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ESTIMATION OF INCIDENCE OF THE VAGINITIS/CYSTITIS COMPLEX IN PUPPIES

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August 2015

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1. ABSTRACT

This study aimed to estimate the incidence of the vaginitis/cystitis complex in bitches before the first heat cycle. The goal of the study was to get a better estimation of breeds predisposed, occurring clinical signs, complications and rate of natural resolution in dogs before the first heat cycle.

The study was set up in two different designs: in the first a questionnaire was filled out by 380 veterinarians registered by the de Royal Dutch Society for Veterinarians. In the second design, patient registration files of ten small animal private practices in the Netherlands were looked into and analyzed.

The annual incidences of vaginitis, cystitis and pyelonephritis were 67 per 10 000, 77 per 10 000 and 83 per 100 000 visits respectively. Vaginitis was an incidental finding during routine examination in 25% of cases. Most bitches before the first heat cycle with vaginitis and/or cystitis were diagnosed between 2-4 months of age, with an average age at diagnosis of 17 weeks. Bitches as young as 7 to 8 weeks old were already diagnosed with vaginitis/cystitis. There was no breed predisposition for the vaginitis/cystitis complex. The most frequently diagnosed breeds with vaginitis was the Labrador Retriever and with cystitis the American Staffordshire Terrier. Seventy percent of breeds diagnosed with vaginitis and/or cystitis had an adult weight over 25 kilograms. Resolution of symptoms of vaginitis and cystitis took 66 days and 68 days respectively. Antimicrobial treatment gave no resolution of symptoms of vaginitis. In the majority of bitches, vaginitis/cystitis complex resolved before the first heat cycle. Vaginitis could be preceded or followed by cystitis; or vaginitis and cystitis could occur simultaneously. Cystitis was followed by pyelonephritis in 6 percent of bitches.

2. INTRODUCTION

Puppy vaginitis, also known as juvenile vaginitis, is described as an inflammation of the vagina associated with clinical signs occurring in young female dogs before the first heat cycle. The age of onset varies between six weeks to puberty and the duration from days to months. The clinical symptoms are usually mild varying from mucoid, whitish-yellow discharge at the vulvar lips, mild perivulvar dermatitis to frequently licking at the vulva^{1,2}. Puppy vaginitis can be intermittent² and no breed predisposition has been reported.

It is thought that puppy vaginitis resolves spontaneously in about 90% of cases^{3,4}, although rare papers have been published to support the presumption. There is one retrospective study⁴ describing chronic vaginitis lasting over more than 1 month in 71 bitches. Of those bitches, 37 were younger than one year. There are no data present about incidence of chronic vaginitis in young bitches⁴.

Vaginitis may be complicated by cystitis. In one study about 10% of bitches with vaginitis also showed signs of cystitis like pollakisuria⁴. It is thought that the cystitis can lead to pyelonephritis, although hard data are absent. Most infections of the urinary tract are associated with bacterial pathogens ascending from the gastrointestinal tract or the skin surrounding the vulva to the urethra and urinary bladder⁵. When there is only puppy vaginitis present, without cystitis, antibiotic therapy is not recommended because vaginal bacterial cultures reveals no significant bacterial growth^{1,2}.

In bitches with puppy vaginitis it is advised to wait after the first heat cycle before performing ovari(ohyster)ectomy in order to avoid a chronic condition⁶. It is thought that the estrus cycle might hasten resolution, although strong evidence is lacking^{4,6-8}. In one retrospective study describing seven dogs with juvenile vaginitis that were left intact, three improved after one heat cycle, one after two heat cycles, and three showed no change after multiple heat cycles but had subsequent resolution by 3 years of age⁴. It is not known whether the hormone exposure occurring during the first heat or the maturation of the immune system of the dog causes resolution of the signs of puppy vaginitis^{1,8}. The aim of our study is to get a better estimation of the incidence of the vaginitis/cystitis complex, breeds predisposed, occurring clinical signs, complications and rate of natural resolution in dogs before the first heat cycle.

3. MATERIAL AND METHODS

The study was performed in two different designs: in the first a questionnaire was sent by mail to all small animal veterinarians registered by the de Royal Dutch Society for Veterinarians. In the second design all patient registration files of ten small animal private practices in the Netherlands were searched for female puppies born between 2 July 2011 and 1 July 2014.

