**Prevalence and clinical outcome of subclinical bacteriuria in female dogs**

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**Objective**—To determine the prevalence of subclinical bacteriuria and its natural clinical course over a 3-month period in healthy female dogs.

**Design**—Observational, prospective, cross-sectional study.

**Animals**—101 healthy client-owned female dogs.

**Procedures**—In all dogs, screening clinicopathologic tests and bacteriologic culture of urine were performed. In culture-positive dogs, subclinical bacteriuria was confirmed by 2 positive culture results within 2 weeks and dogs were reevaluated at 3 months.

**Results**—The prevalence of subclinical bacteriuria in healthy female dogs was 9 of 101 (8.9%). Three-month follow-up data were available for 8 of 9 dogs with subclinical bacteriuria. Four dogs had persistent bacteriuria, and 4 had transient bacteriuria. No dogs with subclinical bacteriuria developed clinical signs during the 3-month observation period. Subclinical bacteriuria was diagnosed in 6 of 51 (12%) young and middle-aged dogs and 3 of 50 (6.0%) senior and geriatric dogs. No significant difference was found in the prevalence of subclinical bacteriuria with age.

**Conclusions and Clinical Relevance**—Results suggested that subclinical bacteriuria is a nonprogressive condition in healthy female dogs and can be persistent or transient. No significant difference in the prevalence of subclinical bacteriuria in young and middle-aged dogs versus senior and geriatric dogs was detected. No dogs with subclinical bacteriuria developed clinical signs requiring antimicrobial treatment during the 3-month observation period. Healthy female dogs with subclinical bacteriuria may be a population of dogs in which antimicrobial treatment is unnecessary. (J Am Vet Med Assoc 2014;245:106–112)

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In human females without symptoms of lower urinary tract infection, asymptomatic bacteriuria is defined as the presence of $\geq 10^5$ CFUs/mL of a single bacterial pathogen in 2 consecutive midstream urine specimens.1,2 Asymptomatic bacteriuria is commonly recognized as a transient or persistent, benign condition that does not require treatment in healthy pre- and postmenopausal women. The reported prevalence of asymptomatic bacteriuria increases with age and is estimated to be 5% in premenopausal women, 25% in women $>65$ years old, and $\geq 50\%$ in women $>80$ years of age.3 *Escherichia coli* is the most common uropathogen isolated in association with asymptomatic bacteriuria. *Klebsiella* spp, *Enterococcus* spp, and *Staphylococcus* spp are other common isolates.4

As in women, lower urinary tract infection is a common diagnosis in female dogs with a similar distribution of uropathogens and risk factors.2 However, in veterinary medicine, subclinical bacteriuria is not a widely recognized condition and bacteriuria remains a common indication for antimicrobial use. Subclinical bacteriuria in both male and female dogs has been reported as early as 1972.5,6 Canine populations recognized to have subclinical bacteriuria are dogs with diabetes mellitus,7 puppies with parvovirus infections,8 dogs with inflammatory skin disorders treated with cyclosporine,9 and obese adult dogs.10 In these populations, treatment is generally pursued when positive results of bacteriologic culture of urine are obtained. However, the International Society for Companion Animal Infectious Diseases recently published guidelines for the treatment of urinary tract disease in cats and dogs and stated that treatment may not be necessary in animals with subclinical bacteriuria.11 This recommendation was extrapolated from human studies and not based on objective clinical evidence in dogs.

No clinical studies evaluating the prevalence and natural clinical course of subclinical bacteriuria in healthy female dogs are available to guide objective treatment recommendations. In light of the rapidly growing concerns for the more prudent use of antimicrobials in veterinary medicine, there is a progressive trend to adopt more stringent guidelines against empirical antimicrobial treatment similar to those in human medicine. As in healthy women, treatment of subclinical bacteriuria in healthy female dogs may not be nec-
essary and the risks of antimicrobial use may outweigh the potential benefits.

