

### **ARE MY HEIFERS PERFORMING?**

Greg Bethard, DRMS and G&R Dairy Consulting

Replacing the dairy herd is a significant financial cost to a dairy business. Metrics to judge the efficiency of this process typically relate to biological parameters of animal performance. Perhaps the most appropriate measure of success is replacement cost per hundredweight for the dairy business. This broad and inclusive number relates to the cost of maintaining herd size and structure, and is typically the second largest cost of producing milk for dairy businesses. Accounting and production software applications are typically not integrated, making this number difficult for most dairy producers to calculate. Should the industry move toward integrating production and accounting software?

Traditional metrics such as age at first calving, conception rate, and body weight at calving suffer from statistical anomalies that often lead to erroneous or delayed decisions. Problems with bias, lag, momentum, and variation limit the use of many of these traditional variables. Heifer metrics typically evaluate six areas: Financial, Reproduction, Health, Survival, Growth, and Post-Fresh Performance. Dairy and heifer businesses need to develop metrics to evaluate performance that are relevant to their operation. Industry metrics generated by software packages need to improve to address these needs.

Financial metrics are currently poorly defined within the industry. There is a need to develop meaningful financial metrics for heifer performance. Reproductive performance is most accurately measured by 21 day pregnancy rates. Pregnancy hard count is another accurate assessment of reproductive performance. Conception rates can provide valuable insight, but are inherently biased and sometimes misleading. Health is difficult to objectively assess, but can be judged by mortality, morbidity, culls, reproductive performance, or growth rates. Health treatments and disease incidence are less often monitored but have merit in evaluating health within an operation. One goal of health monitoring should be to identify culls as young as possible to avoid the financial costs of delayed culling. Survival is rarely calculated or evaluated beyond stillborns and wet calf losses, yet is integrally associated with a successful heifer program. Growth rates are poorly recorded and monitored within the dairy industry, but are useful at key points during growth. The ability of a population of heifers to freshen into a herd with a live calf and few complications, and subsequent first lactation performance, are perhaps the last measures in the timeline of heifer performance.

Bethard, Greg L. Dairy Records Management Services, Raleigh NC; G&R Dairy Consulting, Inc., Wytheville, VA. Phone: 540-230-6383. E-mail: greg.bethard@ncsu.edu.

## **FIELD ASSESSMENT OF NUTRITIONAL PERFORMANCE AND RESPONSES: CHALLENGES AND OPPORTUNITIES**

Buzz W. Burhans, PhD; Dairy-Tech Group, W. Glover VT & Twin Falls, ID

The nutrition advisor plays a critical role affecting dairy viability and profitability. Feed cost is typically and overwhelmingly the largest operating expense for a dairy. Herd performance and economic returns are very sensitive to herd nutrition. To optimize herd performance and dairy profitability, “informed” recommendations and decisions should be made by feed advisors. Unfortunately, recommendations and decisions by feed advisors are frequently made based on impressions, intuition, and experience rather than by being informed by knowledge derived from comprehensive and specific current data and information describing herd performance. This occurs largely because evaluation of herd performance and assessment of responses to interventions requires that myriad pieces of data, sourced from multiple origins, be aggregated and processed into concise informative reports and then interpreted. Time constraints and ease of access inhibit the development of such knowledge and understanding. Comprehensive systems that facilitate capture of disparate data, integrate it into information, and then further facilitate engagement and consideration by producers and feed advisors rarely exist on dairies. Developing tools and systems that accomplish this would enhance feed advisors’ ability to make informed decisions. By contributing to making performance and profitability differences, better informed recommendations and decisions confer a competitive advantage to the dairy, to the feed advisor, and to his employer. For this reason, development of improved data tools and systems is a worthwhile investment for agribusinesses engaged in providing nutrition related products and services.

Also, better understanding of interventions, strategies, and factors that affect herd performance can enhance dairy nutrition recommendations. Such knowledge needs to include awareness of the range of responses expected and of factors which influence the “effect size” of responses. Field trials to test factors hypothesized to impact herd performance can provide useful information. Observational studies using common epidemiological designs to explore unrecognized factors associated with differences in herd performance can also provide important insights about dairy nutrition and management. Information obtained from both these study types can confer a competitive advantage to dairymen and their advisors. Field trials are often deprecated, but can be more useful for understanding some performance outcomes than controlled trials conducted at research institutions. Epidemiological study designs are common and fruitful in human medicine, but these methods are rarely applied to dairy management and nutrition, though they can be very informative.

This talk will promote the increased application of these three elements of dairy metrics as a useful and viable investment for enhancing dairies’, feed advisors’, and feed-industry companies’ performance. The intent is to stimulate discussion of, and resource commitment to, these methods as an effective way for feed and ingredient suppliers, feed advisors, and dairymen to make better, more profitable decisions regarding nutritional management of dairy herds.

