Evaluation of the use of an on-farm system for bacteriologic culture of milk from cows with low-grade mastitis

Nicole L. Neeser, DVM, MPH; William D. Hueston, DVM, PhD; Sandra M. Godden, DVM, PhD; Russell F. Bey, PhD

Objective—To determine factors associated with implementation and use of an on-farm system for bacteriologic culture of milk from cows with low-grade mastitis, including information on how producers used the on-farm bacteriologic culture system to guide antimicrobial selection practices and the resulting impact on patterns of antimicrobial use.

Design—Retrospective cohort study.

Sample Population—Producers of 81 dairy farms.

Procedure—Farms that used an on-farm system for bacteriologic culture of milk from January 2001 to July 2003 were surveyed.

Results—Over half of those producers continuing to use the on-farm culture delayed antimicrobial treatment pending results of bacteriologic culture. Most other producers initiated empirical antimicrobial treatment while bacteriologic culture results were pending. Several barriers to the use of an on-farm system were identified. Significant reductions in rates of antimicrobial use were detected when comparing antimicrobial use rates before and during use of the on-farm system. Most producers chose to treat cows with mastitis caused by gram-positive pathogens with antimicrobials, whereas treatment choices for cows with mastitis caused by gram-negative bacteria and in cases in which no growth was detected varied.

Conclusions and Clinical Relevance—Readily available results permit antimicrobial selections to be made on the basis of the causative agent of mastitis. Adoption of an on-farm system for bacteriologic culture of milk may result in significant reductions in the percentage of cows treated with antimicrobials. Decreasing antimicrobial use may have several benefits including preventing unnecessary discarding of milk, decreasing the potential for drug residues in milk, and improving treatment outcomes as a result of targeted treatments. (J Am Vet Med Assoc 2006;228:254–260)

Bacteriologic culture and antimicrobial susceptibility testing are useful tools that veterinarians and producers are encouraged to use to help choose appropriate antimicrobials and optimize treatment success. From a practical standpoint, use of bacteriologic culture to guide antimicrobial selection, treatment for a specific condition in an animal is often delayed for several days because of the logistics involved in performing a bacteriologic culture at a diagnostic facility. Waiting days to obtain bacteriologic culture results and initiate treatment or empirically treating with an inappropriate antimicrobial may adversely affect the clinical outcome of a disease. Because of this delay, a veterinarian or producer may choose to use an empirical antimicrobial treatment for all cases of suspected disease, instead of performing bacteriologic culture and antimicrobial susceptibility testing and treating according to the results. This is especially likely when similar cases of a specific disease, such as mastitis, are frequently seen on a farm.

New diagnostic tools, such as on-farm systems for bacteriologic culture of milk, are being developed to help veterinarians and producers address these problems. These systems permit livestock producers to perform a bacteriologic culture on the farm and obtain results within 24 hours. The dairy producer uses the system by aseptically collecting a milk sample from a cow with mastitis and inoculating the sample onto a bacteriologic culture plate by use of a sterile swab. After incubation for approximately 24 hours, producers can identify the type of bacteria causing the mastitis by observing colony morphology and hemolysis and by the type of medium the bacteria grew on. Producers can then use the bacteriologic culture results to guide treatment decisions for individual cows with mastitis.

Little is known about the use of bacteriologic culture systems on farms or their biologic or economic impact. One on-farm system has been marketed or used in research settings. Basic evaluation of these systems has been performed; however, it is no longer commercially available in the United States. Minimal validation testing has been performed on other on-farm bacteriologic culture systems. A similar on-farm bacteriologic culture system has also been marketed or used in research settings. Basic evaluation of these systems has been performed; however, to our knowledge, peer-reviewed literature on validation of these systems is lacking. Studies that determine the impact of the use of an on-farm bacteriologic culture system on treatment protocols and patterns of antimicrobial use are also lacking.

The purpose of the study reported here was to determine factors associated with implementation and use of an on-farm system for bacteriologic culture of milk from cows with low-grade mastitis, including information on how producers used the on-farm bacteriologic culture system to guide antimicrobial selection practices and the resulting impact on patterns of antimicrobial use.
antimicrobial use. Our hypothesis was that antimicrobial use in cows with mastitis would change if producers and veterinarians used results of an on-farm system for bacteriologic culture of milk to guide treatment choices. This information was also collected to generate hypotheses for future investigation into the impact of on-farm bacteriologic culture systems on antimicrobial selection for mastitis, treatment outcomes, and other treatment issues. Understanding how and why an on-farm bacteriologic culture system is used may affect how future diagnostic tools for guiding antimicrobial selection are designed and implemented.

