Using DHI Records On-Farm to Evaluate Reproductive Performance

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Take Home Messages

- On farm records should be kept and evaluated with clear questions and objectives established at the outset.
- The 21-day pregnancy rate is the best single tool for assessment of current overall reproductive performance in a herd.
- Caution is needed in evaluating modest changes in pregnancy and insemination rates and conception risk, or in breaking down these outcomes into sub-groups in herds with fewer than approximately 500 cows.
- Herd performance goals should be realistic.
- Traditional measures of dairy herd reproduction such as calving interval, herd average days open, and services per conception do not accurately reflect herd performance.

Getting cows pregnant is economically important. The main goal of dairy herd reproductive management is to efficiently generate enough pregnant cows to maintain herd inventory in an optimal state for profitable production. Specifically, the objective is to make open cows pregnant in the most economically beneficial window of time postpartum. The objective of evaluating records is to measure current performance in order to decide if management action is needed presently, or to evaluate the effect of an intervention.

Evaluation of records by itself rarely leads to a full explanation of why performance is good or poor. Rather, thoughtful evaluation of records generates and refines hypotheses and leads to more focussed further questioning and investigation until a management decision can be made to make a change in practice or not (which should then itself be evaluated after an appropriate time; Fetrow et al., 1997). Conversely, use of poor means of evaluation, invalid interpretation, or failure to monitor records at all, lead either

to unnecessary actions or failure to act soon enough, both of which can be costly to the farm.

For herd reproductive performance, important questions for herd managers and advisors to ask include:

- What is current performance?
- Have things changed recently, and if so, are they better or worse?
- Do I need to investigate further now?
- Is the herd generating enough pregnancies to maintain herd size?
- Are pregnancies occurring at a time to optimize economic return?
- Do I need to take new action now?

For routine task management and implementation of management programs and decisions, managers and workers need to know:

- Which cows do I need to do something to today (breed, inject, present to the vet for pregnancy diagnosis)?

This paper will address the concepts of evaluation of reproduction records, as well as methods to perform specific analyses using Dairy Comp 305 (Valley Agricultural Software). This particular software will be referred to as all customers of CanWest DHI have access to this tool, if they choose to have their herd's reproductive data entered at the time of DHI testing, whether or not the program is purchased for use on the farm. A practical issue for producers is that use of paper records on-farm is at best laborious, and often does not allow for appropriate analyses.

An effective and valid method of monitoring reproduction should measure the ability of the farm to make open cows pregnant, and should quickly and accurately reflect changes in the success of this process.

Minimum Production of Pregnant Cows

Typically, if herd size is stable, approximately 10% of the cow herd should calve each month. To maintain current performance, the number of calvings required per month = [(milking + dry cows)/ calving interval]. (e.g. if annual average inventory is 100 milking cows and 20 dry cows and calving interval is 13 months then 120/13 = 9-10 calvings per month). This needs to be adjusted upward to account for abortions and possible culling of pregnant cows. If the rate of fetal loss after confirmed pregnancy is 8% and culling of pregnant cows is 2% (total of 10%), then the 10 pregnancies required per month must be adjusted 10/(1-.1) = ~ 11 pregnancies needed per month. To achieve this, the

required number of breedings is the required number of pregnancies/current conception risk. If conception risk (CR) is 35%, then continuing the example, 11/0.35 = 31. Therefore, at least 31 cows (not including heifers) should be bred each month, just to maintain the status quo.

■ Pregnancy Rate

Pregnancy rate (PR) measures the speed at which open cows become pregnant. Pregnancy rate is the probability that an open cow will become pregnant per unit of time. Because cows are expected, on average, to be in estrus once every 21 days, pregnancy rate is calculated on a 21 day basis i.e., in a group of 10 open eligible cows today, what proportion of them will become pregnant in the next three weeks? As such, this calculation is a risk, not a true rate. "Eligible" means the cow is past the herd's voluntary waiting period, and is not identified as a cow not to be bred. To contribute to the calculation, cows must spend the 21-day period in the herd, and have a known outcome at the end of the period (pregnant, or still open).

By this definition, one need only know the date that a cow calved and the date of pregnancy (or departure from the herd). However, pregnancy rate can be approximately estimated by insemination rate ("heat detection rate" (HDR)) multiplied by conception risk (PR $\approx$ HDR $\times$ CR; Ferguson and Galligan, 2000). The difficulty with this approach is generation of an accurate estimate of HDR (Eicker et al., 2002). On the other hand, the relation does illustrate that PR can be increased by driving up HDR, even if CR decreases slightly (as with systematic synchronization programs).