3.1. Questionnaire

The questionnaire, made in Survey Monkey, contained 90 questions of which 33 open, 12 semi-closed and 45 closed. All questions were related to vaginitis and/or cystitis and/or pyelonephritis occurring before the first heat cycle. The questionnaire was distributed by mail and reminders were sent to those who had not responded.

3.2. Patient registration files

All patient registration files of ten small animal private practice were searched for bitches born between 2 July 2011 and 1 July 2014. Three different patient registration systems were used by the 10 practices: Animana, RXWorks and VIVA. Two different search methods were used to select cases in the three patient registration systems. For Animana all patient maps had to be looked into individually, while for RXWorks and VIVA an initial selection using searching terms was made. Thereafter the individually patient registration file of selected cases was looked into. Bitches older than 18 months without a record of the first heat cycle were excluded from this study.

3.3. Statistical analysis

Statistical analysis was performed using SPSS 20 and Excel 2013. To perform statistical analysis, the open ended questions of the questionnaire were converted into categorical variables where appropriate. Some categories (e.g. '0%'/'1-10%' and '11-25%'/'26-50%'/'51-75%'/'76-100%') were grouped together to perform statistical analysis. Results were considered significant if $p < 0.05$. For calculating the mean adult weights in the questionnaire, the mixed breeds and large groups like 'hunting dogs' were excluded because estimation of weight was not feasible.

4. RESULTS

4.1. Results questionnaire

A mail containing the questionnaire in Survey Monkey was sent to 2153 veterinarians of which was registered that they worked in small animal and mixed practices. Of those, 380 responded (response rate 18%) of which 263 veterinarians completed all questions. Of those 263, 196 (75%) worked in solely small animal practices. In total 228 veterinarians of the 261 (87%) reported that they exclusively treated small animals. Of the responders who provided information on age and gender (262), 31% was male and 69% female and the majority was between 30 and 40 years of age (38%).

4.1.1. Vaginitis

Of all bitches presented to the responding veterinarians, 70% reported that up to ten percent of young bitches had vaginitis before the first heat cycle, while 23% of the responders said that vaginitis occurred in 11-30% of bitches before the first heat cycle.

Seventy six percent of responders provided an age predilection. According to 86% of them, bitches were between 2-6 months of age when they were first diagnosed with vaginitis.

There was no weight predilection according to 45% of responding veterinarians. The majority of the remaining responders (91%) reported that puppies with an adult weight over ten kilogram were predisposed. Reported breeds in which puppy vaginitis was frequently diagnosed are reported in table 4.1.1.

TABLE 4.1.1. Breed distribution of reported dogs having vaginitis before their first heat cycle.

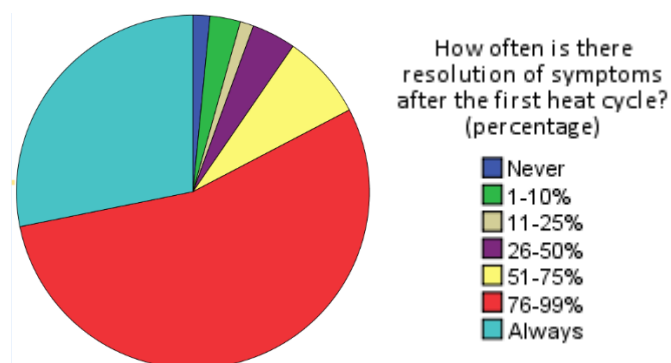
Breed group	Total (n=273)
Labrador Retriever	68
Golden Retriever	19
Boxer	17
Retriever breed	17
Staffordshire Bull Terrier	14
Others (≤11)	138*

* For more detailed information see appendix.

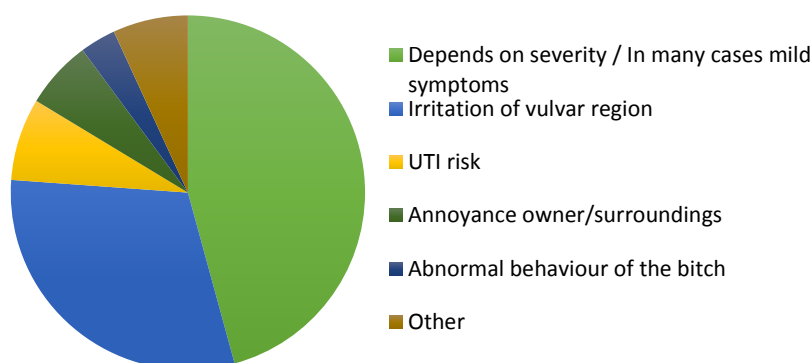
The adult weight of the mentioned breeds was in 90% of cases over ten kilograms, of which 78% was over 25 kilograms.

