Monitoring Transition Cow Programs

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Introduction

The preventable economic losses from failures in transition cow program are significant. They involve both short and long term effects– on milk yield and components, on disease incidence and severity, on subsequent reproductive performance, and on the associated labor and treatment costs. Performance of fresh cows is important to the success of a dairy. Therefore, it is important to set up monitoring systems that can detect problems as accurately and rapidly as possible. Traditional measures of fresh cow performance often fall short of needs when used to identify current problems or current performance. There are newer approaches that can provide more accurate and timely measures of the success of a transition cow program. This discussion will address general principles of monitoring, and possible ways to assess transition programs by using a combination of on-farm records and DHIA information.

Why Do We Monitor?

There are three general reasons (not always in this order):

1. To measure the effect of an implemented intervention.
2. To detect the occurrence of an unintended disruption in performance.
3. To help motivate behavioral change on the dairy or to market other consulting services.

The goal of monitoring must be to find an area where we can make a change that will increase the profit or reduce the risk on the dairy.

Interventions might include ration changes, herd policy decisions (i.e., 3X milking), reproductive programs, etc. Not all changes are profitable. As these changes are implemented, the impact should be estimated to decide if the change was profitable and should be continued, or was a mistake and should be reevaluated.

Changing just because a *number* is changing can be an expensive mistake for a manager to make. Changing too frequently is expensive and frustrating.

Disruptions in performance occur on every dairy, seemingly on a continual basis. One goal of monitoring is earlier detection of problems. It is almost always cheaper to fix problems sooner rather than later, whether they are diseases, reproductive problems, or even labor issues. Equally important is to NOT change something when it is not really broken.

Finally, many consultants use monitoring as a motivation and marketing tool for other services. Routine monitoring can get them on the dairy on a regular basis, where hopefully they are providing services that enhance the profitability of that dairy over and above their fees. The ideal consultant looks for opportunities to market solutions that are found in monitoring. Solutions help improve the bottom line; merely pointing to problems and making excuses does not.

Monitoring is not unique to dairies. Most businesses have been monitoring for years. Also, every patient in every intensive care unit has a chart where important parameters are monitored. If we consider our dairies as our patients, we can use a similar framework. In an intensive care unit, the purpose of monitoring is not just monitoring; monitoring is not an end in itself. The purpose of monitoring patients is to decide when to start and stop treatments. It is these actions that help the patient, not the monitoring. In intensive care units, the measured parameters have limit points. If, for example, the heart rate exceeds some cutoff, further action is indicated - either diagnostic, therapeutic, or communication. There is almost always a clear management action if a monitored parameter is outside an expected range.

If the information on the chart is wrong, or not recorded, the patient may suffer. Treatments may be stopped that should have been continued, and other treatments may not be started as soon as they are indicated.

Definition and Goals of Monitoring

Monitoring is the routine, systematic collection and evaluation of information from the dairy, intended to identify problem areas and to track performance over time. Traditional monitors started from an academic focus. Usually, they were attempts to describe industry benchmark performance (benchmarks) as opposed to making timely management decisions on dairies.

Monitors take the form of a table, with a column of numbers for each date (month) and each row is a parameter, or as graphs that track trends of data over time. These parameters are usually averages, such as average days open, or average milk production, but can also include counts and percentages. These tables often show a historical progression toward a goal. Thus, they provide significantly more information than a single test-day snapshot. For instance, a bulk tank average somatic cell count of 200,000 is much more meaningful if the past history is known. Had the previous months' values hovered near 500,000, this new result would be a cause for some celebration! Had the prior month's values been near 100,000, this result should be a strong warning.

Until the early 1980's, most of these monitors were very laborious to calculate. They were time consuming, and frequently were only done by Universities or DHIA systems. They took so long, that even doing the calculations once a year was a huge task. The introduction of on-farm computer systems and software has eliminated that. In fact, the calculations are so easy to make that they are frequently made monthly, weekly, daily, or in some instances hourly! Today's dairy manager can easily calculate many parameters, many different ways, and is very much tempted to do something with that calculation. Because of today's computing power, we now have the luxury of deciding what parameters are most appropriate to calculate to answer an important question the manager is asking. Today's *smart* manager is asking "what can I change today that will improve the future performance of my herd." This is fundamentally, a new type of question that was not even being asked when many of the traditionally accepted monitors were developed.