Materials and Methods

We assessed use of an on-farm system for bacteriologic culture of milk, which was developed for detection of mastitis pathogens by the University of Minnesota’s Laboratory for Udder Health. This system uses a biplate culture plate or a triplate culture plate to help differentiate bacteria. The biplate is a 100 × 15-mm culture plate that is divided in half; 1 half contains MacConkey medium for detection of gram-negative bacteria, and the other half contains factor medium for detection of gram-positive bacteria. The triplate is a 100 × 15-mm culture plate that is divided into thirds for detection of gram-negative bacteria (MacConkey medium), gram-positive bacteria (factor medium), and Streptococcus spp (modified TKT medium). Staphylococcus spp and Staphylococcus aureus can be distinguished by observing colony morphology and hemolysis on Factor medium.

To use the on-farm bacteriologic culture system, the dairy producer aseptically collects a sample of milk from a cow with mastitis and, by use of a sterile swab, obtains a milk swab specimen to inoculate the plate. The plate is incubated for approximately 24 hours in an incubator (37°C) on the farm and evaluated for bacterial growth approximately 24 hours after initiating the culture. The dairy producer can make a determination of the bacterial cause of mastitis by following the step-by-step instructions in the accompanying laboratory manual, which contains photographs of bacterial colonies for the most common bacteria responsible for causing mastitis in cows. The photographs can be used for comparing bacterial growth and identifying bacteria.

A survey was developed to collect information on use of the on-farm system for bacteriologic culture of milk. In July 2003, surveys were mailed to all farms that had used the on-farm bacteriologic culture system since January 2001. A list of these farms with contact information was obtained from the Laboratory for Udder Health of the University of Minnesota Veterinary Diagnostic Laboratory. The complete contact list consisted of 84 farms located in 13 states.

Producers were classified according to the type of bacteriologic culture plates (biplate or triplate) they had purchased. Separate surveys were sent to producers that used biplates and triplates. Producers that had purchased more than 1 type of plate were classified according to their most recent purchases. The general portion of these surveys was identical; however, questions regarding bacteriologic culture results and treatment protocols were specific for the type of plate the dairy used. Follow-up surveys were mailed to producers that had not responded 2 weeks after the first survey was mailed. As an incentive, producers that chose to complete and return the survey received 10 bacteriologic culture plates free of charge. All surveys that were returned by September 30, 2003, were included in the study.

Eighty-four surveys were initially mailed to farms that had previously used or were presently using the on-farm bacteriologic culture system. Of those surveys, 2 were returned because of incorrect contact information and 1 producer contacted the investigators because the on-farm bacteriologic culture system had never been used on the farm. As a result, 81 surveys were mailed to producers that had purchased (and presumably used) the bacteriologic culture system. Of those 81 surveys, 22 were mailed to producers who had purchased biplates and 29 were mailed to producers who had purchased triplates.

Although most producers completed all questions on the survey, 5 surveys were incomplete. In addition, some producers that no longer used the bacteriologic culture system chose to complete questions on the survey in addition to those they were asked to complete. For data analyses, responses for all questions that were completed on each survey were included. As a result, in some cases, the number of responses analyzed for each question was different.

Producers were asked to estimate only the percentage of cows with grade 1 or 2 (low grade) mastitis that were treated with antimicrobials. Cows with grade 1 mastitis were defined as having abnormal milk. Cows with grade 2 mastitis were defined as having abnormal milk and a swollen mammary gland quarter. Cows with grade 3 mastitis were defined as having abnormal milk, a swollen mammary gland quarter, and clinical signs of illness. Categories used to estimate the approximate percentage of antimicrobial use were as follows: none (0%), a few cows (1% to 10%), some cows (11% to 50%), most cows (51% to 90%), almost all cows (91% to 99%), and all cows (100%). Respondents were asked to include both systemic and intramammary use of antimicrobials in their estimates. These categories were used to help minimize differences in reporting accuracy attributed to differences in record-keeping systems on dairy farms.

