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A COMPARISON OF THE DANISH, U.K., U.S. AND NEW ZEALAND SYSTEMS OF MASTITIS CONTROL

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MASTITIS has been defined as "a disease of man transmitted to cows". This slightly off-target definition properly and correctly calls attention to the major role which management practices play in causing or controlling mastitis in a given dairy herd.

If poor management frequently leads to mastitis, it should follow that good management should minimize mastitis problems. Consequently, there are many throughout the world who are striving to find and utilize management practices which lead to mastitis control. In general terms these are believed to revolve around management of the milking procedures, including environmental sanitation, milking machines, and control of infections by therapy and culling.

One of the earlier programmes in the state of New York, started in 1946, relied primarily upon veterinary observation of management practices, physical examination, and some voluntary elimination of *Streptococcus agalactiae* infected cows. Careful records showed that this programme was effective in increasing production by 8% (Morse, 1961). However, such an approach is no longer satisfactory in our modern age of critical examination of milk quality and current economic realities.

Milk quality is monitored by most developed countries today. Cell counts, and to a lesser extent, bacteria counts, are adversely affected by mastitis. Consequently, mastitis must be controlled if markets are to be maintained. The dairyman must be primarily concerned for the market of his own product. But the nation, and especially one like New Zealand, must protect its foreign market from charges of inadequate quality of its total production. Not only must New Zealand be equal to other nations in standards of milk quality, it should in fact be better in the hope of avoiding discriminatory marketing decisions.

There are two major philosophies toward mastitis control in the western world today. The first approach is directed toward

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diagnosis and eradication of specific pathogens such as *Strep. agalactiae*. This approach requires intensive efforts in infected herds and usually restricts official activity to a relatively small number of herds at any one time. The second approach advocates adoption of management practices by all herds which, it is believed, will substantially reduce the mastitis incidence and lead to increased production of higher quality milk.

Programmes for elimination of *Strep. agalactiae* infection have been advocated for many years and many have been practised. Such programmes can be highly successful when sufficient supervision and motivation are present. They are, however, fairly expensive initially in terms of repeated cow sampling, culture, treatment and general surveillance. There is often a great danger of infection being re-introduced, in which case it usually spreads rapidly in the herd. In the past, difficulties in controlling re-introduction and spread have seriously handicapped this approach. However, complete eradication from large areas and compulsory culture examination of all dairy cattle brought in to the area is a desirable objective and one which is encouraged in many circles.

Scandinavian countries have taken the first approach — *i.e.*, eradication of *Strep. agalactiae*. The programme in Denmark (Olsen, 1975; Schmidt-Madsen *et al.*, 1975) may be taken as an example. A systematic mastitis control scheme was started in 1948 with emphasis upon diagnosis and treatment. In 1962 it was revised to give additional attention to milking machines and management. About 81% of Denmark's 60 000 herds (1.2 million cows) are enrolled in the programme which is compulsory for the 15 000 town milk producers and voluntary for the 45 000 others.

Leadership for the programme is vested in seven large regional veterinary diagnostic laboratories, the largest ones covering 5 000 to 11 000 herds. By Danish law, antibiotics for preventive or curative purposes must be administered by veterinarians, of which there are 900 practitioners in Denmark or about 1/1 333 cows. These restrictions on antibiotic administration were endorsed by the Danish dairy organizations in order to prevent antibiotic residues in milk.

The following procedures are followed in co-operating herds in Denmark.

- (1) Once each year bulk tank milk is screened for presence of Group B streptococci (*Strep. agalactiae*). When found, indi-

vidual cows are sampled and the infection is eliminated by lactation therapy and culling.

- (2) Cell counts are made on bulk milk four times per year. Generally two consecutive counts above 500 000 will classify the herd as a "mastitis herd".
- (3) Information provided to the laboratory by the owner, veterinarian or others may also justify classification as a "mastitis herd". Requests for assistance owing to occurrence of clinical mastitis or increased cell counts in connection with quality payment schemes are becoming more common.

Depending upon the criterion for classification, the chief of the laboratory decides, according to pre-determined rules, whether an initial bacteriological examination of milk from individual cows is required or whether a survey of management and environmental factors should have preference. Aside from the continuing effort against Group B streptococci, increasing emphasis is being placed toward improved environmental factors as contrasted to culture and therapy.

Between 1968 and 1973 the percentage of bulk milk samples above 500 000 cells/ml dropped from 38.8 to 19.6. Of 51 709 herds under control programmes, only 2.5% were shown in 1973 to be infected with Group B streptococci, and this accounted for only 1% of the total mastitis infection. Eradication of *Strep. agalactiae* would appear to be possible in Denmark within the near future.

