Options in dairy data management

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Introduction

Progressive dairy veterinarians are becoming increasingly proficient in the use of herd management software to monitor and evaluate the health and productivity of clients' herds. This trend is facilitated by increasing affordability of powerful computer hardware, particularly truly portable microcomputers, and the evolution of software. Microcomputers have sufficient speed, power, and storage capacity to rapidly process the large amounts of data necessary to investigate factors affecting herd health and performance.

Good dairy herd managers recognize the value of well-designed information management systems. A comprehensive dairy health management software program should allow the herd manager to monitor production, reproduction, genetic progress, milk quality, and health within an economic context; direct management of individual cows on a day-to-day basis (e.g. which to breed, which to present for rectal examination, etc.); and have the flexibility to allow adaptation to different management styles and to grow as managerial sophistication increases. These programs should allow veterinarians to monitor performance and critically analyze herd data, in order to diagnose deviations from target productivity and remove some of the risk in providing management advice affecting animal health and productivity (1–3).

Early detection of deviations from targets can help to identify areas where changes in management procedures may be warranted, such as causes of decreases in milk production during summer months. The challenge to the consultant is to differentiate real dips in productivity from the inherent biological variability within a population of animals (4,5). Often a dairyman perceives a problem that more detailed investigation does not support. If a problem does exist, the subgroup of the herd most affected should be identified. Computer databases allow us to examine historical data to determine if the problem has occurred in previous years (e.g. is it a recurring seasonal problem?), and diagnostic database queries may further help to identify factors contributing to the problem (e.g. feeding or housing problems). The resulting economic loss must be compared with the cost of any proposed solution. If it is economically sound to attempt to correct the problem and improve production, the most difficult task still lies ahead in many cases; namely, the actual implementation of a suggested change in management procedure (compliance) and the monitoring of progress made.

In 1983, the findings of a standardized assessment of selected software suggested that none of the systems evaluated satisfactorily addressed all the requirements of a comprehensive dairy herd management program (6). Following that study, one system [DHMS Omnisoft Corp., Elma, Washington, USA (presently marketed as "DairyTRAK", Control Data Corp., Minneapolis, Minnesota, USA)], which fulfilled many of the requirements of the "ideal" system, was implemented and evaluated both "on-farm" and as a "bureau" system. The system performed well, and information produced by it was well received by producers and veterinarians. However, small herd sizes and the expense of hardware and software ($8,000–$10,000 at that time) deterred dairy managers from purchasing it (7). Many improvements have been made to dairy health management software since that time, and when considered with the increased performance of hardware at greatly reduced prices, the use of dairy herd information management technology has changed significantly. The Guelph comparison study has not been repeated for current software due to the high cost and time required to do so. Recently, six systems used in the Netherlands and six systems used in the United States were compared (8). However, this comparison was made on the basis of responses by system developers to a mail survey, and no testing was done using a standardized dairy herd data set.

Options to consider in the implementation of dairy health management software

Bureau versus on-farm approach

Bureau approach

During the late 1980s, an increasing number of veterinary practices in Ontario began to provide dairy herd, information management services, utilizing the bureau approach. Data are either retrieved from farms at routine veterinary visits and carried to the veterinary clinic or mailed in by the producer. Report packages are usually custom designed to suit the individual farm requirements and desires. For instance, herd inventory reports are favored, as they provide general information on parity, production, and reproduction for the entire herd. Due to calve, due to dry-off, and other action lists are also very popular. With the advent of increased use of notebook computers and portable printers, veterinarians can carry the program and updated herd data with them to the farm and generate reports on the farm, which can be viewed on screen and only printed when a hard copy is deemed essential.

Advantages and disadvantages of the bureau approach

Advantages

1. Data entry conventions are consistent across herds, hence there are more uniform data for herd-by-herd analysis purposes (e.g. data integrity may be greater). Producers who do not wish to purchase a computer or learn to use one benefit from the technology through the bureau service.