The purpose of the study reported here was to prospectively determine and characterize subclinical bacteriuria in healthy female dogs. Specific objectives were to determine the prevalence of subclinical bacteriuria in healthy female dogs as well as its prevalence in dogs of various life stages (young and middle-aged vs senior and geriatric), describe the uropathogens associated with subclinical bacteriuria, and describe the natural clinical course of bacteriuria in the absence of antimicrobial treatment during a 3-month period. We hypothesized that subclinical bacteriuria is a benign nonprogressive clinical condition in healthy female dogs that increases in prevalence with increasing age.

Materials and Methods

Animals—Client-owned healthy female dogs without clinical signs of lower urinary tract disease (urgency to urinate, dysuria, pollakiuria, stranguria, hematuria, malodorous urine, or perit尿) were recruited from May 2011 through November 2012 to be used in the study. The dogs were from the University of Wisconsin-Veterinary Medical Teaching Hospital Primary Care population and belonged to faculty, staff, and students; the dogs were undergoing annual wellness examinations. Female dogs were eligible for inclusion in the study if they were at least 1 year of age; were deemed to be healthy at the time of enrollment on the basis of history, physical examination, and results of screening clinicopathologic testing; and were free of any clinical signs consistent with lower urinary tract disease. Dogs were excluded if they had a history of receiving antimicrobials orally or immunosuppressive treatment within 3 months after initial evaluation, fever, overt signs of vaginitis or vaginal discharge, or clinical evidence of acute illness. All study protocols were reviewed, approved, and conducted in accordance with the University of Wisconsin Animal Care and Use Committee. Written informed consent was obtained from all dog owners prior to enrollment into the study.

Study design—An observational, prospective, cross-sectional study was used. Age, breed, sex, reproductive status, body weight, body condition score, clinical history including medications or supplements, and physical examination findings were recorded for all dogs. At enrollment, blood (5 to 6 mL; < 1% of body weight) and urine (3 to 6 mL) were collected. The initial urine sample used to screen for bacteriuria was collected by use of a clean, midstream voided sample to facilitate initial enrollment. Screening diagnostic testing performed included a CBC, limited serum preanesthetic panel, urinalysis, and bacteriologic culture and antimicrobial susceptibility testing performed on voided urine. The limited preanesthetic panel included serum activities of alkaline phosphatase and alanine aminotransferase; concentrations of urea, creatinine, albumin, total protein, glucose, sodium, potassium, and chloride; and total carbon dioxide content. The dogs enrolled in the study were categorized into 2 life stages: young and middle-aged dogs and senior and geriatric dogs (Appendix). Criteria for defining dogs as young and middle-aged versus senior and geriatric were based on age and body weight because large-breed dogs have shorter life expectancies.

All young and middle-aged dogs were skeletal mature and at least 1 year of age at the time of enrollment.

Dogs with a positive bacteriologic culture result at the initial evaluation that remained free of clinical signs of lower urinary tract disease were returned within 7 to 14 days for a follow-up physical examination, complete serum biochemical panel, bacteriologic culture of urine, and lateral abdominal radiography. Urine was collected by cystocentesis to rule out any false-positive culture results associated with the initial screening culture caused by secondary urogenital contamination of the collected sample. The additional screening at the second evaluation was used to confirm bacteriuria and to rule out potential underlying predisposing conditions for bacteriuria, including urinary incontinence, myelopathy, urolithiasis, or underlying metabolic diseases (eg, hyperadrenocorticism or diabetes mellitus). Dogs were excluded if they had evidence of acute disease on the basis of results of physical examination or complete serum biochemical panel, radiographic evidence of urinary calculi, or a predisposing condition for bacteriuria.