Targets of performance – The 75th percentile (i.e. the top quarter) of pregnancy risk among 3600 herds on CanWest DHI in 2004 was 16% (Figure 1). Very well managed herds achieve PR of 18-22%, with a handful exceeding this. The average herd in Canada and in much of the USA has a 13% PR.

To generate the PR estimate in Dairy Comp 305 (DC305) the command is: BREDSUM\E. With the PR report on the screen, clicking on the "GRAPH" tab at the bottom will display a graph of both pregnancy and insemination rates over the last year.

For herds with PR < 16%, investigation into the factors limiting performance and economic evaluation of intervention strategies to increase PR is warranted.

The default voluntary waiting period (VWP) is 50 DIM, but this can be changed with BREDSUM\EVxx, where xx is the herd's actual VWP e.g., BREDSUM\EV60 sets the VWP to 60 DIM. The default is to look at 21-day periods over the last 1 year, excluding the last 2 periods, because the pregnancy status of recently bred cows is unknown. The time period of interest

can be changed with BREDSUM\ED, which will prompt for dates to start and end the analysis.

BREDSUM\ERVxx will calculate PR starting from the end of the specified VWP. This is useful to look at the efficiency of getting cows pregnant quickly after the VWP. Again, clicking on the GRAPH tab at the bottom of this report provides a visual of the numbers.

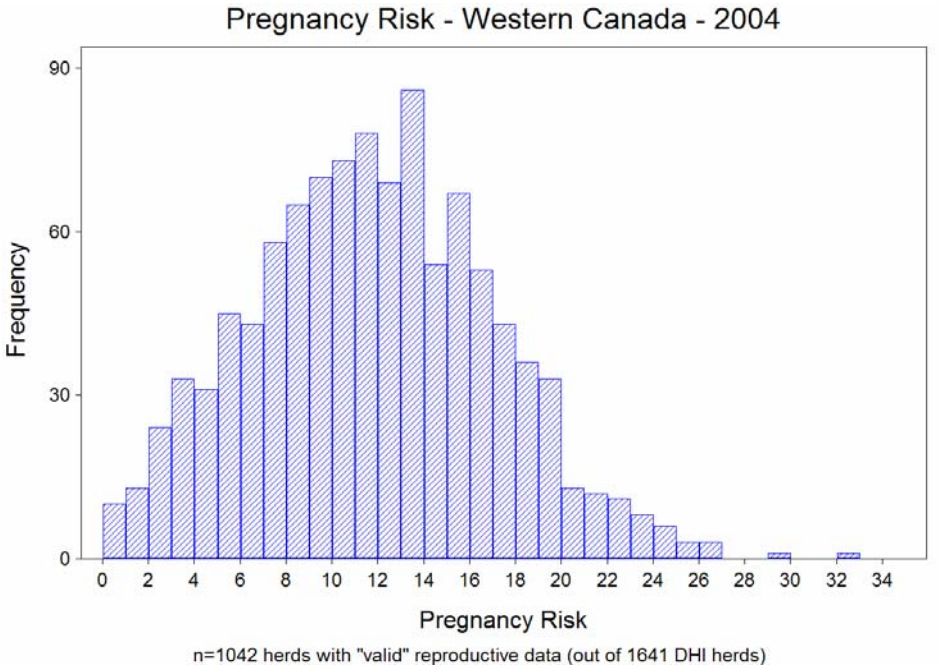

Figure 1. 21-day pregnancy risk in western Canadian herds on CanWest DHI in 2004 (Courtesy of David Kelton, unpublished data)

A spreadsheet is available on the internet to estimate pregnancy rate based on insemination rate and conception risk. See "Pregnancy Rate Estimation Spreadsheet", under references, for the URL.

■ Further Investigation

If assessment of overall pregnancy rate indicates that herd performance could or should be improved, or suggests that recent performance is tending to worsen, further investigation of the causes should be pursued. A holistic approach should be employed including inspection of the cows and facilities for factors limiting performance as well as further analysis of records. In addition

to assessment of the cows, records should also be evaluated to quantify disease problems in the transition period and lameness, as well as to examine specific elements of reproductive management.

Efficiency (Intensity) of Inseminating Cows

Insemination risk – This is the probability that an open cow will be inseminated per unit of time, which like pregnancy rate is standardized at 21 days. This is often referred to as heat detection rate (HDR), but the event of interest is insemination, and this terminology also better accounts for timed AI programs. The average herd in Canada has an insemination risk of only 33% (Figure 2). This is an area of opportunity for most herds that can be improved in the short term with practical, consistently profitable management changes (synchronized breeding programs).

DC305 – BREDSUM\E provides the insemination rate as well as the PR.

