Korean J Vet Res(1999) 39(4) : 730~737

Development of a model for animal health monitoring system in Gyeongnam
I. Design, data and frequencies of selected dairy cattle diseases

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(Received Sep 17, 1999)

Abstract : A national animal health monitoring system(NAHMS) in Gyeongnam area was started from 1997 to develop statistically valid data for use in estimating disease frequencies in dairy cattle, and the associated costs. The objectives of this study were to : (1) discribe what was done to implement and maintain the system in Gyeongnam ; (2) present selected disease frequencies ; (3) discuss the epidemiological consideration of what was done and implications for the results obtained.

Veterinary Medical Officers(VMOs-professors and graduate students from Gyeongsang National University, Faculty of Gyeongnam Livestock Promotion Institute, and Clinic veterinarians) served as data collectors. After training on current disease and management problems of dairy cattle, interview techniques, sampling methods, and data collection instruments, the VMOs participated in selection of the sample herds and data gathering. Forty of 167 dairy herds were selected randomly and the VMOs visited farms once a month for 12 months to collect data about management, disease, inventory, production, preventive treatment, financial and any other relevant data. Strict data quality control devices were used. Specific feed-back was developed for the producers and data collectors.

Of the three age groups studied, cows had the greatest number of disease problems. The six disorders found most frequently were (from the highest to the lowest) breeding problems, clinical mastitis, birth problems, gastrointestinal problems. metabolic problems, and lameness. In young stock, respiratory, multiple system, breeding problems, and gastrointestinal problems were pre-

This project was supported by grants from the Ministry of Agriculture(number of project : ARPC ; 197015-2).
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dominant, whereas in calves, gastrointestinal, respiratory, and integumental problems were major.

Key words : monitoring, design, data, frequency, disease.

Introduction

The National Animal Health Monitoring System(NAHMS) is an information system designed to collect, analyze, and report useful information on animal health events. NAHMS is voluntary, cooperative project among food-animal producers and their associations, animal health specialists in university, and local animal health personnel. NAHMS is not a one-time snapshot, but rather a continuous picture of animal-health events and the economic impact of those events.

Some monitoring systems have been developed to estimate prevalence and/or incidence of a single infection/disease. For example, the brucella milk ring test[1] was strict for brucellosis in the our country as well as other countries, and the tuberculosis program[2] is primary for bovine tuberculosis. Various monitoring systems were designed to estimate disease frequencies of more than one disease, but the place of observation and type of measure of disease were various. Slaughterhouse-based monitoring systems, for instance, have been designed primarily to measure prevalence of disease as detected at slaughter[3-5].

Animal health monitoring system in our country combines information from branch or departments of Livestock Promotion Institute and reports from the farms. This system is passive monitoring system and, for most time, the numbers of animals at risk are not know and true rates of diseases cannot be estimated. In addition, data on management, production, and cost of disease are not collected. Furthermore, the sampling and criteria used for data collection are not very clear. For their intended use, however, these systems provide valuable disease information on the all over country and/or regional level.

Many farm-level monitoring systems have been developed where multiple diseases, production, management factors were estimated[6-9]. Although these monitoring systems included production, management and cost data, the results obtained may not be generalizable to the original reference populations because of the type of sampling used. The objective of the this program in Gyeongnam area was to generate statistically valid data on dairy cattle health-related events for use in computing regional estimates of incidence rates and cost of these animal events.

The objectives of this study are to : (1) describe what was done to implement and maintain the system in Gyeongnam area ; (2) present selected results ; (3) discuss epidemiological consideration of what was done and implications for interpretation of the results.

Materials and Methods

Implementation of the system :

initiation : A committee was composed the development of this program. The planning committee, which dealt with policy matters and met monthly, was composed of the four professors, seven graduate students, one clinic veterinarian, and four veterinarian from the Gyeongnam Livestock Promotion Institute. This committee coordinated the everyday activities of the program, including data collection, management and processing. This program was developed for two years from 1997. 10.