Subclinical bacteriuria was diagnosed if results of the second bacteriologic culture of urine, collected by cystocentesis, at the 7- to 14-day follow-up evaluation were positive and if clinical signs of lower urinary tract disease were absent. These dogs were returned in 3 months for a physical examination and repeated bacteriologic culture of urine to determine the natural clinical outcome of the subclinical bacteriuria. At this 3-month follow-up visit, history was obtained and physical examination and bacteriologic culture of urine collected by cystocentesis were performed. Dogs that remained free of clinical signs of lower urinary tract disease during the 3-month observation period were determined to be either persistently bacteriuric (on the basis of positive results of bacteriologic culture of urine) or transiently bacteriuric (on the basis of bacteriologic culture of urine with no bacterial growth of note). Dogs that developed clinical signs of lower urinary tract disease or became systemically ill over the 3-month observation period were considered to have progressive clinical bacteriuria.

For this study, on the basis of the standard of care for women with asymptomatic bacteriuria, antimicrobial treatment was not initiated in dogs identified with subclinical bacteriuria. Antimicrobial treatment was recommended if the dogs developed clinical signs consistent with lower urinary tract disease or became systemically ill. Choice of antimicrobial treatment, based on results of bacteriologic culture of urine and antimicrobial susceptibility testing, was at the discretion of each patient's attending veterinarian.

Sample collection and analysis—Blood samples for a CBC and preanesthetic or complete serum biochemical panel and urine for urinalysis were analyzed by the Clinical Pathology Laboratory by use of standard protocols. A single lateral abdominal radiograph was obtained by the Radiology Service and was interpreted by the attending board-certified radiologist for the presence of urinary calculi.
Urine was submitted to the Microbiology Laboratory for routine bacteriologic culture and antimicrobial susceptibility testing. Urine was submitted directly to the laboratory or stored at 4°C if transport was delayed. Urine was plated for quantitative bacteriologic culture within 24 hours after collection. The quantitative culture consisted of plating 10 μL of urine collected by cystocentesis. Bacteriologic cultures of urine were evaluated for growth at 24 and 48 hours. Growth was quantitated as the number of CFUs per milliliter. Bacterial growth cutoffs were defined for each urine collection method used and were based on human and veterinary recommendations. For this study, a positive result from a clean voided sample was defined as 1 to 3 pathogens present at >10,000 CFUs/mL. The presence of >3 species of microorganisms or <10,000 CFUs/mL indicated probable urethral contamination, and results of these cultures were considered unremarkable or negative. Any microorganism growth from urine collected by cystocentesis was considered important, unless the growth was suggestive of gastrointestinal contamination during cystocentesis. All relevant isolates were identified by use of standard microbiological methods. Minimal inhibitory concentrations were determined by broth dilution for all important isolates. Methods and antimicrobial susceptibility breakpoint interpretations were performed in accordance with Clinical Laboratory Standards Institute guidelines.

Statistical analysis—A priori power analysis based on published data in women with asymptomatic bacteriuria was used to determine the target total enrollment of 100 dogs. The enrollment of 50 young and middle-aged dogs and 50 senior and geriatric dogs provided 80% power to detect a 20% difference in the prevalence of subclinical bacteriuria between the 2 groups.

Ordinal data (age, body weight, and clinicopathologic values) and categorical data were compared between the 2 life stages of female dogs (ie, young and middle-aged vs senior and geriatric) on the basis of a Mann-Whitney U test and Fisher exact test, respectively. Descriptive statistics were used to characterize the uropathogens cultured. The overall percentage of female dogs with subclinical bacteriuria was calculated. The percentages of young and middle-aged dogs and senior and geriatric dogs with subclinical bacteriuria were calculated and compared by use of a Fisher exact test. All numeric data are reported as median and range. Significance was set at P < 0.05.

Results

One hundred seven dogs were screened for enrollment, and 101 dogs were enrolled. Six dogs were excluded from study enrollment for the following reasons: 2 dogs with initial positive results of bacteriologic culture of urine were lost to follow-up, 2 dogs had Capillaria spp in urine sediment, 1 dog had a markedly high alanine aminotransferase activity (>1,000 U/L), and 1 dog had a high creatinine concentration.

