

Options for Handling Mastitis during Lactation in Modern Dairy Farms

Leitner, G.,^{1*} Jacoby, S.,² Frank, E.² and Shacked, R.²

¹National Mastitis Reference Center, Kimron Veterinary Institute, P.O. Box 12, Bet Dagan 50250, Israel.

²Institute of Animal Science, A.R.O. The Volcani Center, P.O. Box 6, Bet Dagan 50250, Israel.

* Corresponding Author: Dr. G. Leitner, Kimron Veterinary Institute, P.O. Box 12, Bet Dagan 50250, Israel. Email: leitnerg@moag.gov.il

ABSTRACT

Mastitis in both clinical and subclinical forms has a significant negative affect on dairy economics. Previously, we suggested making treatment decisions according to the monthly milk testing and/or the constant on-line data available on each cow during routine implementation of performance evaluation and lactation. This decision relied on expected costs/losses resulting from the treatment during the cow's productive life. This study reports on-line computerized data surveillance together with routine monthly milk quality testing for controlling mastitis and maintaining high milk yields and low somatic cell counts (SCC) in medium dairy herds. During one year of the surveillance, 77 of 220 cows were detected on-line and/or by the monthly milk testing as suspected of having intramammary infection, about 30% of them with clinical symptoms. All suspected glands were tested for the causative pathogen. Clinical infections diagnosed by the on-line and/or visual inspection, were caused by *Escherichia coli*, *Streptococcus dysgalactiae* or *Strep. uberis*, and in certain cases no causative agent was found. Subclinical infections were diagnosed mainly by the monthly milk testing, where the causative bacteria found were mainly *Streptococcus dysgalactiae* and *Staphylococcus chromogenes*. In some cases no causative agent was identified. Clinically infected cows were treated with penicillin and gentamycin on the day of appearance of mastitis. Following antibiotic withdrawal milk from the infected gland was tested for quality and quantity. Milking resumed from glands that returned to normal, whereas those retaining a high somatic cell count were dried-off. Some of the glands infected with *Strep. dysgalactiae* and *Staph.* were treated with Nafpenzal Dry Cow as a group. When treatment failed and bacteria were isolated in cases of cows high SCC, the cows were dried-off (300 mg Procaine benzylpenicillin (300,000 I.U.), 100 mg Dihydrostreptomycin, 100 mg Nafcillin) (Intervet, Boxmeer, The Netherlands). The bulk milk tank SCC at the beginning of the surveillance contained 240-300 × 10³ cells/mL and was reduced to 93-140 × 10³ cells/ mL in 7-9 months. The milk price for the bulk milk containing <200 × 10³ cells mL⁻¹ received a 0.5% bonus.

Keywords: Mastitis, Treatment, Casein hydrolyzate, Herd management.

INTRODUCTION

Dairy farming economics are greatly influenced by animal diseases. Mastitis, inflammation of the mammary gland/s, is one of the major causes of milk loss and culling of animals. Moreover, in countries where milk payment is evaluated according to milk quality, the producers suffer further losses due to reduced milk prices. Recently a protocol for handling mastitis during lactation in modern dairy farms has been suggested (1). The protocol described the practical use of on-

line computerized herd management systems together with the routine monthly testing of milk yield, milk composition and somatic cell count (SCC) for identifying and treating cows suspected to have infected quarter/s, as close as possible to the bacterial invasion. The protocol is aimed mainly at subclinical mastitis cases and suggests bacteriological testing together with cow data: history of SCC, lactation, days in milk, pregnancy and milk yield, before making treatment decisions.

Many modern dairy herds number hundreds and thousands of cows. In these large herds, management and health control should focus on the herd rather than on the individual cow (2). However, even among large herds the availability of on-line computerized data enables modern farmers to reach decisions regarding individual cows (3). Consequently, integrated herd management, focusing on each animal by utilizing the on-line daily information can achieve synergistic effects. Prevention of udder infection is the best approach of control, however, even with the optimal environment and nutritional conditions, clinical and subclinical mastitis still exists. Handling herd udder infection is a continuous effort. Proper handling of infected glands can reduce loss of milk, culling and financial losses due to high SCC. The decision whether to treat a cow or to ignore the infection is complex: unlike many cases of clinical mastitis requiring treatment, antibiotic treatment for cows not at risk requires justification with respect to the costs of drugs and milk loss (4, 5, 6). Regarding SCC, the influence of a few or even one cow with a million cells in the bulk tank SCC (BTSCC) has a much higher significance than the other milk components (fat, protein). The current study reports the use of the above mentioned protocol for the surveillance of one herd for one year (1).

