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 system for 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-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 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 and antimicrobial susceptibility testing are useful tools that veterinarians and producers are encouraged to use to help choose appropriate antimicrobials and optimize treatment success.

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 are also lacking.

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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 X 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 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 sp (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, 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 analysis, 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-
Ruminants was used.

Incidence of mastitis by type of pathogen in dairy herds in which a triplate on-farm system 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 Staphylococcus spp (24)</th>
<th>Percentage of Streptococcus spp (24)</th>
<th>Percentage of Staphylococcus aureus (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 ± 21.3</td>
<td>17 ± 12.7</td>
<td>21 ± 14.9</td>
<td>5 ± 8.0</td>
<td>12 ± 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>
</tr>
</tbody>
</table>

The triplate 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.

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<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 × 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.
brial 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 animals 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).

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 4). 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 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.

Table 3—Rates of use of an on-farm system for bacteriologic culture of milk samples obtained from cows with 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>16 (44)</td>
</tr>
<tr>
<td>All cows (100%)</td>
<td>10 (24)</td>
</tr>
<tr>
<td>Total No. of farms responding</td>
<td>40 (100)</td>
</tr>
</tbody>
</table>

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

Table 4—Number (percentage) of 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 4). 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).

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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 (biplate 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 *S aureus* (triplate users only), and 100% (26/26) 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 study 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, there is some scientific debate over whether cows with mastitis caused by gram-negative pathogens benefit from antimicrobial treatment. Results of several studies 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, 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-
ducers 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 the reasons included 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 study from Denmark suggest that producers balance clinical signs of an individual cow against economic factors in determining whether to use antimicrobials.

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 study 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 a strong 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.

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b. GPN plate test, Udder Health Systems Inc, Bellingham, Wash.
Selected abstract for JAVMA readers from the American Journal of Veterinary Research

Prevalence of vesivirus in a laboratory-based set of serum samples obtained from dairy and beef cattle

Andreas Kurth et al

Objective — To examine sera obtained from dairy and beef cattle to detect antibodies against vesivirus and compare seroprevalence among cattle within the sample population.


Procedure — Sera were analyzed for vesivirus-specific antibodies by use of a recombinant vesivirus–San Miguel sea lion virus serotype 5 capsid peptide antigen in an indirect ELISA.

Results — Overall, 693 sera were tested and 105 (15.2%) had positive results. Seropositive cattle were from 7 states (all cattle from Montana and Maryland [10 and 4, respectively, were seronegative]). Overall seroprevalence for antivesivirus antibody in herds ranged between 0% and 80% (median, 14%). Higher antibody prevalence was significantly associated with older age, dairy rather than beef cattle, and reasons for submission. Logistic regression of factors (abortion, respiratory tract disease, and all other reasons for sample submission) revealed that older age and other reasons were independently associated with higher seroprevalence. Higher seropositive optical density values for the ELISA were observed among older cattle and cattle that aborted, compared with values for cattle with respiratory tract disease or other reasons for submission.

Conclusions and Clinical Relevance — This laboratory-based surveillance sample provided a point estimate of seroprevalence against vesivirus among cattle in 8 US states. This suggests that vesivirus infection is widespread with high prevalence in some herds. Risk factors associated with vesivirus seroprevalence in beef and dairy cattle should be confirmed in population-based studies. (Am J Vet Res 2003;54:114–119)