Investigating Herd Problems and Production on Dairy Farms

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Introduction

Herd level assessments of productivity and health are a normal part of dairy practice. Many veterinarians undertake informal herd investigations when they discuss herd management issues with the farmer during herd visits. The objective of these informal herd investigations is no different than the objective of a formal herd investigation. After identification and confirmation of a problem, the primary objective of the veterinarian should be to focus on *control of the current situation.* When emergency situations are under control the next step is to *identify key determinants of the problem.* Finally, and most importantly, plans need to be put in place to *prevent future problems.* Epidemiologic techniques that have been developed for outbreak investigations can be modified and used to direct the investigation toward resolution.[1,2,3,4]

Identification of herd problems

In general, problems can be identified by either clients or the herd veterinarian. With many competing interests on farms, it is also not unusual for problems to be identified by other agribusiness consultants. When the farmer and his or her consultants are in agreement about the existence of a problem, it is generally easy to proceed toward resolution. Progress toward resolution of herd problems becomes more difficult when various consultants do not communicate nor agree about the direction of a herd investigation.

There are tremendous differences between farms in the perception of what constitutes a herd problem. On some farms, a bulk tank somatic cell count of 300,000 would be a cause for celebration, while on other farms it would be an occasion for panic. Problems that are slowly developing may be more difficult to identify than an abruptly developing concern (Figure 1). While epidemics (an unexpected increase in disease or death to a level clearly greater than normal)[5] of disease are generally easily identifiable, there are many situations that are not as clearly defined. As part of the daily routine of scheduled herd visits, reproductive health exams and sick cow treatments, it is common for veterinarians to be confronted with problems on dairy farms that are vague and easy to ignore. Sometimes the problems are simply perceptual. For example, during a reproductive health visit, a farmer may perceive (without the benefit of record analysis) that more cows are open than desired. Sometimes the problems are based upon expectations. A farmer may be concerned in the fall because milk production has not recovered from heat stress related depressions to a level that the farmer expects. At other times, the problem is related to profitability of the dairy. A dairy farm that has recently expanded may require 60 pounds of milk per cow in the bulk tank to be profitable. The farmer may be concerned when production is lower than budgeted in the expansion plan. At some point, one or more of these problems can become limiting to the productivity of the dairy and require additional investigation. The use of a systematic approach to investigate herd problems can help focus the investigation and lead to rapid resolution of the problem.

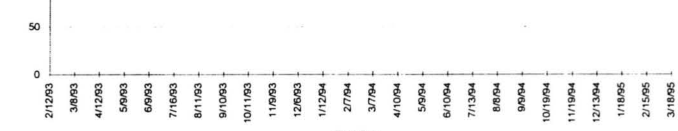

Figure 1. Somatic Cell Count by Test Date 250 Cow Ohio Jersey Herd.

General Paradigm for The Investigation of Herd Problems

1. Verify the diagnosis. The first step in problem resolution is verification that a problem exists.

Problems identified by clients are often perceptual and may be based upon short term recollection of events or discussions with neighboring farmers. Problems identified by veterinarians may not be valid because of inaccurate data (such as when incomplete Dairy Herd Improvement Association (DHIA) data are used or computerized dairy management programs are not kept up to date). Problems that veterinarians have identified also need to be fully explained to the client. Unless the client agrees that a problem exists, it will be difficult or impossible to proceed toward resolution.

To verify the diagnosis of a problem it is necessary to have access to some type of records relating to the area of concern. It is also important to ensure that we understand how data had been collected and what the data mean. Rolling herd averages (RHA) are a good example of a potentially misleading production parameter. Rolling herd averages are calculated from the 365-day total herd production divided by the average number of cows per day (milking and dry) for the 365 day period. Rolling herd averages are slow to respond to change and can be misleading if a large portion of the herd is dry or if cows are dry for long periods (Figure 2). While rolling herd averages are useful to get a general impression of the historical performance of a dairy, the use of RHA to make or assess management decisions should be discouraged.

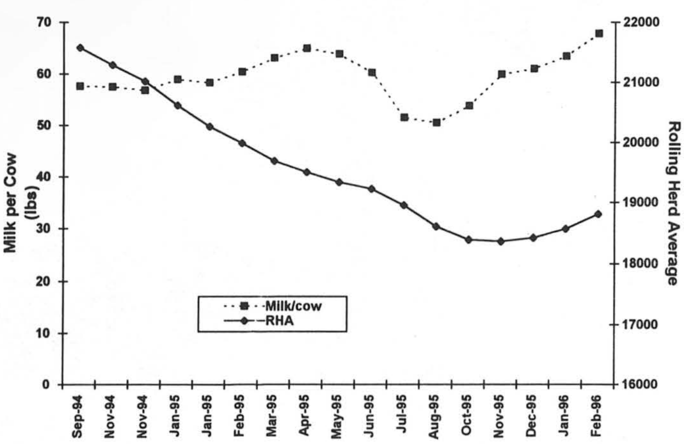

Figure 2. Rolling Herd Average versus Test Day Milk 220 Cow Indiana Dairy.