Statistical analysis—Survey responses were individually entered into a database. Survey responses were compiled and analyzed by use of the database and other computer software. Analysis was performed to assess the difference in patterns of antimicrobial use among farms prior to and during use of the on-farm bacteriologic culture system by use of statistical software. To perform the χ² analyses, the survey categories used to estimate patterns of antimicrobial use were collapsed from the 6 categories used on the survey to 4. Data in categories “none” and “a few” were combined, as were data in categories “almost all” and “all.” Additional statistical analyses were performed by use of the sign test. All data analyses were performed by comparing data on the farm level rather than the individual cow level. A value of P < 0.05 was considered significant.

Results

Of the 81 surveys mailed to producers that had purchased the on-farm system for bacteriologic culture of milk, 32 surveys were returned for a response rate of 64% (52/81). Seventeen surveys were returned by producers that used biplates for a user response rate of 77% (17/22); 35 surveys were returned by producers that used triplates for a user response rate of 59% (35/59). Of the 52 surveys that were returned, 38 (73%) respondents indicated they were using the on-farm bacteriologic culture system in some manner, whereas the remaining 14 (27%) respondents indicated that they were no longer using the on-farm bacteriologic culture system. Of the producers that did not return a survey, 38% (12/32) were not actively using the on-farm system according to the list of recent purchases, whereas 62% (20/32) were actively using the on-farm system.

Information on the characteristics of the farms choosing to use the on-farm bacteriologic culture system at any time was compiled. Except for 2, all pro-
ducers surveyed had herds with > 200 head of cattle. For herds still using the bacteriologic culture system, herd size ranged from 70 to 4,000 (mean, 1,093; median, 613). For herds no longer using the culture system, herd size ranged from 70 to 6,000 (mean, 1,137; median, 841). Herds of survey respondents were located in 12 different states but were concentrated in the upper Midwest. The distribution of herds was as follows: Wisconsin (n = 24 [46%]); Minnesota (10 [19%]); Iowa (4 [8%]); Illinois (3 [6%]); Michigan (2 [4%]); Florida (2 [4%]); Idaho, Pennsylvania, South Dakota, and Vermont with 1 (2%) each. Data on the incidence of mastitis were collected for herds that were using the on-farm bacteriologic culture system at the time of the survey (Tables 1 and 2). The incidence of mastitis varied widely from farm to farm.

For producers of the 14 herds reporting that they no longer used the on-farm bacteriologic culture system, various reasons were given for choosing to discontinue use of the on-farm system on their dairy. Multiple reasons were given by many producers. Seven of 14 respondents found it difficult to delay treatment of cows with mastitis when using the on-farm bacteriologic culture system. Five of 14 respondents thought that because they treated most cows with antimicrobials anyway, there was no advantage to use of the on-farm system. Cost was also a common reason (5/14 respondents) for discontinuing use of the on-farm system.

Respondents reporting that they were using the on-farm bacteriologic culture system were using it at various levels (Table 3). Various reasons were given for choosing not to use the on-farm system for 100% of the cases of mastitis. Most commonly (7/30 [23%]), respondents cited individual cow factors such as choosing not to obtain a milk sample for bacterial culture from a cow that had had mastitis several times previously or choosing to cull a cow rather than treat it. Six respondents (6/30 [20%]) also reported choosing not to obtain a milk sample for bacteriologic culture from a cow if they believed that the bacterial pathogen causing mastitis could be identified on the basis of clinical signs. Six respondents (6/30 [20%]) chose to obtain samples for on-farm bacteriologic culture only from cows for which original treatment choices were ineffective. Five respondents (5/30 [17%]) found it difficult to delay treatment of cows pending results of bacteriologic culture, whereas the same number of respondents cited equipment problems as a reason for choosing not to obtain a sample for bacteriologic culture from a cow with grade 1 or 2 mastitis.

The on-farm bacteriologic culture system was used to make treatment decisions in 1 of 2 ways on most farms. Fifty-eight percent (22/38) of respondents obtained milk samples for on-farm bacteriologic culture from cows that were identified as having grade 1 or 2 mastitis. Treatment was initiated after bacteriologic culture results were obtained (protocol A). A small number of respondents (15/38 [39%]) identified cows with grade 1 or 2 mastitis, obtained milk samples for on-farm bacteriologic culture, and initiated treatment with a routinely used antimicrobial while culture results were pending (protocol B); treatment was changed according to the type of bacteria identified. Two farms used alternative methods, and 1 farm reported use of protocols A and B.

