Monitoring Fresh Cow Programs

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Fundamentally, monitors are intended to make sure that performance matches expectations. Dairy management has two kinds of expectations:

1. expectations about what is done (implementation)
2. expectations about what happens after it is done (results)

Expectations may come in the form of formal, specific plans and procedures on the dairy, goals or standards set by management, benchmarks of performance on other dairies, or little more than an ill-defined desire that things stay the same as before. Obviously, expectations are more powerful when they are explicit. From the dairy's point of view, in general, monitoring is intended to serve one or more of three functions:

1. To detect the occurrence of an unintended disruption in performance under existing management conditions.
2. To measure the impact of an implemented intervention or management change.
3. To help motivate management or human behavioral change on the dairy.

More specifically, monitoring is the routine, systematic collection and evaluation of information from the dairy, intended to identify problem areas and to track performance over time. Each of these terms is important for best results from monitoring:

1. routine: monitoring is not the same as problem investigation. Monitors should be consistently in place to detect changes.
2. systematic: monitors should be thought out in advance, consistently applied, and the effort should be consistent over time
3. evaluation: data collected for data's sake is of little value. Someone must evaluate the data to see if it has meaning to management and the dairy.

CHARACTERISTICS OF A GOOD MONITORING PARAMETER

Some monitors of performance are better than others. Monitoring the average calving interval for all of the calvings in multiparous cows in the past year is a much poorer monitor of current reproductive management than pregnancy rate in all cows eligible to be bred in the period from 43 to 63 days ago. What are the characteristics of a good monitor, and what factors come into play and must be considered?

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Proximity in Time (lag)

A good monitor is derived from data arising quickly after the event of interest, so that events that deviate from expectation are detected quickly enough that more problems don't occur and the detected problem can be fixed quickly. Tracking culling events is generally a poor monitor of transition cow disease effects; culling mostly happens too long after the causative event to be useful to a manager making day-to-day corrections of program implementation. In contrast, taking the temperature of fresh cows or performing urine ketone checks can detect diseases immediately.

- **Aggregation of data (momentum)**

If data over a long period of time is aggregated into a monitoring parameter, then recent changes are "diluted" or "dampened" in their effect on the parameter as calculated. Recent important changes may thus go undetected. If one averages the cell count on the first test day for all cows that calved in the past year, recent spikes in fresh cows may not be noticed.

- **Summarization (variation)**

The average performance in a group may hide poor performance in a subgroup. Thus average production in a group may not reveal that a portion of the cows are milking very poorly. Graphical presentation of data where each individual is shown may "catch the eye" of the analyst and highlight problems that would be hidden by a single summary statistic.

- **Exclusion of data or systematic errors in data (bias)**

Parameters that exclude certain individuals or data points may skew the results and mislead the evaluator. Thus DHIA somatic cell counts may look better than reality if cows with abnormal milk are excluded from sampling on test day. Data based on a systematically inaccurate measure can also lead to poor results in a monitor. If the person doing body condition scores consistently gives clean heifers just off pasture a higher BCS than dirty cows in the dry lot that in fact are the same BCS, then the results may lead the evaluator astray.

- **Test sensitivity**

In general, everyone wants the tests they apply to be accurate, i.e. to reliably detect problems if they are there and also to reliably find no problems where there are none. This desire for accuracy leads to concerns about the sensitivity and specificity of tests. Sensitivity is the ability of a test to detect a problem when it is really there, i.e. the ability to avoid false negative tests. No "test" is perfectly able to detect all cases of a disease or problem. For example, some cows with elevated betahydroxybutyrate (BHB) levels will none-the-less show negative on a urine dip stick for ketones. Sensitivity is most important when testing for rare problems; if the problem occurs you don't want the test to miss it. Similarly, if the problem has a major impact, you want a sensitive test so that the problem is not missed. Thus a test for antibiotics in milk should be very sensitive; if the rare mistake is made you don't want to ship a contaminated tank of milk.

- **Test specificity**

At the same time, you want your "test" to be as specific as possible. Specificity is the ability of the test to confirm a problem is absent when it really isn't there, i.e. the ability to avoid false positives. If there is no problem, it would be best if the "test" gave a clean report. Ideally, if a cow has no LDA, you'd like to be confident that you will hear no ping on her left side. There is in general a trade-off between sensitivity (catching the problem if it is there) and specificity (being confident that all is OK if the "test" is negative. Take urine ketone tests, for example. If the "trace" level or higher is chosen as the level at which a cow is called ketotic, then you miss few cows with ketosis, but also gather quite a few that are not really ill. If you set the cutoff at severe, you'll be pretty sure that every positive cow is sick, but you'll also miss many sick ones as well. All of this, unfortunately, is dependent on the prevalence of the problem. If nearly every cow has the problem, pretty much any positive test will be accurate. If it is rare, there will likely be a lot of false positives unless the test is very specific. This holds true for non-disease "tests" as well. Looking at the filter sock after milking is pretty sensitive for detecting poor employee performance in cleaning cow's teats at milking. If teats are left dirty, it will show up on the sock. The "test" is not all that specific, however. A dirty sock could be the result of a heifer kicking off the unit and having it suck up dirt from the floor.

- **Applicability (usefulness, ease of access to the data)**

A monitoring parameter should provide information that relates to behaviors and outcomes that matter. One could, for example, monitor the proportion of cows that calve facing north, but why bother? Monitoring takes time and effort; it should be applied to things that matter. In a similar vein, simple, easy monitors may be better than difficult, complex monitors that provide marginally better information, if only because simple monitors are more likely to get done. Daily examination of the milk filter sock may not be as good as daily bulk tank cultures in terms of quality information, but they may be the better monitoring tool when ease, cost, and speed are factored into the choice. The bulk tank culture could be run at less frequent intervals.

MONITORING AND MANAGEMENT ACTION

If monitoring is done to compare the actual situation with expectations (implementation of results), then for each expectation that will be monitored a series of questions naturally follow:

- What is the expectation (in measurable terms)?
- What measure will be used to compare results and expectation?
- What parameter or which cows will be used for the data (e.g. bunk space to evaluate access to feed, pre-fresh cows within two weeks of expected calving for urine pHs)?
- When will the data be collected (i.e. when in the year, in lactation/gestation, during the day/week)?
- Who will collect it?
- How will it be collected?

The easiest way to avoid wasted monitoring effort is to start with the question:

What do we want to know and how would we use the information if we had it?

Monitoring a parameter simply because it is available is not enough motivation. If the actual results are not meeting expectation, what will management do about it? If the answer is that management will do nothing, then don't bother to monitor and don't complain about the actual results. Remember as well that identifying a problem does not always mean it is worth solving. Some solutions are worse than the problems they were meant to address.

Some things are "monitored" (evaluated) on a problem investigation basis (e.g. is there enough bunk space?) whereas other things are monitored on an on-going basis (e.g. the incidence of retained placentas). The on-going monitoring will only be successful if top levels of management see the value, insist on standard operating procedures to insure quality and consistency of basic data, and assures that the information is reviewed and used regularly.

EXPECTATIONS

Setting useful expectations is not an easy task. It is too glib and easy to simply say that one expects things to get better than they are now. With that definition, everything on the dairy is below expectation and there is a risk that all problems become equally important. Management becomes either reactive, apathetic, or burns out.

In many cases, it makes sense to compare current performance to either industry "standards" (expected rate of retained placentas) or to the dairy's own historical performance. Both approaches can be useful if done with reason and perspective. Expecting "average" stillbirth rates is not reasonable if a startup dairy is calving all purchased heifers. It does no good to berate the nutritionist for their transition cow rations because peak milks have fallen if the dairy has concurrently increased stocking 20 percent and has the worst haylage in the county.

MONITORING IMPLEMENTATION

As we learn more and more about managing transition cow programs, we will gradually move from monitoring the results of the program to monitoring the implementation process itself. As an analogy, McDonalds will monitor the cooking time on its fries and the temperature of the oil and the moisture content of the frozen fries, rather than monitoring the quality of the cooked fries. The presumption is that if the inputs are OK and the process is properly done, the results will be within the expected range. It is not likely that we will stop monitoring the results (either the fries or milk production). It is likely, however, that the dairy's management will detect problems and correct them far more quickly by monitoring the implementation of the system and avoid learning too late that something has gone wrong.

For example, feeding programs are likely going to be monitored using loading information, dry matters of forages, particle lengths, rapid content tests (e.g. NIR, not wet chemistry), and group intakes far more in the future, with less reliance on milk produced or butterfat levels.

The following discussion considers some of the fundamental aspects of transition cow management that should be properly implemented on every dairy, with a few comments on how that implementation might be monitored.

Excellent transition cow management arises from a combination of:

- Proper physical facilities to house cows, calve, and for special care with a focus on all aspects of cow comfort (physical surfaces, pen and equipment design, air flow and quality, temperature)
- Calm approach to cow handling, ease of cow movement, and regular observation of cows for problems
- Animal and environmental cleanliness
- Proper diet formulation and excellent feeding management
- Ready access to clean, plentiful water
- Appropriate intervention in the calving process
- Organized observation of cows, accurate and complete records, and prompt intervention for sick cows
- Clear, logical protocols and adequate training of personnel
- Healthy, properly managed cows should enter this phase of production from their previous lactation or the heifer rearing program

Proper physical facilities to house cows, calve, and for special care with a focus on all aspects of cow comfort (physical surfaces, pen and equipment design, air flow and quality, temperature)

Proper design of transition cow facilities is a critical issue when designing a new dairy facility, but unfortunately one that is often done with too little care and consideration. These "special needs" facilities are often almost an afterthought in dairy design and the emphasis is on creating a facility as cheaply as possible. While transition cow facilities typically do not in themselves earn much revenue, what happens there has enormous impact on cow and calf production, health, and longevity. These facilities also consume large amounts of specialized labor and are the site of many of the dairy's "exceptions management" efforts. Poor design to save on construction costs can haunt the dairy's economic health for the life of the facility and can be a pernicious source of irritation to managers and employees alike.

On many farms, the physical facilities are often taken as a given. Even this need not be so; simple modifications or changes in the management of the facilities can lead to improvements in cow performance and labor ease. Good managers can achieve good results in a variety of physical setups.

Cows have fairly simple physical facility needs that can be assessed directly:

- Clean, well cushioned beds for resting and rumination available when the cow wants to lay down
- Ready access to good feed and clean water for essentially the entire day
- Traffic alleys that allow the cows to be moved as needed that are designed for calm cow flow and secure footing
- Calving areas that are clean, comfortable, and dry
- Fresh air, as free as possible of irritants and pathogens
- Protection or abatement from extreme heat or cold (including wind chill)
- Facilities and equipment that allow individual cows to be examined, treated, or trimmed with a minimum of stress or risk to the cow or the handler.

Most of these needs can be readily assessed by observation or fairly simple measurements. Beds should be clean and soft. Sand bedding, properly filled and maintained, is still the "gold standard" for bedding in confinement housing. Even sand, however, can be mismanaged and fail. Other bedding systems can work, but will demand higher efforts to maintain sufficient cushion and cleanliness. Overcrowding plays a role in comfort, particularly in freestall systems. Close-up and just fresh pens should never be filled beyond 100% capacity of stalls.