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2. Reports are consistent and are provided at regular intervals. Reports can be accompanied by written advice from the veterinarian (or other consultants) regarding their interpretation.
3. Comparisons among herds within a practice can be accomplished easily. Such comparisons with regional peers may provide dairy herd managers with more meaningful information and incentive than other forms of comparison.
4. Reports are generated and evaluated by someone with experience from a number of herds, which allows for a more critical and unbiased assessment to be made.

Disadvantages

1. Less use can be made of the day-to-day herd management aspects of the programs because of the delay between retrieval of data and delivering reports. Depending on the frequency of updates and report generation, the timeliness and relevancy of reports may not be optimal.
2. While the bureau approach increases consistency of event classification at the data entry stage, it increases the likelihood of errors because of the two phases of data handling; namely, the transfer of data from the farm to the veterinary clinic and the entry of data at the clinic, due to the fact that the entry person is not as familiar with the animals as the dairy manager, spouse, or employee.
3. Restricts the ability of the dairy manager to learn about and improve dairy herd management through hands-on use of the software.
4. The database applications (user defined) aspects of report generating capabilities of some systems may not be utilized to full advantage under the bureau approach.
5. Reports and analysis may reflect the consultant's interests and goals, not those of the dairy.

On-farm approach

All data entry is done onfarm. All farm personnel are encouraged to record pertinent events observed during their daily working routines.

One of the greatest impediments to establishing on-farm computerized databases is the time required for initial entry of individual cow biographical data and data required for proper action list and report generation (initial start-up). It requires at least a full day and sometimes two for a 45 cow herd if information pertaining to the lactating herd and replacement stock is also keyed in. Some dairy herd improvement (DHI) record processing centers are now providing historical data files in an electronic format that is compatible with most dairy herd management software. Hence, a task that previously took several days can now be done in a matter of minutes and provides far more complete and accurate historical information. Another new service provided by DHI centers, which enhances the utility of dairy herd management software, is the provision of test-day production data on diskette or via modem. This allows production, reproductive, and health data to be integrated into useful reports. This information may be utilized by anyone providing service to the producer (e.g. nutritionists, dairy extension specialists, veterinarians, geneticists, lenders, and accountants). The on-farm computer could form the basis of a one-step-entry system, linking the herd database with DHI center, artificial insemination (AI) center, breed association, and extension office databases. Exchange of information among those industry service groups and the producer could be facilitated by such a system (9).

Advantages and disadvantages of the on-farm approach

Advantages

1. The computer is on-farm; hence, individual cow histories, herd inventory and action lists, and performance evaluations are readily available when the producer requires them. Therefore, data is always current and reports are timely.
2. Data entry is performed by a person familiar with the animals and the events occurring on the farm. Animal identification errors are minimized as the person doing data entry is closer to the source of the data and can readily check on any discrepancy.
3. The dairy herd manager has an opportunity to increase his/her knowledge of herd management techniques through use of the software.
4. Some software handles multiple-generation pedigree information, enabling dairy managers to maintain, access, and print this information for marketing purposes. Electronic registration will be possible once the breed associations offer this as an option (10). Also, electronic downloading of official extended pedigree and production certificates from breed association offices may prove useful to some breeders.
5. The farm computer can be utilized for multiple dairy farm software applications, including accounting systems, sire summary and selection programs [e.g. Sireview (Semex Canada, Guelph, Ontario)], spreadsheets, and nutritional evaluation programs.
6. Modem communications software (e.g. PCAnywhere, Symantec, Pointe Claire, Quebec) allows a veterinarian or consultant to provide on-line instruction to the dairy herd manager during the early stages of software implementation or when problems arise. File transfer is also possible with this software, although it was primarily designed to facilitate on-line communication between two computers.