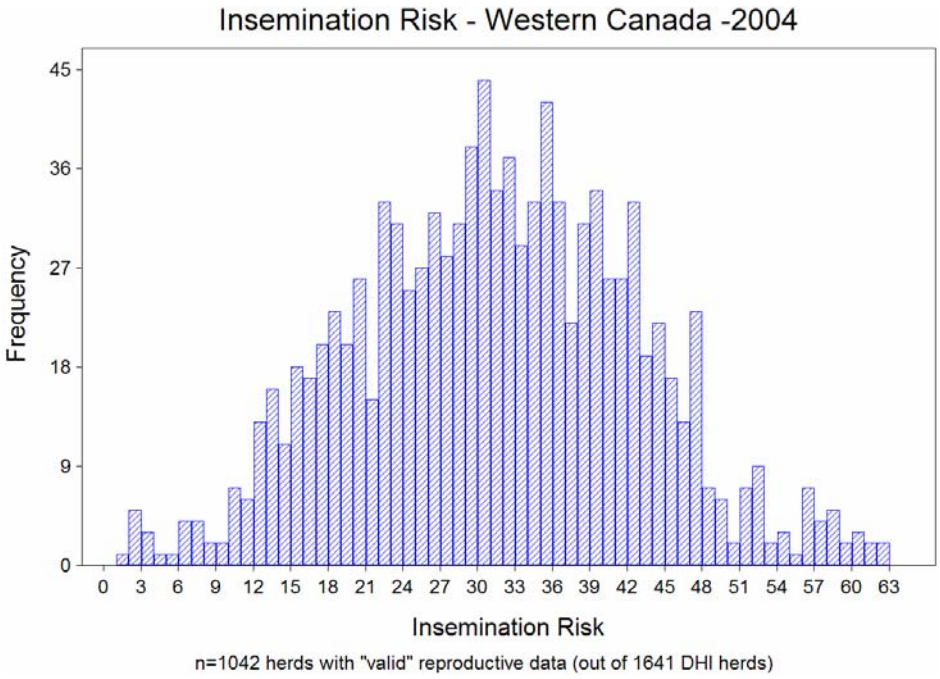

Figure 2. 21-day insemination risk ("heat detection rate") in western Canadian herds on CanWest DHI in 2004 (Courtesy of David Kelton, unpublished data)

It is useful to look at actual practice of first insemination (i.e. actual vs. stated voluntary waiting period) as well the efficiency with which cows are inseminated after the VWP.

DC305 - GRAPH BRED1 BY DSFSH FOR LACT>0 DSFSH<366\TZB produces a scatter plot of the DIM at first insemination for cows that calved in the last year. From this, it can be seen how early cows are actually bred, and the approximate proportion that are inseminated by the herd target (e.g. 80 DIM).

SUM BRED1=80 FOR LACT>0 DSFSH<366 calculates the proportion of cows that calved in the last year that were inseminated by 80 DIM.

These measures also reflect how well systematic reproductive management programs are being implemented. For example, if the policy is to start Ovsynch groups each week at 60-66 DIM, then essentially all cows should be inseminated by 76 DIM.

Conception risk (CR)

This is the probability that an inseminated cow will be diagnosed pregnant. It is important to recall that on many farms, the first limitations to reproductive performance are getting cows inseminated for the first time, then getting open cows re-inseminated. Presently, in the average Canadian herd, CR is approximately 38% (Figure 3). It is important to note that the timing of pregnancy diagnosis affects interpretation of CR. If pregnancy is diagnosed at 28 days with ultrasound, apparent CR will be higher, but fetal loss will also be higher, than if pregnancy is diagnosed after 42 days. The point of early pregnancy diagnosis is to find open cows so that they are re-inseminated; early-diagnosed pregnancies must be confirmed at 45-60 days of gestation.