Fifty-one dogs were categorized as young and middle-aged, and 50 dogs were categorized as senior and geriatric. Baseline descriptive characteristics of all the enrolled dogs were summarized (Table 1). With the exception of age, there were no significant differences between the dogs in the 2 life stages. Baseline clinicopathologic data from the CBC, serum biochemical panel, and urinalysis of all dogs were summarized (Table 2). The senior and geriatric dogs had significantly lower Hct, higher platelet count, higher serum alanine aminotransferase and alkaline phosphatase activities, and lower urine specific gravity, compared with the young and middle-aged dogs. No significant differences were found in the remainder of the CBC, serum biochemical panel, and urinalysis results between the 2 study groups.

Dogs with subclinical bacteriuria—Among all the enrolled dogs (n = 101), 9 dogs had subclinical bacteriuria (overall prevalence, 8.9%), including 6 of the 51 young and middle-aged dogs (prevalence, 12%) and 3 of the 50 senior and geriatric dogs (prevalence, 6.0%). No significant (P = 0.485) difference in the prevalence of subclinical bacteriuria was found between the 2 life stages. The uropathogens and the number of CFUs of bacteria isolated from all dogs with subclinical bacteriuria were summarized (Table 3). The distribution of uropathogens isolated was as follows: E coli (n = 1), Enterococcus faecalis (1), Staphylococcus pseudintermedius (3), and Streptococcus canis (1) were cultured in the young and middle-aged dogs; E coli (1), Enterococcus faecium (1), and Klebsiella spp (1) were cultured in

<table>
<thead>
<tr>
<th>Variable</th>
<th>All dogs (n = 101)</th>
<th>Young and middle-aged (n = 51)</th>
<th>Senior and geriatric (n = 50)</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (y)</td>
<td>8 (1–14)</td>
<td>5 (1–8)</td>
<td>10 (6–14)</td>
<td>&lt; 0.001</td>
</tr>
<tr>
<td>Neutered status</td>
<td></td>
<td></td>
<td></td>
<td>0.148</td>
</tr>
<tr>
<td>Sexually intact</td>
<td>13</td>
<td>4</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>Spayed</td>
<td>88</td>
<td>47</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>Weight (kg)</td>
<td>23.5 (3.2–52.0)</td>
<td>22.1 (3.3–52.0)</td>
<td>25.3 (3.2–38.2)</td>
<td>0.185</td>
</tr>
<tr>
<td>Breed status</td>
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<td></td>
<td></td>
<td>0.211</td>
</tr>
<tr>
<td>Purebred</td>
<td>66</td>
<td>30</td>
<td>36</td>
<td></td>
</tr>
<tr>
<td>Mixed</td>
<td>35</td>
<td>21</td>
<td>14</td>
<td></td>
</tr>
<tr>
<td>Top 3 breeds</td>
<td>Labrador Retriever (12), Alaskan Malamute (8), and Golden Retriever (2).</td>
<td>Labrador Retriever (6), Chihuahua (3), and Alaskan Malamute (2).</td>
<td>Labrador Retriever (6), Alaskan Malamute (6), and Golden Retriever (5).</td>
<td>NA</td>
</tr>
</tbody>
</table>

Values reported are median (range). P values indicate comparisons between age groups. NA = Not applicable.
the senior and geriatric dogs. These uropathogens were susceptible to all antimicrobials tested.

3-month follow-up—In the population of dogs with subclinical bacteriuria (n = 9), 3-month follow-up data were available in 8 dogs. One dog in the senior and geriatric group was lost to follow-up. Four dogs with subclinical bacteriuria had persistent subclinical bacteriuria (2 young and middle-aged dogs and 2 senior and geriatric dogs), and 4 young and middle-aged dogs had transient subclinical bacteriuria. The same bacterial genus was isolated at 7 to 14 days and 3 months in each of the dogs with persistent subclinical bacteriuria (Table 3). None of the dogs with subclinical bacteriuria developed clinical signs of lower urinary tract disease within the 3-month observation period.