Bulk tank values are often used by farmers to assess management changes. There can be tremendous variations in bulk tank milk weights due to variables such as number of cows milked and the number of milkings included (Table 1). Without an adequate record of the cow numbers, it can be difficult to determine if of the cow numbers, it can be difficult to determine if changes in bulk tank weights (ex: August 8 and August 14) are due to management, environmental influences or differences in the number of animals milked.

Table 1. Milk Shipped in August 1995 for a 100 cow dairy herd in SW Michigan

Date	8-2	8-4	8-6	8-8	8-10	8-12	8-14	8-16	8-18	8-20	8-22
Milk	15010	15010	14913	17202	12567	14400	10420	11492	12567	12077	12372

Many of the values that dairy practitioners use to monitor performance on dairies are either arithmetic averages or rolling averages. Average (or mean) values are most accurate when the parameter being measured is normally distributed. Many values that are used for monitoring dairy herds are not normally distributed (Table 2).

Table 2. Distribution of statistics commonly used to monitor dairy herds.

Often Skewed	Usually Normally Distributed
Days Open	Number of Days Dry
Days to First	ServiceFat Corrected Milk
Age at First Calving	Milk per Cow per Day (Test Day or Daily)
Somatic Cell Count	Peak Milk Yield
Number of Times Bred	Pounds of Fat and Protein

Data that are derived from *normally distributed* parameters follow a bell shaped curve and have a mean and median (50th percentile) that are approximately equal (Figure 3). The mean and median for the test day fat percent for the 65 cow dairy herd shown in Figure 3 are 4.6% and 4.5% respectively. In contrast, it is very easy to draw inaccurate conclusions from mean values that are derived from *skewed* distributions (Figure 4). The mean and median for the SCC data shown in Figure 4 are 187,000 and 81,000 respectively. In the

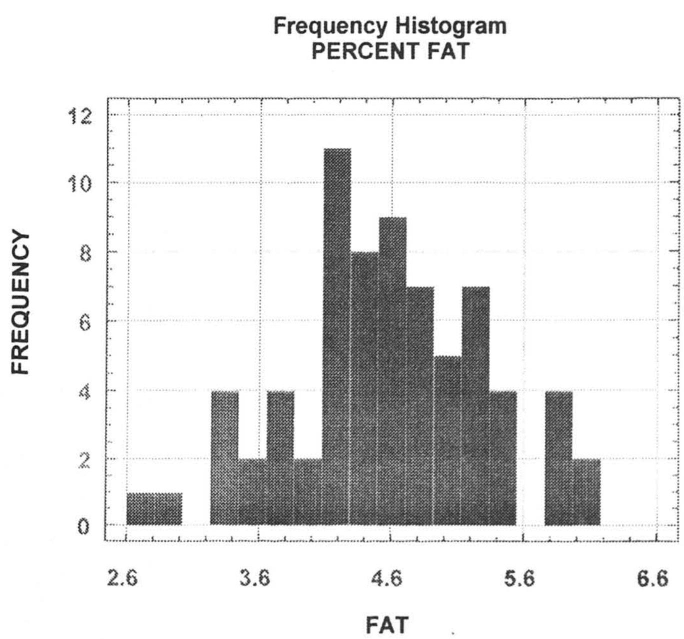

Figure 3. Distribution of Percent Fat for a 65 Cow Dairy.

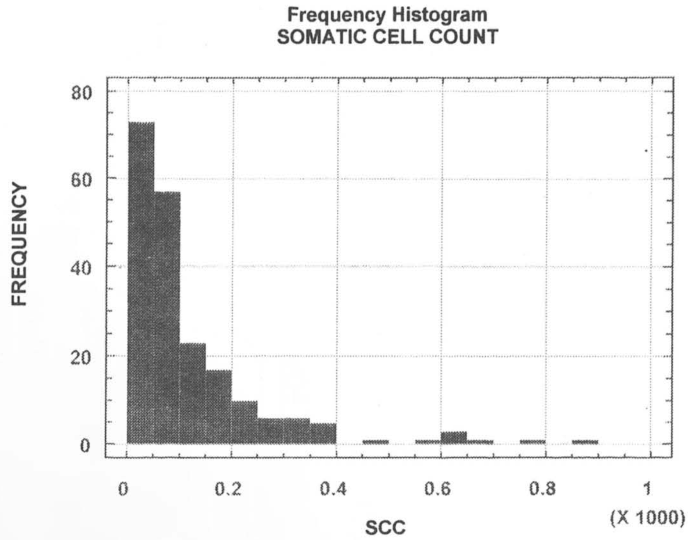

Figure 4. Distribution of Test Day Individual Cow Somatic Cell Counts for a 200 Cow Indiana Dairy Farm