Respondents using the on-farm bacteriologic culture system cited several benefits of the system for their dairy. Nearly all (35/40 [88%]) respondents believed that use of the on-farm bacteriologic culture system helped them make better treatment decisions. Most (28/40 [70%]) respondents also believed that the use of fewer antimicrobials had resulted in some cost savings for the farm. A similar number of respondents (27/40 [68%]) cited less need for bacteriologic cultures to be performed at outside laboratories as a benefit to the farm. Whereas most respondents reported at least 1 disadvantage, 9 respondents reported no disadvantages to use of the on-farm system. The most common disadvantage cited was that antimicrobials were used for mastitis with less need for bacteriologic culture.

### Table 1—Incidence of mastitis by type of pathogen in dairy herds in which a biplate on-farm system was used for bacteriologic culture of milk was used.

<table>
<thead>
<tr>
<th>Incidence</th>
<th>Percentage of herd affected per month (n = 13 farms)</th>
<th>Percentage of gram-negative bacteria (12)</th>
<th>Percentage of gram-positive bacteria (12)</th>
<th>Percentage of results with no growth (12)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD</td>
<td>4 ± 2.2</td>
<td>30 ± 28.6</td>
<td>34 ± 23.1</td>
<td>28 ± 20.3</td>
</tr>
<tr>
<td>Median (range)</td>
<td>4 (1–8)</td>
<td>24.5 (0–90)</td>
<td>39.5 (5–75)</td>
<td>22.5 (5–60)</td>
</tr>
</tbody>
</table>

The biplate is a 100 x 15-mm culture plate that is divided into thirds for detection of gram-negative bacteria, and the other half contains Factor medium for detection of gram-positive bacteria.

### Table 2—Incidence of mastitis by type of pathogen in dairy herds in which a triplate on-farm system was used for bacteriologic culture of milk was used.

<table>
<thead>
<tr>
<th>Incidence</th>
<th>Percentage of herd affected per month (n = 28 farms)</th>
<th>Percentage of gram-negative bacteria (27)</th>
<th>Percentage of gram-positive bacteria (24)</th>
<th>Percentage of S. aureus (24)</th>
<th>Percentage of S. dysgalactiae (24)</th>
<th>Percentage of S. agalactiae (24)</th>
<th>Percentage of Staphylococcus spp (24)</th>
<th>Percentage of results with no growth (24)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean ± SD</td>
<td>3 ± 1.8</td>
<td>33 ± 23.0</td>
<td>42 ± 21.9</td>
<td>17 ± 12.7</td>
<td>21 ± 14.9</td>
<td>5 ± 8.0</td>
<td>12 ± 14.0</td>
<td>10 ± 14.0</td>
</tr>
<tr>
<td>Median (range)</td>
<td>3 (1–7)</td>
<td>30.5 (0–90)</td>
<td>45.5 (0–94)</td>
<td>19.5 (0–47)</td>
<td>24 (0–50)</td>
<td>1 (0–30)</td>
<td>10 (0–45)</td>
<td>10 (0–45)</td>
</tr>
</tbody>
</table>

The triplate is a 100 x 15-mm culture plate that is divided into thirds for detection of gram-negative bacteria (MacConkey medium), gram-positive bacteria (Factor medium), and Streptococcus spp (modified TKT medium).
bacterial susceptibility testing could not be obtained by use of the on-farm system.

Respondents using the on-farm bacteriologic culture system were asked to estimate the percentage of cows with grades 1 and 2 mastitis treated with antimicrobials prior to and during use of the bacteriologic culture system. Patterns of antimicrobial use between respondents who used biplates and triplates were not different; therefore, results were combined for the analyses (Table 4). The distribution of antimicrobial use during use of the on-farm bacteriologic culture system shifted significantly ($P = 0.001$) toward use of fewer antimicrobials.

Responses from individual producers were compared to determine the difference in antimicrobial treatment rates on specific farms. More than half of all respondents (21/39 [54%]) reported a decrease in antimicrobial use since the on-farm system had been used (Table 5). The change in patterns of antimicrobial use also varied among farms according to the way in which the on-farm bacteriologic culture system was used on the farm. Seventy percent of respondents that used protocol A decreased antimicrobial use, whereas antimicrobial use by most respondents that used protocol B remained the same (Table 6).

All respondents reported that they had protocols for treatment of mastitis. Most respondents (34/40 [85%]) reported working with a veterinarian to determine the herd’s treatment protocols. Only 2 producers (2/40 [5%]) determined their own protocols without help from a veterinarian or other consultant. Most respondents (37/40 [93%]) believed that they followed the treatment protocol for the type of bacteria identified on bacteriologic culture of milk > 95% of the time.