Calving pens should be well bedded, clean, and dry. Footing should be secure for calving cows. Calving facilities should be easily observed, well lighted, and have ready access to water and equipment for assisting calving cows.

Calm approach to cow handling, ease of cow movement, and regular observation of cows for problems

Cow flow and the ability to move cows is critically important in a transition cow facility because cows inevitably will need to be moved <u>as individuals</u> more often as they approach calving, move for colostrum collection, to be examined or treated, etc. For transition cows, the cow who is an exception rules the system, and a large proportion of fresh cows become "exceptions". What happens to the wobbly fresh cow? How does one give daily follow-up treatments efficiently and calmly? Can the night herdsman move a calving cow to the calving pen? If exceptions cannot be easily handled, they will be poorly handled, with the resulting poor outcome for the cow and frustration for labor.

Cow alleys, chute systems, trimming chutes or tables, self-locking stanchions at feed bunks, palpation rails all can play a role in being able to access cows. If sorting out an individual is a fight, if giving an IV bottle of calcium or dextrose risks injury or requires more than one person, it is inevitable that people will not do the job consistently when needed.

It is important to look at the cows. How do they respond to the people around them? Are they skittish or actually afraid of people? Do workers touch cows and talk to them, or poke, hit and shout at them? Are people always trying to "rush" cows as they move? The fundamental of caring husbandry is a lost art on some farms, to the detriment of the cows, the people who work with them, and the long term success of the dairy.

Animal and environmental cleanliness

Too often, dairies become accustomed to a remarkable degree of filth and to dirty cows. After a while, these conditions become "normal". Filth hurts performance in several ways. Cows themselves perform more poorly when they are dirty, particularly in extremes of heat and cold. Filth and manure transmit diseases, interfere with mechanical systems and degrade structures. Poor manure handling can lead to regulatory enforcement action. Trash and filth are demoralizing for everyone. Working conditions are poor and workers gradually don't care themselves or leave for better conditions. There are many dairies that would be improved by the creative use of a dumpster.

Proper diet formulation and excellent feeding management

Ration formulation for transition cows is a key aspect of feeding, but improper formulation of the ration on paper is probably not the major cause of failure in the implementation of feeding programs for transition cows. Separate from what the nutritionist has done with computer software, the dairy must look at many other areas in feed management.

- What forages, feeds, and additives are made available and what is their quality?
- How are rations assembled and delivered and what checks are in place to evaluate whether the ration delivered (actual) matches the ration specified (expectation)?
- What is done to encourage (or discourage) the cows from consuming the ration delivered?
- What else is done to the cow that could interfere with her ability to make effective use of the ration she has consumed?

Dairymen have be exhorted to assure constant access to feed and water ad nauseum, but the problem still is a major bottleneck on many dairies. Limited feed access is quite common, often driven by time in holding pens, feeding schedules, amount of feed placed in the bunk, frequency of push-ups, and simple bunk space per cow. Timid cows and heifers are the most impacted by limits to bunk space; this is one argument for "heifer only" pens on dairies.

Ready access to clean, plentiful water

Expectations regarding access to water are well known. Each pen must have at least two separate water sources. There should be a minimum of one watering space or 2 feet of accessible tank perimeter for every 15 to 20 cows. Water flow must be faster than consumption. Water should be clean. Far too many dairies fall behind in cleaning waterers and lose dry matter intake, put health at risk and lose production as a result.

Appropriate intervention in the calving process

There is considerable demand for an answer to the question "When should I intervene in a calving?" Unfortunately, there is no good answer because there is no good answer to the question “From when?” Experience at the University of Minnesota’s Transition Management Facility (TMF) would say that the key issue is not a specific time to wait, but rather the dairy’s ability to identify cows not making adequate progress during calving. If calving cows are properly detected (pushing, feet or membranes or mucus at the vulva) and moved to a calving area or otherwise closely observed, then experienced workers soon learn how to tell which animals are making normal progress and which need at least to be checked. Often the check reveals that everything is in proper alignment and only more time is needed. Sometimes only a small assist is needed once the feet appear, particularly in heifers. Calves presenting backwards need assistance with more urgency or the risk of stillbirth goes up quickly.

Above all else, any assistance must emphasize excellent cleanliness, excessive lubrication, careful examination for proper presentation before pulling, efforts to aid full dilation, and only as much force as needed during extraction.

Organized observation of cows, accurate and complete records, and prompt intervention for sick cows

No matter whether a dairy has 1 cow or 10,000 cows, every transition cow must be observed every day as an individual. Things like self-locking head catches are feed bunks make this far easier, but nothing substitutes for experienced personnel with a good eye for the abnormal cow. Recording systems, daily milk weights, and other cow side tests can help identify sick cows. Records are also needed to assure that follow-up treatments are properly administered. These systems must be consistently used and accurate records maintained or the process will not work and management may develop a false sense of security that things are being watched that really are not. Cow ID is critical for this process. As fundamental as it may be, there are still dairies inept enough that they re-use ear tags on cows and then wonder why the data in their record systems is misleading.

Clear, logical protocols and adequate training of personnel

It is not easy to establish protocols for the management of transition cows and treatment of their illnesses. As simple as it might seem, the process of developing protocols (often in English and Spanish), training and retraining workers (often in the face of significant turnover) and assuring that things are done as written is a constant challenge for dairy managers and herdsmen.

Healthy, properly managed cows should enter this phase of production from their previous lactation or the heifer rearing program

No transition management program will succeed if the cows delivered to it are in poor condition, lame, diseased, mastitic, or not well grown (heifers). Evaluating the success of a transition program must be done in the context of the cows presented to it. Miracles cannot be expected in the last 4 weeks of gestation and the first 3 weeks of lactation. There may be reasons to hold a cull cow through calving (e.g. to get the calf), but subsequent early lactation culling or poor performance in those animals should not be a measure of the transition program itself. In reproduction, recording systems designate some cows as DMB (do not breed) cows. Acknowledging the fact that such designations may bias interpretation of some reproductive parameters, removing those cows from some monitoring statistics (such as estrus detection rates) provides a more useful measure of the dairy's performance. Perhaps dairies need to identify some cows as DNK (do not keep) at dry off so that their records after a subsequent calving are excluded from transition program monitoring statistics.

MONITORING RESULTS

The following is a non-exhaustive list of items that might be applied to monitoring a transition program on a dairy. Most of these are "results" monitors.

Feeding Program

Dry matter intake In a way, this is the key measure for monitoring a feeding program. On large commercial dairies, it is usually possible to obtain an estimate of the dry matter intake of a group. Feed refusals are deducted from feed fed, adjusted for dry matter content of the ration and divided by the number of animals in the group fed. The result is dry matter intake in the group. Calculated on a regular and frequent basis, dry matter intake can give indications of the overall performance of feed management.

There are a wide variety of numbers given for expected dry matter intake of pre-fresh and just-fresh cows. In actual application, the numbers seen vary at least as widely. Intakes depend on many factors, including the quality and type of forage fed, ration balance, and all of the cow factors that affect intakes. Population dynamics also significantly compound the problem of establishing an expected intake for pre-fresh and post-fresh cows. In many cases, the number of cows that the record system says are in the pen is not the actual number in the pen. By the nature of management of these smaller groups of cows and the dynamic nature of cow flow through these groups, the demographic profile of the cows in the group (and therefore the expected intakes) can change rapidly. For example, in the pre-fresh group, how many cows are within a day or two of calving? These cows have a much reduced expectation for intakes? After they calve (in two days) and cows are added to the pen that are further from calving, is the intake expectation adjusted upward? In the just-fresh pen, what is the average days in milk of the group? Is it the same as last week, or should intake expectations shift.

Estimates of dry matter intake are not perfect in practice, however. Figure 1 provides an illustration of how a combination of small errors can compound to result in a significant error in estimating dry matter intake. The errors in the illustration are well within the limits of real operating errors on a dairy. The most significant errors (in terms of estimating dry matter intake and also probably in terms of cow health and productivity) are errors in the actual dry matters of wet forages or grains, particularly if those feeds are fed in large quantities. In terms of nutrient composition, errors in measuring amounts in small quantity feeds are likely more important.

For all of these reasons, monitoring dry matter intake in transition groups is an inexact science. This does not argue against doing so, rather it modifies what should be done with the information. In practice on the dairy, dry matters should be monitored regularly in the transition groups (daily), with an eye toward both trends and sudden large changes. Measured changes should be viewed initially with skepticism for the accuracy of the number itself, then used to direct management attention to possible problems that can be fixed. In general, however, management should try not to constantly "fiddle" with feeding programs based on today's dry matter intake measurements. Doing so will likely just make things worse.

Particle size measurements The Penn State Particle Separator has become the industry standard (there is now a new 4 tray version in addition to the more widely used three tray version). Results provide information about the relative proportions of feed by length of particles and research has correlated particle size characteristics with rumen health and ration digestibility. The three tray version has proven useful, particularly for forages. The new four tray version is intended to separate out what previously was collected on the bottom of the three tray version into two categories of finer particles. In the four tray version, the particles that reach the bottom tray are those that are either rapidly broken down in the rumen or pass quickly out of the rumen (Heinrichs, 2002). Figure 2 provides the current recommended ranges for particle sizes of corn silage, haylage, and a TMR based on these forages.

In practical application, particle size evaluation is not an exact measurement. Repeated shaking of samples of the same forage will yield varying results; even re-shaking the same sample will show some variation. At the University of Minnesota's TMF, the ration for the post-fresh group was sampled at several times over the course of three weeks. On each sampling day, multiple samples were shaken. The feeding management at the TMF is closely monitored and rations are carefully assembled. Forages in the ration are principally corn silage with some straw and alfalfa hay. Over the course of the evaluation, the ration proportions did not change, nor were there any changes in terms of the forages fed. Under these very tightly controlled conditions, shaker box analysis on any single day could show a 4 to 6 percent change in the amount of forage in a tray of the box, and over the course of the three weeks the variation in findings were as much 8 to 12 percent different (Figure 3 shows the results for the bottom tray). Some of this variation may be due to real changes in the TMRs sampled, but some is undoubtedly due to simple variation in the testing process outcome. This observation should make one thoughtfully skeptical of evaluations based on a single shaken sample. Interpreting the contents of the top sieve is fraught with problems if the expected amount is only 6 to 10 percent and the variation of the test method is 4 percent.

Manure scoring The process of evaluating manure is probably still more art than science, but it is still a key part of the daily evaluation of a feeding program at any stage of lactation, including the transition feeding program (Hall, 2003). Manure within a pen should be generally consistent from cow to cow. If manure from different cows is notably different, it suggests that there is sorting of the ration, with different cows actually consuming different rations.