Most reported clinical signs of vaginitis were abnormal (purulent) vaginal discharge (76%), licking at the vulva (61%) and inflammation of the vulva (29%). Three in four responders mentioned that vaginitis could be an incidental finding during routine examination. According to 37% of the responders it was an incidental finding in up to 10% of puppies, while 10% of responding veterinarians said that puppy vaginitis was an incidental finding in 76-100% of bitches. There was a significant correlation ($p < 0.01$) between veterinarians that reported vaginitis as an incidental finding and the reported prevalence. The veterinarians that found vaginitis as an incidental finding reported more often a higher prevalence, and the veterinarians that did not find vaginitis during routine examination reported more often a lower prevalence.

Puppy vaginitis was never treated by 25% of responders, while 9% always initiated treatment. When treated, 95% of responders used systemic antibiotics with a mean treatment duration of 7 days (range 3-28 days). Treatment resolved symptoms of puppy vaginitis in 75% of the puppies according to the responders. The first heat cycle resolved puppy vaginitis in 76-99% according to 55% of the responders, while 28% thought that puppy vaginitis always disappeared after the first heat cycle (see graph 4.1.1. (1)). How often the responders initiated treatment and how often they reported resolution of symptoms after the first heat cycle were not correlated.

**GRAPH 4.1.1. (1)** Answers by responders: resolution of vaginitis after first heat cycle.

Vaginitis impaired welfare according to 38% of the responders. Most mentioned reasons were: irritation of the vulva/vagina; abnormal behavior (licking of vulva), risk of urine tract infection and uncleanness due to the abnormal vaginal discharge. Some responders gave an argument against the impairment of welfare: most symptoms of vaginitis went unnoticed by the owner and most dogs showed no discomfort from it (see graph 4.1.1. (2)).



Graph 4.1.1. (2) Arguments given by responders about impairment of welfare due to vaginitis.

Veterinarians that thought vaginitis impaired welfare were significantly ($p<0.01$) more likely to initiate treatment and for a longer period of time ($p=0.02$).

4.1.2. Cystitis

According to 61% of responders, cystitis before the first heat cycle was seen in 1-10% of bitches, and 23% mentioned that cystitis before the first heat cycle was seen in 11-30%. Fifty one percent of responders reported an age predilection, of which 2-6 months was most frequently mentioned (81%). There was no weight predilection according to 57% of responders. The majority of the remaining veterinarians (89%) reported that puppies with an adult weight over ten kilogram were predisposed. Reported breeds in which cystitis was frequently diagnosed are reported in table 4.1.2.

TABLE 4.1.2. Breed distribution of reported dogs having cystitis before their first heat cycle.

Breed group	Total (n=132)
Labrador Retriever	21
Retriever breed	16
Mixed Breed	10
Golden Retriever	9
Boxer	8
Staffordshire Bull Terrier	6
Other (≤ 5)	62*

* For more detailed information see appendix.

The adult weight of the reported breeds was in 85% of cases over ten kilograms, of which 78% was over 25 kilograms.

Most reported clinical signs of cystitis were: hematuria (72%), pollakisuria (66%), inability to houstrain the dog (61%) and stranguria (51%).

At least 81% of the veterinarians used a short course (7-14 days) of antibiotics as treatment for cystitis. The most often prescribed antibiotics was amoxicillin (with clavulanic acid) followed by TMP/S.

Seventy percent of the responders reported that resolution of symptoms occurred in 51-100% of the bitches after the first heat cycle, while 8% of responders said that resolution only occurred in up to ten percent of cases.

4.1.3. Vaginitis and cystitis

One in three veterinarians reported that vaginitis and cystitis did not occur simultaneously in bitches before the first heat cycle, while 51% said that vaginitis and cystitis occurred simultaneously in 1-10%

of the bitches. Seventy one percent of the veterinarians reported that in up to ten percent of puppies, vaginitis was followed by cystitis, and 21% reported it was in 11% to 30% of the puppies. Fifty three percent of the responders said that in 76% to 99% of the bitches resolution of the clinical signs occurred after the first heat cycle, and 17% reported that symptoms of vaginitis and cystitis always resolved after the first heat cycle.