Buzz Burhans, Dairy-Tech Group, 815 S Albany Rd, West Glover, VT 05875-9548, PH: (208) 320-0829, EM: buzzb3@earthlink.net

## OBJECTIVE MEASURES OF DAIRY CATTLE WELL-BEING

Nigel B. Cook MRCVS

University of Wisconsin-Madison, School of Veterinary Medicine

Largely as a result of animal activism in the US, driven by powerful organizations such as PETA and HSUS, a variety of welfare auditing systems have been created to document well-being on farms, and help assure the consumer that the food they are eating is safe, and the animals making that food have been well cared for. However, the measurement of well-being is far from an exact science and the approach commonly taken has been to use the concept of the Five Freedoms developed by the Farm Animal Welfare Council in the UK. These concepts were used by the farm assurance programs developed in the UK in the early 90's that culminated in the RSPCA Freedom Foods Welfare Monitoring System, which can be viewed as a standard for this approach. Many elements of this system can be found in the audits being used in the US today. Therein lies a potential problem. Our current well-being audits use as a model a system designed primarily to deal with the issue of confidence over food safety. The RSPCA Freedom Food audits have been viewed as a success in this regard, but current evidence suggests that while auditing is able to discourage bad practice and legislate against the worst in the industry, it has not been very successful in significantly improving well-being when compared with farms that are not audited, which is perhaps disappointing given that concerns over well-being are the main driving force behind audits in the US. In order to drive the average herd toward excellence in well-being, perhaps a different approach is required. We require research derived objective outcomes of health and performance that we can benchmark against the rest of the industry and create achievable goals. Currently, audits deal more with the process than the outcome. For example, the majority of audits clearly state that calves should receive a certain quantity of colostrum within a set number of hours of birth. An objective outcome would use research to identify how much immunoglobulin the calf actually requires, and a test that can determine whether this occurs. Thus, an objective outcome would be that calves tested at 1-7 days of life achieve a serum protein  $> 5.5$  g/dL. Once we have defined an objective outcome, the next step is to benchmark it with the rest of the industry to create an achievable target. For example, we may use death rate  $< 60$  DIM as an objective measure of fresh cow well-being and suggest that this be  $< 2\%$  based on industry performance. For this outcome to effectively be used to improve well-being we must then perform a risk assessment and develop a herd action plan for improvement. With this model for improvement in well-being, objective outcomes that may be benchmarked to create achievable goals become an essential part of a process that uses herd risk assessments to create action plans for implementation, and they maybe further used to monitor the success or failure of these interventions.

Nigel B. Cook MRCVS

Clinical Associate Professor in Food Animal Production Medicine

School of Veterinary Medicine

University of Wisconsin-Madison

2015 Linden Drive, Madison WI 53706

Tel: 608 265 4981

Fax: 608 262 8595

Email: [nbcook@wisc.edu](mailto:nbcook@wisc.edu)

## **PREGNANCY RATE ISSUES**

Albert De Vries, University of Florida

Pregnancy rate measures the speed with which non-pregnant cows become pregnant after the voluntary waiting period. The scientific and popular literature use different definitions of pregnancy rate and sometimes different terminology for the same statistics. This creates confusion and makes reproductive performance difficult to compare. With timed-AI programs, it may be unclear if cows are eligible, and thus may or may not contribute to the denominator in the pregnancy rate calculation. An example with 2 apparently accepted calculation methods resulted in 25% and 29% pregnancy rates for the same data as will be shown. A preferred way of calculating pregnancy rates is proposed. Another issue is that voluntary waiting period, end of the breeding period, service rate and conception rate may all differ, but result in the same pregnancy rate. Such differences may result in different economics. Additional statistics to quantify the reproductive program will be discussed.

Albert De Vries, Associate Professor, Department of Animal Sciences, University of Florida, L.E. "Red" Larson Dairy Science Building, Shealy Drive, Bldg. 499, Rm. 104F, PO Box 110910, Gainesville, FL 32611-0910  
phone: (352) 392-5594, fax: (352) 392-5595, [devries@ufl.edu](mailto:devries@ufl.edu)

## **ANALYZING WHEN AND WHY COWS LEAVE THE HERD**

Albert De Vries, University of Florida

Culling (exiting) is the departure of cows from the herd due to dairy sale, slaughter, salvage, or death. In October 2004, the 8<sup>th</sup> Discover Conference focused on "Reducing Cow Culling Rates: Creating an Environment for Success". Herd turnover rate was proposed as the preferred culling statistic. The denominator is the population of cows at risk for culling, but different calculations exist. Risk factors for culling include parity, pregnancy status, and stage of lactation and new population statistics will be shown. The use of single culling reasons has been discouraged, but parity and stage of lactation have marked effects on the risk of culling for any reason. Every dairy farm has its own optimal herd turnover rate, which results from the timely replacement of cows. Tools exist that help dairy producers make economically sound culling decisions. Ideally, the actual time of culling is compared to optimal time of culling. Underlying factors that influence culling decisions, such as reproduction, milk production, cow health, should be analyzed so problems and opportunities for improvement can be identified.

Albert De Vries, Associate Professor, Department of Animal Sciences, University of Florida, L.E. "Red" Larson Dairy Science Building, Shealy Drive, Bldg. 499, Rm. 104F, PO Box 110910, Gainesville, FL 32611-0910  
phone: (352) 392-5594, fax: (352) 392-5595, [devries@ufl.edu](mailto:devries@ufl.edu)

## PRECISION, ACCURACY, AND THE DIMENSIONS OF MILK PRODUCTION

Jim Ehrlich, D.V.M., Dairy Veterinarians Group

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Milk production in dairy cows is a sensitive measure of cow health, as well as being the most important determinant of a dairy farm's income. Almost everything we control in managing a dairy herd, including health, feeding, environment, breeding, and welfare, will influence daily milk production. This suggests that by developing more precise and accurate tools for measuring changes in milk production, we can better measure the effect of many other factors.