Disadvantages

1. Lack of uniformity with respect to data entry. This may limit the use of the data for some forms of research (can be overcome with the design of prospective standardized data recording and entry conventions).
2. Greater start-up costs to the producer: namely, purchase of a computer, printer, and software; time required to learn the program; and time required to enter initial data needed to get the program up and running, if historical identification and production files are not available in electronic format from the local DHI center.
3. Excessive cost due to travel time required for data collection, unless modem transfer of data is utilized.
4. It is becoming increasingly important for producers to know where they stand relative to their peers in an industry that is becoming more competitive. Therefore, a potential disadvantage of on-farm systems is a lack

of central data registry enabling among herd comparisons. This is overcome in the case of some software via site licence agreements signed at the time of purchase, which ensure that data will be sent periodically to a university for analysis and summarization/comparison.

5. Lack of veterinarian and consultant familiarity with the program. The veterinarian/consultant may not be aware of how indices are determined or populations of animals included in the formulas.

Data input options

As far as possible, the program should allow data to be recorded at the level of detail desired by the user. Dairies vary greatly with respect to data requirements. Ease and speed of data input and error detection and correction are very important considerations. Data entry time represents a considerable cost to veterinarians offering a bureau service to their clients, so any features that improve the efficiency of data entry are desirable. Users of dairy herd management software are wise to employ the most competent individual for the least cost for data entry.

Since dairy herd management software programs must be capable of integrating health and production information, electronic access to DHI information is essential (11).

Interface with dairy herd improvement associations

There are three major areas of dairy herd improvement, microcomputer, and information exchange.

(i) Historical DHI, individual cow, biographical and production information can be transferred by modem or diskette to the microcomputer in a veterinary practice or on-farm, rather than being entered by hand (the utility of this option when installing a dairy herd management system on-farm or in practice was discussed earlier). Dairy herd improvement services in Edmonton, Alberta, currently offers this information on diskette at a cost of $75.00 per herd. The information includes an identification and pedigree record for every cow in the herd currently on active DHI computer files, DHI test-day information for at least two lactations for each cow in the herd currently on active DHI computer files, and a production summary of every completed lactation for each cow in the herd currently on the active DHI computer files. Dairy herd improvement services in Guelph, Ontario will provide four files for a fee of $25.00 per herd; namely, a historical cow (and/or heifer) pedigree file, historical test day herd summary files for at least the previous 18 mo, a historical individual cow lactation summary of production file for all lactations (for current and/or removed animals), and a historical cow test detail file containing all individual test data for current and previous lactations.

This service saves many hours of individual animal biographical and event data entry.

(ii) Milk (fluid and component) production data can be updated from the DHI database monthly. Currently, in Alberta, more than 10% (92) of the herd owners in the DHI program are enrolled on the monthly Data Transfer Option (data mailed out on diskette at a cost of approximately $7.00/mo). Of those owners, 40% have copies of their diskettes sent to a third party (veterinarian, feed representative, consultant). The herd owner's signature is necessary to release the data. Alternatively, 20 herd owners have chosen to use the Alberta DHI bulletin board option to download their monthly DHI file via modem. Dairy health improvement services in Ontario currently has 52 producers receiving information directly from its bulletin board and 13 advisers receiving information in order to provide service to 100 producers (at $8.30 per test). An additional 78 producers receive information directly via diskette and 7 advisers servicing 10 producers use the diskette option (at $11.00 per test).

(iii) Management and health data can be sent back to the DHI center, thereby eliminating the need to complete monthly barnsheets by hand. Some DHI centers [LATLQ (QUEBEC DHAS), P.O. Box 333, St. Anne de Bellevue, Quebec; Agri-tech Analytics, PO Box 177, Tulare, California, USA; Michigan DHIA Inc., Lansing, Michigan, USA; Dairy Records Processing Center, Raleigh, North Carolina, USA] now accept uploading of milk weights either from a microcomputer used by the DHI supervisor or directly from the milking equipment. Some Ontario DHI testers have recently begun to employ this technology.

For those producers not enrolled in DHI services, on-farm microcomputer or bureau-derived production information systems can provide an alternative source of herd management information.