4.1.4. Pyelonephritis

Most responders (72%) reported that they had never encountered bitches with pyelonephritis before the first heat cycle, while 27% reported that 1-10% of presented bitches before the first heat cycle had pyelonephritis. The responders (74/379) said that bitches with pyelonephritis always (23%) or sometimes (61%) had (a history of) vaginitis and/or cystitis.

Reported breeds in which pyelonephritis was diagnosed are reported in table 4.1.4.

TABLE 4.1.4. Breed distribution of reported dogs having pyelonephritis before their first heat cycle.

Breed group	Total (n=26)
Boxer	7
Retriever breed	4
Labrador Retriever	3
Other (≤ 1)	12*

* For more detailed information see appendix.

Most reported clinical signs were polyuria/polydipsia (88%), malaise (67%), vomiting (21%), and inability to housetrain the dog (12%).

Seven out of ten responders, who had not diagnosed pyelonephritis in bitches before the first heat cycle, had encountered polydipsia and polyuria in bitches before the first heat cycle: almost half of those responders had encountered bacteriuria in those bitches.

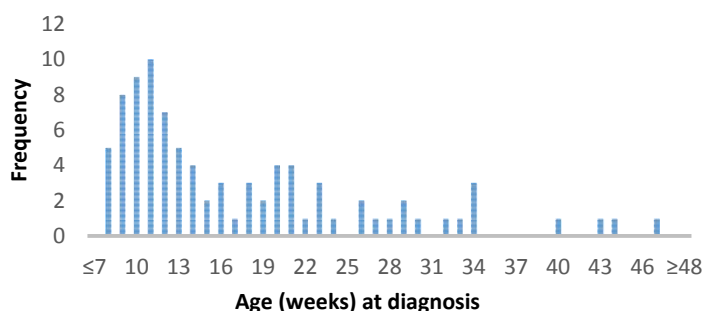
Responders diagnosed pyelonephritis most often with diagnostic imaging (45%), positive urine culture (33%), clinical symptoms (malaise (32%), polyuria/polydipsia (28%), fever (24%), abdominal pain (16%)), abnormal findings in blood analysis (27%) and urine analysis (27%).

4.2. Results patient registration files

Patient registration files of ten small animal private practices were searched for bitches born between 2 July 2011 and 1 July 2014. A total of 4452 patient registration files were found, of which 175 files met our criteria. The total amount of patient registration files varied per clinic from 76 to 1298.

4.2.1. Vaginitis

Vaginitis before the first heat cycle occurred in 2.0% (range 0.2-5.8%) of bitches. During this study (1095 days), 89 of the 4452 bitches were diagnosed with vaginitis before the first heat cycle which gave an annual incidence of 669 per 100 000. The average age at diagnosis was 17 weeks (range: 54-308 days).



Graph 4.2.1. Age at which vaginitis was diagnosed.

The most common breed diagnosed with puppy vaginitis was the Labrador Retriever (11%), followed by the American Staffordshire Terrier (7%) (Table 4.2.1.): in three out of four litters the average adult weight was over 25 kilograms.

TABLE 4.2.1. Distribution of dog breeds having vaginitis before their first heat cycle by breed.

Breed group	Total (n=88)
Mixed breed	16
Labrador Retriever	10
American Staffordshire Terrier	7
Bernese Mountain Dog	4
Boxer	4
Golden Retriever	4
Other (≤ 3)	43*

* For more detailed information see appendix.

Clinical signs indicating vaginitis were: vaginal discharge (83%), licking at the vulva (25%), inflammation of the vulva (17%) and 2% of the bitches were attractive to male dogs. In 25% of bitches diagnosed with vaginitis, the symptoms were only noticed during standard physical examination by the veterinarian. We found that the incidence of vaginitis per animal clinic and the frequency of incidental findings per animal clinic were not significantly correlated ($p > 0.05$). In puppies with vaginitis, 28% of them also developed or had a history of cystitis (pollakisuria and/or hematuria).

Resolution of symptoms of vaginitis took 66 days (range 3-348 days). Most bitches (96%) showed no symptoms of vaginitis by one year of age. Only nine bitches had a record of the first heat cycle. Eight dogs had no symptoms of vaginitis after the first heat cycle, and in one dog it was not clear. Antibiotics were given in 20% of cases, and amoxicillin with clavulanic acid was most commonly prescribed. There was no significant difference in resolution of vaginitis between treated and non-treated bitches ($p = 0.16$).