Quantifying lactation requires multiple dimensions to capture quantity, quality, and distribution of milk production within individual lactations. The MilkBot® lactation model was developed to quantify **scale**, **rise**, and **decay** dimensions of individual or aggregate lactation curves. Scale describes overall magnitude. Rise describes the increase in early lactation. Decay (or the inversely-related equivalent, **persistence**) describes the rate of decline.

Several fitting algorithms have been developed to fit the nonlinear MilkBot® model to observed production data, returning fitted parameter values. Since each parameter is linked to a specific dimension of milk production, parameters can be treated statistically as production metrics, and used in a variety of analytic applications:

- Residuals between observed data and model predictions can be used to correct for the effect of lactation stage and animal variables on daily milk production and improve accuracy in evaluating the response to an intervention or to detect changes in productivity.
- Residuals may be studied with respect to variables like season or feeding to develop subsidiary models to further correct for factors confounding the estimation of productive capacity or the influence of management.
- Correlation between parameter values and variables of management and environment may support or refute causal hypotheses.
- Parameter values may be used with the model to improve accuracy in predicting future milk production..
- Parameter values may be used to quantify differences in lactation curve shape between populations, or changes over time.
- Parameter values could be analyzed as genetic traits for genetic selection on lactation curve shape.

Jim Ehrlich, D.V.M.,  
Dairy Veterinarians Group  
832 Coot Hill Rd.  
Argyle, NY 12809  
[jehrlich@dairyvets.com](mailto:jehrlich@dairyvets.com)  
(518) 638-8566

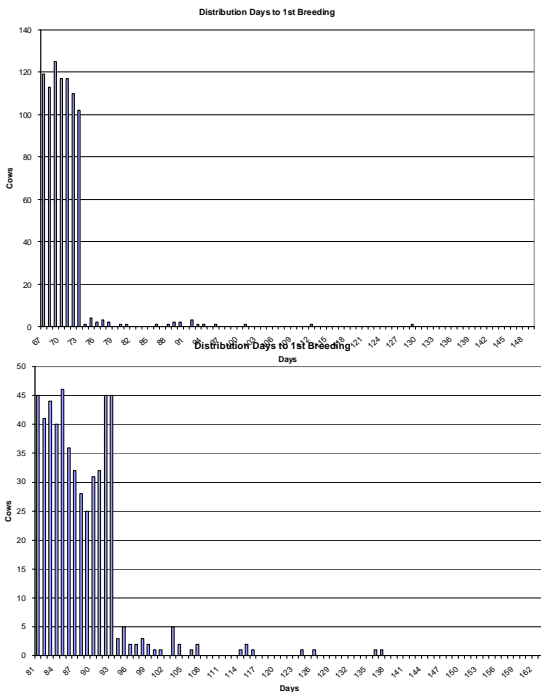
# REPRODUCTIVE ANALYTICS USING DHIA DATA

James D. Ferguson  
University of Pennsylvania, School of Veterinary Medicine

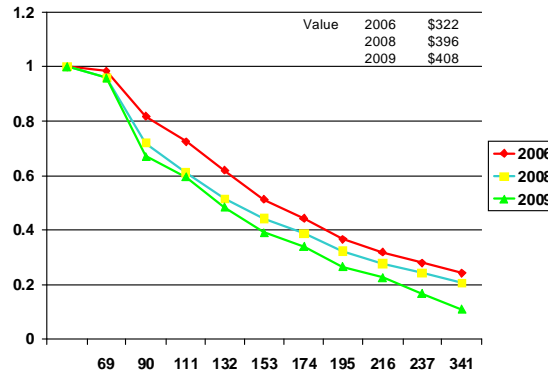
DHIA data provides a ready source of reproductive event data. Data is best analyzed from individual cow records which include information on cow, date of calving, parity, total current services, each insemination date, previous calving interval, previous service number, and current reproductive outcome. Data should be collected for active cows in the herd and cows culled over the last year. Data can be used to analyze distributions of days to first insemination and days between sequential inseminations, conception rate to first and subsequent inseminations, and pregnancy rate. Data can be analyzed by parity groups and season. Reproductive data from DHIA records contains some bias related to patterns of calving within a herd, so adjustments need to be made to account for this.

DHIA data presents a snapshot of reproductive performance and typically only 40% to 66% of the cows in the data have known reproductive outcomes. Cows which have calved in the last four months have little useful reproductive information in the current lactation due to early days postcalving. Often many cows have insemination data but have not been confirmed pregnant, and therefore outcome to the most recent insemination is unknown. These cows should be considered censored at last insemination for data analysis.

Distributions of service information provides more information than mean data. Rigorous consistency should be followed when analyzing data from dairy herds.



Distribution of days to first insemination in a herd using a Presynch – Ovsynch program. Compliance is excellent and it can be determined they are giving injections weekly.



Distribution of days to first insemination in a herd using a Presynch – Ovsynch program every other week (14 day grouping).

Change in survival (PR) in a herd over time as they improved compliance. Faster decline indicates a higher efficiency.