Respondents were also asked to provide information regarding their first choice for antimicrobial treatment for each type of pathogen causing grades 1 and 2 mastitis. Most respondents (36/38 [93%]) chose an antimicrobial treatment on the basis of the type of pathogen identified rather than using the same antimicrobial for every cow with mastitis. Only 2 respondents reported that all cows were treated with the same antimicrobial treatment regardless of bacteriologic culture results. Overall, rates of use of antimicrobials for...

### Table 3—Rates of use of an on-farm system for bacteriologic culture of milk on dairy farms continuing use of an on-farm system for detection of the causative agent of grades 1 and 2 mastitis.

<table>
<thead>
<tr>
<th>Category of use</th>
<th>No. (%) of farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>None (0%)</td>
<td>0 (0)</td>
</tr>
<tr>
<td>A few cows (1% to 10%)</td>
<td>2 (5)</td>
</tr>
<tr>
<td>Some cows (11% to 50%)</td>
<td>3 (7)</td>
</tr>
<tr>
<td>Most cows (51% to 90%)</td>
<td>8 (20)</td>
</tr>
<tr>
<td>Almost all cows (91% to 99%)</td>
<td>18 (44)</td>
</tr>
<tr>
<td>All cows (100%)</td>
<td>10 (24)</td>
</tr>
<tr>
<td>Total No. of farms responding</td>
<td>41 (100)</td>
</tr>
</tbody>
</table>

Cows with grade 1 mastitis were defined as having abnormal milk. Cows with grade 2 mastitis were defined as having abnormal milk and a swollen mammary gland quarter.

### Table 4—Number (percentage) of antimicrobial treatment rates in cows with grades 1 and 2 mastitis treated with antimicrobials prior to and during use of an on-farm system for bacteriologic culture of milk.

<table>
<thead>
<tr>
<th>Category of use</th>
<th>Before use of on-farm culture</th>
<th>During use of on-farm culture*</th>
</tr>
</thead>
<tbody>
<tr>
<td>None (0%)</td>
<td>1 (3)</td>
<td>0</td>
</tr>
<tr>
<td>A few cows (1% to 10%)</td>
<td>2 (5)</td>
<td>8 (20)</td>
</tr>
<tr>
<td>Some cows (11% to 50%)</td>
<td>2 (5)</td>
<td>11 (27)</td>
</tr>
<tr>
<td>Most cows (51% to 90%)</td>
<td>10 (25)</td>
<td>13 (32)</td>
</tr>
<tr>
<td>Almost all cows (91% to 99%)</td>
<td>17 (43)</td>
<td>8 (20)</td>
</tr>
<tr>
<td>All cows (100%)</td>
<td>8 (20)</td>
<td>1 (20)</td>
</tr>
<tr>
<td>Total no. responding</td>
<td>40 (100)</td>
<td>41 (100)</td>
</tr>
</tbody>
</table>

*Significantly ($P < 0.05$) different from antimicrobial use before use of the on-farm bacteriologic culture system. See Table 3 for remainder of key.

### Table 5—Estimated changes in antimicrobial use for individual dairy farms continuing to use an on-farm system for bacteriologic culture of milk samples obtained from cows with grades 1 and 2 mastitis.

<table>
<thead>
<tr>
<th>Type of culture plate used</th>
<th>Decreased use</th>
<th>Remained the same</th>
<th>Increased use</th>
<th>Total</th>
<th>$P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biplate</td>
<td>8</td>
<td>5</td>
<td>1</td>
<td>14</td>
<td>0.040</td>
</tr>
<tr>
<td>Triplate</td>
<td>13</td>
<td>10</td>
<td>2</td>
<td>25</td>
<td>0.007</td>
</tr>
<tr>
<td>Total</td>
<td>21</td>
<td>15</td>
<td>3</td>
<td>38</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>

**Within a row, superscripts refer to significant ($P < 0.05$) differences detected when comparing the distribution of results across the categories to the expected normal distribution in which results would be equally spread across the categories by use of the sign test. See Table 3 for remainder of key.**

### Table 6—Changes in antimicrobial use according to treatment protocol on farms continuing to use an on-farm system for bacteriologic culture of milk samples obtained from cows with grade 1 and grade 2 mastitis. In protocol A, treatment of cows with low-grade mastitis was delayed pending results of on-farm bacteriologic culture, whereas in protocol B, treatment was initiated with a routinely used antimicrobial while culture results were pending.