4.2.2. Cystitis

Cystitis before the first heat cycle occurred in 2.3% (range 0.2-5.8%) of bitches. During this study 103 of the 4452 bitches were diagnosed with cystitis before the first heat cycle which gave an annual incidence of 774 per 100 000. The average age at diagnosis was 17 weeks (range 56-377 days). The most common breed diagnosed with cystitis before the first heat cycle was the American Staffordshire Terrier (9%), followed by the Bouvier des Flandres (7%) (Table 4.2.2). Nearly 67% of bitches had an average adult weight over 25 kilograms.

TABLE 4.2.2. Distribution of dog breeds having cystitis before their first heat cycle by breed.

Breed group	Total (n=100)
Mixed breed	13
American Staffordshire Terrier	9
Bouvier des Flandres	7
Bernese Mountain Dog	5
Labrador Retriever	5
Rottweiler	5
Staffordshire Bull Terrier	5
Other (≤ 4)	51*

* For more detailed information see appendix.

In 15% of bitches with cystitis, cystitis reoccurred once, and in 8% there were at least three episodes of cystitis.

Symptoms of cystitis were: pollakisuria (77%), stranguria (30%), hematuria (19%), dysuria (13%) and 14% urinating indoors while housetrained. The symptoms were similar for recurrent cystitis, except for dysuria, which was significantly noticed more often (40%) ($p=0.012$). One in four bitches with cystitis also had (a history of) vaginitis. Six percent of bitches with cystitis had or were suspected of pyelonephritis with associated symptoms (polyuria, polydipsia). The time between diagnosis of cystitis and diagnosis of pyelonephritis ranged from 0 to 57 days.

Urine analysis of puppies with symptoms compatible with cystitis showed: leukocyturia (72%), hemoglobinuria (65%), proteinuria (23%), and elevated pH (46%).

The average duration before symptoms of cystitis were not reported anymore was 68 days (range 4-395 days). Antibiotics were given in 75% of bitches with cystitis for 5-10 days and NSAIDs were prescribed in 33% of cases. The most common prescribed antibiotic was amoxicillin (with clavulanic acid) (88%), followed by TMP/S (10%) and third generation antibiotics (2%).

Some of the bitches (14%, 14/103) had persistent cystitis, and of those bitches, five to ten days of antibiotic treatment gave resolution of the symptoms. Of the bitches with persistent cystitis, 45% also developed recurrent cystitis. Bitches with persistent cystitis were significantly ($p=0.01$) more likely to develop recurrent cystitis than bitches without persistent cystitis.

4.2.3. Vaginitis and cystitis

Vaginitis along with cystitis occurred in 0.6% of prepubertal bitches (annual incidence of 188 per 100 000). There were 25 of 170 bitches diagnosed with vaginitis and cystitis before the first heat cycle: fourteen bitches received the diagnoses simultaneously; four developed cystitis after vaginitis (21-58 days); and six had a history of cystitis before vaginitis was diagnosed (15-138 days).

4.2.4. Pyelonephritis

Almost one percent (38/4452) of prepubertal bitches had polyuria and polydipsia. A quarter (11/38) of those bitches had (4/11), or were suspected of (7/11), pyelonephritis: i.e. pyelonephritis occurred in 0.2% of young bitches (annual incidence of 83 per 100 000). All dogs with pyelonephritis, except for one, had an average adult weight over 10 kilograms, of which eight dogs had an average adult weight over 25 kilograms.

The bitches showed the following symptoms: polyuria (100%), polydipsia (100%), urinating indoors while housetrained (22%), and signs of lower urinary tract infection (22%). Urine analysis showed leukocytic cylinders in two cases, and in four cases bacteriologic examination of the urine had revealed three positive cultures: the dog with the negative culture had received antibiotics before examination.

The average age at diagnosis was 16 weeks (range 54-278 days). All bitches with (suspicion of) pyelonephritis had received antibiotics: the symptoms disappeared after two to three weeks (range 1-6 weeks) of antibiotics. One dog still had symptoms of pyelonephritis at the time of this study. Bitches with polyuria and polydipsia, and without pyelonephritis, took an average of 14 weeks until resolution of the symptoms. Two out of 27 of those bitches had received antibiotics, but showed no improvement of the symptoms.

Six of the eleven dogs were also diagnosed with cystitis: two had symptoms of pyelonephritis and cystitis simultaneously; four had a history of cystitis (8, 29, 57 days); and one had developed cystitis after pyelonephritis (80 days).

4.3. Comparison of patient registration files and questionnaire

The data from the patient registration files were compared to the data from the questionnaire. Solely the main interests of this study were compared.