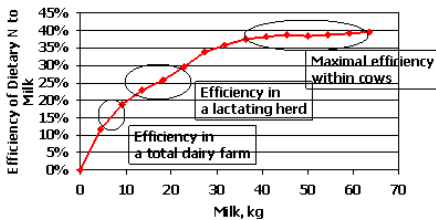
# PRECISION FEEDING – ANALYTICS FOR MONITORING

James D. Ferguson  
University of Pennsylvania  
School of Veterinary Medicine

Dairy farms must reduce their environmental footprint, which results from losses of N and P to water systems and emission of ammonia to the atmosphere. Increased N and P in water systems stimulates algae growth, leading to eutrophication, reducing dissolved oxygen and water clarity, impairing aquatic species. Atmospheric ammonia reacts to create 2.5 µm particulates, ozone haze, and acid precipitation. Losses of N and P to water systems occur through leaching and sediment run-off from land disposal of manure. Emission of ammonia from animal housing structures occurs as urinary urea decomposes and can be up to 50% of feed input N. In addition, agitation of manure liquids in storage structures and at field application to soils can result in significant ammonia loss. Precision feeding aims to reduce manure N and P through ration formulation by closely matching dietary nutrient content with animal requirement. A major goal in precision feeding is to improve the proportion of dietary N partitioned to milk N and reduce urinary N.

Precision feeding encompasses ration formulation, accuracy of mixing of diets on farm, evaluation of feed intake, feed delivery and feed wastage, cattle grouping, and reproductive efficiency. Accurate analysis of feeds is critical as dietary formulation and evaluation of TMR mixing accuracy cannot be accomplished without knowing inputs. Secondly, ration formulation programs need to characterize rumen degradation of feeds and microbial synthesis to precisely meet rumen requirements. Feed analysis must be coordinated with ration formulation software. Monitoring feeding performance includes evaluation of mixing, feed intake, and cattle grouping. Milk production has a critical influence on efficiency of capture of dietary N in milk.

**Efficiency of Dietary N Utilization**  
Higher production, the higher efficiency of conversion of input to output

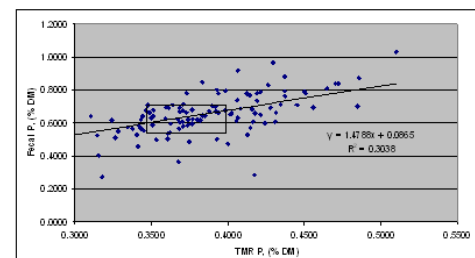


Almost 40% of dietary N can be captured in milk when production is over 30 kg of milk/day. As production decreases, efficiency is reduced, even with lower dietary inputs. Herds should strive to produce greater than 30 kg of milk per cow per day. However, as animals are spread across lactation, with varying DIM and production levels, efficiency in the lactating herd can decrease. Cattle grouping and reproductive efficiency will influence the efficiency across the lactating herd. For the farm, efficiency can be further diminished depending on the number of nonlactating animals in the herd.

Milk urea nitrogen (MUN) provides a good monitoring tool for evaluating N efficiency. Many milk processors include MUN in bulk tank samples analysis. Targets should be less than 14 mg/dl and many farms are between 8 to 10 mg/dl with high milk production.

Dietary P should be below 0.40% of diet DM for all groups of cows. Fecal P is directly correlated with dietary concentrations. Lactating cow diets should be greater than 0.33% and dry cow diets greater than 0.24% P.

## TMR and Fecal P




## VISUAL ANALYTICS – CONVEYING THE MESSAGE

University of Pennsylvania, School of Veterinary Medicine

David Galligan

Producers and their consultants must maintain and interpret a tsunami of data to successfully manage the modern dairy operation. Production, health, reproduction, nutrition, finance, inventory, milk production as well as data from disparate sources such as feed and future prices are just a few of the data sets that commonly exist and are accessed on a typical dairy. Computer technology has greatly enhanced our ability to store (DC305, PCDart), and access real time data, evaluate (Repmon, ProMon) and present data (Excel, Powerpoint, Dashboards). The presentation of data and information processing has perhaps made some of the greatest advances. However, data often needs to be manipulated in a manner that transforms it into “consumable” information that can be used for decision making. Business intelligence (BI) focuses on the analysis (summary, statistical, forecasting) and reporting of key performance indicators (KPIs) of an operation. The functionality of spreadsheets (the killer application of the 80’s) continues to evolve as a tool to manipulate and present data and the workhorse of the BI community. In addition to the presentation of data, spreadsheets and visual analytics allow the user to interact with the data locally and now in web-based modalities. Pivot table analysis allows the user to create a two dimensional tables from any data set and perform a variety of calculations (count, average, standard dev. etc) in a flexible environment. User defined function capabilities allow the development of specific functions for various types of industries (BaseCow). The table function as well as the ability to generate tornado and spider graph

analysis allow for comprehensive sensitivity analysis. Sparklines, for example **MILK**  **80 lbs**, a new function addition to Excel and found in many data rich dashboards are “data intense, design simple, word size graphs” (Tufte, 2006). These mini graphs have no scale but are intended to give the viewer a historical trend of the metric of interest over a given period of time. Add-on programs bring functions that allow stochastic elements of a problem to be modeled as well (@Risk, BaseCow). More recently, dashboards are an emerging modality in which data can be presented through the use of dials, graphs, gauges as well as variety of sliders, pull-down menus, radio buttons and navigation tools (menu bars) allowing the user to interact (drilldown) with the data. Stephen Few has defined the dashboard as: “Visual display of the most important information needed to achieve one or more objectives with fits entirely on a single computer screen so it can be monitored at a glance.” Many of the output devices can present additional information beyond the actual metric of interest being displayed. For example a simple gauge can point to value of the metric and display its actual value. Additionally the range on the gauge can suggest what the expected possible values might be. By coloring ranges of values, frequency attributes of the data can be inferred and when the dial is “driven” by a slider, the user can see the rate of change. Components of gauges (the needle) can change color when certain values are reached (alerts). Sliders, a tool used to enter data can also be color coded to give the user information regarding the frequency of expected values, for example a green section might indicate the +/- range of values within 1 standard deviation of the population, while orange might indicate values outside of that range. Lastly the platform in which a report is given is moving from the personal PC to the handheld devices (Iphone) that can be updated and accessed 24/7.