There are some standards developing for manure evaluation. Three major characteristics of manure are considered: color, content, and consistency. Color is affected by the feed eaten and the rate of passage (slower passage makes manure darker), as well as other factors. Manure should be uniformly brown or tending toward green if pasture or fresh forages are fed. Manure content is usually evaluated by gently washing several samples from a pen through a household strainer. The materials that remain provide a measure of the effectiveness of rumen digestion of the diet. Little grain should be visible in the manure screenings and there should also be little long fiber (> ½ inch). Paradoxically, excess long fiber in manure is usually indicative of too little effective fiber being consumed in the ration. If too little fiber is consumed, there is a poor rumen mat to trap long fibers for proper digestion and those fibers can pass undigested through the digestive tract. Mucus casts in manure probably indicate hind-gut irritation, perhaps from starch fermentation and acidosis in the hind gut due to inadequate starch digestion in the rumen. Normal manure does not contain visible blood. Manure consistency can be scored on a 1 to 5 scale, where 1 is liquid or diarrhea and 5 is very stiff and dry or formed into fecal balls. Many things can cause manure scores to decline, including increased amounts of protein, increased starch content or the fineness of grind of grain in the ration, excess minerals, and decreasing effective fiber. Total intake also affects consistency. As intakes increase and rate of passage increases as well, manure consistency becomes more fluid.

Scores of 1 or 5 are abnormal in any cow. Excess mineral, protein, NPN, or starch as well as disease states can cause a manure scoring 1. Very high fiber rations (e.g. principally straw), dehydration or disease states that block passage can cause manure scores of 5. With a manure score of 2, the manure appears runny and does not form a distinct pile. The manure pad will stand less than one inch thick. Cows on pasture lush will have this sort of manure. Low fiber, high starch rations will also tend toward producing manure scores of 2. Manure scoring at 3 is generally the optimal consistency, with high producing cows on the loose side of 3 and pre-fresh or high fiber rations tending toward the stiff side of 3. Score 3 manure piles will be firm and self-contained and will stand 1 – 2 inches thick. The manure pad may have concentric rings in it. Manure with a score of 4 will stand over 2 inches and may indicate too little digestible nutrients in the ration.

Pre-fresh cow urine pH Pre-fresh rations for cows are often formulated to provide a negative cation/anion balance to encourage calcium mobilization and prevent parturient hypocalcemia. The effectiveness of these pre-fresh feeding programs can be evaluated by testing the pH of urine in cows in the pre-fresh pen. At least ten cows should be checked, typically using pH strips with the proper narrow pH sensitivity. It is important that any cow checked has been eating the pre-fresh ration for at least a week to be fully acclimated. Recommended pH levels vary, but one standard might be that at least 7 of 10 pre-fresh cows checked should have a urine pH in the range of 6.5 – 7.2. Normal urine pH in a cow fed a lactating cow ration is typically above 7.5. If urine pH in pre-fresh cows is below 6.0, the anionic salt content of the ration is likely excessive.

Cow Performance

There are several measures of milk production that can be used to monitor the effectiveness of a transition cow program. Each has its place, although there are many drawbacks to some traditionally used measures.

Individual cow performance compared to an expectation of production There are several approaches that can be used to compare the actual production of early fresh cows to an expectation of her production. The first challenge for doing so is making a reasonable prediction of expected production in a recently calved cow or heifer with limited production data. DairyCOMP 305 (Valley Ag Software, Tulare CA) approaches the issue in a variety of ways, depending on the dairy's and the cow's situation. For herds depending on a monthly DHIA test, a projected 305 milk production (and from there 305 mature equivalent) are calculated based on with first test day information (if the test is at 8 days in milk or longer). If there is no test data yet, a projection can be made for cows based on previous lactation performance. For newly calved heifers, projections are based on either average heifer performance in the herd or the dam's production information. In herds with milk meters, actual milking data can be used as it becomes available. An expectation for each milking is generated that takes into account both absolute levels of production in previous days at that milking and the change in production between days. The most recent days' information is weighted more heavily than production or changes further ago. Given these measures of expectation, several approaches to monitoring production during and after the transition period are possible.

Deviation of individual cow expected daily milk production In herds with daily milk meters, the performance of an individual cow can be tracked each day (or milking) and compared to her "expected" milk production to try to identify cows in need of individual examination and perhaps treatment. Figure 4 shows one such cow (selected from a scatter plot of cows by milk production deviation). Her production at each milking for the previous week is displayed, as well as some pertinent demographic information. Her production at the first milking (1 pound) is also displayed and a deviation of that from expected production (-30 pounds). The next obvious questions should be: is this what she made or did the meter malfunction? If the screen were accessed after the previous day's last milking information was transmitted into DairyCOMP and before the first milking, the deviation calculated would reflect the entire milk production (all milkings) for that day.

This production deviation information can be assembled into a list used by the herdsman to screen for cows with possible problems on a daily basis. The list can provide basic information (ID, days in milk, lactation, pen, and limited production data). The list can be used in the barn as just fresh cows are screened for postpartum problems (Figure 5). The DairyCOMP command used to generate the list and some other definitions are provided in Figure 6.

Milk production at first test In larger herds, transition program effects are often monitored by simply tracking milk production at the first test by lactation group. This summary statistic (or scatter graphs by days in milk) provides a window into the performance of early lactation cows. The numbers generated are influenced by season, lactation demographics (number of heifers versus cows), and particularly by the average days in milk on the particular test day. This measure works for large herds where individual cow's production cannot bias the average results as easily. Care must be taken to include both living and dead cows in the calculation, particularly if scatter plots are generated over longer periods of time. If dead cows are excluded, current production may appear to suffer (poor cows are still in the herd) compared to earlier period (the poor cows are no longer included). Figures 7 and 8 illustrate this monitor. As tempting as it might be, one should avoid trying to create a regression line through these points. Doing so assumes that cows just calved will follow a lactation trajectory that will carry them to the same points as cows already later in lactation. With such a regression, one might assume that a steep upward slope is desirable. One can achieve a steep slope just as easily by making just fresh cows milk very poorly, pulling the starting end of the regression down.

Milk production per cow per day in the just-fresh pen This is another direct and measurable method to look at production in cows that recently calved, presuming the dairy can separate out production by pen (milk meters, monitoring tank volume before and after the pen is milked, etc.). Monitored over time and watched for trends, this is a possible approach to watching for problems or improvements. Unfortunately, this milk per cow per day monitor is fraught with difficulties that require caution before taking any management action based on the number.

- The fresh pen cow numbers often fluctuate widely, even within a given day, as cows move into and out of the group. This can radically change the denominator of the number (per cow).
- Depending on other flows of cows and available pen space, cows may be held in the group for different lengths of time. Sometimes the group may have mostly very early fresh cows; sometimes the group may have cows several weeks or more in lactation. This will significantly alter production per cow. Comparisons between today's production and three weeks ago may simply not be reliable.
- Flows of cows into the fresh pen may also vary over time by the lactation of entering animals. One week may see a burst of heifers calving, the next week more older cows.

For these reasons, caution is required when interpreting production in the fresh pen. With daily milk measurements and good record systems, some of these problems can be reduced with judicious editing and categorization of the data, e.g. limiting the data to cows less than 15 days in milk, stratified by lactation, etc. The problem with these approaches is that the number of cows per category can become small and individual cows can distort the apparent averages. Before using such a summary number, it is very important to look at the scatter of the data; sometimes this visual spread tells more than an average.

First test-day mature equivalent 305-day projected milk All DHIA processing centers 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 began 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, reducing the lag between performance and measurement by as much as 45-60 days.
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 calving at different ages can be compared one to another.
5. Cows in different lactation numbers can be compared.
6. Cows calving in different seasons can be compared.
7. Cows calving in different areas of the country can be compared.
8. Different breeds can be compared.
9. Adjustment is made for herd productivity.

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. DHIA reporting programs typically do not report "true" peak milk, i.e., the highest milk production that the cow will produce this lactation. Usually the number reported is the highest milk produced at any test day so far during the current lactation. This can vary considerably from "true" peak milk, as it is not likely that DHIA test day will coincide with the actual peak milk day for 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 calving
- 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, particularly if peak milks are reported as an average over the past year.

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. For all of these reasons, monitoring peak milk production is not a particularly desirable approach to evaluating the transition cow program. Given that we have several better and more useful approaches, this long-standing traditional measure should probably be gracefully retired.

First test-day percent butter fat Higher than "normal" butterfat 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 present with 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. As usual, both summaries and scatter plots of these data are useful (Figures 9 and 10). Note that the summary includes all cows, whether they have a butterfat test or not. Those cows with no fat test are not included in the averages. The scatter plot displays only those cows with data (no cow less than 21 days in milk has a butterfat test yet).

Lower than "normal" butterfat in individual cows (tests less than 3.3) 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. Many of these cows would probably have been quite high if tested at day 8-15, but now are low since essential 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 In addition to level of milk production of cows entering lactation, the mastitis status is also important. Levels of subclinical infection can be monitored in many herds using the cows' first test day somatic cell count. In cows entering the second or later lactations, the change in their somatic cell count status from their dry off status is also useful as a measure of the dairy's dry cow and early lactation mastitis control programs. Figures 11 and 12 again illustrate the use of summary data and scatter plots to monitor these parameters. In addition, the DairyCOMP allows for the creation of 2x2 tables of parameters that can segment cows into groups by their change in infection status (Figure 13). The upper left quadrant reflects those cows that were dried off with lower than 4.0 linear SCC scores (DRYLG<4.0; likely not infected) and that were subsequently more than 4.0 at their first test (LOG1>4.0). These cows were newly infected either during their dry period or after calving before the first test. Using the same logic, the lower right quadrant reflects cows cured of mastitis either as dry cows or between calving and their first test. These monitors provide a useful approach to identifying problems with mastitis infection during the transition period.

Cows leaving the herd One expects an effective transition cow program to reduce the number of cows that leave the herd in early lactation due to disease and unfortunate events like nerve damage at calving. Large scale studies across the Minnesota dairy industry show that typically about 25% of all cows that leave the herd do so in the first 60 days of lactation (Figure 14). These culls and deaths are particularly expensive. Money has been invested in either purchasing or rearing the new heifer or for maintaining the cow through her dry period that are not fully recouped by a complete next lactation. Herd policy influences this parameter significantly. Some dairies are unwilling to cull any pregnant cow. This means that some cows calve into the next lactation that reasonable consideration should have culled at the end of the previous lactation. Everyone has seen the extremely thin cow (Johnes suspect), the cow with a severely pendulous udder, the 3-teated cow, the cow with chronic mastitis, etc. that should never have been retained through a new calving. Perhaps some of these cows are worth carrying through a dry period in hopes of getting a heifer calf, but they should probably not be entered into the record system as a new lactation. Doing so will prejudice the apparent effectiveness of transition management downward, making it appear as if more cows were culled than desirable.