4.3.1. Vaginitis

Subject		Patient registration files	Questionnaire	
Frequency*		2.0% (0.2%-5.8%) ¹ (95% CI: 1.6-2.4%)	Mean ² : 12.5% (0%-27.7%) Lowest: 6.1% (0%-19.9%) Highest: 18.8% (2.1%-35.6%)	
Age at diagnosis	<2 months	6%	5% ³ (5%)	
	2-4 months	56%	52% (48%)	
	4-6 months*	21%	41% (38%)	
	>6 months	17%	10% (10%)	
Breeds⁴	Mixed breed*	18.2%	3.3%	
	Labrador Retriever*	11.4%	24.9% (31.1%) ⁵	
	American Staffordshire Terrier*	8.0%	1.1%	
	Bernese Mountain Dog*	4.5%	1.1%	
	Boxer	4.5%	6.2%	
	Golden Retriever(*)	4.5%	7.0% (13.2%)	
	Belgian Shepherd Dog*	3.4%	0% (4.0%)	
	Rottweiler	3.4%	2.6%	
Adult weight	<10 kg	11%	7% ⁶ (10%)	10% ⁷
	10-25 kg* ⁸	16%	33% (45%)	20%
	>25 kg* ⁸	73%	33% (45%)	70%
Symptoms⁹	Vaginal discharge	83%	76%	
	Licking at vulva*	25%	61%	
	Inflammation vulva*	17%	29%	
	Attractive to male dogs	2%	1%	
Frequency incidental finding		25% (0%-35%) ¹	Mean ² : 21.9% (0%-50.6%) Lowest: 16.1% (0%-41%) Highest: 27.6% (0%-60.4%)	
Resolution after first heat cycle¹⁰		89%-100% (8/9 out of 9) ¹¹	Mean ² : 82.6% (59.6%-100%) Lowest: 74.7% (50.1%- 99.4%) Highest: 90.5% (67.9%- 100%)	

* Statistical significance $p < 0.05$
95% CI: 95% confidence interval

1. Range represents different clinics.
2. For example '0-10%': the lowest frequency the responders could mean is '0%' and the highest '10%', and the mean of the '0-10%' group is '5%'.
3. The 'No' group in the questionnaire has been excluded from this table. Responders could give multiple answers for this question.
4. The eight most frequent breeds, found in the study with the patient registration files, were used.
5. The responders sometimes grouped different breeds together: for instance 'retriever breed' could also include Labrador Retriever. Therefore that number has also been added to Labrador Retriever group: the resulting number is in between parentheses.
6. The 'No' group in the questionnaire has been excluded from this table. Responders could give multiple answers for this question.
7. These percentages were calculated from the breeds reported in the questionnaire.
8. Statistically significant from the first column.
9. The most frequent symptoms, found in the study with patient registration files, were used.

10. Resolution after first heat cycle: no symptoms of previously diagnosed vaginitis after the first heat cycle.

11. There were 9 records of the first heat cycle available: for one dog it is not clear whether vaginitis is present after the first heat cycle or not.

4.3.2. Cystitis

Subject		Patient registration files	Questionnaire	
Frequency*		2.3% (0.2-5.8%) ¹ (95% CI: 1.9%-2.7%)	Mean ² : 14.7% (0%-32.8%) Lowest: 8.7% (0%-25.3%) Highest: 20.6% (0.7%-40.5%)	
Age at diagnosis	<2 months	3%	2% ³ (3%)	
	2-4 months*	60%	38% (45%)	
	4-6 months	29%	30% (36%)	
	>6 months	8%	14% (16%)	
Breeds⁴	Mixed breed	13%	7.6%	
	American Staffordshire Terrier*	9%	2.3%	
	Bouvier des Flandres*	7%	1.5%	
	Bernese Mountain Dog	5%	3.8%	
	Labrador Retriever*	5%	15.9% (28.0%) ⁵	
	Rottweiler	5%	1.5%	
	Staffordshire Bull Terrier	5%	4.5%	
	American Bulldog*	4%	0% (3.8%)	
Adult weight	<10 kg	12%	6% ⁶ (11%)	15% ⁷
	10-25 kg* ⁸	20%	26% (43%)	19%
	>25 kg* ⁸	68%	27% (46%)	66%
Symptoms⁹	Pollakisuria*	77%	66%	
	Stranguria*	30%	51%	
	Hematuria*	19%	72%	
	Dysuria*	13%	34%	
	Urinating indoors while housetrained*	14%	61%	
Resolution after first heat cycle^{10*}		92.3% (12/13) ¹¹	Mean ² : 63.1% (35.4%-90.7%) Lowest: 51.9% (25.8%-78.0%) Highest: 74.2% (44.9%-100%)	

* Statistical significance difference $p < 0.05$

95% CI: 95% confidence interval

1. Range represents different clinics.

2. For example '0-10%': the lowest frequency the responders could mean is '0%' and the highest '10%', and the mean of the '0-10%' group is '5%'.