Discussion

In this population of healthy female dogs the overall prevalence of subclinical bacteriuria was 8.9%. The uropathogens associated with subclinical bacteriuria included \textit{E coli}, \textit{Enterococcus} spp, \textit{S pseudintermedius}, \textit{Klebsiella} spp, and \textit{S canis}. In this small female dog population, no significant difference was found in the prevalence of subclinical bacteriuria with increasing age. Subclinical bacteriuria followed a persistent or transient clinical course during the 3-month observation period of this study, and none of the dogs with subclinical bacteriuria developed clinical signs of lower urinary tract disease or illness requiring antimicrobial treatment.

No predisposing factors for development of bacteriuria were identified via history, physical examinations, or baseline clinicopathologic data from the same dogs as in Table 1.

Table 3—Uropathogens isolated from dogs with subclinical bacteriuria at study enrollment (initial), 7 to 14 days later, and 3 months later.

<table>
<thead>
<tr>
<th>Uropathogen</th>
<th>Initial (n = 9)</th>
<th>7–14 days (n = 9)</th>
<th>3 months (n = 8)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>\textit{Escherichia coli}</td>
<td>\textit{800}T (1) and \textit{1,000}T (1)</td>
<td>&gt; 100,000 (2)</td>
<td>&gt; 100,000 (1)</td>
</tr>
<tr>
<td>\textit{Klebsiella pneumoniae}</td>
<td>&gt; 100,000 (1)</td>
<td>&gt; 100,000 (1)</td>
<td>—</td>
</tr>
<tr>
<td>\textit{Klebsiella oxytoca}</td>
<td>—</td>
<td>—</td>
<td>&gt; 100,000 (1)</td>
</tr>
<tr>
<td>\textit{Staphylococcus pseudintermedius}</td>
<td>&gt; 100,000 (3)</td>
<td>50 (1) and</td>
<td>&gt; 100,000 (1)</td>
</tr>
<tr>
<td>\textit{Enterococcus faecium}</td>
<td>10,000 (1)</td>
<td>&gt; 100,000 (1)</td>
<td>&gt; 100,000 (1)</td>
</tr>
<tr>
<td>\textit{Enterococcus faecalis}</td>
<td>&gt; 100,000 (1)</td>
<td>1,000 (1)</td>
<td>—</td>
</tr>
<tr>
<td>\textit{Streptococcus canis}</td>
<td>5,000T (1)</td>
<td>&gt; 100,000 (1)</td>
<td>—</td>
</tr>
</tbody>
</table>

Values reported are CFUs per milliliter. Number in parentheses is the number of dogs with each bacterial isolate. *No follow-up bacteriologic culture of urine was available for one of the senior and geriatric dogs; the case was lost to follow-up. Results of bacterial culture of a midstream voided urine sample were suggestive of bacteriuria on the basis of a pure culture or substantial growth of a single bacterial species despite the low organism count. A second culture was performed with urine collected by cystocentesis to rule out contamination. — = Not determined.
screening clinicopathologic data, and a single lateral abdominal radiograph. The available routine clinicopathologic markers of urinary tract disease in the dogs with subclinical bacteriuria (n = 9) were clinically unremarkable. These included urine specific gravity and plasma urea and creatinine concentrations. The single dog with a urine specific gravity approaching isosthenuria (urine specific gravity, 1.013) had a plasma creatinine concentration of 0.8 mg/dL.