Some useful information can be gleaned from records if the dairy keeps meticulous records of cows that exit, recording not only the culling/death event but also the reasons (in DairyCOMP as a remark). Figure 15 shows an example of such a list. DairyCOMP maintains to measures of time from calving: DIM = days in milk and DSFSH = days since fresh. While on their face these two numbers are the same, they are in fact usefully different. DIM increments each day after calving until the cow is no longer milked, i.e. is dried off, sold, or dies. DSFSH increments each day until the cow calves again. Thus for culled/dead cows, DIM stops incrementing on the day the cow exits the dairy. DSFSH continues incrementing forever for those cows. For the listing of cull cows, DSFSH serves as a useful way to capture cows that left the herd over a particular period. Thus DSFSH < 200 would capture cows that calved in the past 200 days, regardless of their lactation status. Listing DIM on those cows would provide their stage of lactation at culling. The RC code = 7 in DairyCOMP includes all cows dead or sold. The \B switch means that the report will include cows that have exited the herd, provided the dead cows are still in the active file or that the archive file is also available. Thus the DairyCOMP FOR statement of DIM<60 DSFSH<150 RC=7 \B would capture all cows that exited the herd in the first 60 days of lactation after calving within the past 150 days. If items are created that display the remarks of the sold/dead events, a listing such as Figure 13 is possible. These are the cows (particularly those of DSFSH < 50 or so) of most immediate interest for monitoring the success of the transition program. A scatter plot can be created to look for trends or sudden changes in the incidence of early lactation culls (Figure 16).

Certainly there are culling events in later lactation that are also a result of failures in the transition period. Cows with metabolic disorders breed back more poorly and some never become pregnant and are culled. Cows that have a bout of acidosis may suffer in milk production and lameness and be more likely to be culled. Trying to monitor these culls as indicators of transition cow programs is far more problematic. First, the culling event is so long after the transition program cause that it is too late to do anything about it once you detect the problem. Second, reasons for culling in later lactation are far more prone to be arbitrary and unrelated to the original cause. The lame cow might be recorded as a cull due to lameness, but she may also not stand when in estrus and be recorded as a reproductive cull. In general, trying to relate late lactation culling back to a transition program is not a productive effort. There are much more immediate and useful ways to monitor the impact of disease and mismanagement.

Routine daily monitoring of cows in the days following calving It is increasingly standard practice for dairies to routinely screen fresh cows each day to try to detect any problems so that they can be dealt with quickly. A variety of approaches are possible; unfortunately there is little hard data to support one particular approach over another and there is little known about the value of routinely treating cows once problems are detected. For example, is routinely taking temperatures to help detect metritis cases better than waiting to detect the case in some other, more indirect, way? Once detected, is it truly better to treat those metritis cases, or would some recover without treatment? Is there a way to separate those cases that need treatment from those that, while abnormal, would recover anyway? There is always the risk that as our detection methods become more sensitive we will take actions that have no value or even do damage.

Post-partum health screens typically involve restraining cows for examination. Self-locking catches at the feed bunk make this process much easier and are recommended for any pre-fresh pen. Taking temperatures is probably the first most important screen, followed by collecting urine for ketone checks. The cow should be observed as well for her attitude, posture, character and rate of respiration, signs of dehydration, rumen fill, udder fill, and for any foul odors (usually indicative of metritis). Coupled with information from the record system on her days in milk and (if available) her milk production and possible deviation from expectation, a fairly reliable assessment of the cow's status can be made. Cows considered to be abnormal can then be given a thorough physical examination, particularly to check the udder and listen for a displaced abomasum. Separate from any actions as a result of screening findings, this process takes about a minute per cow. This screening process should probably continue until a cow is at least one week from calving and has had a minimum of 3 to 4 days of consistently normal screens. Most cows will reach this point within the first 10 days after calving; some will take longer or develop a problem for the first time after that point.

DISEASES

Effective transition programs should reduce the incidence and the impact of peripartum diseases. Incidence of these clinical illnesses can be tracked over time, considering, as usual, both the absolute amounts and the trends. There are studies of the incidence of major early lactation diseases and these can serve as beginning benchmarks against which transition programs can be compared (Figure 17). In many herds, there are several hurdles that must be cleared before even this is possible. First, everyone on the dairy should agree to a standard set of criteria that define what constitutes a disease. There are recommended standards for these (Kelton 1998), but agreement and consistency within the dairy is the most important aspect. Once this case definition issue is resolved, then all cases must be reliably entered, including treatment or other remark information as required. Erratic data entry probably renders more disease monitoring programs moot than any other issue. With erratic entry it is impossible to tell if a change reflects real management issues of simply lack of data.

For some diseases, notably ketosis, the incidence of the disease can appear to vary widely from farm to farm or over time on a single farm depending on how and how intensively the cows are screened for the disease. If only apparently sick cows are ever urine checked for ketones, the incidence will appear to be low. At the other extreme, if every cow is blood tested for betahydroxybutyrate (BHB) daily or with a urine test strip, the incidence will be high on most dairies (depending on the cut point used as positive). This makes comparing data from one dairy to the next nearly worthless, but provides those who never test with ample bragging rights about how little problem their dairy has.

Allowing for these considerations, initial benchmark goals for common disease might be set as follows:

- Retained placenta: < 8%; fewer in first calf heifers
- Milk fever: < 5%, very rare in first calf heifers
- Ketosis: < 25%; this depends very significantly on how aggressively the dairy screens for ketosis
- Displaced abomasums: <5%
- Metritis: < 10% is usually described; with more aggressive screening of fresh cows this is probably too low
- Clinical lameness: < 10% in the first month of lactation; again very variable depending on case definition as well as actual disease rates

These recommendations must be considered with a high degree of caution; the variation of detection, recording, and case definition from dairy to dairy make them rough guidelines at best.

Cost of Disease

Many of the economically important effects of many of the common pre-partum diseases have been studied. These effects include lost milk production secondary to the disease and due to discard during treatment, increased risk of culling and death, treatment costs, and costs of additional labor to deal with sick cows. Estimates of those effects have been assembled in a spreadsheet by Dr. Charles Guard of Cornell University (Figure 18). Using the spreadsheet, one can estimate the cost of a case of several common diseases using prevailing economic conditions. Given incidence estimates, a general summation can be calculated for costs of those diseases for the herd over a year. One must keep in mind that these total costs will never be zero; no dairy of any size can expect to operate with no incidents of disease.

Interestingly, it is generally not a bad rule of thumb to say that a case of clinical mastitis, retained placenta/metritis, milk fever, ketosis, or lameness each cost roughly

$200 per case. A case of left displaced abomasum costs roughly $400. While not as accurate as the spreadsheet, these estimates provide a rough starting value when considering either the value of a program that has reduced disease incidence or when contemplating an additional effort to do so.

Mastitis

Mastitis is a very common problem at and after calving. Mastitis should be monitored in a variety of ways. As discussed above, DHIA somatic cell testing can provide useful information regarding subclinical infection rates. The first test log somatic cell count is an indicator of the mastitis status of the cow in early lactation. First DHIA tests on cows are done on average at day 15 to 20 postpartum, so results cannot distinguish infections at calving from infections acquired shortly after calving. As with all DHIA/computer data monitoring, both summary indicators and scatter plots are helpful in the evaluation (11 and 12). By comparing the somatic cell count status at dry off (an indication of infection status at the end of the previous lactation in second and older lactation cows) with the somatic cell count status at the first test, one gains some insight into the effectiveness of dry cow mastitis therapy and early postpartum mastitis control (Figure 13). California mastitis testing (CMTs) is another way to screen for subclinical mastitis in fresh cows. Cows with colostrum are difficult to accurately assess using a CMT.

Culturing fresh cows (quarter cultures or composite cultures) is the most reliable indicator of infection status at calving. This can either be used as a problem investigation technique on a dairy or as a routine monitor and screen for such contagious pathogens as Staphylococcus aureus, Streptococcus agalactiae or Mycoplasma. Bulk tank cultures may also be useful it the milk from transition cows can be segregated from the general herd's milk.

The incidence of clinical mastitis should be recorded and monitored the same as any other major clinical illness. A starting benchmark for incidence of mastitis is less than 10% incidence in the first month of lactation. A least a sample of clinical cases should be cultured to track the prevailing organisms causing mastitis in the herd.

Monitoring for Ketosis and Energy Imbalance

Monitoring for ketosis, or more generally for energy imbalances in the transition period is an important aspect of transition cow management. Cows at the end of gestation routinely drop in feed intake and enter a period of negative energy balance that last for 5 – 7 weeks after calving. This energy imbalance can lead to metabolic complications, notable ketosis. Ketosis is associated with a variety of other peripartum disease conditions and later impacts on production, mastitis, and reproduction.

There are several approaches to monitoring energy balance in the transition cow. The first question is whether one is monitoring for the status of the individual cow (e.g. by using urine dip strips for ketosis) or for herd status (e.g. by measuring non-esterified fatty acid {NEFA} levels in pre-partum cows). Individual cow monitoring for ketosis is generally recommended for all postpartum cows to identify and intervene in cases of clinical or subclinical ketosis. Using a cutoff of 1,400 umol/liter betahydroxybutyrate (BHB) in serum, Duffield (2001) found a median incidence of 41 percent ketosis in dairy cows in 25 dairy herds in Ontario. The highest observed incidence was 85% of cows on one dairy! BHB levels are the gold standard for post-partum ketosis testing, but lab turnaround time and expense make the test impractical for clinical screening. Serum BHB testing may be useful, however for herd level monitoring or investigation. Studies at the University of Minnesota of various methods for testing for ketosis in the postpartum cow concluded that urine dip sticks were probably the most accurate cow-side test, using the "small" level on the strip as the cutoff for diagnosing ketosis. This approach has the disadvantage of requiring daily urine collection, a task that takes time and is not universally successful with all cows. In addition, this test has relatively poor specificity, so there will be a fair number of false positive tests if used at this cutoff level. Some consideration of the cow's general status is probably indicated before routinely treating all cows that test positive by urine dip strip.

Prepartum energy balance tests tend to be done as a herd or management level monitor (similar to urine pH testing), not specifically aimed at the individual cow being tested. A representative group of cows is sampled, tests are run, and the results are compared to expectation as a way of monitoring the pre-partum feeding and cow management program. Traditionally, body condition scoring, or change in body condition scores from prepartum to 4 – 6 weeks postpartum were used to assess energy status. The recommendation is that cows should calve at a body condition score of 3 to 3.5 and lose no more than 0.5 condition score in early lactation.

A more sensitive test is to evaluate NEFA levels in at least a dozen cows from 2 – 14 days prepartum. Plasma samples are taken, separated immediately, and chilled for shipment to the testing laboratory. Samples are best taken just prior to feeding (levels are highest). The question of appropriate cutpoints is still under development, but one recommendation is that if more than 10% of cow within two weeks of calving have a NEFA higher than 425 uEq/L, then attention should be paid to prepartum feeding and management (Oetzel, 2001).

