The Bovine Mastitis Diagnostic Expert System

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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 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®. 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 different 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 demon­
stration 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 veterin­
narian 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 ques­
tions 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 esti­
mated 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 interfac­
ing 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 hypertest system was used to develop a comput­
erized mastitis knowledge database to describe and
identify herd mastitis problems. Information from popu­
lar national mastitis literature, scientific publications
and scientific experts were used to construct the knowl­
edge base. More than 100 screens of graphics and text
provide systematic information retrieval on specific sub­
jects. 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.
Non-agalactia Streptococci (Non-Ag. Strep.)

Two of the most common forms are Strep. uberis and Strep. dysgalactiae. Strep. uberis survives mainly on the cow's teat skin and belly skin, and in the reproductive tract. Infections can also be associated with uddery dry and heading 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 also take place during milking.

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. cases decrease. In addition to Strep. uberis and Strep. dysgalactiae, there are many other non-agalactia Streptococci that are capable of causing mastitis: inflammation of the udder in dairy cows.

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