Essentially, the values of these parameters are used as a *test* to identify situations where a change is needed. Thus, the purpose of monitoring is to identify areas on the dairy that can be **changed** so profit is enhanced or risk is reduced. Unlike making a calculation of a metric, records analysis takes time; it costs money to collect and analyze the information. If reports are generated, but action is never taken that increases the profitability or reduces the risk of the dairy, that time and money was wasted.

There is an important distinction between monitoring and historical evaluation of past herd performance. A banker might be interested in past herd performance, as might an academic study creating benchmarks to compare herds.

There is also an important distinction between effective monitoring parameters and outcome goals for a dairy. For example, poor heat detection rate will affect pregnancy rate (**PR**), which will affect average days-in-milk, which will affect average milk yield. The goal is high milk yield, but milk yield is a poor monitor of heat detection rate.

Monitoring Issues

Unfortunately, traditional monitoring parameters have not been as helpful as possible. As mentioned above, monitoring parameters are typically averages. Like all parameters, averages may suffer from four potential problems:

1. ***Variation***: The use of averages can be misleading when an individual or a few extreme cases can distort the general trend.
2. ***Momentum***: When data from long past are included in the calculation of the parameter, recent changes may be obscured by the weight of history.
3. ***Lag***: The time between when an event occurred and when it is measured.
4. ***Bias***: The inappropriate inclusion or exclusion of cows.

Variation

Measures that simply report the mean (*average*) of the herd or subgroup can lead to problems, especially in smaller herds. When dealing with small numbers of individuals, a single or a few values can greatly skew the mean in either direction. Usually, this skewing is upward since most measures have an absolute lower end, but no maximum value (e.g., voluntary wait period, age at first calving, and somatic cell count all have minimums, but no necessary maximums). This can lead to unwarranted alarm due to a single individual's problem, rather than a more pervasive herd problem. On the other hand, a good average does not mean there are no problem animals in the herd.

For example, in a 50-cow herd with 25 confirmed pregnant animals, a single cow with days open of 250 days increases the average days open of the currently pregnant cows by 10 days. If this cow is then sold, the average will drop by 10 days. If the operator is unaware of this, false credit for a positive result may be given to an irrelevant intervention. Conversely, two animals conceiving at 30 days would drop the average by 6 days. Inclusion of standard deviations, standard errors, etc., may be helpful in larger herds, but in smaller herds may not add a great deal of additional information. In addition these statistical measures may not be well understood by many producers.

Momentum

In attempts to counteract the problem of low numbers in smaller herds, distant historical data is often included. Difficulties arise here because traditional statistics such as means and standard deviations are not *time-sensitive*. For example, if these measures include a whole year's worth of information, it is difficult to differentiate between three problems: one arising recently versus one of long standing versus one already resolved.

Historical data can cause misinterpretation regardless of herd size. A relatively severe and recent problem may have only a small effect on the average due to the dampening effect of the historical data. Conversely, a recent improvement may also not be as dramatically illustrated. False re-assurance arises in the first case; in the second case unwarranted discouragement may cause abandonment of a positive change. This dampening characteristic of data analysis is referred to as momentum.

Lag

Lag is the time between when an event happens and when it is measured. Long lag times prevent prompt response to problems. For instance, calving interval requires two consecutive fresh dates. This means the information is at least nine months old (usually much older) and does not reflect any changes in reproductive performance in the last six months! Even a measure such as days open is dated by at least 35 days for any individual cow since it requires a pregnancy confirmation.

Bias

Many of these measures also report on the performance of individuals with a positive (or otherwise known outcome), but ignore (or do not reflect) the current numbers of animals either pending status confirmation or past a management cutoff with no action. In addition, bias can arise if a measure either includes cows or excludes cows inappropriately. Formally, this is termed *selection* bias.

Another form of bias is missing or incomplete data. There are many different forms of data corruption that exists in farm records systems. It is necessary to be concerned about the quality of the data that are available. Fundamentally, there are two types of bad data: incomplete data and incorrect data.

Incomplete data exist because only partial information was collected into the system. For example, this can occur when a producer identifies ketosis cases, but does not record the information, or enters that data on some cases, but not others. Sometimes incomplete data exists because the data was entered initially, but later lost or deleted. One example has occurred when producers re-use ID numbers for animals and delete all evidence of a previous cow from the record system.