Dystocia/Stillbirths

By monitoring stillbirths (variously defined as calves born dead, calves dead within 4, 12, or 24 hours of parturition), dairy managers hope to determine if supervision of the calving process is effectively intervening to protect the life of the calf during parturition. If the longer time intervals are included, stillbirth rates also accumulate deaths due to poor management of the calf born alive but in a weakened or vulnerable state. This is probably not desirable; it is better to define stillborn calves as those born dead, or perhaps those that live less than one hour. The stillbirth rate is increased in heifers compared to cows and is also increased in herds experiencing clinical or subclinical hypocalcemia. Calves born in a posterior presentation are more likely to be stillborn and merit more rapid assistance. At the University of Minnesota's TMF over a 12 month period (August 2002 to August 2003), the recorded stillbirth rate was 8% out of approximately 2,300 calvings (Figure 19, generated using DairyCOMP command EVENTS \3). Stillborn rate in heifers was 12% and 6% in cows.

COMFORT

Monitoring cow comfort always involves subjective judgments, and starts first and foremost by observing cows during times when they are undisturbed. In freestall herds, cows should be observed particularly as they enter the stall, lie down, or rise. These efforts should be easy for the cow, involve little contact with stall dividers or neck rails, and require little time (at most a few minutes) between entering a stall and lying down. Stall utilization can be measured as the proportion of cows that are lying down out of those cows not eating at the bunk. Under such conditions, more than 70 percent of cows should be lying down. Of those lying down, at least 60% should be chewing their cud. Actually arriving at such numbers is problematic. When are cows "undisturbed"? In transition facilities, there are often a regular schedule of planned and a variety of unplanned "disturbances" during the cow's day. There is milking of fresh cows (including new possibilities of 6X milking in the early postpartum period), vaccinations to be given, checks for calving, feeding, stall maintenance, alley scraping, post-partum health checks, hoof trims, dry treatments, parlor training runs, the list can go on.

This leads to two observations about the cow's daily routine and thus about observing stall utilization or cow comfort. First, the best transition managers insist on gentle handling and minimum intrusion of their cows. Cows soon learn to ignore people unless specifically "targeted" to be moved or cared for. Good facilities for handling cows help immensely with this effort. When monitoring a dairy, one should ask themselves whether it is possible to walk past most cows lying down and have them remain down, essentially ignoring one's presence. Second, look at the schedule of daily tasks and activities and see if they are geared to minimize the number of times a cow is asked to do anything except eat and rest (and for fresh cows to be milked). Bundling activities into one session can allow the cow to lie down for longer undisturbed periods.

Beyond the simple number of stall utilization, one can also look at the resting positions used by cows, cow cleanliness, stall and feed bunk dimensions, temperature and humidity, air exchanges, adequacy of lighting (for both cow and human working environment), areas that risk injury, any abnormal use of stalls or alleys, bunching of cows, stall maintenance, and certainly more. Evaluating cow comfort requires time in the housing, thoughtful observation, and a willingness to see things from the "cow's perspective".

CLOSING THOUGHTS

As this paper documents, there are a host of different approaches that can be applied to monitoring the transition management program on a dairy, and this paper is by no means a complete listing. Just as evident, few if any dairies will include all of these potential monitors in their everyday routine. The goal is to select those monitors that oversee the most crucial aspects of the management program or that target particular problem areas, apply those monitors consistently, and use the information to adjust and improve management. As time goes by, what and how we monitor transition programs will change and more parts will become automated or at least computer captured. Monitors will gradually place more emphasis on observing implementation, with less emphasis on monitoring outcomes.

Whatever else develops, the need for careful observation by someone with good animal husbandry skills will continue to be the key ingredient in a good transition management monitoring program.

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200	number of cows to feed in mix: expectation		
210	number of cows actually in the group	5.0%	percent error in inventory
2%	percent underloading per ingredient (scale error, operator inaccuracy)		
400	pounds left in the mixer after unloading	2.5%	of load left in mixer

	expected as fed	expected % DM	expected DM/ cow	expected mixer amount	expected pounds DM fed	loading error (lbs)	actual pounds in mix	actual % DM	actual lbs DM fed	% of the deviation
Corn silage	40.0	33%	13.2	8,000	2,640	160	7,840	31%	2,369	42%
Dry hay	12.0	90%	10.8	2,400	2,160	48	2,352	88%	2,018	22%
High moisture corn	8.0	70%	5.6	1,600	1,120	32	1,568	68%	1,039	13%
Brewers grains	10.0	20%	2	2,000	400	40	1,960	18%	344	9%
Cottonseed	3.0	90%	2.7	600	540	12	588	90%	516	4%
Protein mix	8.0	90%	7.2	1,600	1,440	32	1,568	90%	1,376	10%
Total	81	51%	41.5	16,200	8,300	324	15,876	50%	7,662	100%

amount of dry matter not fed (compared to the expected)	638	pounds
	7.7%	percent

41.5	Expected Dry Matter Intake / cow based on load sheet and number of cows thought to be in the pen
36.5	Actual Dry Matter Intake / cow
5.0	Error in dry matter intake measurement
12%	percent error

assumes that refusals (zero in this illustration) were deducted from load sheet amount and divided by assumed number of cows in the pen
assumes no weighback for illustration purposes

Figure 1. Accuracy of estimates of dry matter intake: an example.

3-tray version

Screen	Pore Size (in)	Particle Size (in)	Corn Silage	Haylage	TMR
			------- percent of sample by layer -------		
upper sieve	0.75	> 0.75	10 to 15 (a)	15 to 25 (b)	6 to 10
middle sieve	0.31	0.31 to 0.75	40 to 50	30 to 40	30 to 50
bottom pan		< 0.31	40 to 50	40 to 50	40 to 60

4-tray version

Screen	Pore Size (in)	Particle Size (in)	Corn Silage	Haylage	TMR
			------- percent of sample by layer -------		
upper sieve	0.75	> 0.75	3 to 8	10 to 20	2 to 8
middle sieve	0.31	0.31 to 0.75	45 to 65	45 to 75	30 to 50
lower sieve	0.05*	0.07 to 0.31	20 to 30	20 to 30	30 to 50
bottom pan		< 0.07	< 5	< 5	< 20

a) kernal processed / rolled silage

b) bunker silos

*pores are square, so on the diagonal particles 0.07 can pass

Figure 2. Penn State Forage Particle Separator particle size recommendations (Heinrichs and Kononoff, 1996, 2002).

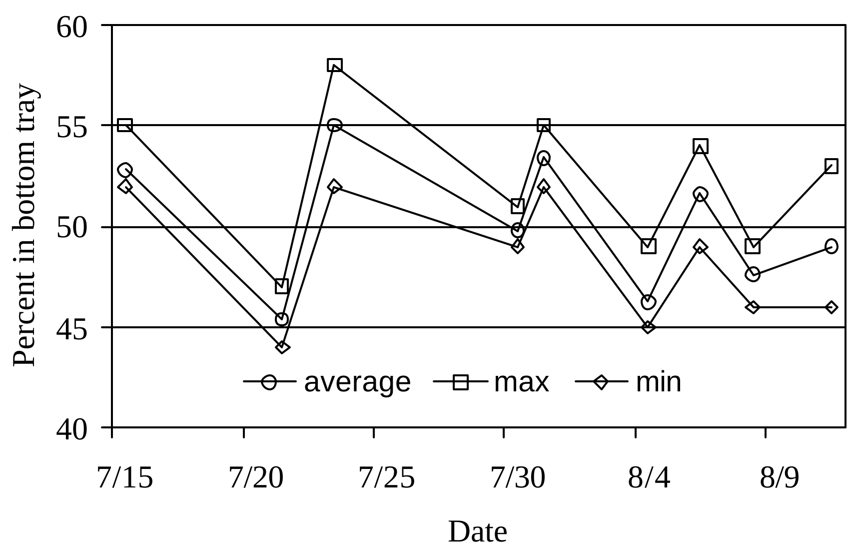


Figure 3. Test results using a shaker box for the same ration: variation on the same day and over time on the same milking ration (~5 samples shaken/day).

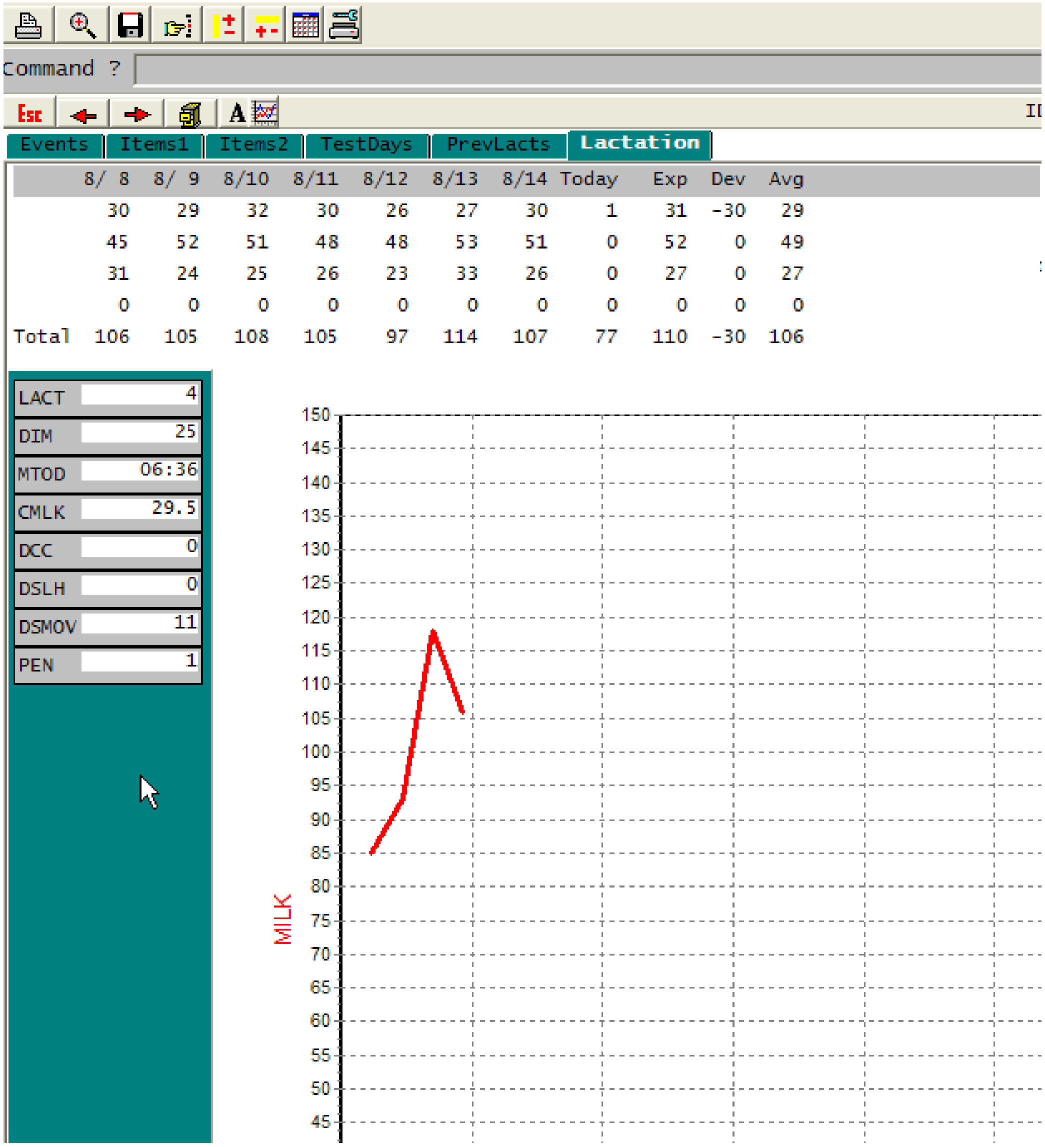


Figure 4. Individual cow page for a cow selected from a scatter plot for large milk deviation from expected.