Design of sample : Forty of the 167 available dairy herds were to be selected for participation in the project. We were identified the number of herds in each herd size category to be included in the sample. Using information data from Gyeongnam Livestock Promotion Institute, herd size were stratified. Herds within each animal-density stratum were stratified, according to the number of adult cows available, into five size strata : 1-20 ; 21-40 ; 41-60 ; 61-100; $\geq$100. Because sometime foreign country lists tend to overlook

small herds, we included small herds(1-20). As a result, a sample(based upon probability proportioned to animal numbers) of 40 herds was obtained.

Training of data collectors : A total of 15 veterinary medical officers(VMOs) from the College of Veterinary Medicine, Gyeongsang National University(11 VMOs), Gyeongnam Livestock Promotion Institute(3 VMOs), and one clinic veterinarian served as data collectors. The VMOs had been trained in interview techniques, current management practices, common dairy disease problems, data collection, and the need for probability-based random sampling.

Selection of the 40 samples herds : The VMOs were asked to use the following procedures for the final selection of the herds : (1) we visited the producers in the Chinju-Sachon areas farms and explain the program ; (2) and if he accepted to participate in the program ; (3) we confirmed the herd sizes with the producers ; (4) we wrote his names and addresses of the eligible producers in notebook ; (5) we wrote a serial number of the producers, i.e. from one to n ; (6) finally, we received the signature of the producers. (7) If the producer refused, the VMOs wrote down the reason for refusal and visited the other farm.

Using a simple random procedure and the information provided by the VMOs, the committee selected which particular producer(s) would be included in the sample. To save time, we noticed the order in which herds were to be approached by using telephone.

Maintenance of the system :

Data collection : All producers who agreed to participate in the program signed an agreement to keep records. The VMOs collected data at the begining of the program using the initial-visit form(Form 1) and provided the farmer with forms(Producer's Daily Log) to record animal events during the time between visits. The VMOs visited the farm monthly and interviewed the producer regarding any animal events that occurred during the previous month. Data on inventory and disease(prevention activities, cases, actions taken to correct them, and consequences of the disease) were recorded on Form 2. A special worksheet was developed to maximize the availability of individual cow identifications. It was produced for each farm every month, and listed all cows on the farm, their most recent calving dates, and any diseases/conditions that were reported during the previous month. These sheets enable the VMOs to gather data on a case-by-case basis for each individual cow, which should have improved the ability to identify new cases. Because of limited spaces, the forms used are not presented in this paper, but are avilable upon request. Data for the completion of the forms were extracted from the interviews, producer daily log, other sources such as bills, milk receipts.

Data quality control : After data was collected, the data were checked for errors, missing values, proper disease codes, and changes in inventories by veterinary graduate students, and faculty in the college. Data were entered on microcomputers softerware program(this program was developed by Research Institute of Industrial technique Gyeongsang National University). Checks were built into the data entry processor to avoid errors of entry. After correction of errors on microcomputers, data were copied into files and stored for analysis.

Feedback system : A monthly newsletter was sent to producers. The report included risk rates of diseases reported the previous month in the given herd and means of risk rates of the same diseases observed in their stratum and any available information for the farms.

Computation of disease frequencies in a herd :

Incidence density(ID) : The incidence density (ID) method was used as a measure of disease frequency for the individual herd for 1 month (Miettine[10] ; Kleinbaum *et al*[11] ; Martin *et al*[12],) This method was used as there may be a high turnover of animal during a month. Multiple cases can occur in the same animal within a month, and no individual animal data used. It is modified version of the actuarial method discussed by Elandt-Johnson[23] [eqn. (1)]. For this paper, the monthly incidence densities were summarized into an annual figure (aID_{ij}) for each herd as shown in equation.(2).

$$ID = \frac{\text{No. of case}}{\text{animal-months}} \quad \cdots\cdots\cdots\cdots (1)$$

$$= \frac{\text{No. of case of disease(X) during current month}}{\text{No. of animals at risk at end of previous month} - 1/2 \text{ withdrwals} + 1/2 \text{ additions}}$$

withdrawals = no. sold + no. died due to other disease + no. transferred to different age group

additions = no.purchased + no. transferred in from other age groups

$$aID_{ij} = \left(\frac{\sum_{m=1}^{12} case}{\sum_{m=1}^{12} aniaml - months} \times 12\right) \times 100 \quad \cdots\cdots (2)$$

(aIDij = "annual" incidence density for the ith herd in the jth stratum expressed per 100 cow-years)

Computation of the weighted mean "annual" incidence density for a stratum is shown in equation. (3).