Incorrect data are a more insidious problem of a record analysis problem. These errors arise from both animal misidentification (ie, faulty electronic identification systems) or measurement error (incorrect milk weight was transcribed).

Most traditional parameters suffer from one or more of these four problems. Some may be unavoidable, but it is important to understand the magnitude of each potential error for each parameter monitored. For example, age at freshening is commonly reported as a measure of replacement program. It may be an excellent overall summary measure, but it is a horrible monitoring parameter, based on the above objectives. First, it is an average, and one or two extended cows may move the average. More importantly, it is usually an average of all heifers that freshened over the past year, so there is 12 months of momentum that hampers early reaction to a problem. Most importantly, there is lag, over nine months since conception before it can be measured, and even much longer if a poor feeding program at weaning was responsible for older age at first calving. For completeness, the age at freshening also has bias, since heifers that never conceived are not included in the calculation!

Using parameters that have one or more of these four sources of errors can cause our *patient* to remain on a treatment that is not profitable or to not start a treatment that would be profitable. Each monitoring parameter should be evaluated in terms of these criteria.

Other Monitoring Issues

There are other issues with monitoring that have produced less than desirable results. Remember, if monitoring is really calculating parameters, then using their values as a test, there are other characteristics of a test that are important: how sensitive is the test (will it always detect the actual problem) and how specific is the test (can other factors create the appearance of the problem when the problem does not really exist?). In addition to all these issues of lag, momentum, variation, bias, sensitivity and specificity, there are often multiple parameters that are available for the same problem. Many times, one parameter will be far superior to another.

How *sensitive* is the parameter?

A monitor is sensitive if it always detects a problem. Unfortunately, there are few examples of really sensitive monitors. There are many more examples of insensitive monitors. For example, perhaps someone proposes using bulk tank SCC to monitor fresh cow mastitis. Fresh cow mastitis probably has an affect on the bulk tank SCC, but it makes little sense to use bulk tank SCC as a monitor of fresh-cow mastitis. Bulk tank SCC is not very sensitive to fresh cow mastitis – it is diluted by too many other cows. The following are relatively sensitive: fever in cases of clinical coliform mastitis or maybe hemorrhages in the sole in cases of grain overload-rumenitis/laminitis.

How s*pecific* is the parameter for the problem?

A monitor is specific if it only changes when there is a real problem. Fresh cow mastitis causes decreased reproductive performance, but it makes little sense to use pregnancy rate to monitor fresh cow mastitis. Thus, a change in PR is not a very specific indicator of fresh cow mastitis. An example of a highly specific monitor might include fecal culture for Johnes or Salmonella.

Screening Tests.

The purpose of monitoring is not to follow a problem until we are absolutely certain that a problem exists ($P<0.05$), but rather to detect problems as early as possible. Operating a dairy farm involves management of risk. The level of evidence required to launch an investigation, or its subsequent intervention, depends on both the strength of the evidence and the potential cost-benefit ratio of the proposed intervention (note intervention here includes changes that improve an already acceptable situation, as well as those needed to correct *problem* areas). Therefore, for management purposes, measures that will reliably alert one to potential problems are critical. It is likely far better to occasionally declare that a problem may exist than to provide false reassurance that no problem exists when one truly does. In traditional diagnostic terms, one wants a monitoring system that is very sensitive, i.e., is likely to detect problems if present. Again, mere detection of a problem is no guarantee that the cause is identified, nor is it assurance that intervention is justified.

If there is a very large economic downside potential, but an inexpensive intervention is possible, the evidence needed for implementing this *insurance* may be much less than that required for scientific proof. An example of this might be the routine use of Leptospirosis vaccine to prevent abortions. On the other hand, if there is a high cost of implementing a given intervention, but relatively low downside potential, even evidence that is statistically significant may not be enough to justify an intervention.

Is this parameter the best monitor?

Often we have focused on monitoring parameters, rather than trying to find out the answer to a question. We too often say "We have all this data, what is it telling us?" We should be asking, "Here is the question, let us find the data to help us answer it." We must frame the question carefully first. We do not go to the hardware store, buy a hammer, then wander around the dairy looking for nails! Rather, we decide to build something and then procure the appropriate tools.