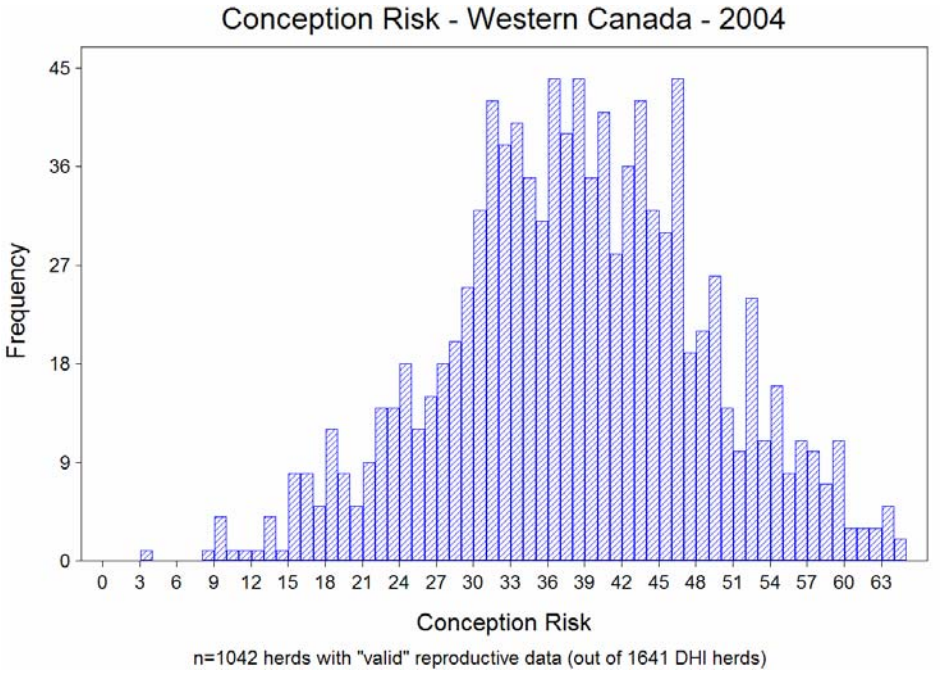

Figure 3. 21-day conception risk in western Canadian herds on CanWest DHI in 2004 (Courtesy of David Kelton, unpublished data)

Starting with specific questions, the association of various factors with CR can be calculated to examine hypotheses for further investigation.

DC305 – BREDSUM\B provides the overall conception risk, broken down by insemination number.

BREDSUM\W – CR broken down by day of the week when insemination occurred. The distribution of when breedings occur can be used to monitor compliance with synchronization programs.

Is there a seasonal trend in conception risk? BREDSUM\C – CR broken down by calendar month when insemination occurred.

BREDSUM\N – CR broken down by stage of lactation when insemination occurred. This may be associated with, or confounded by synchronization programs initiated after, or in parallel with heat detection.

BREDSUM\O – CR broken down by breeding code. Codes can be set up using the ALTER command (with on-farm DC305, or with the DHI representative) to track CR for observed heats versus a synchronization program.

Caution is necessary with all of these analyses because few Canadian herds will have sufficient numbers of inseminations to make such comparisons statistically valid, but it may be useful to generate further investigation. Moreover, the key outcome is PR, not CR.

■ Interpretation of Rates

Calculations of PR, HDR, or CR are only estimates of the true probabilities of pregnancy and insemination in a herd. Because they are proportions, the confidence interval around a single value is generally wide. For example, in a 100 cow herd, one 21-day period may include 40 cows eligible to become pregnant. If 6 cows actually become pregnant in that period, PR = 15%, but the probability of pregnancy in the herd (the 95% confidence interval) most likely lies between 4% and 26%, which spans from abysmal to fantastic. Including more inseminations and 21-day periods increases the precision of the estimate, but by widening the window of time considered, other factors may confound the question that is being addressed. Therefore, caution is needed in interpreting trends and associations.

■ Task Management

On some farms, consistently getting routine tasks done is a challenge that can be helped with practical checklists of cows to focus on, or to find and do something with.

Simple Action Lists

A list of cows for heat detection:
DC305 – LIST %ID LACT DIM FOR RC=3-4 DIM>50\2UP3 produces a compact list of all open cows past 50 DIM and bred cows that should be observed for heat.

A list of cows to synchronize (e.g. start on Ovsynch or to give prostaglandin): LIST %ID LACT DIM FOR RC=3 DIM>50\2UP3 produces a compact list of confirmed open cows and cows past 50 DIM and not yet bred that could be included in a synchronization program. Such a checklist list should be generated every 1 to 2 weeks to ensure that no cows fall through the cracks and fail to be inseminated in a timely way.

NB – it is critically important to enter accurate and up-to-date breeding and pregnancy data before running and acting on this list.

Should I Breed This Cow Today; Should I Keep On Breeding This Cow?

Although a full discussion of the economics of reproductive performance is beyond the scope of this paper, a tool is widely available to estimate the net present value of a cow, and the change in her value from making her pregnant. These numbers are the cow value (CWVAL) and pregnancy value (PGVAL) in Dairy Comp 305. Pregnancy value can be used to help decide whether to breed or continue to breed cows, and the results are not always what would be guessed by intuition. Typically a pregnancy is worth $300-400, so additional inseminations and synchronizations are frequently a profitable decision. Pregnancy value can help guide these decisions on cow-specific basis.