The species of uropathogens isolated in the dogs with subclinical bacteriuria were common pathogens associated with urinary tract disease in dogs and were susceptible to all antimicrobials tested. The concentrations of bacteria isolated from urine collected by cystocentesis in the dogs with confirmed subclinical bacteriuria were variable, ranging from 50 to > 100,000 CFUs/mL. More than 100,000 CFUs/mL was isolated in the majority (7/9) of dogs with subclinical bacteriuria, yet none developed clinical signs of urinary tract disease during the study observation period. These findings do not support the notion that subclinical bacteriuria in dogs is limited to dogs with clinically unimportant bacteriuria (< 100,000 CFUs/mL). As described in humans, despite the similarities in species and numbers of uropathogens isolated in association with clinical and subclinical bacteriuria, clinical disease may be the result of differences in the virulence factors expressed by the uropathogens or the individual dog’s susceptibility or response to bacterial colonization.3,22,23

Investigations of the long-term outcomes in healthy women with asymptomatic bacteriuria consistently reveal that asymptomatic bacteriuria is not associated with development or progression of chronic kidney disease, hypertension, urinary tract cancer, other metabolic diseases, or decreased survival rate.24,25 Furthermore, antimicrobial treatment does not decrease the frequency of clinical infections or prevent recurrence of asymptomatic bacteriuria. However, treatment of asymptomatic bacteriuria can lead to increased symptomatic reinfections and development of antimicrobial-resistant uropathogens in humans.26,27 On the basis of these observations, the risks of antimicrobial treatment (adverse drug events, selection for antimicrobial-resistant bacteria populations, and increased cost) outweigh the potential benefits.24,25,26

The Infectious Diseases Society of America guidelines do not recommend screening and treatment of asymptomatic bacteriuria in healthy women aside from pregnant women and patients undergoing urological procedures, in whom treatment is beneficial.27 Other patient populations in which treatment of asymptomatic bacteriuria is not recommended include diabetic women, patients with spinal cord injuries, and patients with indwelling urinary catheters.27,28 In light of the information from women with asymptomatic bacteriuria and similar concerns associated with antimicrobial use (adverse drug reactions, selection for antimicrobial-resistant bacteria populations, and increased cost) in veterinary medicine, the findings from the present study do not support the treatment of subclinical bacteriuria in healthy female dogs.

The result of routine urinalysis was not always in agreement with the result of bacteriologic culture of urine. In the present study, bacteria were only detected via urine sediment analysis in 4 of 9 dogs with subclinical bacteriuria, and bacteria were detected in 2 of 92 dogs without subclinical bacteriuria. Pyuria (ie, > 5 WBC/hpf) was detected in 5 of 9 dogs with subclinical bacteriuria and 14 of 92 dogs without subclinical bacteriuria. Considering that screening for bacteriuria is appropriate only if treatment is recommended, routine screening for bacteriuria via urine sediment analysis or bacteriologic culture of urine in healthy female dogs without clinical signs of lower urinary tract disease may not be indicated.

The risk factors for development of asymptomatic bacteriuria in humans are multifactorial and include hormonal, anatomic, functional, metabolic, and host immunologic factors.3,22 Increased prevalence of asymptomatic bacteriuria in postmenopausal women led to the conclusion that estrogen is an important factor in preventing asymptomatic bacteriuria. Estrogen contributes to the maintenance of adequate glycogen in the vaginal epithelial cells, which favors a normal lactobacilli-dominant vaginal flora. Lack of estrogen creates an unfavorable microenvironment for lactobacilli. This predisposes overgrowth of uropathogens, thereby increasing the likelihood of development of asymptomatic bacteriuria.22 Interestingly, in the present study, the prevalence of subclinical bacteriuria in female dogs did not increase with age. Two of the 9 dogs with subclinical bacteriuria were sexually intact females: one in the young and middle-aged group and the other in the senor and geriatric group. The authors acknowledge that this study evaluated a small population of female dogs, which may have contributed to the inability to detect a difference in the prevalence of subclinical bacteriuria with increasing age. However, this lack of significant difference may have been complicated by the relative homogeneity of the female dog population; the majority of dogs were spayed females (n = 88/101).