For instance, most DHI organizations provide a culling summary, stratified by reasons why the animal was culled. What can we do with these data? Perhaps we can quantify the economic effects of mastitis, or identify the impact of reproductive problems, etc. Unfortunately, we found an answer (tool), and asked, "What can we do with this?" Had we asked, "How can we assess mastitis?" we might have listed the following: bulk tank SCC, individual cow SCC, recent incidence of clinical cases, etc. Almost no one would suggest waiting for a year to see how many cows died or were sold that were *identified* as mastitis culls.

Do not monitor what cannot or will not be changed.

Each measurement should logically lead either to another question or directly to a management action. What is often needed is not a measurement of the performance of those animals whose outcome (positive or negative) has already been resolved, but rather the identity and status of those animals where positive management action can still be taken. Monitoring pregnant cows is rarely useful - there is little action that can be taken on pregnant cows that will help the dairy. We must monitor open cows and be prepared to implement some action.

Always estimate the economic impact of the solution.

Most every dairy could improve heat detection, lower bulk tank SCC, and have fewer fresh-cow diseases. Informing a dairy that they have *too much* disease is not useful. Telling them that they **had** too much disease last year is even less useful. Suggesting a plan, and estimating both the implementation costs, and also the benefits and probability of success are useful. Implementing a monitoring system that can track the changes resulting from the plan is recommended.

Summary of Monitoring Issues

1. Lag – the time delay between the problem and the ability to detect it.
2. Momentum – a time effect because of dampening changes with averages.
3. Variation – false changes in averages because of outliers or too few cows.
4. Bias – errors that occur when certain data are ignored.
5. Sensitive – will the test actually detect the problem?
6. Specific – what else could cause a similar change in the test?
7. Screening test – better to have a sensitive test than a specific test.
8. Ask question first, then look for the BEST tool.
9. Never run a test that will never change an action.
10. Not all solutions are superior to the existing problem.

Fresh Cow Monitoring

The ideal cow freshens with no problems, has a healthy calf and a voracious appetite, consumes an excellent diet, and her milk production increases quickly to a very profitable level and remains high throughout lactation. She gets bred back promptly; does not get mastitis, become lame, or contract any other disease; has the correct length of dry period; and repeats as necessary.

Transition programs can have an impact on this process. Deficiencies can decrease milk yield, affect milk components, cause diseases, result in premature replacement or death, and contribute to calf diseases and even calf death. Monitoring becomes important.

Disease costs

There are both direct and indirect costs of diseases in dairy cows. These costs include the following categories: decreased milk production, decreased milk sold, treatment costs (including labor, drugs, and facilities), decreased reproductive performance, and premature replacement.

Dr. Charles Guard, Cornell University, has estimated the average financial losses incurred from the common diseases of dairy cows. Even a cursory look at this analysis will be sobering for most dairies. As a general rule, there is significant profit that results from proper efforts to better control these diseases.

Obtaining accurate information on disease incidence is often difficult. On many farms there are neither written or computerized disease records. On these farms the producer's memory is the only source of information, not always as objective a source as desired.

Even on dairies with written or computerized records, diseases may be either under- or over-reported. Under-reporting has arisen because the computer software is attempting to record each disease event in great detail. The burden of data entry becomes too much and the producer ends up recording nothing. Over-reporting occurs when each treatment is recorded as a new incident of a disease.

For many dairies, the establishment of standardized protocols for diagnosing, recording, and treating diseases provides immense value. Daily, each dairy needs a list of diseased cows to be treated with the proper medications, or cows that must have their milk withheld. Weekly or monthly, the incidence of each disease can be tracked to see if changes have occurred. And long term, the records are available for federal and local requirements.

For reporting and monitoring, a simple list of cows sorted by date or even a count of the event occurrences can go far in meeting the needs of a monitoring system. Tables or graphs with a time-scale are also often useful.

Fresh cow diseases of primary interest include retained placenta, metritis, ketosis, displaced abomasum, and clinical mastitis.