$\overline{aIDj}$ = estimate for the "annual" incidence density for the jth herd size stratum

$$= \sum_{i=1}^{n} W_{ij} aID_{ij} \quad \cdots\cdots\cdots\cdots (3)$$

$$W_{ij} = \frac{aNAR_{ij}}{\sum_{i=1}^{n} aNAR_{ij}}$$

aNARij = number of animal-years=sum of animal-months/12, equivalent to average herd size for years

Results

Sample characteristics of the herds selected are presented in table 1. The ratio of participation of this study was 23.95% and many of the producers contacted refused to participate for four reasons : (1) cow is received stress by sample collection. (2) it is hard to keep record. (3) lack of interest. (4) "make bother". Herd size was ranged from 8 to 120 (mean ± SD = 194 ± 18), The number of farm that had herd size from 1 to 20, 21-40, 41-60, 61-100, and over 100 cows per farm were 20(11.98%), 58(34.74%), 55(32.93%), 28(16.77%), and 6(3.59%), respectively. To compare with the ratio of participation of this project, the farm that had herd size over 100 cows per farm had the highest ratio(83.33%), and the farm that had herd size from 41 to 60 cows per farm had the lowest ratio(14.55%) (Table 1).

Of the three age groups, cows (lactating and dry females after first parturition) had the greatest number of disease problem. The nine disorders found most frequency reported disease problems in cows were (from the highest to the lowest) breeding problems(20.97 ± 4.07), clinical mastitis(17.08 ± 3.76), birth problems(9.58 ± 2.94), gastrointestinal problems(6.38 ± 2.44), metabolic/nutritional problems(4.91 ± 2.16), lameness(3.71 ± 1.63), multiple system problems(2.50 ± 1.56), integumental problems(1.90 ± 1.36), and respiratory problems(0.35 ± 0.59) (Table 2). Among the all of strata, stratum 3 had the highest ratio of breeding problems and stratum 4 had the lowest ratio of breeding problems. From this results, the higher herd size, the lower breeding problem(Table 2). Clinical mastitis, birth problems, and gastrointestinal were also showed the same incidence as breeding problems but metabolic problems and lameness, except stratum 3, had some difference above of those(Table 2). Integumental problems and respiratory occurred rarely in cows. Specific things of disease group was that unknown (die) problem occurred in stratum 1. It may be due to lack

Table 1. Sample characteristics of dairy herds in the animal health monitoring system in Gyeongsang area ; Round 1, 1997-1998

Herd size	No. of cattle	% of cattle	No. of herds(%)	No. of herds in sample(%)
1-20	226	2.92	20(11.98)	9(45%)
21-40	1,739	22.45	58(34.73%)	12(20.69%)
41-60	2,924	37.75	55(32.93%)	8(14.55%)
61-100	2,144	27.68	28(16.77%)	6(21.43%)
≥100	712	9.19	6(3.59%)	5(83.33%)
Total	7,745	100	167(100%)	40(100%)

Table 2. Most frequently reported disease porblems in cows-expressed as mean incidence densities±1 SD per 100 cows-years

Disease group	stratum 1	stratum 2	stratum 3	stratum 4	stratum 5	All strata
Breeding problem	19.40±4.95	18.47±3.98	22.44±4.17	3.06±1.72	18.96±3.91	20.97±4.07
Mastitis	26.11±4.39	38.51±7.31	14.85±3.55	4.59±2.09	10.83±3.10	17.08±3.76
Birth problem	14.18±3.49	7.31±2.60	12.21±3.27	2.55±1.58	5.41±2.26	9.58±2.94
Gastrointestinal	6.72±2.50	9.41±2.92	5.94±2.36	2.04±1.41	2.71±1.62	6.38±2.44
Metabolic/nutrition	6.72±2.50	3.14±1.74	2.31±1.50	0.51±0.71	6.77±2.51	4.91±2.16
Lameness	2.99±1.70	3.14±1.74	2.31±1.50	0.26±0.50	2.26±1.49	3.71±1.63
Multiple system	2.98±1.70	1.39±1.17	3.30±1.79	1.02±1.00	1.58±1.25	2.50±1.56
Integumental	4.48±2.07	0.34±0.59	0.0±0.0	0.26±0.50	0.32±1.75	1.90±1.36
Respiratory	1.49±1.21	0.35±0.59	0.0±0.0	0.0±0.0	0.23±0.48	0.35±0.59
Urogenital	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.23±0.47	0.08±0.29
unknown (die)	5.22±2.23	1.40±1.17	0.33±0.57	0.0±0.0	0.68±0.82	1.30±1.13