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Decreased use</th>
<th>Percentage of total</th>
<th>Remained the same</th>
<th>Percentage of total</th>
<th>Increased use</th>
<th>Percentage of total</th>
<th>Total No. of farms</th>
</tr>
</thead>
<tbody>
<tr>
<td>A*</td>
<td>14</td>
<td>70</td>
<td>4</td>
<td>20</td>
<td>2</td>
<td>10</td>
<td>20</td>
</tr>
<tr>
<td>B</td>
<td>4</td>
<td>31</td>
<td>9</td>
<td>69</td>
<td>0</td>
<td>0</td>
<td>13</td>
</tr>
</tbody>
</table>

*Significantly ($P = 0.004$) different when comparing the distribution among the categories. See Table 3 for remainder of key.
treatment by type of pathogen varied. Thirty-nine percent (15/38) of all producers used an antimicrobial to treat cows with gram-negative infections, whereas 93% (13/14) of producers used an antimicrobial to treat cows with gram-positive (triplate users only) infections. One hundred percent (26/26) of producers used an antimicrobial for treatment of mastitis caused by Streptococcus spp, whereas 92% (22/24) used an antimicrobial for treatment of mastitis caused by Staphylococcus spp. Thirty-three percent (13/40) of all respondents used an antimicrobial when no growth was identified on bacteriologic culture of milk samples.

Discussion

Use of an on-farm system for bacteriologic culture of milk permits dairy producers to determine the type of bacteria causing mastitis within a day after mastitis is suspected. By having this information available within a reasonable amount of time, dairy producers and veterinarians can choose antimicrobials on the basis of the causative agent. Results of the study reported here indicated that use of an on-farm system for bacteriologic culture of milk can influence antimicrobial selection and may result in decreased use of antimicrobials for treatment of mastitis. Although studies assessing the actual success of similar diagnostic tools on changing patterns of antimicrobial use on multiple farms are lacking, results of our study support a wide-scale generalization of the results of a study7 performed in Michigan indicating an 80% reduction in antimicrobial use for treatment of mastitis on a single farm after controlled implementation of an on-farm procedure for bacteriologic culture.

Minimizing the amounts of antimicrobials used to treat mastitis may have many benefits for dairy producers. Decreased antimicrobial use would prevent unnecessary discarding of milk and decrease drug treatment costs, resulting in a substantial economic impact for the dairy. Decreased antimicrobial use also reduces the possibility of residues in milk. Use of bacteriologic culture results as a guide for antimicrobial treatment choices may also be expected to improve treatment outcomes because dairy producers and veterinarians are able to target antimicrobial treatments for the causative agent. Further research is required to test this hypothesis.

Successful treatment outcomes are likely dependent on which drugs are chosen for treatment of specific types of mastitis and how results of on-farm bacteriologic culture systems are used to guide antimicrobial treatment choices. Most respondents (93%) attempted to target antimicrobial treatment toward the pathogen isolated rather than treating all cows with mastitis with the same antimicrobial. This may mean that producers may choose not to use antimicrobials for treatment of some types of mastitis. Results of our study indicated that many producers that use the on-farm bacteriologic culture system are choosing not to use antimicrobials for treatment of cows with mastitis in which no growth or gram-negative bacteria were identified. However, most respondents were continuing to use antimicrobials for treatment of most cows with mastitis caused by gram-positive pathogens.

Although there is little debate over whether antimicrobial treatment of mastitis caused by gram-positive bacteria is beneficial,6,11 there is some scientific debate over whether cows with mastitis caused by gram-negative pathogens benefit from antimicrobial treatment. Results of several studies11-13 indicate that use of antimicrobials for gram-negative pathogens is not beneficial, whereas results of other studies indicate that use of certain antimicrobials may be beneficial. This debate is also evident from some of the responses on our survey, as approximately a third of respondents that had discontinued use of the on-farm bacteriologic culture system believed the results were not useful because all cows were being treated with an antimicrobial anyway. Because of this debate, the overall benefits of use of an on-farm bacteriologic culture system to guide antimicrobial treatment choices on an individual farm may depend on the veterinarian's or producer's interpretation of treatment outcomes on that farm, rather than solely on scientifically proven methods for treatment of mastitis caused by gram-negative pathogens. Further investigation is required to better describe the efficacy of treating gram-negative infections with antimicrobials.