A data capture option that has been adapted by some segments of the swine industry is that of scanning systems: an electronic scanner (Scanning Systems, H.E.I. Inc., Victoria, Minnesota, USA) is utilized to read "sow cards", which have been designed to be useful to the producer in the barn, but which also can be scanned to eliminate the need to key in data.

Data storage and manipulation

Ideally, producers should only collect and record data that will produce useful management information. This approach involves regular and complete recording of a minimum data set, supplemented with further data from time to time to investigate possible problems and monitor progress following interventions. The minimum data set should include calving dates, breeding dates, disease and treatment events, removal reasons and dates, and production information. A good measure of a software system is how efficiently it can capture a minimum set of useful information for the manager and practitioner from the outset of implementation. As dairy herd managers become more aware of the benefits of having various information, the nature of the data recorded should be reviewed.

A critical feature of database design is the length of time for which data are stored and are accessible for report generation. When performance over time is being analyzed, it is essential that information from all animals, including those that have been removed from the herd, be used. Time-series reports generated using data from records of only those cows still present in a herd can be very misleading, because summary statistics produced for historic periods are biased toward the performance of animals that tend to survive longer in the herd.

Differences in dairy cow survival rates (longevity) are dependent on many economic factors and breeder

preferences, as well as on the cow's ability to produce profitably over a number of lactations (16). A need has been identified for the development of sophisticated computerized decision aids that define objective, herd-specific, culling policies designed to optimize the economic lifetimes of dairy cows (12–17). Some preliminary attempts have been made to develop such systems for use in North American and European dairy industries (18,19). It will soon be possible to integrate these decision aids with on-farm management information systems for field use, but only where complete lifetime histories of animals are permanently maintained in the database.

Decision aids pertaining to areas of herd management other than culling have also been developed (20–23).

The formulas utilized in and populations contributing to reports generated by the program should be defined, so that new indices can be evaluated as our experience grows with this type of software. There is variation in the methods used for calculating performance indices among DHI record processing centers and microcomputer systems (24). Inconsistencies in the programs make among herd comparisons difficult, and interpretation of performance goals confusing. An ad hoc committee appointed by the American Association of Bovine Practitioners (AABP) has developed a set of proposed standards (25). Some of the more advanced programs provide a summary of the records that contributed to a given report. This information is essential to the accurate interpretation of reports.

Data output format

The ability to graphically demonstrate associations of factors affecting productivity is useful in both a diagnostic and an educational sense. Reports should be concise and provide information in a logical sequence to aid in interpretation. The ability to view all reports on-screen and then selectively print out only relevant information is essential. The most useful programs allow the creation of user-defined reports, in addition to preprogrammed worklists and reports. The program should also have the capability of analyzing selected subgroups, so that time intervals and subpopulations of the herd (such as feeding groups and animals of different reproductive status or production level) can be selected for evaluation and comparison purposes (1,3).

Transfer of data files to other data management programs may be just as important as the ability of a program to accept information from other data sources. The ability of a program to output data in a format that can be utilized by other software is necessary, so that maximum utility of data entered into the system is achieved. This allows farmers and veterinarians to gain maximum decision-making assistance from the system. For example, many DHI centers have the facility to upload reproductive, health, and production information electronically from on-farm milking and computer systems. This eliminates the need for the double recording and key punching of monthly animal history updates by DHI field personnel. In addition, it allows people to analyze the data using software and techniques with which they are familiar.

Facilitation of user defined report generation, intervention evaluation and observational studies

Practitioners and producers have different requirements for dairy herd management software; producers generally utilize individual animal data, whereas practitioners and other consultants are more concerned with herd summary information (23,26). Flexible database programs allow producers and veterinarians to record detailed data specific to individual cows. Such data may be accessed through a variety of user defined reports pertaining to groups of individuals that satisfy a particular set of conditions. The peak milk yield of all second lactation cows calving between November and March following a dry period of less than 50 d is one such example. Analysis of this information may be of use in making management decisions (1–4,23,26–32) and allows users to design and generate analyses beyond the standard reports programmed into the software or received from DHI centers.