of care of producers. Because the herd size was very small (Table 2). Calves (male or female animals from birth to weaning off liquid ration) were second in numbers of disease problem(Table 3). The four disorders found most frequently were (from the highest to the lowest) gastrointestinal problems, respiratory problems, integumental problems, and multiple system problem in calves. Gastrointestinal problems were showed the highest incidence densities and it was consistent with those of others. So, we concluded that gastrointestinal and respiratory problems were major diseases in dairy calves. Stratum 4 showed very lower incidence densities in four most frequently reported disease problems (Table 3). It may be due to low ratio of participation than other groups in this project. Stratum 1 (small herd size : 1-20 cows per farm) showed relatively low incidence densities in four most frequently report disease problems than other groups except gastrointestinal problems(Table 3). The young stock [male or female animals from weaning to first calving (female) or first use for breeding purposes (male)] had the fewest disease problems (Table 4). The most frequently reported disease problems were respiratory problems and other disease problems was showed very low incidence densities as compare with cows and calves(Table 4). The composition of the diseases groups are presented in Table 5. There was

Table 3. Most frequently reported disease porblems in calves-expressed as mean incidence densities±1 SD per 100 calf-years

Disease group	stratum 1	stratum 2	stratum 3	stratum 4	stratum 5	All strata
Gastrointestinal	69.22±5.16	53.14±4.23	31.26±3.27	12.16±1.25	41.13±3.21	82.34±6.23
Respiratory	4.18±1.03	18.42±2.43	12.10±1.68	0.0±0.0	9.27±1.23	24.12±2.63
Integumental	0.0±0.0	10.21±1.24	0.0±0.0	0.0±0.0	20.31±3.64	5.41±2.57
Multiple system	0.78±0.25	5.11±1.37	2.11±1.27	0.0±0.0	3.27±1.46	1.24±1.14
Metabolic/Nutrition	0.23±0.14	0.41±0.23	0.25±0.15	0.0±0.0	0.0±0.0	0.13±0.11
Lameness	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0
Urogenital	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0	0.0±0.0

Table 4. Most frequently reported disease porblems in young stock-expressed as mean incidence densities±1 SD per 100 animal-years

Disease group	stratum 1	stratum 2	stratum 3	stratum 4	stratum 5	All strata
Respiratory	0.57±0.45	9.24±2.74	3.72±1.54	5.54±1.47	6.31±1.98	4.68±1.28
Multiple/nutrition	2.46±1.45	1.65±0.54	0.24±0.13	2.15±0.97	1.47±0.23	0.97±0.64
Breeding problem	0.25±0.16	0.34±0.12	0.21±0.14	0.12±0.15	0.41±0.15	0.24±0.17
Gastrointestinal	0.47±0.23	0.0±0.0	2.14±1.41	0.0±0.0	1.61±0.21	0.13±0.11
Lameness	0.0±0.0	0.27±0.16	0.41±0.47	0.0±0.0	0.67±0.54	0.24±0.18
Mastitis	0.0±0.0	0.0±0.0	0.15±0.24	0.0±0.0	0.03±0.02	0.0±0.0

Table 5. Disease grouping used in the animal health monitoring system in Gyeongnam area ; 1987-1988

