

The Bovine Mastitis Diagnostic Expert System

Program Developers:

C. William Heald, *Department of Dairy and Animal Science*

Mike A Foster, *Director of the Laboratory for Artificial Intelligence Applications*

Jae D. Lee, *Project Associate Department of Dairy and Animal Science*

Presented by:

Dale A. Moore, *Department of Veterinary Science*

William M. Sischo *Dept. of Veterinary Science*

Pennsylvania State University

University Park, PA 16802

Abstract

A hypertext system was used to develop a computerized mastitis knowledge database to describe and identify herd mastitis problems. Information from popular national mastitis literature, scientific publications and scientific experts were used to construct the knowledge base. More than 100 screens of graphics and text provide systematic information retrieval on specific subjects. The system integrates DHIA data, laboratory culture results, management and health practices to evaluate herd mastitis status. The system is organized for easy access by veterinarians, consultants and others who assist dairy farmers with mastitis problems. The program also calculates milk loss, computes individual cow SCC contributions to the bulk milk, allows users to select different mastitis control schemes and teaches accepted mastitis control practices.

Introduction

Identification of the bacterial pathogens and risk factors for mastitis can lead to recommended control procedures that prevent future cases, lower use of antibiotics and contribute to increased farm income. In order to assist farm health consultants and dairy herd managers in the identification of mastitis problems and teach appropriate udder health control methods, the Department of Dairy and Animal Science and the Laboratory for Artificial Intelligence, Penn State, have developed a prototype of a bovine mastitis diagnostic expert system.

What is an expert system? An expert system is a computer program that uses available knowledge to analyze and solve problems. The idea of an expert system is to have a program which can function as effectively as human experts at their highly specialized tasks.

Prototype Development

The objectives of the project were to (1) develop a knowledge base for identification and classification of mastitis herd problems and to implement that knowl-

edge base in a prototypical expert system for personal computers; (2) field test the system with veterinarians, extension agents, and farm consultants in the collection, analysis, and interpretation of Dairy Herd Improvement Association (DHIA), clinical, and laboratory data in a systematic manner; and (3) distribute the system to users.

Information from the national mastitis literature was reviewed and organized for use in developing the system and put into a hypertext program called TOOLBOOK^{®1}. Consultation with experts, in addition to the literature review, was used to construct the knowledge base.

The diagnostic part of the system relies heavily on the use and interpretation of DHIA somatic cell count data and other data as available. Diagnostic culture laboratory results and clinical observations will be evaluated as the developing system matures.

The program is organized for easy access by novice field persons assisting farmers with mastitis problems. It currently can calculate milk loss, compute individual cow percentage somatic cell contribution to the bulk milk, allow users to select mastitis control schemes and teach commonly accepted mastitis practices. Veterinarians that have tested this mastitis expert system have found it useful and satisfactory to the needs of a dairy production medicine clinician.

How Would A Veterinarian Use The Expert System?

The knowledge base can be used by anyone for self-study or as a teaching tool for veterinarians to use with their clients. The database of information is available from cooperative extension and other sources but is now conveniently packaged into the computer program. Where the expert system comes in useful is for the evaluation of the herd with a mastitis problem.

From the main menu (Figure 1), the selection "Evaluate your herd" will bring the user to a list of

questions to be answered about the herd (Figure 2). If the questions about changes in management and dirty udders are answered affirmatively, the next screen gives the DHIA data for each cow (Figure 3). A demonstration herd of ten cows is currently in the system. Their somatic cell count history and the questions one answers about the individual cows helps to point the consultant into a particular direction about the herd mastitis problem.

For example, if the herd has had a number of clinical cases of mastitis recently, the first step would be to evaluate the herd and answer the questions posed by the program for the individual cows. The command "Evaluate the herd" must be given and each question which pops up must be answered. When the questions are answered, the numbers next to the types of mastitis pathogens change. To follow the logic for the suspect pathogens selected for each cow, the user would press the "Why and How" button. For each cow, a set of criteria are given (Figure 4).