In the human medical field, practice databases have been used to investigate clinical epidemiology, risk assessment, postmarketing surveillance of drugs, practice variation, resource use, quality assurance, and decision analysis (33). Databases for human medical practice have several advantages over databases for health insurance claims for conducting research: more accurate timely data, rich clinical detail, and continuous parameters (33). In the field of dairy health management, databases maintained on farm and in veterinary practices have advantages over those maintained by DHI organizations, breed associations, artificial insemination units, and government agencies. Additional advantages are that the databases are more efficiently maintained and more comprehensive in that they combine inventory, production, health and pedigree information, with the objective of improving financial accountability. Historically, financial accountability has not been of primary concern in the implementation of human health care services.

The use of dairy herd management databases will facilitate the collection and analysis of field trial data for evaluating the impact of pharmaceutical or management interventions at both the individual animal and herd level (23). Several large observational studies have recently been conducted that would not have been feasible prior to the availability of dairy herd information management databases (34–36). Information gathered from these and similar observational studies will facilitate the development of multifactorial decision models, utilizing individual animal and herd level information to assist herd managers in making management decisions. Many of the limitations to the conduct of sound epidemiological research (37) are addressed with the development and maintenance of these databases. As recently as 1987, some developers of economic simulation models (19) suggested that it was not feasible to use actual herd data to test economic models, because the process would be too costly and time consuming. Broader acceptance of information management technology by dairy herd managers and increased flexibility of dairy herd management software have decreased the importance of these limitations to the herd specific application of decision models in a growing portion of the dairy industry.

Herd level monitors

Herd level monitors (28) have played a major role in the delivery of dairy health management services by veterinarians and in stimulating interest in the development of more comprehensive and flexible database systems. Research at the University of Minnesota using large swine databases has shown that setting targets without regard to the underlying biological and mathematical relationships among performance parameters is imprudent. It inevitably results in a biologically impossible combination of values being set as targets (29). Similar research involving 87 dairy herds concluded that it was important to derive performance parameters from a population of herds of similar size and management characteristics, rather than to blindly accept values published in the literature (30).

Modem transfer of information

This method of information transfer will become the standard means of data transfer, as our knowledge and acceptance of the technology improves.

Summary

A great deal of progress has been made in the development of dairy herd management software in the last few years. At the same time, the speed, capacity, and portability of computer hardware have increased, while costs have decreased, thus encouraging use by veterinarians, dairy herd managers, and other industry support groups. A review of the literature indicates that an increasing number of producers, veterinarians, and other dairy industry service personnel are using computers and dairy herd management software in the delivery of their services (1–3,5,9–11,26–30,38,39). Wider adoption will occur if information generated through the use of these systems is directed towards the improvement of the profitability of dairy production.

The quality of a decision is only as good as the information used to make it. In the past, the limited availability of reliable herd data has restricted our understanding of factors that influence herd performance. In essence, we must define what is normal before we can determine what is abnormal. More importantly, we must define what management practices are profitable and to what extent they increase revenue (31,32). Improved record keeping will benefit the dairy industry by allowing producers and dairy consultants to make profitable decisions based on more accurate and complete information. The ability to merge biological, management, and economic data may prove valuable in the evaluation of intervention at the herd and individual animal level. The impact of interventions is often as much a function of the unique combination of management factors on a dairy, as the biological effect that can be evaluated in a clinical trial. For example, the use of gonadotrophin-releasing hormone therapy at the time of service has been shown to be more successful in herds with better than average conception rates than in herds with poor conception rates. This difference in efficacy may be due to nutritional and other herd level management factors. Sophisticated dairy information management systems provide valuable herd specific management information, which allows more comprehensive understanding of the complex interaction of pharmaceutical, biological, and management factors that ultimately determine the profitability of veterinary intervention strategies.

The use of electronic transfer of data will become essential in order to increase efficiency of use of information through data sharing. This will decrease transfer time and cost of information exchange between dairy herd managers and support industries. CVJ

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