Dave Galligan, Professor of Animal Health Economics, University of Pennsylvania, School of Veterinary Medicine, Department of Clinical Studies, New Bolton Center, 382 West Street Road, Kennett Square, PA 19348, Office: 610-925-6306, FX: 610-925-8123, EM: galligan@vet.upenn.edu

# CONNECTING FEED MANAGEMENT AND WHOLE FARM NUTRIENT MANAGEMENT

Joe Harrison- Washington State University, Department of Animal Sciences

Society expects the management of nutrients (manure) at the farm level to be done in a manner that minimizes the loss of nutrients to the environment (air and water). The majority of nutrients imported to dairy farms is contained in feeds and feed ingredients. Nitrogen (N) and phosphorus (P) are captured in milk for off-farm export at maximal amounts of 20-35 % of intake, and thus the majority of the consumed N and P are excreted in manure. The nutrients nitrogen and phosphorus are of major importance to the animal and of concern from an environmental perspective. Nitrogen and phosphorus can be lost to air, and surface and ground water when applied for crop production in excess of crop nutrient needs.

Since a majority of the nutrient import to dairy farms is from feeds, developing and increased understanding of the role that feed plays in whole farm nutrient management is a key part in managing nutrients at the whole farm level. A number of metrics are available that can assist with assessing the efficiency of nutrient capture in milk (see Table 1). Adopting a systematic approach to feed management can minimize the need for imported feeds and decrease the nutrient import dependency. Whole farm nutrient estimator tools can be found at <http://www.puyallup.wsu.edu/dairy/nutrient-management/software.asp>. A financial incentive program is available through USDA-NRCS to assist dairy producers with the development and completion of a feed management plan (see <http://www.puyallup.wsu.edu/dairy/nutrient-management/publications.asp>). Additional financial incentives can be realized from management related to greenhouse gas emissions. Information on carbon footprint, carbon credits and payments can be found at: Financial incentives - <http://www.chicagoclimatex.com/> , Carbon foot print calculators – 1) US Dairy Greenhouse Gas Model - <http://ars.usda.gov/main/docs.htm?docid=2708>, 2) United Kingdom - <http://www2.cplan.org.uk/> , and New Zealand - <http://www.lincoln.ac.nz/carboncalculator/>

Table 1 – Metrics Relating Feed Management and Whole Farm Nutrient Management

Indicator	Range or Target
DM of diet	Minimize variation
P import	0.09 % x milk production
Milk Nitrogen Efficiency	20 – 35 %
Milk Urea Nitrogen	10 to 14 mg/dl
Feed Efficiency	1.2 to 1.8 unit milk/unit intake
Carbon Footprint	0.5 to 1.0 unit CO <sub>2</sub> e/unit milk

Joe Harrison, Professor - Nutrient Management Specialist, PAS  
Washington State University  
2606 West Pioneer, Puyallup, WA 98371  
Phone 253-445-4638, Fax 253-445-4569, e-mail: [jhharrison@wsu.edu](mailto:jhharrison@wsu.edu)

## **Integration of Information: The Science of Analysis**

Mark L. Kinsel, Agricultural Information Management, Inc.

Information is the result of conversion of raw numbers (data) into an organized or summarized form. The conversion of data into information is necessary because of the variation inherent in biological systems. Thus, the goal of converting data into information is to present all essential pieces of knowledge from a collection of raw data while removing the variation that “clutters” this knowledge such that “proper” decisions can be made. Many analytical methodologies have been developed for this purpose, some better than others. An important caveat to evaluating these analytical methodologies is that different dairies achieve optimal performance in different ways such that “one size doesn’t fit all” and care must be used when using any analytic to compare dairy performance across farms.

Conventional statistical methods such as analysis of variance (ANOVA) or multivariate regression have been the hallmark of science applied to dairy herd analytics. The strength and weakness of these methods are their narrow and specific interpretation. Although assumptions specific to each statistic give it more power to “sift through the chaff”, if the assumptions are not appropriate, classical methods may hide important features of the data (the information). Also, traditional methods account for variation by aggregating measurements over time. This creates a delay while “sufficient data” accumulates which often limits application of analysis and greatly increases the cost. Coupled with the fact that conventional statistics ignore the time order in which events occur, many researchers, especially in the human health care field, have started looking for alternative analytical methods. One such methodology is statistical process control (SPC), a family of analytical techniques developed in the manufacturing industry in the 1920’s. This methodology is gaining popularity among the human health scientific community and has only recently been applied to production agriculture. It, and other non-conventional approaches, warrant further discussion in the agricultural science community, and have the potential to be important options in the toolbox of dairy herd analytics.