Benefits of use of an on-farm bacteriologic culture system may be diminished if delaying antimicrobial treatment, even if for only 24 hours, has a negative impact on treatment outcomes when compared with implementation of treatment as soon as a case is identified. The impact of delaying treatment has not been well studied and could result in poor treatment outcomes. Results of our study indicated that most treatment decisions were guided by use of 1 of 2 methods on the basis of results of on-farm bacteriologic cultures. Protocol A involved delaying treatment for 24 hours, whereas protocol B involved performing treatment as soon as mastitis was detected and changing antimicrobial treatment if results of the on-farm bacteriologic culture indicated this was necessary. Because treatment outcomes were not assessed in our survey, benefits of use of a specific protocol could not be evaluated. Further research is necessary to examine the full effect of delayed treatment on the outcome of mastitis.

The benefits of use of an on-farm bacteriologic culture system can only be achieved if its use is surveyed on a regular basis. A significant number of respondents that began using the on-farm bacteriologic culture system discontinued its use and did not adopt use of the on-farm system on a long-term basis. Understanding characteristics of dairy farms presently using the on-farm system, benefits of its use, and reasons for using or not using the on-farm system for specific cases of mastitis may be helpful for veterinarians or producers contemplating use of such a system and improve the percentage of producers that continue its use. For example, nearly all respondents indicated that the size of their herd was > 200 head of cattle. When compared with data obtained in the 2002 National Animal Health Monitoring System dairy survey,16 these herds are disproportionately large, as only 8.2% of herds in the United States had > 200 head of cattle. Large herds are more likely to have a greater number of clinical cases of mastitis than small herds simply because they have larger numbers of cows at risk in the herd. As a result, pro-
Producers with large herds may consider the on-farm bacteriologic culture system more useful, practical, or economical than producers with small herds.

Commonly cited barriers to adoption of the on-farm system on a dairy farm included difficulty waiting for bacteriologic culture results prior to initiating treatment, cost, and finding no advantage to use of on-farm bacteriologic cultures because all cows were treated anyway. Although these reasons may be barriers to use of the on-farm bacteriologic culture system on certain farms, they also indicate some preconceptions producers or veterinarians may have concerning treatment of low-grade mastitis in cows.

Most commonly, respondents believed that it was difficult to wait for the bacteriologic culture results prior to treating cows. Most dairy producers are accustomed to treating any cow with mastitis as soon as clinical signs are detected. This standard of care may be difficult to change on many farms, especially if the producer believes that a cow’s clinical signs and prognosis for cure will worsen without immediate treatment. As previously mentioned, the effect of delaying treatment for 24 hours after detection of mastitis on treatment outcome has not been well documented. This preconception may or may not be well founded and may be a legitimate barrier to adoption of an on-farm bacteriologic culture system.

Cost was also cited as a common reason for discontinuing use of the on-farm bacteriologic culture system. These respondents believed that the overall cost of the on-farm system, including bacteriologic culture plates, incubators, labor, and other related costs, was high. Whether the total cost of the on-farm system outweighed the benefits of use of the system on those farms is not known. However, these beliefs may be unfounded because 70% of respondents continuing to use the on-farm bacteriologic culture system believed that some economic benefits were realized by use of the system. Further research into the economic impact of use of an on-farm bacteriologic culture system would be useful to clarify this issue.

Dairy producers that used the on-farm bacteriologic culture system also had barriers that limited the degree of use of an on-farm system for cows with low-grade mastitis. Many of those reasons involved cow-specific factors, such as having had mastitis several times previously or other health-related problems. The producer’s perception of the economic value of an animal influences the decision to perform additional diagnostic tests or further antimicrobial treatment of that animal. Results of a study17 from Denmark suggest that producers balance the cost of the on-farm system with the benefits of the overall treatment, cost, and finding no advantage to use of on-farm bacteriologic cultures because all cows were treated anyway. Although these reasons may be barriers to use of the on-farm bacteriologic culture system on certain farms, they also indicate some preconceptions producers or veterinarians may have concerning treatment of low-grade mastitis in cows.