3. The 'No' group in the questionnaire has been excluded from this table. Responders could give multiple answers for this question.

4. The eight most frequent breeds, found in the study with the patient registration files, were used.

5. The responders sometimes grouped different breeds together: for instance 'retriever breed' could also include Labrador Retriever. Therefore that number has also been added to Labrador Retriever group: the resulting number is in between the parentheses.

6. The 'No' group in the questionnaire has been excluded from this table. Responders could give multiple answers for this question.

7. These percentages were calculated from the breeds reported in the questionnaire.

8. Statistically significant from the first column.

9. The most frequent symptoms, found in the study with the patient registration files, were used.

10. Resolution after first heat cycle: no symptoms of previously diagnosed cystitis after the first heat cycle.

11. One dog had another episode of cystitis 6 months after the first heat cycle.

4.3.3. Vaginitis and cystitis

Subject	Patient registration files	Questionnaire
Frequency*	0.6% (95% CI: 0.4%-0.8%)	Mean ¹ : 7.6% (0%-19.6%) Lowest: 3.8% (0%-13.6%) Highest: 11.4% (0%-26.0%)
Development of cystitis following vaginitis	20.2% (18/89)	Mean ¹ : 12.3% (0%-26.8%) Lowest: 6.0% (0%-18.9%) Highest: 18.6% (2.4%-34.7%)
Resolution after first heat cycle	100% (4/4)	Mean ¹ : 75.6% (50.0%-100%) Lowest: 66.4% (39.9%-93.0%) Highest: 84.8% (59.1%-100%)

* Statistical significance $p < 0.05$
95% CI: 95% confidence interval

1. For example '0-10%': the lowest frequency the responders could mean is '0%' and the highest '10%', and the mean of the '0-10%' group is '5%'.

4.3.4. Pyelonephritis

Subject	Patient registration files	Questionnaire
Frequency*	0.2% (95% CI: 0.1%-0.3%)	Mean ¹ : 1.6% (0%-4.6%) Lowest: 0.4% (0%-1.4%) Highest: 2.9% (0%-7.9%)
Prior diagnosis of vaginitis and/or cystitis	54.5% (6/11)	Mean ^{1,2} : 53.4% (22.3%-84.5%) Lowest: 23.6% (0%-65.3%) Highest: 83.2% (46.6%-100%)

* Statistical significance $p < 0.05$
95% CI: 95% confidence interval

1. The answers to the question were 'yes', 'sometimes', and 'no'. To calculate the frequency we used the following percentages for the answers: 'yes' = 100%, 'sometimes' = 1% (lowest), 50% (mean), 99% (highest), 'no' = 0%.

2. For 'sometimes' the lowest frequency the responders could mean is '1%' and the highest '99%', and the mean of 1%-99% is '50%'.

5. DISCUSSION

To our knowledge, this was the first study to investigate the incidence of vaginitis and cystitis in female dogs before the first heat cycle.

In our study, we found that 2.0% of bitches before the first heat cycle (annual incidence of 67 per 10 000) were diagnosed with vaginitis, which was significantly different from what the responding veterinarians in the questionnaire thought (6.1%-18.8%). This could be because veterinarians could not specify the frequency and could only choose from a few different categories.

In a study done by Johnson⁴, chronic vaginitis was defined as having been present for longer than 1 month and included lesions within the vestibule and vagina. In that study⁴, during a 5-year period, chronic vaginitis was diagnosed in 71 of 10 000 bitches (bitches presented to a university veterinary clinical center). At the time of diagnosis, 37 of the bitches were young (8 weeks to younger than 1 year).⁴ It was not known how many of those young bitches had gone through the first heat cycle, and furthermore, some of the mature bitches (>1 year of age) had yet to go through the first heat cycle.

