Herd Health Problems: The Epidemiological Approach

O. Nir (Markusfeld)
Hachaklait, the Mutual Society for Cattle Insurance and Veterinary Services in Israel Ltd.
57 Balfour St, Nahariya, 22426, Israel.

Introduction

Modern approach to herd medicine involves collection and evaluaton of data. Good data should include records of clinical cases, as well as those based on routine clinical examinations and laboratory tests. Data are recorded and processed, active care for detection of any fall from preset targets is carried out through statistical monthly reports. Integrated computer programs are designed to provide ongoing monitoring of herd performance which is compared to targets of performance. When falls from targets are detected, epidemiologic study designs are used to explain the fall from targets. The procedure involves the evaluation of the statistical associations between the traits and any known contributing factors, so that the impact of management on health and performance is determined and herd health, preventive and control programs are carried out.

While the aspects of monitoring and statistical reports have been extensively dealt with in the new developing field of herd health (1), studies describing clinical applications of quantitative epidemiological techniques are rare (7). The present study describes the use of a computer program based on individual cow records for epidemiological evaluation under common practice conditions.

Materials and Methods

Study population.

Data are from the author's routine practice on eight Israeli Holstein herds (250 to 400) cows each. These herds are characterized by high annual milk yield (8500 to 10,000 kg/cow) and heavy feeding. Cows are kept in groups according to yield, dry cows are kept in a separate group. Rations basically conform to NRC recommendations. All herds are artifically inseminated. Heifers and cows are inseminated 70 to 90, and 50 to 80 days from calving respectively.

Data collection and storage.

Farms are visited five times weekly while routine examinations are carried out once a week. Cows that calve are presented for routine examination 5 to 12 d postpartum when the state of the uterus is evaluated. All cows with observed heat are presented for a rectal examination 60 to 90 d postpartum. Inseminated cows are examined for pregnancy 40 to 47 d from insemination. Data are recorded on individual cards for each cow. Although some of the data are collected on microcomputers on the farms, a veterinary program is run as a part of the routine service given and covers all aspects of herd health. The data are recorded on DBASE softwear in two files. One file is based on individual cow data (Table 1) and contains the informaton about calving and reproductive traits (a record per lactation). The second file deals with populations and stores information on herd basis. Additional information such as monthly milk recordings, are obtained from the farm microcomputer, when needed.

Table 1: Parturition file: Structure of Database.

Field	Field name	Description	Type
1	FARM	NUMBER OF FARM	N
2	CALVING	CALVING DATE	DATE
3	NUMBER	COW NUMBER	C
4	PARITY	NUMBER OF PARITY	N
5	DAYDRY	NUMBER OF DAY DRY	N
6	DEXA	INDUCED CALVING	L
7	TWIN	TWIN CALVING	N
8	STILL	STILLBIRTH	N
9	MF	MILK FEVER	L
10	PRO	PROLAPSED UTERUS	L
11	LDA	DISPLACED ABOMASUM	L
12	RP	RETAINED PLACENTA	L
13	MET	PRIMARY NETRITIS	L
14	KET	KETOSIS	N
15	ACID	ACIDOSIS	N
16	MAST	MASTITIS	L
17	RESNUM	CULLING	N
18	ANEST1	NON-OBSERVED HEAT	L
19	ANEST2	INACTIVE OVARIES	L
20	IST	CONCEIVED FROM 1ST	L
21	CONCEIVED	DATE CONCEIVED	DATE
22	REPEAT	REPEAT BREEDER	L

Type: N = Numeric, C = Character, L = Logical, Date = Date.

A monitoring monthly report is issued to each farm. The report details the informaton for the running calendar month and for the cumulative period. Actual performance

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of the cows is compared with targets of performance. Shortfalls are further investigated using the epidemiological programs described. The chapter presented here (Table 2) is that dealing with reproduction. Herds with rate of cows OPEN GREATER THAN 150 d of more than 30.0% are further investigated. Heifers and cows are analyzed separately.

Table 2: Monitoring Report. (Reproduction).
(Farm 7 December 1988)

4. Reproduction.

	1st calf heifers		Cows	
Calving period:	Month	Year	Month	Year
a. Total	16	84	21	132
b. % anestrus	43.8	38.1	66.7	59.1
c. % inactive ovaries	6.3	6.0	19.0	19.7
d. % 1st service C.R.	81.3	47.0	45.0	28.0
e. % days open >150	6.3	28.0	33.3	37.8
	heifers		Cows	
Running month:	Month	Year	Month	Year
f. -ve in preg check				
1) n checked	12	158	14	237
2) % negative	0.0	10.1	28.6	27.0
g. % aborted				
1) abortions	1.2	2.7	0.0	0.4
2) return to heat	0.0	9.4	0.8	5.5

Epidemiological designs.

These designs aim to identify and quantify any possible associations between the traits examined and known possible factors which can explain the fall from targets. The following designs will be presently described:

1. The relative contribution of various factors to OPEN GREATER THAN 150 d.
2. The association between ANESTRUS and HIGH MILK YIELD (representing a relative shortage of energy)

Variables definitions:

1. TWIN = any cow with a multiple birth.
2. RP = any cow of a single calving with a history of retained placenta of more than 18 h.
3. MET = any cow of a single calving with a history of primary metritis (without previously retaining the placenta) as diagnosed by a routine examination 5 to 12 d post partum.
4. KET = any cow with ketonuria of more than 1.5 mmol/l with no previous history of TWIN, RP, MET.
5. ANESTRUS = any cow presented for examination 60 to 90 d postpartum because of unobserved heat with no previous history of TWIN, RP, MET, KET.
6. REPEAT BREEDER = any open cow reaching 150 d postpartum with at least 3 inseminations and with no previous history of TWIN, RP, MET, ANESTRUS, KET.
7. OPEN GREATER THAN 150 d = any open cow kept for breeding reaching 150 d postpartum.