Once certain pathogens are suspected, the veterinarian could use the program to educate the producer. If there are, for example, a number of cows with possible environmental pathogens, the "?" button next to the type of pathogen could be pressed to obtain information on these bacteria. The knowledge base is invoked and screens of information are available about the pathogen (Figure 5). If more information is sought, a list of questions of what course to take for a problem with this pathogen are given (Figure 6).

As a teaching tool, the program has a number of features to illustrate the importance of mastitis in the herd. From the main menu (Figure 1), a selection of "Economic Loss (\$\$\$) due to Mastitis" shows the milk loss from different ranges of somatic cell counts from

individual cows. Dollar loss for the herd may be estimated to demonstrate the economic impact from milk loss from cows within certain somatic cell linear score ranges.

Future of the System

After additional testing and refinement of the knowledge base in the system, links to DHIA processing centers will be made. A user will be able to communicate electronically with a processing center and by interfacing with that center, pull in the herd information desired and have the data analyzed all within the expert system. The developers also plan to expand the power of the system and continue to add more current information to the database.

Summary

A hypertext system was used to develop a computerized mastitis knowledge database to describe and identify herd mastitis problems. Information from popular national mastitis literature, scientific publications and scientific experts were used to construct the knowledge base. More than 100 screens of graphics and text provide systematic information retrieval on specific subjects. The system also integrates DHIA data, laboratory culture results, management and health practices to evaluate herd mastitis status. The system is organized for easy access by veterinarians, consultants and others that assist dairy farmers with mastitis problems. The program also calculates milk loss, computes individual cow somatic cell contributions to the bulk milk, allows users to select different mastitis control schemes, and teaches commonly accepted mastitis control practices.

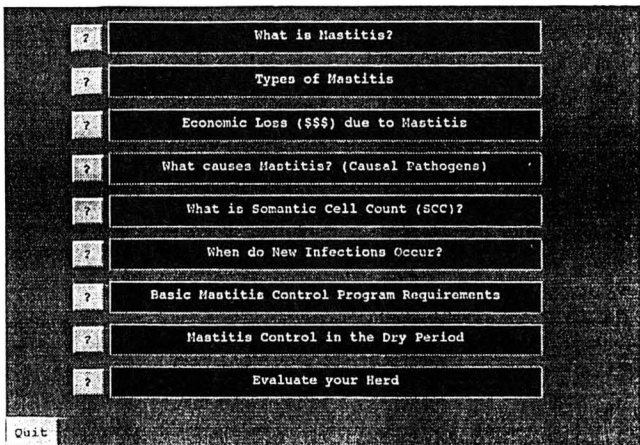


Figure 1.

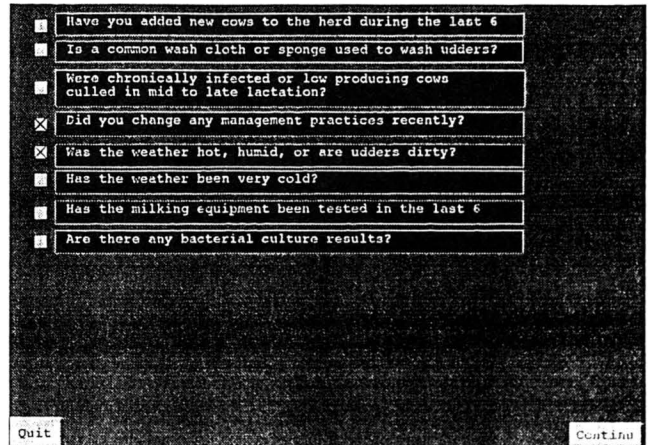


Figure 2.