MATERIALS AND METHODS

Study protocol

The study was carried out in a dairy herd of 200-220 lactating Israeli Holstein cows at the Agricultural Research Organization, the Volcani Center, Beit Dagan. The dairy parlor was equipped with an on-line computerized AfiFarm Herd Management data acquisition system that includes the AfiLab milk analyzer, which provides on-line data on gross milk composition (fat, protein and lactose) and milk conductivity (a measure of mastitis) (Afirmilk, Afikim, Israel; <http://www.afimilk.com>). The cows were milked three times daily: average milk yield throughout 2012, 10,475 L during 305 days of lactation. Routine monthly milk yield and SCC were recorded by the Israeli Cattle Breeders Association (Caesarea, Israel). Food was offered *ad libitum* in mangers located in the sheds.

The possibility of udder infection was identified by the farm personnel and/or by the daily computerized information on the basis of individual deviations from averages re-

ported during the previous 10 days (conductivity, milk yield and animal behavior). The suspected glands were tested by the California mastitis test (CMT) and a milk sample was sent to the National Mastitis Laboratory, Kimron Veterinary Institute for bacteriological testing (7). Clinical mastitis was treated by antibiotics or anti-inflammation drugs according to the decision of the herd veterinarian (see below). Moderate udder infections and the monthly routine milk recordings served as the basis for identification of suspected cows. Cows with SCC >200,000 cells/mL (monthly routine milk recording) were examined on the quarter level, for bacteriology, CMT and SCC. If bacteria were isolated, accompanied by SCC >200,000 cells/mL, an antimicrobial susceptibility test was performed (National Committee for Clinical Laboratory Standards guidelines) (8). According to the results of the bacteriology and the history of SCC, lactation, day in milk, pregnancy and milk yield, cows were treated with antibiotics, quarter drying-off with casein hydrolyzate and then dried-off, or culled. Cows that failed the antibiotic treatment underwent quarter drying-off, complete drying-off, or were culled.

All treatments protocols were approved by the Institutional Animal Care Committee of the Agricultural Research Organization, The Volcani Center, Beit Dagan, Israel.

Treatment protocol

Clinical infection: 30 mL of "PEN 30" and "GENTAJECT" (ABIC Biological Laboratories, Teva Ltd., Israel) intramuscularly injected daily for 3 days + NSAID 30 mL Flunixin or 17 mL Carprieve (Norbrook, laboratories, Ireland). Treatments were carried out after the midday milking and the treated cows were not milked in the evening. The milk was discarded for a few days in accordance with the instructions of Delvotest antibiotic residue test results (DSM Food Specialties, Delft, The Netherlands).

Subclinical infection: antibiotics were infused with a tube of Nafpenzal DC- (300 mg Procaine benzylpenicillin (300,000 I.U.), 100 mg Dihydrostreptomycin, 100 mg Nafcillin) (Intervet, Boxmeer, The Netherlands) once into the infected quarter. Treatments were carried out after the midday milking and the treated cows were not milked in the evening.

The milk was discarded for a 10 days in accordance with

the instructions of the Manufacturer Delvotest (DSM Food Specialties, Delft, The Netherlands), and was then tested daily for antibiotic residues until complete disappearance of inhibition on the cow level (~20 days).

Cows treated with casein hydrolyzate (Home Made prepared under Good Laboratory Practice conditions) (9) received one or two infusions of 10 mL of peptide concentrate of the casein hydrolyzate preparation, at ~7 mg/mL into the infected quarter at the midday milking and were not milked in the evening. Dried-off cows received the routine treatment of the herd, i.e., Nafpenzal DC ampoules which were inserted into the mammary streak canal.

RESULTS

In 2010, a previous study was conducted in the same herd (1). The average BTSCC then was $183 \pm 5.7 \times 10^3$ cells/mL. Loosening the intensive udder health handling program caused the BTSCC to increase steadily to $223 \pm 7.5 \times 10^3$ cells/mL in 2011 and $230 \pm 13.2 \times 10^3$ cells/mL in 2012.

As a result, from the beginning of 2013 the current suggested protocol was employed (1). BTSCC was $\sim 300 \times 10^3$ cells/mL at the beginning of 2013 and as a result dropped sharply to $\sim 170 \times 10^3$ cells/mL at the end of the year (Fig. 1). At the beginning of the year, there were 204 cows, the number of which increased to 215 (~5%) towards the end of the year in spite of culling of 41 cows (20%). 52 new heifers (25%) replaced older cows.