Most commonly, respondents believed that it was difficult to wait for the bacteriologic culture results prior to treating cows. Most dairy producers are accustomed to treating any cow with mastitis as soon as clinical signs are detected. This standard of care may be difficult to change on many farms, especially if the producer believes that a cow’s clinical signs and prognosis for cure will worsen without immediate treatment. As previously mentioned, the effect of delaying treatment for 24 hours after detection of mastitis on treatment outcome has not been well documented. This preconception may or may not be well founded and may be a legitimate barrier to adoption of an on-farm bacteriologic culture system.

Cost was also cited as a common reason for discontinuing use of the on-farm bacteriologic culture system. These respondents believed that the overall cost of the on-farm system, including bacteriologic culture plates, incubators, labor, and other related costs, was high. Whether the total cost of the on-farm system outweighed the benefits of use of the system on those farms is not known. However, these beliefs may be unfounded because 70% of respondents continuing to use the on-farm bacteriologic culture system believed that some economic benefits were realized by use of the system. Further research into the economic impact of use of an on-farm bacteriologic culture system would be useful to clarify this issue.

Dairy producers that used the on-farm bacteriologic culture system also had barriers that limited the degree of use of an on-farm system for cows with low-grade mastitis. Many of those reasons involved cow-specific factors, such as having had mastitis several times previously or other health-related problems. The producer’s perception of the economic value of an animal influences the decision to perform additional diagnostic tests or further antimicrobial treatment of that animal. Results of a study17 from Denmark suggest that producers balance the cost of the on-farm system with the benefits of the overall treatment.

Twenty percent of producers also claimed they did not obtain a sample from every cow for on-farm bacteriologic culture because they believed that they were able to predict the type of pathogen that was causing mastitis by a cow’s clinical signs. Results of 1 study18 performed in Scotland indicate that this is not a highly accurate method for diagnosis. In that study, the sensitivity and specificity of predicting the causative agent in similar cases were 28% and 96%, respectively. Although the skills of producers in identifying the causative pathogen by observing clinical signs may be better than average because of the frequent identification of causative agents of mastitis on those farms, they are not likely to approach the accuracy of an actual bacteriologic culture. Veterinarians must work closely with producers to address this barrier for a farm to gain the full benefit from use of an on-farm bacteriologic culture system.

Because this study was designed primarily to collect general information concerning use of an on-farm system for bacteriologic culture of milk, many questions concerning the impact that use of this type of system has on dairy farms and treatment of mastitis remain unanswered. Although results of our study indicated a general tendency toward changing antimicrobial use practices on dairy farms, this analysis was made by use of producers’ perceptions and estimations of their patterns of antimicrobial use on a general basis. Respondents that used the on-farm system were asked to estimate their pattern of prior use of antimicrobials for treatment of mastitis. In some cases, this may have been as long as ≥ 2 years earlier and their estimations may not have been accurate. As a result, recall bias may affect the accuracy of our results. This method was used for this general survey because exact information on patterns of antimicrobial use is not likely to be easily accessible on many farms, even those with computer record keeping. Despite this, results of the study reported here indicated that there was a strong tendency for farms that adopted an on-farm system for bacteriologic culture of milk to change their antimicrobial use practices, providing a foundation for further research on how use of an on-farm system for bacteriologic culture of milk affects antimicrobial use.

Although results of our study indicated a strong temporal association between implementation of a new diagnostic tool and decreased antimicrobial use, other factors may affect patterns of antimicrobial use for treatment of mastitis on dairy farms. Other changes in dairy herd management were not assessed, and their effect on antimicrobial use during the same time frame could not be evaluated. Further studies to definitively identify use of an on-farm system for bacteriologic culture of milk as the major factor involved in changing patterns of antimicrobial use for treatment of mastitis on those farms are needed.

Results of the study reported here provide important indication that use of an on-farm system for bacteriologic culture of milk can change antimicrobial use practices for low-grade mastitis in cows. Despite some of the limitations of our study, questions were generated and a foundation for further investigation into use of an on-farm system for bacteriologic culture was provided. Many questions, such as the economic impact of use of an on-farm bacteriologic culture system, its impact on the prevalence of pathogens causing mastitis or antimicrobial resistance patterns, and antimicrobial treatment outcomes, need to be addressed to assess the full effect of use of an on-farm system for bacteriologic culture of milk. Because wide-scale adoption of on-farm bacteriologic culture systems is occurring and has the potential to provide many benefits to dairy farms choosing to use them, research into these areas has important implications for dairy producers.

---

b. GPN plate test, Udder Health Systems Inc, Bellingham, Wash.
References