?	Strep ag	3
?	Staph	1
?	Environment	3
?	Coliform	0
	Unknown	3

cow1
1
07/01/91
344
3.98
7
07/31/91
30
678
4

Evaluate Herd
Evaluate Cow

Name Search <-- < > -->

Quit Why & How Question/Answer Search Back

Figure 3.

History of Evaluation

-----cow1-----
Number of times severe for cow1 is 7
Average SCC score of cow1 is 3.98
cow1 was treated for mastitis previously.
Based on the above facts, cow1 is evaluated as environmental mastitis.

-----cow2-----
Number of times severe for cow2 is 2
cow2 has not have repeated mastitis.
Based on the above facts, cow2 is evaluated as unknown mastitis.

-----cow3-----
Number of times severe for cow3 is 2
cow3 has not have repeated mastitis.
Based on the above facts, cow3 is evaluated as unknown mastitis.

-----cow4-----
Number of times severe for cow4 is 1
cow4 has not have repeated mastitis.
Based on the above facts, cow4 is evaluated as unknown mastitis.

-----cow5-----

Quit Back

Figure 4.

Non-agalactiae Streptococci (Non-Ag. Strep.)

The term "non-agalactiae streptococcus," or "strep. non-ag." refers to all forms of streptococci bacteria other than Streptococcus agalactiae that are capable of causing mastitis (inflammation of the udder) in dairy cows.

Two of the most common forms of strep. non-ag. are Streptococcus dysgalactiae and Streptococcus uberis. This bulletin will focus mainly on the source of these two forms of non-ag. strep. infections within a dairy herd and suggest useful control and prevention tips for dairy farmers.

Other strep. non-ag. bacteria include Strep. faecalis and Strep. bovis. A more general classification for non-ag. strep. is "environmental streptococci."

There are many forms of strep. non-ag. (environmental) bacteria, but two of the most common forms are Strep. uberis and Strep. dysgalactiae. Strep. non-ag. survives mainly on the cow's teat skin and belly skin and in the reproductive tract. Infections can also be associated with unsanitary dry lots and bedding areas. Strep. uberis and Strep. dysgalactiae are usually transferred from the environment to the teat between milkings, but some transfer from cow to cow can take place during milking.

These infections range from chronic non-clinical cases to very severe acute cases. Strep. uberis is responsible for most new infections in dry cows. Like coliform mastitis, non-ag. Strep. cases tend to increase as Strep. ag. and Staph. aureus infections decrease.

In addition to Strep. uberis and Strep. dysgalactiae, there are many

Quit ? More Information Show pathogen Back

Figure 5.

Environmental streptococci (Strep. non-ag.)

? Where can non-ag. strep. be found on the farm?

? How can non-ag. strep. infections develop and spread within my herd?

? How widespread can non-ag. strep. infections be within a herd, and what kind of problems can they cause?

? What signs might tip me off that a non-ag. strep. problem is present?

? What should I do if one or more of the situations described above?

? Will monthly DHIA somatic cell count (SCC) identify non-ag. strep.?

? If I found that my herd have a problem with non-ag. strep., what management steps should I take to correct the problem?

? Should I treat lactating cows?

? Can milking management factors influence the occurrence rate of new?

? Is there anything I can do to prevent or reduce the chances of my herd becoming reinfected with non-ag. strep. infections once a

? What about the use of teat dips on my herd?

Quit Back

Figure 6.



AABP is grateful to SMITHKLINE BEECHAM ANIMAL HEALTH for an educational grant underwriting this production.

This educational Video Tape will be invaluable to you, your staff, and your clients!

JUMPING OFF: The Video

Please print your NAME and ADDRESS:

(First) _____ (Last) _____

(Business Name) _____

(Street/P.O.B.) _____ (City) _____ (State) _____ (Zip) _____

_____ Tapes @\$35 each = \$ _____

Cash (rcv'd by _____) VISA/MASTERCARD # _____ Exp. Date: _____

Check _____ (Payable to AABP) Mail your order to AABP, P.O. Box 1755, Rome, GA 30162