File Data Screens bST EvtInv Repro1 Repro2 Prod MlkQlty Misc Help

Command ? LIST MDEV MAVG MTOT DIM PEN ID FOR PEN=41-44 BY PEN \P2U

LIST ... FOR PEN=41-44 BY PEN \P2U

MDEV	MAVG	MTOT	DIM	PEN	ID	MDEV	MAVG	MTOT	DIM	PEN	ID
0	22	22	2	41	9	0	71	77	5	43	1392
0	8	8	1	41	865	-3	92	89	11	43	1448
0	43	43	2	41	1028	4	75	75	10	43	1570
0	17	17	2	41	1085	1	86	79	5	43	1579
-8	39	46	8	41	1181	1	64	61	10	43	1793
0	0	0	0	41	1465	4	56	59	4	43	1799
-5	32	27	1	41	1468	0	51	51	16	43	1812
-13	52	50	3	41	1702	2	59	52	6	43	1826
0	0	0	19	41	1788	-4	56	42	5	43	2159
0	42	42	2	41	1934	-1	60	53	10	43	2583
-3	47	37	7	41	2644	2	67	61	8	43	5718
0	8	8	1	41	5030	-13	89	78	8	43	6130
0	0	0	0	41	5842	-2	55	50	17	43	6222
0	38	38	2	41	6227	-2	60	57	8	43	6678
0	14	14	1	41	6232	-7	15	16	10	43	9013
0	7	7	1	41	6389	0	40	38	6	43	9021
8	34	42	2	41	6494	0	15	17	3	43	9030
7	42	49	3	41	6530	0	56	54	10	43	9046
0	9	9	1	41	6608	-11	34	33	9	43	9079
0	32	32	1	41	9018	-5	59	55	6	44	294
-2	38	39	9	41	9053	-12	58	67	4	44	379
1	118	113	9	42	204	3	64	66	4	44	499
-24	85	79	4	42	422	1	95	85	12	44	574
5	38	41	14	42	542	2	104	100	10	44	763
0	85	86	11	42	607	-2	105	102	8	44	783

MDEV: deviation in milk from expected (weighted production previous days' production, more recent days get more weight)

MAVG: average production for last 3 days (if available)

MTOT: milk production yesterday

DIM: days in milk

PEN: Pen #

ID: identification

Figure 5. DairyCOMP listing for screening just fresh cows.

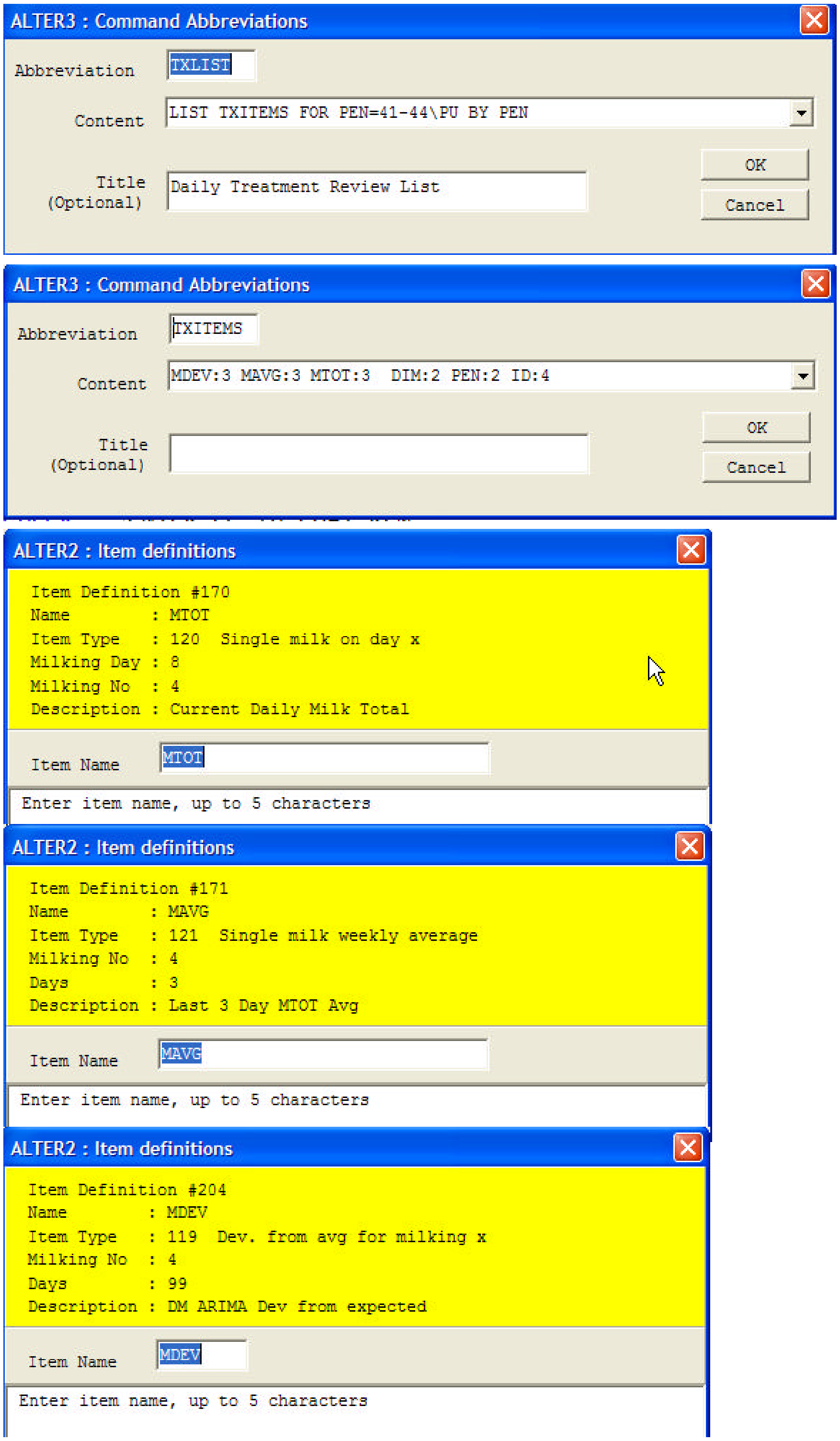
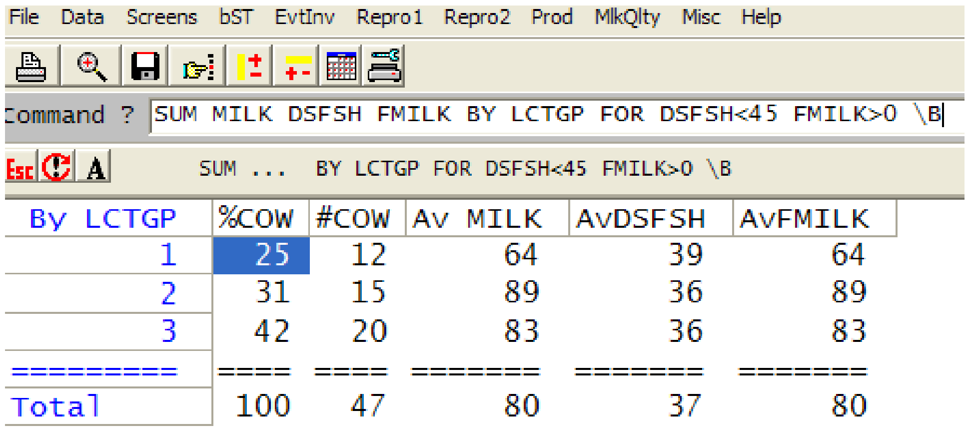


Figure 6. DairyCOMP definitions for commands and items to monitor fresh cow production (example).



By LCTGP	%COW	#COW	Av MILK	AvDSFSH	AvFMILK
1	25	12	64	39	64
2	31	15	89	36	89
3	42	20	83	36	83
=========	====	====	=======	=======	=======
Total	100	47	80	37	80

Figure 7. Summary of first test day milk for cows <45 days in milk.

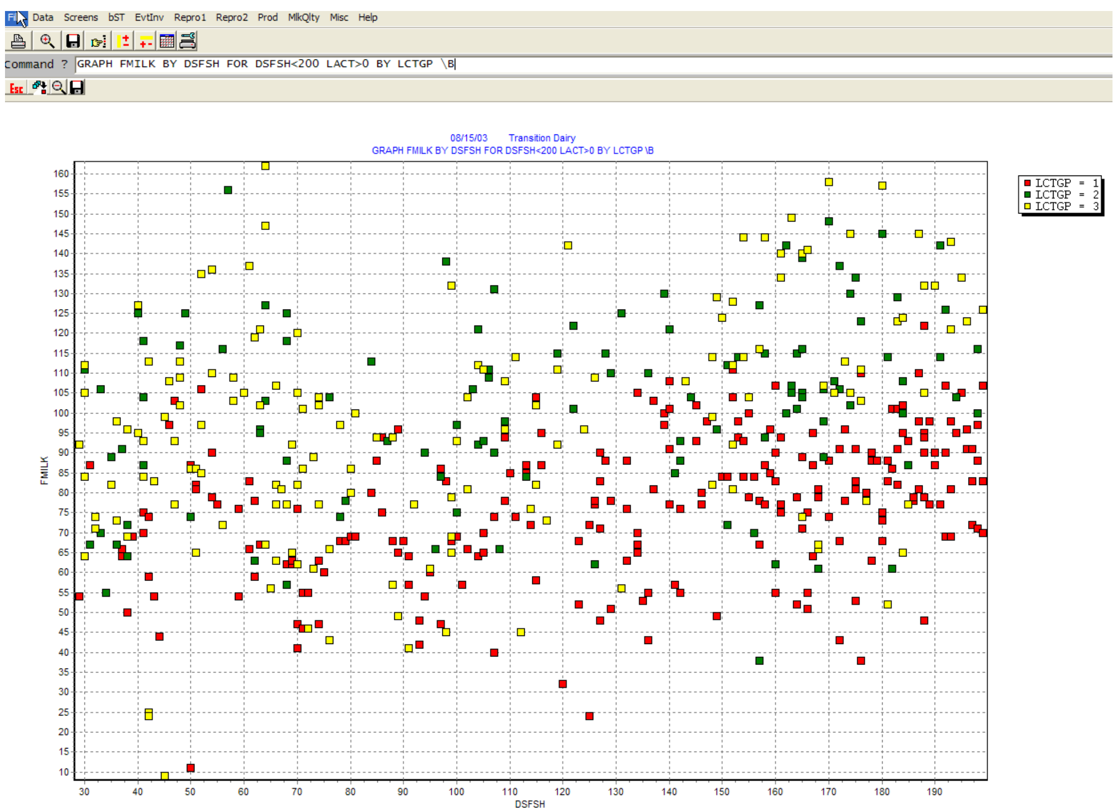


Figure 8. Scatter plot of first test day milk production by days in milk.