Despite excellent progress against *Strep. agalactiae*, about 35% of cows remain infected with other pathogens and total infection levels have come down less than 1% a year since 1955 (Table 1). It is their hope that management changes will more rapidly reduce these other infections without resort to extensive therapy. If management practices can be devised to prevent spread of infection this may be possible.

TABLE 1: COMPARISON OF THE BACTERIAL LEVEL IN COMPARABLE DANISH DAIRY HERDS 1955/58 AND 1972, RESPECTIVELY
(Olsen, 1975)

	1955-58 (± 13 300 cows)	1972 (± 6 800 cows)	Decrease in Bacterial Level
% Infected cows	45.6	33.2	12.4
% Infected quarters	21.9	13.8	8.1

Teat dipping or spraying and dry cow treatment are not practised for the following reasons:

- (1) High cost of products.
- (2) Fear of antibiotic residues.
- (3) Fear of antibiotic resistance.

Because veterinarians must treat all clinical cases of mastitis there is virtually no residue problem and the level of antibiotic resistance is low.

The Danish programme is dependent upon comprehensive veterinary laboratory facilities and large numbers of veterinarians, which they already have, and other expert advisory services. It will be interesting to note the programme's future progress, especially as they are moving toward major emphasis upon improved environmental conditions in the hope of controlling staphylococcal and other infections which still infect about 35% of Danish cows.

For a different approach to mastitis control we turn to the work of Dodd and co-workers, National Institute for Research in Dairying (NIRD), Reading, England, and Wilson and Kingwill, Central Veterinary Laboratory, Weybridge, England. Their research has had a tremendous impact upon the philosophies and practice of mastitis control throughout most of the western world.

These workers recognized that a programme of control based upon diagnoses, treatment and culling of individual animals could reach only a minority of herds and was of limited value in preventing new infection in most herds. Therefore, it was reasoned, a control system was needed which would substantially reduce current levels of infection without need for knowledge of the type of infection or of the specific cows or quarters infected and reduce the rate of new infection.

Although a reduction in new infections of 50% can be achieved by sanitary procedures (Wilson and Kingwill, 1975), infection levels would fall only slowly because of the long duration of established infections. In order to quickly reduce levels of infection, treatment at drying-off was introduced (Dodd and Neave, 1970). By this means, streptococcal infections at calving were reduced by 89% and staphylococcal infections by 75%. Sub-clinical cases of mastitis were treated during lactation.

The demonstrated advantage of teat dipping and dry-cow therapy were then combined into a programme including good milking machine function, treatment of clinical cases only during

TABLE 2: MEAN LEVELS OF INFECTIONS IN COWS IN MILK IN 50 HERDS AT THE START OF MFE3 AND AFTER ONE, TWO AND THREE YEARS
(Wilson and Kingwill, 1975)

	Staph. aureus	Strep. agalactiae	Strep. dysgalactiae	Strep. uberis	All others	Any infection
Quarters infected (%):						
Start	17.6	4.0	2.9	4.4	0.7	28.8
1 yr	8.4	0.4	1.7	2.5	0.7	13.2
2 yr	5.5	0.5	1.4	2.9	0.5	10.1
3 yr	4.2	0	0.6	2.1	1.0	7.5
Cows infected (%):						
Start	39.4	8.7	9.5	11.5	2.2	56.8
1 yr	21.3	1.1	5.6	7.2	2.2	31.1
2 yr	14.2	0.8	4.7	8.7	1.6	24.6
3 yr	11.4	0.1	2.3	6.8	3.2	20.1

lactation, and culling of cows not responding to drying-off therapy or those having several episodes of clinical mastitis during any lactation. The results of a trial of this system in 32 herds involving about 2 000 cows is well known. The control system reduced the level of udder disease by about 70% in all herds (Table 2) (Wilson and Kingwill, 1975).

Essentially the same experiment was run in parallel by Cornell University with almost identical results (Table 3) (Natzke *et al.*, 1972). Similar results have been achieved in New South Wales (Ben *et al.*, 1970) and in Victoria (Hoare, 1972; Thompson, 1974).

The system can be expected to eradicate *Strep. agalactiae* infections without special measures, or at least to reduce them to insignificant levels (Natzke *et al.*, 1972; Wilson and Kingwill, 1975). Both *Staphylococcus aureus* and *Streptococcus dysgalactiae* infections should be reduced to low levels and some reductions

TABLE 3: REDUCTION IN TOTAL QUARTER INFECTIONS ACHIEVED OVER THREE YEARS BY NIRD AND CORNELL EXPERIMENTS

% Quarters Infected	NIRD ¹	Cornell ²
Start	28.8	28.1
1 yr	13.2	11.5
2 yr	10.1	8.5
3 yr	7.5	7.1

¹ Wilson and Kingwill, 1975.