Group name	Composition
Breeding problems	Anestrus, cystic ovaries, follicular cystics, false pregnancy, repeat breeder, vaginitis, pyometria, reproductive problems NOS[a]
Mastitis	Clinical mastitis
Birth problems	Abortion, dystocia, prolapsed uterus, retained placenta, uterine torsion, vaginal tears
Gastrointestinal	Bloat, coccidiosis, constipation, displaced abomasum, diarrhea, enteritis, hardware, intestinal obstruction, gastrointestinal problems NOS
Metabolic/nutritional	Milk fever, downer cow syndrome, ketosis, polyphagia, acidosis, nutritional deficiency
Lameness	Lameness, footrot
Multiple system	Abscesses, accidents, agalactia, neonatal death, off feed, weight loss, injuries NOS
Integumental	External parasites, mycotic dermatitis
Respiratory	pneumonia, respiratory problem NOS
Urogenital system	Nephritis, urinary tract infections NOS

[a]NOS : not otherwise specified.

noticeable seasonal variation in disease frequencies, particularly in respiratory and birth problems(Akabane).

Discussion

The national animal health monitoring system is the best way to prevent and control animals diseases before it's occurrence in the field[14]. In other countries, they developed this system and used it for improvement of animals and human health and production of meat with safety and quality of food and control of livestock food exports-imports[6-9]. Some monitoring systems have been developed to estimate prevalence and/or incidence of a single infection/disease. Various monitoring systems were designed to estimate disease frequencies of more than one disease, but the place of observation and type of measure of disease may vary. Slaughterhouse-based monitoring systems, for instance, have been designed primarily to measure prevalence of disease conditions as detected at slaughter[3-5]. In our country monitoring system, data are obtained from branch or departments of Livestock Promotion Institute. This system is passive monitoring systems and, for most times, the numbers of animals

at risk are not known and true rates of diseases can not be estimated. In addition, data on management, production, and the cost of disease are not collected.

Preparatory steps taken during the initiation phase seemed to have been useful in obtaining dairy industry, and political support within the province country. Such support minimized the problems of implementation of the system. Some of the groups contacted during the preparatory phase wanted know if there was a real need for a NAHMS and how they would benefit from such a system. To maintain a random sample based upon probability proportioned to animal numbers, it was essential for us to confirm sizes of herds. This is because sizes of herds change from time to time. The VMO worksheet was a useful instrument for cross-checking with data recorded on the general NAHMS forms. Additionally, it enabled the VMO to prompt the producer to remember specific events for specific cows, as the worksheet identified individual cows. Data quality has been and will always be an important issue in field studies[15]. Because most producers were not easy in recording various events including drugs used and financial aspects of their farms, and so, we visited farms once a month for 12 months and interviewed the producers regarding any animal events that occurred during the previous month. After interview we recorded various animal events. The availability of identification of individual cows was helpful in confirming new cases. These data will be useful when we examine the relationship of various risk factors to specific disease frequencies. We will report the relationships of various risk factors to specific disease frequencies in next series of paper. The results of most frequently reported disease problems in cows, calves, and young stock were breeding problems, mastitis, birth problems, gastrointestinal, metabolic, lameness(Table 2), gastrointestinal, respiratory, integumental problem (Table 3), respiratory, multiple system, breeding problem and gastrointestinal problem (Table 4), respectively.

As definitions of disease entities may vary from system to system, results reported in this paper may not be directly comparable with other paper reported, but comparable our results with those of others, our results were consistent with those of others[6-9] in dairy cows, but the results of most frequently reported disease problems in calves and young stock were different with those of others[6-9]. The discrepancy between our results and those of others may be due to the size of herds, management, preventive activity, and keeping records. Most producers did not recognize the importance of this system as well as they run on dairy farms without good management and so, we thought that the educational program (or training program) needs to producers how to deal with dairy cattle, to prevent effectively the risk factors and to keep records. It may be useful not only to provide programs for dairy farmers but also to change their concerns about on the importance of this system. If this system is established, this system could provide valuable disease information on the all over the country and/or regional level and can be extrapolated to the rest of other species(for example, pigs, poultry, beefs, equine, fishes). In addition, we know that dairy farmer's attitudes and concerns about keeping records are also very important factor for good diary management. If their concerns and attitudes about this system were changed and the farmers use effectively this system, incomes of farmer's and productivity of dairy cattle may be improved.

In conclusion, this system are very useful tools for prevent diseases, associated costs account, management problems, improvement of productivity, production of meat with safety, and control of export-import of livestock products.

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