File Data Screens bST EvtInv Repro1 Repro2 Prod MlkQlty Misc Help

Command ? SUM MILK DSFSH PCTF PCTP BY LCTGP FOR DSFSH<45 PCTF>0 LACT>0

SUM ... BY LCTGP FOR DSFSH<45 PCTF>0 LACT>0

By LCTGP	%COW	#COW	Av MILK	AvDSFSH	Av PCTF	Av PCTP
1	24	11	66	38	3.4	2.6
2	31	14	88	36	3.6	2.6
3	44	20	83	36	3.8	2.9
=========	====	====	=======	=======	=======	=======
Total	100	45	80	37	3.6	2.7

Figure 9. Summary of milk components for early lactation cows.

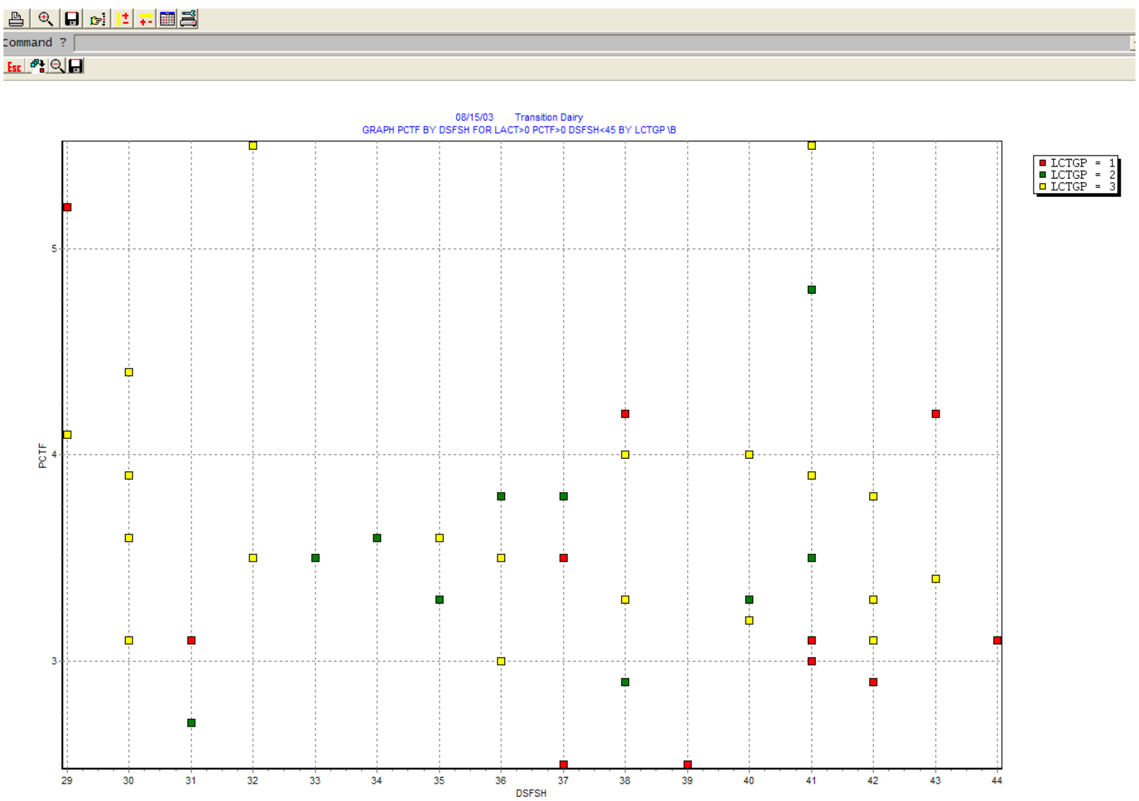
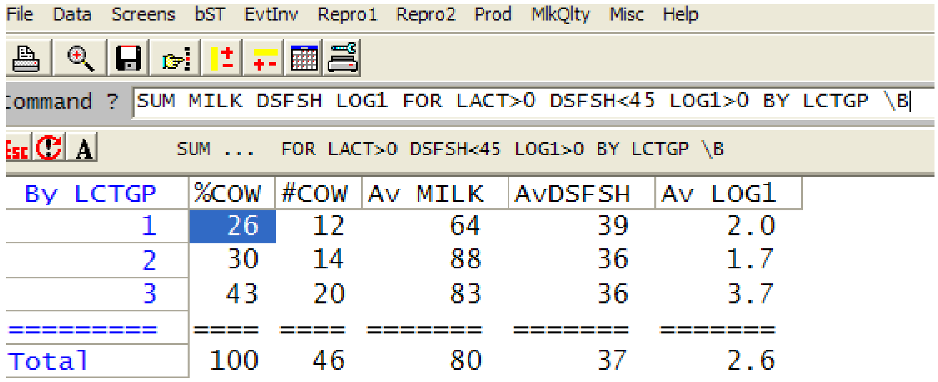


Figure 10. Scatter plot of butterfat levels for cows in early lactation.



File Data Screens bST EvtInv Repro1 Repro2 Prod MlkQlty Misc Help

Command ? SUM MILK DSFSH LOG1 FOR LACT>0 DSFSH<45 LOG1>0 BY LCTGP \B

SUM ... FOR LACT>0 DSFSH<45 LOG1>0 BY LCTGP \B

By LCTGP	%COW	#COW	Av MILK	AvDSFSH	Av LOG1
1	26	12	64	39	2.0
2	30	14	88	36	1.7
3	43	20	83	36	3.7
=========	====	====	=======	=======	=======
Total	100	46	80	37	2.6

Figure 11. Summary of SCC linear scores for early lactation cows.

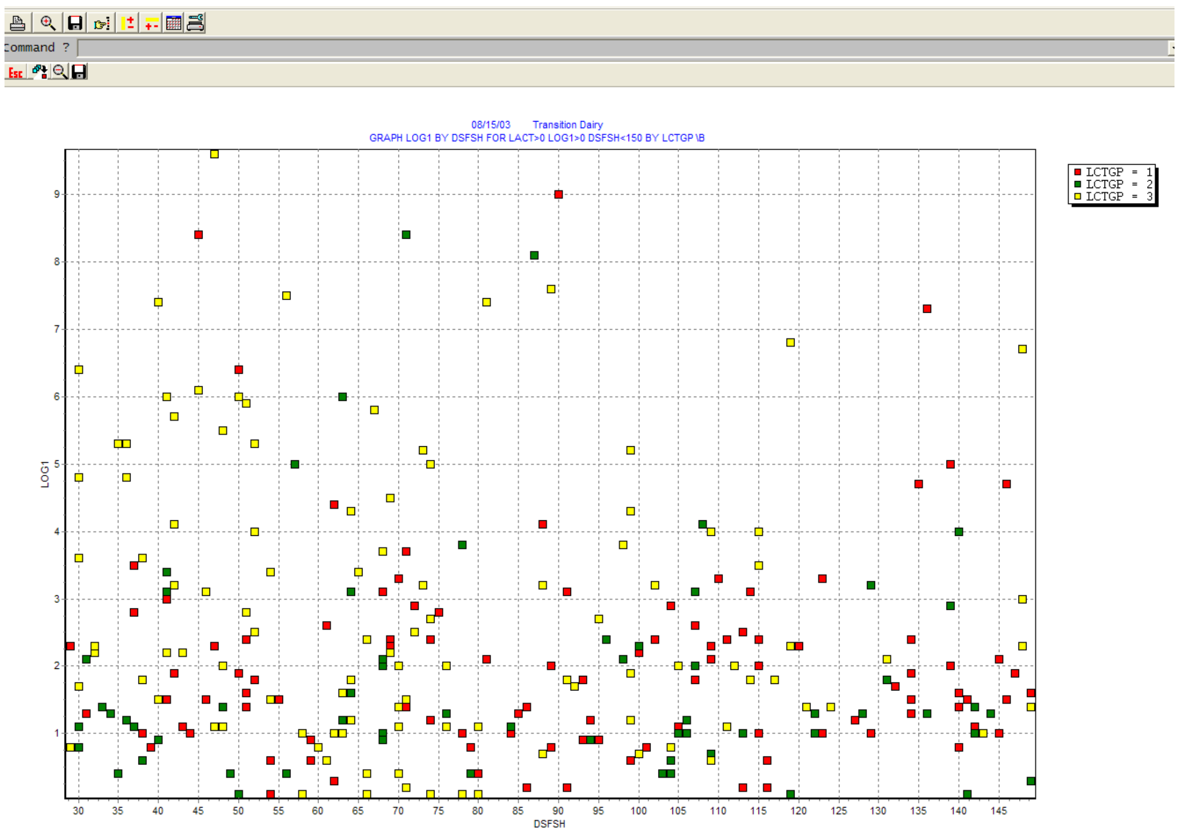


Figure 12. Scatter plot of first SCC linear score for cows fresh < 150 days.

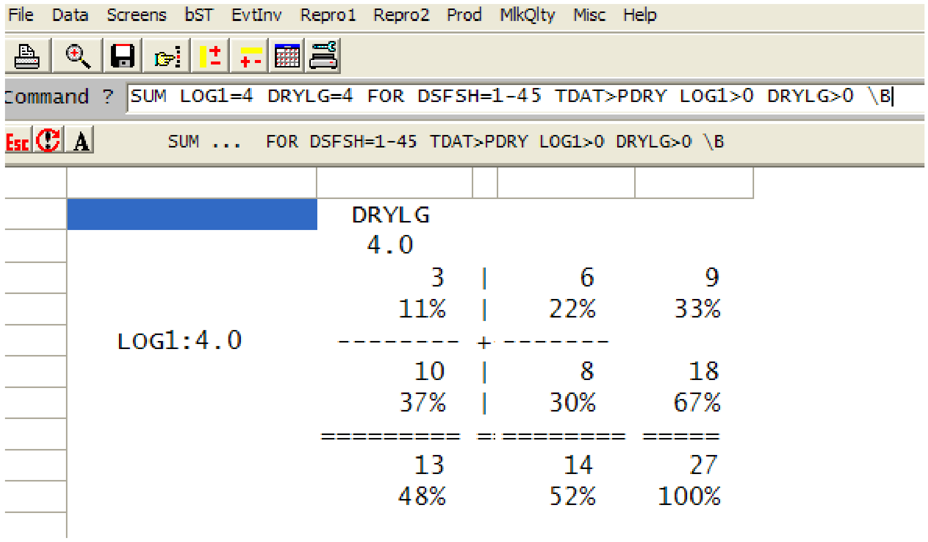


Figure 13. 2x2 table of mastitis status at dry off versus first test after calving.