field, medians can be determined from data charted on a histogram-like form (Fig. 5).

When investigating the relationship between two factors (such as between nutritional changes and milk production) other extraneous factors may affect the relationship that is being investigated. The effect of extraneous factors on the variable of interest is called *confounding*. Essentially, a confounder is a factor that when controlled may reduce or eliminate the effect of the variable being studied. Potential confounders for milk production include: herd average days in milk, percent of the herd in first lactation, percent fat, breed, number of times milked per day, bst usage and culling patterns. Adjusted values such as 150 day milk, management level milk and adjusted corrected milk attempt to correct for some of these confounding variable to enable a fair comparison of production responses to management changes.

When problems are being investigated at the herd level it is important to define the *time span* that is being used to derive the data. In some states, many of the numbers on DHIA reports are either rolling averages or include all of the animals currently lactating in the herd. Rolling averages can mask current changes and make is difficult to recognize and respond to immediate problems. The use of *current data* will allow the identification of problems as they develop. An example of using current data is the calculation of peak milk yield for animals that are currently peaking (which may be defined as animals in a certain stage of lactation such as 30-60 days in milk etc.). Another example of the use of current data would be calculating days to first service for animals that received a first service in the most recent month.

GROUP: Steam Up DATE: 4-23-96 SCORER: PLR

BCS	NUMBER OF COWS																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
>4.00																									
4.00																									
3.75	X																								
3.50	X																								
3.25	X	X	X	X																					
3.00	X	X	X	X																					
2.75	X	X																							
2.50																									
2.25																									
2.00																									
<2.00																									

NUMBER IN GROUP: 20 NUMBER SCORED: 12 MILK/COW:
NUMBER TOO THIN: 2 PERCENT TOO THIN: 10% RATION:
NUMBER TOO FAT: 0 PERCENT TOO FAT : 0 MEIDAN SCORE: 3.00-3.25

GROUP: DRY DATE: SCORER:

BCS	NUMBER OF COWS																								
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
>4.00	X	X																							
4.00																									
3.75	X	X	X																						
3.50																									
3.25	X	X	X	X																					
3.00	X	X	X	X	X	X																			
2.75	X	X	X																						
2.50	X	X																							
2.25																									
2.00																									
<2.00																									

NUMBER IN GROUP: 45 NUMBER SCORED: 20 MILK/COW:
NUMBER TOO THIN: 5 PERCENT TOO THIN: 25% RATION:
NUMBER TOO FAT: 2 PERCENT TOO FAT : 10% MEDIAN SCORE: 3.00

Figure 5. Body Condition Score: Summary Table Herd: L-Acres

Finally, it is important that the proper *diagnostic tests* are used to verify that a problem exists. Diagnostic testing is especially important for the confirmation of ambiguous conditions such as cystic ovaries. In some investigations, diagnostic testing may result in resolution of a perceived problem (Table 3).

Table 3. Serum Progesterone Levels from Cows Diagnosed Rectally with Cystic Follicles

Cow	Serum Progesterone (nmol/l)	Interpretation
443	40	luteal structure
587	27	luteal structure
598	27	luteal structure
563	10	developing luteal structure

2. Define a Case. Case definition is the most important step in delineating a herd problem. A case can be defined as an animal or group of animals that demonstrates the characteristics of the disease or deviation from the production target.[4] For example, a problem with peak milk yields of parity 3+ animals is evident in Figure 6. For a production problem in this herd, a case could be defined as "a peak milk yield in a parity 3+ cow that is less than the average peak milk yield for parity 1 animals." Communication skills are vitally important to this process. Working through a case definition with a farmer often results in the investigation focusing on a very different problem than initially anticipated. Listening to the farmer define the problem and asking the right questions can sometimes lead the investigation to a speedy conclusion.