Factors responsible for "open greater than 150 d".

The relative contribution of each factor to the trait is evaluated as follows: the INCIDENCE RATES for the trait in ALL and "NORMAL" COWS are calculated. The contribution of each factor to rate is then calculated by subtracting the theoretical from the observed values of DAYS OPEN for each factor. The contribution of "other" (undefined) factors can now be calculated by subtracting the sum contribution of all known factors from the total rate of DAYS OPEN. Statistical signification of the difference between theoretical and observed frequencies are then calculated using a Chi-square test with 1 d.f.

Association between anestrus and a high milk yield.

This computation enables evaluaton of possible factors responsible to the traits examined. In the example presented, milk yield in the beginning of the lactation is used to stimulate a negative energy balance in the preservice period. Cases and controls are matched on the trait examined to parity and order of calving. The first 3 monthly milk recordings are interpolated for 3.5% FCM. The highest two out of the first three monthly corrected records for cases and controls respectively are averaged. The averages for each case and control are compared and the higher one scores. Equal averages draw. A Mantel Haenszel test (3) is carried out. The statistical signification of the results are presented.

Results

The monitoring report of farm 3 for 1988 is presented in Table 2. The rates of cows with DAYS OPEN are high for both heifers and cows (37.9% and 39.9% resp.). Quantitatively ANESTRUS is responsible for 3.5% and 6.7% of the heifers and cows open greater than 150 d postpartum respectively (Table 3). Cows with high milk yield (Table 4), showed a greater risk for ANESTRUS compared to low yielders ($R = 4.5$, $p < 0.05$).

Table 3. Contribution to OPEN GREATER THAN 150 d.
Farm # 3 01/01/88–31/12/88

	Heifers			Cows		
n	82			119		
% Open	28.0			37.8		
	IR	Contribution	x^2	IR	Contribution	x^2
TWIN	2.4	-0.4	2.6	10.1	2.2	0.0
RP	2.4	0.8	0.0	13.4	4.2	3.4
MET	34.1	6.0	1.6	7.6	0.6	0.0
KET	0.0	0.0	***	1.7	0.4	0.0
ANEST	20.7	3.5	2.0	37.0	6.7	2.7
RB	7.3	7.3		4.2	4.2	
OTHERS	32.9	10.9		26.1	19.4	

Discussion

Monitoring reports serve as an alarm for any fall from targets and as such should be short, concise, engulph all aspects of herd health and issued at regular times (5,6). Herd size is a limiting factor for both statistical and eqidemiological reports, attempts to use those tools in small

Table 4. Association of REPEAT BREEDERS with HIGH MILK YIELD
Farm #3 01/01/88–31/12/88

with factor		withot factor		
n	% positive	n	% positive	"R"
23	73.9	23	26.1	8.0**

"R" = Risk of a cow with high yield before service to be anestrus compares to her low yielder counterpart.
** $p < 0.01$

sized herds covering short periods often prove futile. It is evident from the results that in few cases, tendencies alone could be pointed while statistical signification is hard to establish. Most recorded health reports are based on various data banks, information from all sources must be collected and processed to one program. This limitation is also valid in the present study where milk recordings must be brought in from the farm data base.

Multivariate analytic techniques which reduce a large amount of descriptive data into multivariate relationships must be employed. These relationships can be further explained by causal studies. The use of a multiple regression technique might be more proper but lack the ability to present the results quantitatively.

The chapter of reproduction presented relates both to the period of calving and to the current one. The index picked to monitor for an existing reproduction problem is that of "% cows with days open greater than 150 d". This choice avoids the problem associated with that of "days open" when culled barren cows cannot be averaged on their true value. When intervention is called for, narrrowing down the field of investigation often proves essential if results are to be obtained (2). This selection process enables the clinician to concentrate both his efforts and resources, in clinical and laboratory investigations at most promising directions. The next step is therefore to try and quantitate the factors responsible for "cows open greater than 150 d". In the method presented, only the first diagnosis for each case is taken into account, its relative contribution to the trait is evaluated. Determinants used must be both of a previously established association with the trait studied and routinely diagnosed and recorded. All unknown factors are grouped together under "others". It is assumed that each open cow with a known factor examined, has two components for her infertility. While one is common to all cows (that of "normal" ones), the second is that brought about by the trait. The relative contribution of each factor to the trait is therefore the difference between the observed and the theoretical (normal) values.

The example used for a further epidemiological investigation presented deals with a herd problem of anestrus. Structured case-control studies are used to establish the disease determinants as suggested before (7). Anestrus was associated with a negative energy balance before (4). It can be postulated, similarly, that high yielders kept at the same feeding group will be in a relative shortage of energy compared to their low yielder counterparts. Milk yield after calving could therefore be used to indicate a relative shortage of energy. Repeat Breeding was found in the present example to be associated with high milk yield in the first three months of the lactation.

Summary

Applied clinical epidemiological methods in an integrated program of herd health are described. These include the data base used to store the data, part of the monitoring report dealing with reproduction, and programs of epidemiological evaluation. Anestrus is used as an example for the methodology applied. Alarming levels of "% cows open greater than 150 d" when monitored, are further evaluated for the relative contribution of various possible factors to the trait. The effect of underfeeding before service on the rate of anestrus is further investigated using the data base. The merits and limitations of such tools as part of the integrated herd health programs are discussed.

References

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