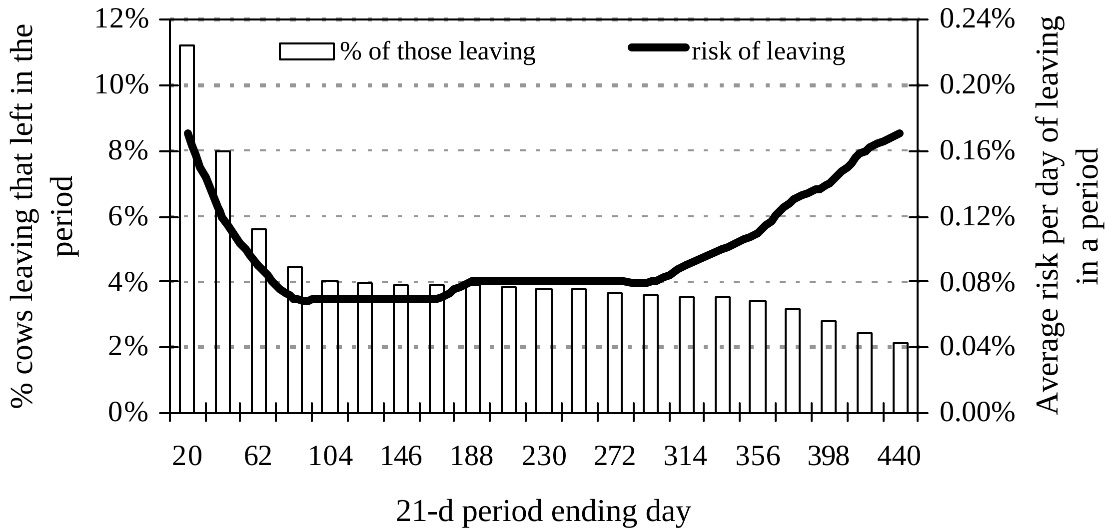


Figure 14. When cows leave and risk of leaving the herd (Stewart et al., 2002).

File Data Screens bST EvtInv Repro1 Repro2 Prod MlkQlty Misc Help

Command ? LIST ID DIM DSFSH RC RPRO SDREM DREM FOR LACT>0 RC=7 DIM<60 DSFSH<365 BY DSFSH \B

LIST ... FOR LACT>0 RC=7 DIM<60 DSFSH<365 BY DSFSH \B

ID	DIM	DSFSH	RC	RPRO	SDREM	DREM
6820	34	44	7	SLD/DIE	J+	-
6059	34	45	7	SLD/DIE	MAST	-
9007	39	50	7	SLD/DIE	J+	-
6461	29	54	7	SLD/DIE	MAST	-
6104	30	61	7	SLD/DIE	DIGEST	-
5719	1	63	7	SLD/DIE	-	SHOCK+MF
5606	31	66	7	SLD/DIE	M.FEVER	-
5990	58	68	7	SLD/DIE	LDA	-
5310	58	74	7	SLD/DIE	LAME	-
5202	22	92	7	SLD/DIE	-	LDATMF
5824	43	95	7	SLD/DIE	-	DA
5081	58	117	7	SLD/DIE	HIPNEU	-
6872	53	120	7	SLD/DIE	RP	-
6844	58	125	7	SLD/DIE	PROD	-
5694	16	131	7	SLD/DIE	ABORTTMF	-
6780	19	135	7	SLD/DIE	LDATMF	-
6839	50	135	7	SLD/DIE	MAST	-
5610	35	141	7	SLD/DIE	MYCO	-
5334	30	146	7	SLD/DIE	DA	-

Figure 15. Example listing of cows culled (sold or died) in early lactation.

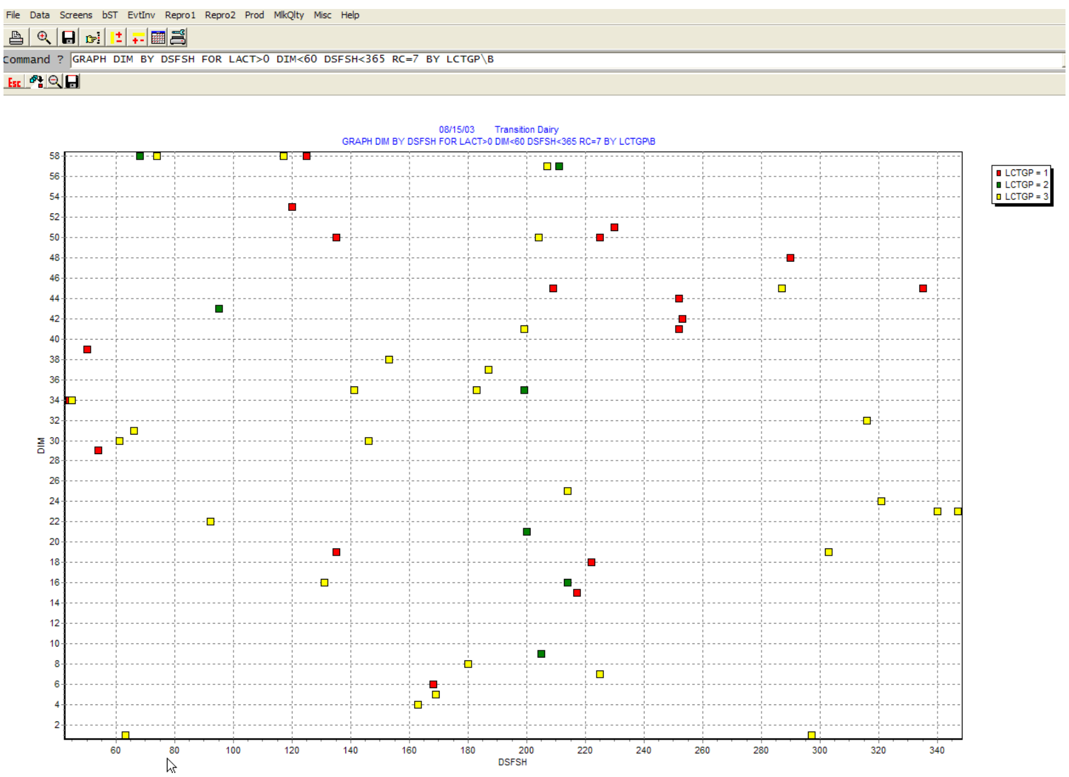


Figure 16. Scatter plot of days in milk at culling over the past year for cows culled at less than 60 days in milk

Disease	Duffield (1997)	Kelton (1995)	Lissemore (1988)
Milk fever	8.0%	12.5%	7.5%
Ketosis	2.0%	3.2%	3.3%
Retained placenta	8.0%	9.0%	8.1%
Metritis	4.0%	9.6%	-
Displaced abomasum	5.3%	2.2%	1.1%

Figure 17. Lactational incidence rates of metabolic disorders.

Costs of Common Diseases

Dairy Farm Name

7-Sep-03

copyright 1998: Dr. Chuck Guard

	user value	default value
Herd size	100	100
Cost of dead cow	$950	$950
Cost of cull	$500	$500

	user value	default value
Cost of milk not produced ($/cwt)	12	12
Cost of discard milk	$12	$12
Cost of extra day open	$3	$3
Farmer labor per hour	$12.00	$12.00

User inputs can be entered in the yellow cells; DEFAULT VALUES ARE IN GREY CELLS.

THE EASIEST APPROACH TO USE IS TO ONLY CHANGE THE INCIDENCE RATES IN THE LIGHT GREEN CELLS.

	Disease Case Rate %	% Death per case	% Culled per case	Milk not made lb/case	Milk Discard lb/case	Extra days open days/case	Farmer Labor hr/case	Vet & Drug $/case		Cost/ case $	Herd cost per year $	difference betw. user & default
MASTITIS	**40**	1.1	7	275	300	0	1	15		$141	$5,658	
	0	1.1	7	275	300	-	1.0	15		$141	$0	$ -
LAMENESS	**35**	1.0	12	330	66	12	0.5	26		$179	$6,266	
	0	1.0	12	330	66	12	0.5	26		$179	$0	$ -
LDA	**8**	2.0	8	840	77	12	1.0	86		$297	$2,376	
	0	2.0	8	840	77	12	1.0	86		$297	$0	$ -
KETOSIS	**14**	0.5	5	506	-	10	0.7	19		$143	$1,995	
	0	0.5	5	506	-	10	0.7	19		$143	$0	$ -
RP/METRITIS	**15**	1.5	6	550	248	15	0.7	20		$206	$3,083	
	0	1.5	6	550	248	15	0.7	20		$206	$0	$ -
MILK FEVER	**8**	4.0	5	286	-	13	0.5	25		$161	$1,287	
	0	4.0	5	286	-	13	0.5	25		$161	$0	$ -
DYSTOCIA	**7**	1.0	2	390	90	12	1.0	44		$163	$1,142	
	0	1.0	2	390	90	12	1.0	44		$163	$0	$ -
		cows	**cows**	**lb**	**lb**	**days**	**hours**	**$**			**Total costs**	
Herd amounts/yr: DEFAULT		1.6	9.8	49,622	19,276	1,069	96	$3,272	DEFAULT		$21,807	
Herd amounts/yr: USER INPUT		0.0	0.0	0	0	0	0	$0	USER		$0	$ -
Herd $ /yr : DEFAULT		$1,553	$4,890	$5,955	$2,313	$2,673	$1,151	$3,272	DEFAULT			
Herd $ /yr : USER INPUT		$0	$0	$0	$0	$0	$0	$0	USER			

Figure 18. Cost of common diseases.

Command ? EVENTS \3

Calf Report for 08/12/02 - 08/12/03

Month	Fresh	None	Twins	%T	Male	Female	%F	Alive	Dead	%D	M:Dead	%M	F:Dead	%F
8/02	146	44	3	2	59	46	44	100	5	5	3	5	2	4
9/02	168	43	8	5	66	67	50	118	15	11	6	9	9	13
10/02	145	10	8	6	65	78	55	134	9	6	5	8	4	5
11/02	158	1	8	5	92	73	44	156	9	5	8	9	1	1
12/02	205	1	9	4	117	96	45	196	17	8	13	11	4	4
1/03	217	1	12	6	116	112	49	207	21	9	10	9	11	10
2/03	171	0	9	5	90	90	50	157	23	13	15	17	8	9
3/03	176	1	6	3	91	90	50	173	8	4	6	7	2	2
4/03	118	2	5	4	63	58	48	102	19	16	13	21	6	10
5/03	168	0	14	8	92	90	49	171	11	6	7	8	4	4
6/03	260	1	17	7	151	125	45	247	29	11	17	11	12	10
7/03	267	0	9	3	154	122	44	263	13	5	9	6	4	3
8/03	81	0	2	2	44	39	47	76	7	8	4	9	3	8
=====	=====	====	======	==	======	======	==	======	======	==	======	==	======	==
TOTAL	2280	104	110	5	1200	1086	48	2100	186	8	116	10	70	6

Figure 19. DairyCOMP calf report for the TMF for one year