Kinsel, Mark L, Future Address: AgriMetrica LLC, 1551 Hanson Road, Ellensburg, WA 98926, Tel: (509) 962-1583, Email: [mkinsel@agrimetrica.com](mailto:mkinsel@agrimetrica.com)

## **DATA EXCHANGE BETWEEN DIFFERENT DATA SYSTEMS**

Mark Kirkpatrick DVM, MS  
Manager – Dairy Veterinary Operations  
Pfizer Animal Health

Many options in dairy record keeping software exist for the dairy producer in the US. While the systems may vary in style and user interface, they all have the capabilities to track the activities of the dairy cow. This includes her life history, progeny, production, reproductive history, status and eventual removal. All this individual information allows the system to assemble daily working lists, and track treatment and residue requirements thus maintaining operation efficiencies and keeping the dairy out of regulatory trouble. Most importantly, today's systems offer records diagnostic reporting to inform the producer about the trends in their operation. Visualization and interpretation of this data offers guidance and provides a powerful motivating factor.

In 2000 Pfizer Animal Health provided a series of national meetings in the US to inform producers about current trends in reproduction and transition cow management. Pregnancy rate was a proposed reproductive metric that offered a more complete picture of reproductive efficiency because it considered all eligible cows in the denominator. Considerable effort was spent coaching dairy practitioners and producers in determining pregnancy rates based on which record keeping system they used. There was no commonality of evaluation.

Pfizer asked the question “could we create an evaluation program that would accept an electronic report from any record keeping system and offer a standardized interpretation? Working with Dr. Mark Kinsel (Ag Information Management) the goal was achieved using custom output reports crafted in each record keeping system. The program was named the Dairy Wellness Plan Manager® (DWPM). As the program advanced to the second version an additional series of reports were crafted to allow access to milk production and quality data as well as removal information.

Input reports are of two types. The first is space delimited text files and the second is comma separated values (CSV). The CSV format has been the most flexible in receiving and editing data. Mechanisms for creating these reports is presented in the discussion.

The program was highly visual, offered 1<sup>st</sup> and 2<sup>nd</sup> plus lactation comparisons and provided information rich evaluations that included both graphics and tabular statistic summaries of the results. Active filtering was incorporated in the program which allowed the user to refine their questions. These features were focused for the on-farm presentation. DWPM was also a link to a nationwide network that tracked reproductive performance. To accomplish this a summary file was created using the Extensible Markup Language (XML). This form of output file facilitated error checking through the linking of content with a description of the content. DWPM is currently able to accept data from six record keeping systems.

Mark Kirkpatrick, Technical Services Veterinarian, Pfizer Animal Health, 2021 Ardell Rd, Kuna, ID 83634-1227,  
PH: (515) 231-0515, EM: [Mark.A.Kirkpatrick@pfizer.com](mailto:Mark.A.Kirkpatrick@pfizer.com)

## REPRODUCTION: WHAT TO MEASURE AND WHY?

Mark Kirkpatrick DVM, MS  
Manager – Dairy Veterinary Operations  
Pfizer Animal Health

In 2000 Pfizer Animal Health initiated efforts with Dr. Mark Kinsel (Ag Information Management) to create interpretive software (Dairy Wellness Plan Manager® [DWPM]) that would evaluate reproduction, removals, milk production and milk quality. The initial focus though was on reproduction. Reproduction is an end-point metric. Much of the success in this area is the direct result of good management techniques during the Dry, Close-Up, Calving and Post Freshening periods of time. While the initial version of the software focused only on reproduction an effort was quickly made to add metrics that would provide insight into these other areas.

Key areas addressed in the program include:

- Milk Production – lactation curve graphs that compare 1<sup>st</sup> against 2<sup>nd</sup> plus lactational performance. An additional metric includes trend examination of the 1<sup>st</sup> test ME305 record for cows censored to 15-30 DIM.
- Butterfat:Protein ratios – greater than 40% of the herd above a cut-point of 1.4 is indicative of potential subclinical ketosis. Excessive fat mobilization and weight loss will negatively impact reproduction.
- Milk Quality metrics – evaluation of the herd using a cut-point of 200,000 somatic cell count. Poor udder health can be shown to have an impact on individual dairies.
- Removals – information is provided on an annualized basis for both the current and removed herd (by lactation group). While this provides a historic view the user is encouraged to examine the question on a more current basis through calving cohort basis trend observation.

With this evaluative basis reproductive results can now be put into perspective. The first essential in a reproductive review is to examine the pattern of first breedings. Is a program in place? Are there any deviations? What is the voluntary wait period and how is it being adhered to?

The user is then directed to a historical survival curve analysis that is limited to the 1<sup>st</sup> ten 21-day cycles. How quickly do you convert cows from open to pregnant, and are there any differences between the lactations? The author uses a benchmark of 50% pregnant by the end of three 21-day cycles as a potential standard.

A unique feature of the DWPM analysis is calving cohort (group) analysis that could be sized for statistical significance in increments of 1, 2, 4, or 8 weeks. Options for analysis include 1<sup>st</sup> cycle pregnancy rates, % pregnant by 3 cycles and % pregnant by 6 cycles. Given the diversity of reproductive programs the % pregnant by 3 cycles has proven useful to understand the dairy's reproductive efficiency in the first 63 days following the onset of the VWP. A goal for this area is 60% pregnant by three cycles.