Peak milk

Peak milk has long been used as a monitor of fresh cow performance. Unfortunately, it has many limitations as a fresh cow monitor. The discussion here assumes the question of interest is "How are my recently fresh cows performing?" Some of the limitations of using the peak milk measurement as a fresh cow monitor include:

DHIAs typically do not report *true* peak milk, i.e., the highest milk production that the cow produced this lactation. Usually the number reported is the highest level of milk produced at any testday so far during the current lactation. This can vary considerably from *true* peak milk, as it is not likely that DHIA testday will coincide with the actual peak milk day for very many cows.

Even if *true* peak milk is being reported, it is difficult to compare one cow to another since the expected peak varies with multiple factors, including:

- Age at freshening
- Lactation number
- Season of calving
- Breed of cow
- Area of country
- Herd production level (small effect)

The presence of these influences must be accounted for before meaningful comparisons can be made between animals or groups of animals. On a practical level, these adjustments are quite difficult to make mentally.

There is considerable **lag** from the time a cow freshens until her peak milk. Since peak milk usually occurs somewhere between 50-90 DIM, this time interval is the lag between what we are trying to measure (fresh cow performance) and the time of the measurement itself (peak milk). This is too long to wait for prompt detection of fresh cow problems. Variations such as summit milk have the same problem with lag.

Often peak milks are reported simply as means (averages) with no indication of the underlying range of values; i.e., with no sense of the **variation**.

These peak milk measurements often include more than the recently fresh animals, lending the dampening effects of **momentum.**

By either the true or highest test-day peak milk definition, a cow must survive long enough in the herd to reach second or third test to have a recorded peak milk. This is a form of **bias**, as it excludes the performance of cows that either left the herd prior to peak milk or those cows currently at first test.

First test-day percent butter fat

Higher than *normal* butterfats in individual cows is often a sign of metabolic difficulties. These cows usually are in a state of extremely rapid weight loss. These cows often have a history of metabolic problems such as ketosis, fatty liver, and/or displaced abomasum. Cut-off points at present are not clearly defined, but Holsteins with tests above 6.0% should be investigated further.

Lower than *normal* butterfats in individual cows is often a sign of past metabolic difficulties, low body condition score, acidosis, or some combination of the three. These cows usually are very thin. In many cases, these cows are 20-30 days in milk at first test. We propose that many of these cows would have been quite high if tested at day 8-15, but now are low since essentially no more body fat is available to be lost into the milk. This likely under-reports problems in cows that are dropping from a *high* to a *low* test as they would not be distinguishable from *normal* cows.

First test-day linear SCC

Unpublished data currently being evaluated suggest animals starting with a higher linear SCC (>4.0) produce 1,000-1,500 pounds less in the coming lactation when compared to cows freshening with lower linear SCC. In addition, recent reports suggest that cows with mastitis in early lactation have lower reproductive performance.

First test-day mature equivalent 305-day projected milk.

All DHIAs offer projections (predictions) of the expected lactation total 305 day milk production. A mature equivalent (**ME**) projection further refines this prediction by adjusting all cows to the same age to allow comparison of cows in different lactations.

Minnesota DHIA, as well as some other DHIAs, begins predicting a cow's 305 day ME projection at the cow's first test of the lactation. The cow must be at least 8 days in milk to receive a first projection. Typically, cows are around 15-20 days in milk at first test.

While this projection is not 100% accurate in predicting the final 305 completed lactation total milk, it is much better than is commonly believed. A cow starting with a low projection at first test is not likely to finish with an excellent total at the end of 305 days and is much more likely to be culled.

Compared to peak milk, the first test-day 305 day ME projection offers these advantages:

1. Measurement can be made starting at day 8, gaining 45-60 days on lag time.
2. Bias due to culled cow exclusion, although still present, is less.
3. Effect of different test-day days-in-milk is removed.
4. Cows freshening at different ages can be compared one to another.
5. Cows in different lactation numbers can be compared.
6. Cows freshening in different seasons can be compared.
7. Cows freshening in different areas of the country can be compared.
8. Different breeds can be compared.
9. Adjustment is made for herd productivity.

Monitoring Questions

To some extent, this discussion has been organized backwards. Common measures were discussed prior to asking the questions, in part to reinforce the potential problems with these measures. But the fundamental questions should include the following:

- Are cows milking OK – both milk volume and milk components?
- Have disease levels changed?
- Are disease levels too high?