During the year of the surveillance, 77 cows were detected on-line and/or by the monthly milk testing as suspected of having intramammary infection, of which ~30% presented clinical symptoms. Summary of the cow's diagnostics is presented in Table 1. Of the 27 cows that developed clinical mastitis, in 10 cows (37%) no bacteria were isolated and in the remaining *Escherichia coli* (10),

Table 1: Cows diagnosed with infection: Bacteriological findings and the nature of treatment

Diagnostic	Bacteriology	Antibiotic treatment	Dried-off quarters	Early drying-off
Clinical infection	No finding	10 (37%)	10	-
	<i>E. coli</i>	10 (37%)	10	1
	<i>Strep.</i>	7 (26%)	7	1
Increased SCC	No finding	17 (34%)	0	1
	<i>Strep.</i>	18 (36%)	15	8
	<i>Staph.</i>	13 (26%)	3	-
	<i>S. aureus</i>	2 (4%)	2	-

Streptococcus dysgalactiae (5) and *Strep. uberis* (2) were identified. All the cows with clinical symptoms were intramuscularly treated with antibiotics as detailed in the materials and methods section.

After the period of washout antibiotic of about 6 days, quarter milk was tested by CMT and all quarters or only those quarters that were not clinically treated continued to be milked. The 10 cows with no bacteria isolation completely recovered and returned to their regular milk yield in 3-5 days. In contrast, of the 10 cows isolated with *E. coli*, only 4 cows completely recovered and returned to milk yield, while the other 6 returned to a new milk yield level of ~80% of that prior to the infection. In one cow, the infected gland was dried-off after 40 days. No changes in milk yield were noted for the 7 cows isolated with *Strep. dysgalactiae* or *Strep. uberis* and all but one completely recovered and returned to previous milk yield in 3-5 days. Cows for which the treatment failed were retreated intramammary. If the treatment failed the second time, the quarter was dried-off. For most of the cows which were tested after treatment the SCC at the monthly test decreased to <200,000 cell/mL. In most of these cows, only one quarter was found with CMT greater than 3.

Of the 50 cows tested, in 17 (34%) the causative agent was not found, therefore these cows were not treated, except for one cow of which the quarter was dried-off and one cow that was over 150 day pregnant which was dried-off as well. Noteworthy was that the 2 cows whose quarters were dried-off were infected with *E. coli* in their previous lactation. In 18 cows *Strep.* was isolated: 13 *Strep. dysgalactiae* and 5

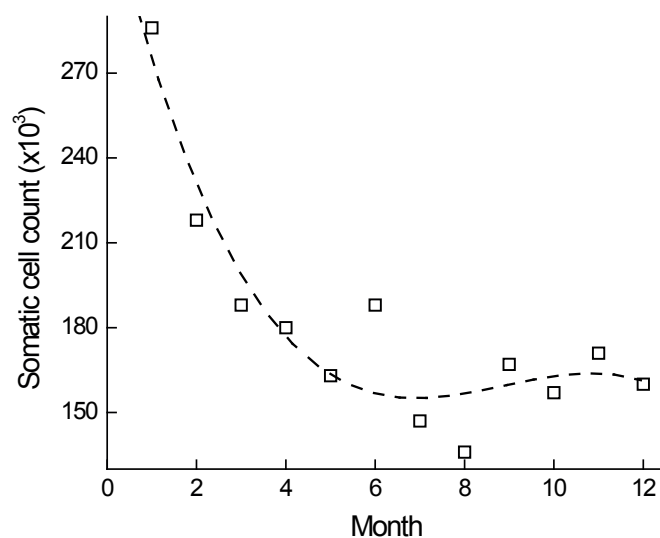


Figure 1: Bulk milk tank mean somatic cell count during the year 2013.

Strep. Uberis and of those, 15 were treated intramammary. The treatment failed in all the *Strep. Uberis*- and 4 of the *Strep. dysgalactiae*-infected glands. Thus, in 8 cows the quarters were dried-off and one cow over 140 days pregnant was dried-off as well. The remaining 13 cows were identified as infected with Staphylococci; 11 with *Staphylococcus chromogenes* and 2 with *Staph. aureus*. Intramammary treatment was performed in 3 cows with *Staph. aureus* and 1 with *Staph. chromogenes*. Of the cows treated, SCC returned in 10–20 days post treatment to <100,000 cell/mL and the milk yield stabilized. Of the cows where quarters were dried-off due to treatment failure, the cow SCC was reduced to <100,000 cell/mL and their milk yield decreased by 75–90%.

DISCUSSION

The current study reports a surveillance of one herd for a year using the protocol for monitoring and handling cows with udder infection as previously suggested (1). The important points exhibited were:

1. On-line computerized data available in modern farms detected all the clinical infections.
2. On-line computerized data failed to detect all of the subclinical infections.
3. Routine monthly milk testing identified all the cows with increased SCC and with additional individual testing of quarter's CMT and bacteriology identified all the subclinically infected cows.
4. Early treatment of clinical infections resulted in a high rate of cure, however, at a relatively high price of milk discarded for at least six days and antibiotic costs.
5. Treatment of only a gland with identified bacteria together with high SCC indicated only partial cure, and thus forced drying-off for those in which cases the treatment failed.