Mark Kirkpatrick, Technical Services Veterinarian, Pfizer Animal Health, 2021 Ardell Rd, Kuna, ID 83634-1227,  
PH: (515) 231-0515, EM: [Mark.A.Kirkpatrick@pfizer.com](mailto:Mark.A.Kirkpatrick@pfizer.com)

## **Bad Metrics are Worse than No Metrics**

Robert D. Lewis, President  
IT Catalysts, Inc.

Bad metrics are worse than no metrics, because with no metrics you're honestly ignorant while with bad metrics you're certain, but wrong. This presentation explains how bad metrics happen, the four "metrics fallacies," and the "6 Cs" of good metrics and how to achieve them.

Robert D. Lewis, IT Catalysts, 6272 Sequoia Circle, Eden Prairie, MN 55346, PH: 952-949-2444, FX: 509-277-9175  
EM: [rdlewis@itcatalysts.com](mailto:rdlewis@itcatalysts.com), [www.itcatalysts.com](http://www.itcatalysts.com)

## **SENSORS, DATA AND PRECISION DAIRY FARMING**

### **Ephraim Maltz, Institute of Agricultural Engineering**

Precision agriculture and its achievements motivated also livestock farming into this direction and the dairy industry is actually leading this progression. Increasing dairy size and production hence economical value of the individual cow on one hand and increased expenses (especially food) on the other hand motivates this process. The definition of precision dairy farming (PDF), is to manage the smallest production unite in order to allow it to express its genetic potential in accordance with the economical goal and animal wellbeing. This approach is expected to improve animal health, wellbeing and profitability of the dairy operation.

Technology provides the ability to develop and use sensors that can supply detailed data about the individual cow in the herd regardless its size. With proper physiological labeling and interpretation this data can be translated into information which in turn, can support management decision making on the level of the individual cow.

The “smallest” unite can be the entire herd, a group of cows with common physiological and performance characteristics or the individual cow. The “size” of this unite is determined by the sensors and facilities involved and availability of automatic and easy operation.

A PDF system is constructed of the following component: A sensor that generates data, a model that gives a physiological interpretation of the data, a management decision making process and finally decision execution. The PDF systems can be divided into two categories: those used for diagnostic and those used for management and the same sensor can serve both categories. For example a decline in milk yield can indicate a health problem, but also a nutritional one. In both categories data have to be labeled and analyzed in order to convert it into meaningful information.

The difference between diagnostic and managerial PDF systems is that the former have to alarm ahead or close to the event it supposes to detect (estrous, lameness) and the latter can be more time tolerant.

Most of the PDF appliances are of diagnostic nature related to health and reproduction and the motivation for their development was to replace human senses and economize on the dairy operation. As technology progressed new sensors were developed following dairy and physiology research and prices drops led to commercialization of many devices that were used only for research purposes.

The common PDF sensors are electronic milk meters, estrous detectors, milk conductivity meters, lameness detection, body weight measurement and computer controlled self-feeders all connected to individual ID which is the key for PDF on individual cow basis.

Sensors, both off the shelf and under development, in the dairy industry providing a verity of data, will be reviewed in this presentation. Four of them will be presented in details in terms of labeling, data analysis, physiological interpretation and a variety of applications. Namely:

1. Measuring body weight – emerging from negative energy balance, indication to improve performance of first insemination, dry matter intake formula, indicate health problems.
2. Activity – barn facilities in relation to welfare, behaviour changes that indicate approaching calving and estrous detection.
3. Milk composition – precision concentrates (energy, protein) rationing, indicate health problems.
4. Milking parlor parameters will be detailed – optimal milking and milking parlor efficiency.

Each and every one of these four sensors if incorporated for automatic performance in the herd management has the potential to contribute significantly to the economy the dairy operation as well as to the well being of the dairy cow.

Ephraim Maltz, Institute of Agricultural Engineering, Department of Growing Production and Environmental Engineering, Agricultural Research Organization - The Volcani Center, P.O. Box 6, Bet Dagan, 50250, Israel

PH: Tel. Office: 972-3-9683499; Tel. Home: 972-3-5345652; Mob: 972-506220499, FX: 972-3-9604704

EM: [emaltz@volcani.agri.gov.il](mailto:emaltz@volcani.agri.gov.il)

## **REPRODUCTION: WHAT TO MEASURE AND WHY?**

Ray Nebel, Senior Reproductive Specialist, Select Sires Inc.

Reproductive performance of a dairy herd is a function of management policies and how well these management policies are implemented. The ability to use records effectively is one of the cornerstones of reproductive management and is necessary to determine if adjustments need to be made in current management policies. Complete herd records provide the tools necessary to define the herd performance historically, assist in establishing goals, and allow monitoring to determine the impact of management changes. The first step in record analysis is to identify the key components of reproductive performance that affect the desired outcome or goals.

Database item needed for analysis are cow ID, sire ID, birth date, fresh date, dry date, lactation number, pen or group, last breeding date, breeding code (standing, timed-AI, etc.), days in milk at first breeding, times bred, repro code (open, pregnant, dry, culled, etc.), somatic cell count, test day milk weight, last service sire. Using these items current key reproductive areas can be summarized. The items range from percent of the herd confirmed pregnant, percent of the herd confirmed pregnant by three cycles past the voluntary waiting period, average 21-day pregnancy rate, and days in milk at first service to percent insemination rate, and percent conception rate for all services.

Excellent reproductive performance is essential to the long term success of a dairy operation and the ability to use records effectively is the cornerstone of reproductive management. Record analysis should be designed to assist in determining the reproduction performance of the dairy herd and if management changes in protocols are warranted to improve profitability.