■ Problems With Traditional Measures of Reproductive Performance

Common measures of reproductive performance used in the past are not standardized among regions and software programs, and suffer from substantial practical programs with bias, lag, momentum and variation (Stewart et al., 1994).

Calving Interval

This is the time span between two calvings. Therefore, this measure is severely biased because it does not include first lactation animals, and it excludes cows that fail to become pregnant again! Furthermore, it suffers from lag (the calving interval of a cow that becomes pregnant today doesn't change for another 9 months) and momentum (a great deal of historical information is built in e.g., the herd calving interval today includes information that is over two years old – the values for stale open cows today are based on their previous two calvings, which may have occurred one and two years ago). Projected (minimum) calving interval generally assumes that all bred cows are pregnant and may further assume that open cows will be bred in the next 11 days, and as such is overly optimistic.

Producers and their advisors should make a conscious effort to abandon calving interval to measure reproduction, as it does not achieve any of the objectives for monitoring of herd performance.

Proportion of Cows Pregnant at Pregnancy Diagnosis

At best, this is an indirect measure of post-insemination heat detection intensity (and also depends on CR and the interval from breeding to pregnancy diagnosis). It does not reflect pregnancy rate in the short term (Table 1). In

particular, this measure should not be used to evaluate a new reproductive management program (e.g., “let’s try Ovsynch on the next 10 open cows and see if it works for us at next herd check”)

Table 1. This illustrates hypothetical cohorts of 10 cows followed for 2 estrous cycles. The proportion of cows pregnant at pregnancy diagnosis is an indirect measure of the intensity of heat detection in a herd. Due to failure of heat detection, open cows will be presented for pregnancy diagnosis and will contribute to a lower proportion of cows pregnant at the time of pregnancy diagnosis. The proportion of cows pregnant at pregnancy diagnosis is not an accurate measure of pregnancy rate. For example, with the average heat detection scenario 67% of cows are pregnant at pregnancy diagnosis, but (rounding up) only 2 of the original 10 cows are pregnant, whereas in the systematic timed AI scenarios, 4 of 10 cows are pregnant.

	Average heat detection	Ovsynch with post-breeding heat detection	Ovsynch without post-breeding heat detection
n	10	10	10
Insemination rate (%)	40	100, 40	100, 0
Number bred in first cycle	4	10	10
Conception risk	40	40	40
Number returning to heat	2	6	6
Number detected in heat in second cycle and re-bred	1	2	0
Number for pregnancy Dx	3	8	10
Number pregnant	2	4	4
Number open	1	4	6
% Open at preg check	33	50	60
Pregnancy rate (1 cycle)	16	40	40

Days Open

It is important to minimize the interval from the end of the voluntary waiting period until cows become pregnant. The concept of days open may help to illustrate and quantify the economic cost of reproductive inefficiency. In this sense, the number of days open is important. However, there are several problems with using days open to monitor reproduction. The main issue is

which cows are included in the calculation, and therefore what the number means. This is not standardized among software programs. Average days open including all lactating cows is not useful for tracking current performance because it will decrease with cows freshening, even though the ability to make presently open cows pregnant has not changed. Looking at days open in pregnant cows reflects past performance, but is biased because cows that fail to become pregnant are excluded. Examination of the trend for days open in open cows beyond the VWP might be useful, but it will include cows inseminated in the last 4 to 6 weeks that are pregnant but whose status is unknown. Finally, it may be profitable (as estimated by pregnancy value) to inseminate an individual at 200 or 250 DIM, even though this pregnancy would increase average days open.

Services per Conception

This number is just the inverse of conception risk e.g. if CR = 35%, then SPC = 1/.35 = 2.85. The major problem is that CR and SPC only look at what happened to cows that were bred – they do not account for cows that have not been bred, nor do they reflect lost time until cows are inseminated.

■ Heifers

The principles discussed above also apply to heifers. PR can be calculated for heifers, and further investigated using HDR and CR and their breakdowns as for cows. However, there are not yet good benchmarking data for PR in heifers.

DC305 – Adding the switch “Y” to any of the BREDSUM commands will change the analysis to look at heifers e.g., BREDSUM\EY produces pregnancy and insemination risks for heifers. The default for heifers is a “VWP” of 365 days of age, so if the actual goal is to start breeding heifers at 13 months old the command should be modified to BREDSUM\EYV395 to reflect a VWP of 395 days (13 months).

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Pregnancy Rate Estimation Spreadsheet, is accessible at: http://www.ahc.umn.edu/ahc_content/colleges/vetmed/Depts_and_Centers/CVM_Dairy_Center/DHMFQ_Software/reprocalc.xls