The presented procedure was costly due to discarded milk during the treatment in addition to the cost of the antibiotics. Nevertheless, after taking all these points into account, the health of the herd improved as indicated by lowering the number of culled cows as well as decreasing and maintaining

the BTSCC at ~150,000 cell/mL indicating high quality milk and therefore a better milk price.

The present results indicate that although a bacterium may be found sensitive to a drug at the laboratory, it will not always be eliminated *in vivo*, as in the case of *Strep. uberis*. Thus if no alternative drugs to the ones used are available, quarters identified with *Strep. uberis* might be dried-off with no treatment and in so doing the milk discarded during and after treatment will be saved.

Another point regarding treatment is related to the time of diagnosis. The on-line recording system used in the farm diagnosed all clinical cases based on a sharp increase in conductivity together with a sharp decrease in milk yield. It is important that in large dairy farms where there are no pre-milking streak withdrawals, many of the cows are not detected by the milking personnel due to a lack of clinical symptoms. On the other hand, the on-line recording system failed to diagnose all of the subclinical infections, despite of the fact that some of the Streptococci infected cows already had higher than usual SCC. A previous study has shown the importance of identifying cows with subclinical mastitis as soon as possible after the bacteria enter the gland. Thus further studies are necessary to develop tools to identify those cows using the on-line recording systems among using other means.

Safety and quality of milk are probably equal or more important than quantity of milk for the dairy industry and consumers. In many countries, milk regulations exist both at the cow/farm level and the dairy. For instance, on the farm level, milk of clinically-infected, drug treated or a sick cow is not allowed to be milked into the bulk tank. At the dairy, antibiotic residues and regulation of maximum SCC with a reward on low SCC and penalty on high SCC regulate overall the safety and quality of the raw milk. Nevertheless, diagnosing all the animals on the farm with udder infection, mainly those with no clinical symptoms remains a challenge, which calls for further efforts by researchers and equipment manufacturers. Early diagnosis and appropriate handling can decrease milk loss, and culling of cows, while increasing milk price for the farmer and increasing quality and safety of milk for the consumer.

REFERENCES

1. Leitner, G., Koren, O., Jacoby, S., Merin, U. and Silanikove, N.: Practical tactics for handling mastitis during lactation in modern dairy farms *Isr. J. Vet. Med.*, 67:162-169, 2012.
2. Nir, O.: What are production diseases, and how do we manage them? *Acta Vet. Scand.* 44:S21-S32 (Suppl. 1), 2003.
3. Katz, G., Arazi, A., Pinsky, N., Halachmi, I., Schmilovitz, Z., Aizinbud, E. and Maltz, E.: Current and near term technologies for automated recording of animal data for precision dairy farming. *J. Anim. Sci.* 85:377 (Suppl. 1), 2007.
4. Steeneveld, W., Swinkels, J. and Hogeveen, H.: Stochastic modeling to assess economic effects of treatment of chronic subclinical mastitis caused by *Streptococcus uberis*. *J. Dairy Res.* 74:459-467, 2007.
5. Barlow, J., White, L., Zadoks, R.N. and Schukken, Y.H.: A mathematical model demonstrating indirect and overall effects of lactation therapy targeting subclinical mastitis in dairy herds. *Prevent. Vet. Med.* 90:31-42, 2009.
6. van den Borne, B.H.P., Halasa, T., van Schaik, G., Hogeveen, H. and Nielen, M.: Bioeconomic modeling of lactational antimicrobial treatment of new bovine subclinical intramammary infections caused by contagious pathogens. *J. Dairy Sci.* 93:4034-4044, 2010.
7. Oliver, S.P., Gonzalez, R.N., Hogan, J.S., Jayarao, B.M. and Owens, W.E.: *Microbiological Procedures for the Diagnosis of Bovine Udder Infection and Determination of Milk Quality*. 4th ed. National Mastitis Council, Verona, WI, USA, 2004.
8. NCCLS: Performance standards for antimicrobial disk and dilution susceptibility tests of bacteria isolates from animals. Approved Standard M31-A, Wayne, PA, USA. 1999.
9. Leitner, G., Jacoby, S., Maltz, E. and Silanikove, N.: Casein hydrolyzate intramammary treatment improves the comfort behavior of cows induced into dry-off. *Livest. Sci.* 110:292-297, 2007.