Nebel, Ray, Select Sires Inc., Rt. 42 North, P.O. Box 143, Plain City, OH 43064, Tel: (614) 733-3494, email: rnebel@selectsires.com

## USING FIRST TEST MILK YIELD TO ASSESS HERD TRANSITION COW MANAGEMENT

Ken Nordlund, DVM, University of Wisconsin-Madison

Approximately 75% of dairy cow disease events occur in the month following calving and are predicated by feed intake and immune function changes in the weeks prior to calving (Leblanc et al., 2006). How cows are managed through this window of time called the transition period can have major consequences on fresh cow health and subsequent performance. Records of disease events would seem to be a logical data source to evaluate programs, but the lack of standardized recording systems, coupled with inconsistent clinical case definitions and erratic recording practices renders on-farm health records nearly useless for comparative herd studies.

Milk yield is recorded in a standardized method through DHIA services. Reduced milk yield associated with each of the common fresh cow diseases (Edwards & Tozer, 2004). A technique called Transition Cow Index™ has been developed where the actual 1<sup>st</sup> test milk yield collected between 5-40 DIM is compared to a prediction of 1<sup>st</sup> test milk yield. The prediction equations were developed using mixed models and the AgSource DHIA cow data from a two-year period merged with herd-level Posilac-purchase records supplied by Monsanto. The merged data set represented 4,025 herds. TCI™, the difference between actual and predicted first test milk, can be expressed as lbs on 1<sup>st</sup> test day or as 305-day 1<sup>st</sup> test projected 305-day milk. Commercial use of TCI™ by AgSource, the Wisconsin-based DHIA service, uses the 305-day projection version.

Individual cow performance subsequent to her TCI™ score shows correlations with survival to 61 days, survival to another lactation, increased milk yield, and modest improvements in likelihood of pregnancy by 150 days in milk. Each increase of 1,000 lbs of TCI™ was associated with an increased survival rate into the next lactation of 2.4% and an increased lactational cumulative milk of 1,270 lbs.

Because TCI™ values can be generated for all cows with a previously recorded lactation, herd average scores can be produced for all herds participating in DHIA testing programs. In the AgSource herd base, approximately 2,500 lbs TCI™ separates the 10<sup>th</sup> and 90<sup>th</sup> percentile of herds. Using associated survival and milk yields, 2,500 lbs TCI™ should yield an gross economic difference approaching \$500 per cow per year between the poorer and best programs.

TCI™ offers an objective method to benchmark individual herd transition management programs, enhances options for field trials and surveys, provides economic information about the value of programs, and offers a tool for ongoing monitoring of herd transition management programs.

Nordlund, Kenneth. Address: School of Veterinary Medicine, University of Wisconsin-Madison, 2015 Linden Drive, Madison, WI 53706, Tel: (608)263-681, email: Nordlund@wisc.edu

# STANDARDIZATION OF ON-FARM HEALTH EVENT RECORDING TO IMPROVE PREVENTION AND CONTROL OF DISEASE ON US DAIRIES

John R. Wenz, DVM, MS  
Washington State University

The producer reported incidence of common dairy cattle diseases and on farm deaths increased from 1996 to 2007. This is particularly alarming given the major advances in knowledge of disease prevention and control made during the same time and suggests either these practices are not effective or they are not effectively implemented on farm. Consolidation in the U.S. dairy industry has resulted in 55% of the cows being managed on herds of 500 or more. Computer record systems are used by 93% of herds with 500 or more cows. Larger herd size and availability of computer based records provides the need and opportunity to use epidemiologic measures of disease to adequately monitor dairy cattle health. By doing so, producers and veterinarians could better evaluate the effectiveness of best management practices for disease prevention and control. However, the current poor quality and availability of on-farm health records limits the use of these epidemiologic tools.

We recently completed a study evaluating the on 50 large US dairies. The results confirmed previous reports of poor health data quality. The percentage of herds with accurate, consistent recording of health events ranged from 44% for clinical mastitis to only 20% for metritis. Thus calculation of disease incidence (a basic epidemiologic measure of disease) was not possible on most dairies. We found that most herds used considerable time and resources to record health events, however, data recording was often inefficient. Furthermore, while there was a lot of data, limited information to guide management decisions could be obtained from those data. Generally the data recorded lacked accuracy and consistency owing to a lack of standardization and the 'user-defined' nature of health events. Evaluation of health event remarks suggested that health data recording was done in an *ad hoc* fashion for evaluation at the individual cow level rather than through planned protocols for herd level evaluation. This study identified a need for; herd management software to prompt users to enter critical data, standard protocols for on-farm data entry and tools for the accurate efficient evaluation of health data once it is available.

Despite a long-standing recognition of poor health data quality little progress has been made in the development and implementation of standards for health event data recording. There is a critical need for standard health data recording protocols to improve the accuracy and consistency of data. There is also a need for efficient methods of data analysis to provide sensitive, unbiased information regarding herd health status. Meeting these health data management needs are necessary steps toward more rational health management decision making and evaluation and thus on-farm disease prevention and control on U.S. dairy operations.

John R. Wenz, Assistant Professor, Washington State University  
POB 646610, Pullman, WA 99164, (509) 335-0773 [jrwenz@vetmed.wsu.edu](mailto:jrwenz@vetmed.wsu.edu)