Limitations of this study included defining the absence or presence of clinical disease in dogs with subclinical bacteriuria, limited diagnostic imaging at enrollment, and the short observation period of 3 months. By definition, the diagnosis of subclinical bacteriuria is dependent on the veterinarians' or owners' perception of the absence of clinical signs of urinary tract disease. This appears to be inherently biased but is inevitable in clinical veterinary medicine. Clinicians rely on the owners' history and assessment to identify clinical signs of disease that prompt the owners to pursue a veterinary consultation, diagnostic testing, or treatment. It is generally accepted that most owners know their dogs well and are the best judges of even subtle clinical changes in their dogs; however, a subset of dog owners may not be as observant. For all the dogs in this study, neither the owners nor primary clinicians perceived any problems or reported clinical signs of urinary tract disease even when questioned at study enrollment.

In this study, diagnostic imaging was limited to a single lateral abdominal radiograph to rule out cystic calculi as a predisposing cause for bacteriuria. Orthogonal radiography and abdominal ultrasonography would have increased the confidence in ruling out radiopaque and radiolucent cystic calculi or identifying other predisposing causes (eg, anatomic malformations) for bac-
teriuria in these female dogs. A single lateral abdominal radiograph was used because of financial limitations but would have likely identified struvite cystoliths commonly associated with bacteriuria. Recruitment of dogs with ectopic ureters would have been unlikely in this study population of female dogs, given that dogs with urinary incontinence, either newly diagnosed or historical, were excluded from study enrollment.

Finally, the short 3-month follow-up period of the dogs with subclinical bacteriuria may have resulted in overestimation of the number of dogs that remained persistently bacteriuric or underestimation of the number of cases that may have progressed to clinical disease. Additional follow-up visits (eg, at 6 and 12 months) would have provided information on the clinical course of subclinical bacteriuria. However, the short-term follow-up in this study was the result of limited funds and the inherent difficulty in compliance with long-term follow-up for a study without a financial incentive.

The present study only investigated subclinical bacteriuria in a population of healthy female dogs. Additional studies are necessary to evaluate the appropriate management of subclinical bacteriuria in dogs with concurrent medical complications, including dogs with an underlying chronic disease (eg, diabetes mellitus or hyperadrenocorticism) or dogs that are undergoing immunosuppression or chemotherapy. The decision to screen for and treat subclinical bacteriuria in these canine populations should be made on an individual basis.

In the present study, subclinical bacteriuria had a prevalence of approximately 9% in healthy female dogs. Within the short-term 3-month observation period of this study, none of the dogs with subclinical bacteriuria developed clinical urinary tract disease and bacteriuria was either persistent or transient. Findings suggested that healthy female dogs with subclinical bacteriuria may be a population in which antimicrobial treatment is unnecessary. Further studies are necessary to investigate the effect of antimicrobial treatment in healthy female dogs with subclinical bacteriuria. In the interest of the advancement of antimicrobial stewardship, the authors do not recommend empirical or routine treatment of subclinical bacteriuria in healthy female dogs. However, if subclinical bacteriuria is detected in a healthy female dog, clinical monitoring is recommended, including serial bacteriologic culture of urine, to determine whether subclinical bacteriuria is transient, persistent, or progressive and to intervene as indicated.

References


**Appendix**

Criteria used for categorizing healthy female dogs into 2 life stages (young or middle-aged vs senior or geriatric) on the basis of age and body weight.

<table>
<thead>
<tr>
<th>Age (y)</th>
<th>Weight (kg)</th>
<th>Young and middle-aged</th>
<th>Senior and geriatric</th>
</tr>
</thead>
<tbody>
<tr>
<td>≥ 34</td>
<td>&lt; 7</td>
<td>≥ 7</td>
<td></td>
</tr>
<tr>
<td>14 to &lt; 34</td>
<td>&lt; 8</td>
<td>≥ 8</td>
<td></td>
</tr>
<tr>
<td>&lt; 14</td>
<td>&lt; 9</td>
<td>≥ 9</td>
<td></td>
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