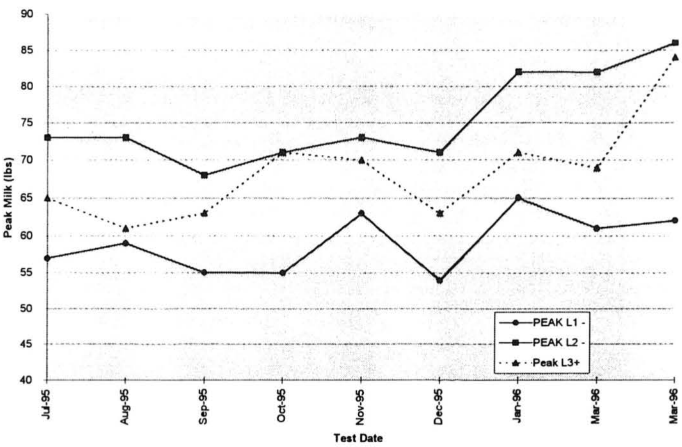

Figure 6. Peak Lactation by Parity (Peak = 31-90 DIM) L-Acres April 1996.

As part of the case definition it is important to define the characteristics of a case. For mastitis investigations the decision of what constitutes a new case of mastitis is extremely important. A farmer may perceive that he or she is treating many cases of mastitis but have just a few cows that are chronically infected and having recurrent clinical episodes. A common case definition for clinical mastitis is that episodes of clinical mastitis need to be separated by at least 14 days to be counted as separate cases. A case of subclinical mastitis is often defined as a cow with a SCC of >250,000 (or greater than a linear score of 4).

It is also important to decide whether the definition will be at the herd level or the individual animal level. This can be especially crucial when herd level data do not reveal an individual animal problem. This issue can be particularly relevant during investigations into herd problems with acidosis and laminitis. It is possible to have normal appearing herd fat and protein levels but to have a significant number of individual animals that exhibit serious inversions of fat and protein percentages suggestive of rumen acidosis (Table 4). In this herd, the herd fat test was never lower than 3.3% and approximately 30% of the herd exhibited clinical signs of laminitis.

Table 4. Fat and Protein Percentages for Selected cows from a 100 cow Holstein Dairy

Cow	Days in Milk (Sept. 15)	September 15, 1994		October 14, 1994	
		Fat Test	Protein Test	Fat Test	Protein Test
1	197	3.3	2.9	2.2	3.3
4	151	2.3	3.4	1.9	3.6
15	175	3.7	3.3	2.0	3.7
40	59	3.1	3.3	2.0	3.6
54	60	3.8	2.9	2.6	3.1
93	84	3.3	3.6	2.4	3.6
123	106	2.6	3.5	2.9	4.1

3. Determine Animal, Place and Time. The next step in the investigation of herd problems is to determine which animals are affected. The questions that we are seeking answers to are as follows: 1) *Who is affected?* 2) *Where are the affected animals?* and 3) *When did they become affected?* These questions are as equally relevant for the investigation of herd production problems as they are for disease outbreaks. Factors that *define dairy cows* include age, breed, parity, stage of lactation, level of milk production, body condition score and disease-specific factors (such as somatic cell count, number of breedings or the presence of serum antibodies). It is important to collect information from both affected and unaffected animals. Disease specific animal factors can be used to pinpoint management areas for further investigation. For example, in an investigation involving subclinical mastitis in a 250 cow Jersey dairy herd, the SCC values indicated that cows were becoming infected very early in lactation (Table 6). Further investigation was then directed at management of early lactation animals.

The *location* of affected animals should also be determined. In larger dairy operations, animals may be located in different production strings or milked in different parlors. Replacement animals may be moved among several housing facilities before entering the milking herd. Location can be a proxy for other management factors. Risk factors such as ration, personnel, and stage of lactation are often related to location. In an investigation regarding nutritional management of a dairy, the bimodal distribution of serum vitamin A values (Table 7) helped to demonstrate inadequate dietary management of animals housed in a remote location of the dairy.

If possible, the *temporal pattern* of the outbreak or production decline should be determined. The chronologic pattern of diseases with obvious clinical signs can be easily determined. The temporal pattern of subclinical problems may be more difficult to establish, especially if the problem was not noticed until it was well established within the dairy herd. Examinations of individual cows may help to pinpoint periods

Table 6. Somatic Cell Counts (x 1000) by Test for Selected Cows from a 250 Cow Jersey Dairy

Cow	Parity	Test 1	Test 2	Test 3	Test 4	Test 5
812	1	4515				
654	2	628	344	743	405	239
670	2	136	cl. mast.	878	57	130
727	1	1146	1282	322	295	5195
415	5	1127	226	127	66	155
750	1	615	67	3185	524	1642
613	3	432	144	233	185	191
675	2	430	378	424	837	1848
114	9	1876	3062	287	2764	180
478	4	592	367	280	1531	407

Table 7. Histogram of Serum Vitamin A levels from 11 dairy cows housed in two locations (A and B) on a dairy.