Better monitors

To promptly assess milk yield, daily meters are useful, both for individual cows (for disease detection), and averages of the fresh cows (for recent transition program changes). Although most new construction includes daily meters, the vast majority of dairies must rely on monthly testing. In-line turbine meters can provide group totals, but those are not yet in wide use either.

As mentioned above, waiting until peak milk has been achieved incurs too long a lag time. On the other hand, the milk yield and component values on the first test day are significantly affected by both days-in-milk and fresh-cow diseases. Typically DHIA does not sample cows in the first week of lactation. Also, some dairies do not record milk weights for diseased cows, which can bias the results. The first projected 305-day milk is useful to track over time. Typically, either the monthly average by lactation group, or a scatter graph of first production index (Milk, %Fat, proj305ME) by fresh date is useful.

When accurate disease records are available, there are likely few more sensitive monitors for assessing transition programs. Either counts by month, or histograms of incidence rates of the common fresh cow diseases are excellent tools. Depending on the size of the dairy, either weekly or monthly counts are usually sufficient to detect and assess changes.

Purists would actually prefer incidence rates, where the denominator is some measure of the cows-at-risk. However, in herds without extreme seasonal calving patterns, a count is usually sufficiently sensitive to screen for a problem.

Charting these disease events by days-in-milk is instructive to assess the average issues last year, but as a general rule, any monitor that uses an entire years wait to accumulate data has significant momentum, and is not suitable for the dynamic monitoring that is necessary.

Proxies if no disease data are available

Few dairies keep accurate disease data. Even fewer DHIAs provide access to these data by consultants or advisors. (Dairy One in New York and Minnesota DHIA are exceptions). Because of the absence of disease data, many lenders and other dairy advisors tried to use annualized cull rates (or reasons) as a proxy for disease morbidity and mortality. Unfortunately, there is no monitoring value in cull rates, either level or stated reasons. There is no such thing as an optimal cull rate, and sometimes even a herd with a high cull rate has cows in the herd that should be replaced. Likewise, a herd with a low cull rate just may not understand the opportunity cost they incur by keeping cows in the herd when a replacement would be more profitable. A cow culled in the first month of lactation is a far more expensive economic event than a cow that is replaced at the end of lactation. Some estimate that the cow value drops about $3 per day after freshening for cows that do not become pregnant.

Culling reasons reported to DHIA are not useful. Although they are rarely coded correctly, that is not the reason why they should be ignored (and actually, not even recorded). Waiting a year to learn about problems by looking at cows that were sold is too late. In every single category, there are far superior choices for monitoring performance. The economic loss suffered from sub-optimal performance likely exceeds the economic loss indicated by the cows that actually left the herd. That is, the morbidity is likely just the tip of the iceberg of economic losses from diseases.

For example, any guess of the number of cows culled for reproduction is likely an indirect estimate of problems that happened many months ago. Using recent pregnancy rate and recent heat detection rate make far more sense. Waiting for a year to see how many cows died from mastitis is a horrible monitor of either clinical or sub-clinical mastitis. It is easy to find numerous superior tools for monitoring a problem on a dairy herd.

Other Performance Monitors

Up to now, this discussion has been focused on monitoring outcome – how did milk production change, have there been more diseases, etc. However, it is also important to monitor processes – are systems being followed as expected? These *causal* monitors include the length of time cows spend in the close-up pen and a distribution of the length of time that cows are dry. These are earlier measures of compliance issues with procedures than actually waiting for the effects of these problems.

Fresh Cow-Care Monitoring

On larger farms it can be instructive to track the person responsible for freshening each cow. Large differences in future production and disease incidence can occur on the same dairy with different persons assisting calving. These differences may arise for many reasons, including immediate postpartum cow access to fresh water, immediate and plentiful access to high quality long forage, calving hygiene, calving trauma, degree of calving trauma, degree of calmness handling the cow, and attention to bedding dryness and cleanliness.

Conclusion

In the end, there are limited things a dairy can change. They include the transition program, ration and feed delivery, cow comfort, milking equipment and procedures, reproductive programs, and better organized labor efforts, including protocols for diagnosing, recording and treating diseases. On the other hand, change will be continual on most dairies, be they intended intervention or an unintended interruption. Using monitors that promptly and accurately describe the impact of these changes should result in continued improvement and profitability.

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