² Natzke *et al.*, 1972.

should be achieved in *Streptococcus uberis* infections (Table 3) (Natzke *et al.*, 1972).

The well controlled studies indicate no effect upon incidence of coliform and other environmental infections. Other reports confirm this although some experience suggests there may be some increase in this type of infection following control of streptococcal and staphylococcal infections.

Herd response to these programmes was not uniform in either the Cornell or the NIRD trials for unknown reasons. All herds following the programmes benefited, but response was tenfold better in some herds than in others.

TABLE 4: CHANGE IN 305-DAY LACTATION MILK PRODUCTION FOR A COW WITH ONE QUARTER INFECTED, AVERAGE OF ALL LACTATIONS
(Natzke *et al.* 1975)

<i>Organism</i>	<i>Production</i>
<i>Staph. aureus</i>	- 762
<i>Strep. agalactiae</i>	- 776
Other streptococci	- 711
Coliforms	- 670
Other organisms	- 724

Production increases were documented in the Cornell experiment (Table 4) (Natzke *et al.*, 1972). The average increase per cow for herds on the programme was 477 kg of milk per lactation. Depending upon the age of the animal and the type of infection, each quarter infection reduced milk production by 740 kg/cow/year (Table 4). Under the conditions of this study it was calculated that the control programme returned about \$62.00/cow over the costs.

Subsequent to these reports, teat dipping and dry cow therapy have been widely recommended in the United States, along with recommendations concerning milking equipment, milking procedures, lactation therapy and culling.

Our general experience has shown the value of this approach to mastitis control and most herds respond quite well.

The major disadvantages to this control programme appear to be:

- (1) Reluctance of dairymen and milkers to follow procedures requiring extra time and effort.
- (2) Cost of teat dip and dry cow therapy preparations.

- (3) Some increased risk of unusual environmental type infections being introduced by careless therapy at drying off.
- (4) Some tendency for reliance on these measures and neglect of other good husbandry practices.
- (5) Inadequate control of coliform and similar types of mastitis.
- (6) Possible hazard of teat dip or spray residues in milk.

Of these, the possible hazard of teat dip residues in milk now appears to need close attention. Iodophor teat spray or dips, especially if misused, can contribute to undesirable iodine levels in milk. It may be necessary to use other products in the future but these, too, will have to be screened for undesirable flavour or chemical residues, or alternative ways of achieving the same objective may be devised.

It is also probable that treatment recommendations can be modified after low infection levels are achieved, especially if hygiene at milking time can be substantially improved.

Procedures for mastitis control, like those for most other agricultural practices, are not perfect and are still subject to improvement. Nevertheless, there is no question that most mastitis can be controlled by measures available today.

Of the two approaches available — *i.e.*, a laboratory intensive diagnostic approach aimed at specific pathogens in a limited number of problem herds or an improved herd management programme directed toward all herds — New Zealand has chosen the latter. In addition, special diagnostic services and veterinary advice are available for the herd with special problems.

The pilot scheme, directed by the National Dairy Laboratory, emphasizes a five-point programme:

- (1) Correct machine function and operation.
- (2) Use of post-milking teat sanitizers.
- (3) Lactation therapy of clinical mastitis.
- (4) Treatment at drying off.
- (5) Culling of chronically infected cows.

Milk cell counts are monitored by dairy companies. In the pilot scheme herds having cell counts over 750 000 are visited by the farm dairy instructors and dairy advisory officers who check the function and use of the milking machines and provide advice on milking management and hygiene. The farmers' veterinarians, utilizing the services of the Animal Health Laboratories, then advise the dairymen with respect to therapy, management and other aspects of mastitis control.

By emphasizing management practices for all herds and providing special help on management, milking machines and veterinary services for the problem herds, the pilot scheme is demonstrating that New Zealand can achieve superior standing among nations in so far as mastitis control and low cell content of milk is concerned. I have been well impressed with New Zealand's achievements in this most important aspect of milk production.

Current programmes can be quite effective against common streptococcal and staphylococcal infections. As these infections are adequately controlled it is probable that the frequency of drying off therapy can be substantially reduced. Perhaps other means can also be devised to accomplish the objectives of teat dipping or spraying as well.

Unfortunately, these measures do not control mastitis owing to coliform and other environmental organisms. More research is needed in this area. Because New Zealand cows are kept on pasture there is probably less risk of coliform mastitis here than under more confining systems of dairying. However, I have seen coliform mastitis outbreaks in New Zealand as a result of sanitation failures in milking parlours and suspect that this may occur more often than is recognized.

New Zealand is doing very well in its mastitis control but should not relax its efforts to do even better. Mastitis can be economically very costly and is a hazard to good milk quality. It is to be avoided on both counts.

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