Class (mg/dl)	Number of Animals					
	1	2	3	4	5	6
10.0-15.0	A					
15.1-20.0	A					
20.1-25.0	A	A	A			
25.1-30.0						
30.1-35.0						
35.1-40.0	B	B	B	B	B	
40.1-45.0	B					

that diseases began. In a herd investigation relating to laminitis, several animals were measured with "hardship grooves" approximately 1.5" away from the hairline. Hooves of dairy cows grow approximately .25" per month, indicating that the initial insult may have occurred 6 months earlier. Production records were supportive of this finding (Table 8). Additional investigations indicated that fiber in the diet was limiting during this time period.

Table 8. Production records of a cow in Northern Indiana examined in November, 1995

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov
Milk	78	77	80	58	61	26	37	22	24	dry	dry

Temporal patterns of reproductive problems may be used to define the nature of the problem. Pregnancy diagnosis lags behind breeding dates by at least 30 days, so often problems are well established before they may be noticed. For example, in an investigation of reproductive performance in a small dairy (24 registered Holsteins) during June 1994, the farmer believed that reproductive performance had suddenly deteriorated. When current data were plotted temporally, it was evident the problem had been present since January (Table 9).

Table 9. Conception Rate by Times Bred by Month Bred for a 24 Cow Dairy in Northern Michigan

Times Bred	1		2		3	
Month	No. Bred	Conc. Rate	No. Bred	Conc. Rate	No. Bred	Conc. Rate
September	2	50%				
October	3	100%				
November	1	100%	1	100%		
December	1	100%	1	0%		
January	1	0%	1	0%		
February	1	0%	1	0%		
March	4	0%	2	0%		
April	3	67%	2	50%	1	0%
May	4	50%	2	0%	3	33%

4. Formulate conclusions. Occasionally, a herd investigation results in rapid identification of an easily correctable causal factor. More commonly, after examination of rates, tables, graphs and figures created to determine animal, place and time, one or more risk factors may seem to be related to the problem under investigation. In a formal epidemiologic investigation , statistical analysis such as chi-square testing and the calculation of odds ratios would be performed.[6] For most on-farm investigations performed by practicing veterinarians, statistical analysis is not necessary. Many times, the identification of risk factors is enough for the farmer and veterinarian to agree to change management factors that appear to contribute to the problem.

Statistical significance or anecdotal evidence of an association does not necessarily mean that an association is biolgically significant.[7] Other evidence supportive of causation includes: 1. a biologically meaningful association; 2. a temporal sequence; 3. dose-response relationship; 4. elimination of the factor decreases the occurrence of the event being studied; and 5. repeatability.

5. Plan preventive measures. Follow-up is necessary to determine whether the problem has been resolved. If the problem was identified early through a herd monitoring program, resolution of the problem may be readily apparent. If there is no monitoring program in place, the veterinarian and the farmer should agree upon the least and most relevant number of parameters to monitor. In this manner, problem investigation may afford the attending veterinarian the opportunity to become more deeply involved in the management of the farm.

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Abstract

Evaluation of the effect of the fenbendazole sustained-release intraruminal device on the immunity of calves to lungworm

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Each of 10 set-stocked calves was given a fenbendazole sustained-release intraruminal bolus at turnout for the control of parasitic bronchitis while a group of 10 similar calves was left untreated. The respiratory rates of the control calves were not greatly increased during the grazing season, but persistent coughing was evident from early July when they all had patent lungworm infections. Only occasional coughing was reported from the bolus-treated calves except for a transient increase in its frequency in late September. In mid-August, one of the treated calves was passing lungworm larvae and when they were housed six of the 10 had patent infections. In August tracer calves picked up an average of 23.5 lungworms per day from the control paddock but only 2.1 from the paddock grazed by the treated calves. In September the corresponding figures were 7.6 and 19.2 lungworms per day, respectively, from the control and "treated" paddocks. After housing, the post mortem worm counts after an experimental challenge with *Dictyocaulus viviparus* larvae were reduced by 99.2 and 98.7 per cent ($P<0.0001$), respectively, for the control and bolus-treated calves in comparison with weight-matched parasite-naive calves. Thus, despite a relatively low level of challenge during the grazing season, the treated animals had developed a considerable degree of protective immunity.