk progesterone levels less than 2 ng/ml as shown in Figure 9.

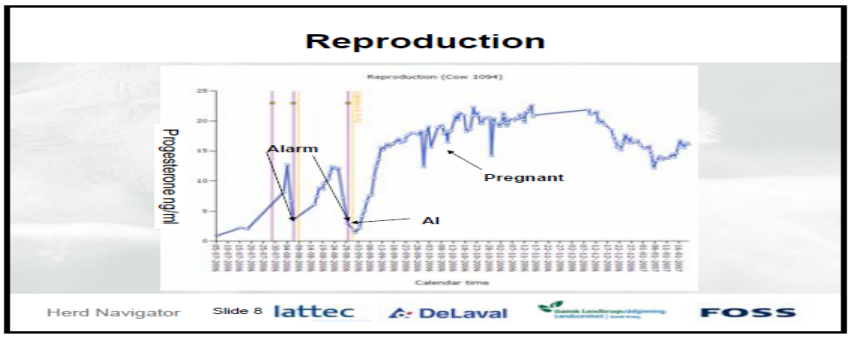

Figure 9. Herd Navigator lactation progesterone graph. The 2 drops labeled an alarm are a heat events.

The average heat detection rate (HDR) in the US is still 50%. Farms that achieve a 65% HDR are considered to be doing an outstanding job. A HDR >70% is very uncommon. Daily progesterone measurements have the ability to set a new HDR standard. Reproduction models with the Herd Navigator find 95% of the heats with the number of false alarms decreasing from 6% to 2%.

Insemination interval as become a key reproduction benchmark. Average insemination interval today on many dairies today is 45 – 50 days. The current goal for insemination interval is <40 days. Timed breeding protocols have been developed to rebred cows at 28d, 35d and 42d. A resync program with a 42d rebred is very common. Five Herd Navigator test farms saw their average insemination interval decease 22% (Figure 10). A 26 – 28 day insemination interval will be an obtainable benchmark.

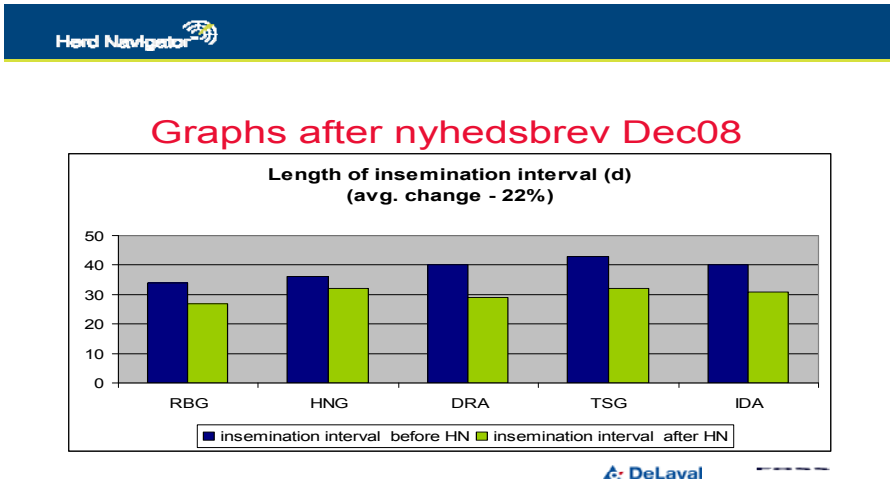

Figure 10. Changes in insemination interval on Herd Navigator trial farms.

Inline progesterone sampling will also have many other impacts on bovine reproduction. Pregnancy checking protocols will change. The number and timing of rectal palpations will change. % anovualtion by VWP is an important benchmark in a successful reproduction program. Maximum reproductive efficiency occurs when cows have their first cycle pre VWP. Dairies today that have this information are the exception. Herd Navigator dairies will know this benchmark.

Pregnancy rate is the gold standard benchmark for monitoring a reproduction program. A successful reproductive tool must positively impact PR. Average PR on Herd Navigator test farms before Herd Navigator was installed was 33.8% in 2006. The average PR on these farms in the first 2 months of 2008 was 40% (Figure 11).

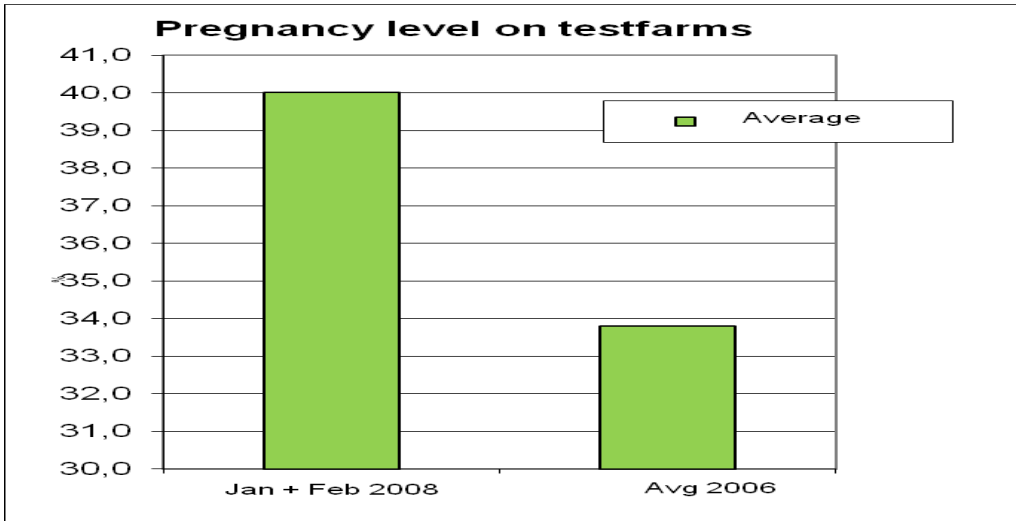

Figure 11. Pregnancy rate changes for Herd Navigator trial herds.

Managing abortions, anestrous and cysts are major problem in reproduction programs today. Inline milk progesterone with the Herd Navigator will allow earlier identification and enrollment in the appropriate treatment protocol.

The Herd Navigator has the potential to revolutionize bovine reproduction.

Conclusion

It is an exciting time to be involved in dairy reproduction. Great advances are being made with new timed breeding programs. Exciting new heat detection tool are being released. Unfortunately, I am seeing a polarization in the industry concerning these technologies. Underperforming timed breeding herds are waiting for the next timed breeding protocol change to meet their reproduction goals. They consider heat detection a non viable tool. On the flip side are dairies committed to heat detection. They can be very resistant to adopting any timed breeding protocol. Time breeding protocols can be very helpful dealing with extended days to first service, cystic and anestrous cows.

Dairies need to outline reproduction goals and utilize all available technologies that fit within their management structure.

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