Vulvovaginitis was also a common gynecological problem in prepubertal girls.⁹ In a study done by Jones¹⁰, the annual incidence of vulvovaginitis in children was 1 in 10 000. One partner in that study¹⁰, responsible for 2200 patients, gave an approximate annual incidence of 5 per thousand. Comparing those results, it looked like that vaginitis occurred more often in dogs than men, which could be due to hygiene, different anatomy and different bacterial environment. Young girls were particularly susceptible to (vulvo)vaginitis for both anatomical and behavioural reasons³⁷. Factors that favored the development of vulvovaginitis were: decreased estrogen stimulus during the prepubertal period resulting in thinning of the vulvovaginal epithelium, local alkaline pH and thin labia minora³⁸. Other reasons for increased risk of developing vulvovaginitis were: poor local immune system, closeness of the vulva to the anal region and inadequate hygiene³⁷. In dogs, immaturity of the reproductive physiology and immune system predisposed young animals to inflammation and/or vaginal infections.⁷

Veterinarians that found vaginitis during routine examination more often reported a higher incidence of vaginitis. In our study, twenty-five percent (21.9% questionnaire) of the vaginitis was found during routine examination as an incidental finding. In the study done by Johnson⁴, vulvar discharge was an incidental, persistent physical finding during the puppy series of vaccinations. This could mean that looking for vaginal discharge during routine examination could increase the frequency in which vaginitis was diagnosed. However, those puppies, did not seem to have clinical relevant symptoms of vaginitis and that raised the question if that should be classified the same as the puppies with irritation and licking at the vulva.

The age of onset varied between six weeks to puberty.^{1,2} In a study⁴, the youngest bitch was 8 weeks old. In our study, the youngest dog with vaginitis was 7 weeks old. Most dogs were diagnosed between 2-4 months of age (56%), which is the same as what most veterinarians (48%) responded in the questionnaire.

Data about the exact dog population around the time of our study were not available. It was therefore not clear if the incidence of vaginitis was higher in the mentioned breeds than in others. It could only be said that the Labrador Retriever and American Staffordshire Terrier were more frequently diagnosed with vaginitis. The Labrador retriever was more often reported by the veterinarians in the questionnaire than we found in our study (24.9 vs. 11.4%). Most (reported) breeds (73%) had an adult weight of over 25 kilograms and it seemed that vaginitis occurred more often in puppies of large breed dogs. No other studies reported a breed predisposition.^{2,4}

Abnormal vaginal discharge was found in 83% of cases (76% questionnaire). Licking at the vulva (25%) and inflammation of vulva (17%) were significantly more often reported by the veterinarians (61% and 29% respectively). In a study by Johnson⁴, mucous, muco-purulent, or purulent vaginal discharge was one of the most common abnormality in bitches with chronic vaginitis (90%, 64/71). In young bitches (<1 year of age) with chronic vaginitis, 89% (34/37) had abnormal vaginal discharge reported by the owner, and 86% (32/37) had vulvar discharge during physical examination by the veterinarian. None of those young bitches had discharge with blood. Pollakisuria (10%) was reported by the owners, as was licking the vulva (10%).⁴ Four of 37 (11%) young bitches had vulvar hyperemia. Nonseptic inflammation was more common (n=5) than septic inflammation (n=1) in young bitches.⁴

In one study done by Jacquieiry et al.¹¹, the most predominant symptoms of vulvovaginitis in prepubertal girls were redness (82%) and soreness (74%) of the vulva/vagina, and itching and discharge were reported in 58% and 62% of cases respectively. Examination confirmed redness of the vaginal introitus in 87% of cases, but also in 30% of the control group¹¹. In a study done by Romero et al.¹², 95% percent of the prepubertal girls with persistent vaginitis presented with vaginal discharge. The most predominant symptom of vaginitis, in both dogs and men, was vaginal discharge. In most bitches, the vaginal discharge was not purulent. Licking at the vulva could indicate soreness and/or itchiness of the vulva/vagina which was more often reported in men. Prepubertal girls with redness of the vulva did not necessarily have vaginitis, which could also be the case in dogs.

It was thought that puppy vaginitis resolved spontaneously in about 90% of cases^{3,4}, which we could support with our data. In our study, resolution of symptoms did not hasten if bitches

received antibiotics. We found that it took 66 days until resolution of symptoms. In a study done by Johnson⁴, in most (84%) young bitches (<1 year of age) chronic vaginitis resolved regardless of the therapy used. They found that 21 of 31 young bitches had resolution of chronic vaginitis within 2 months of diagnosis.

We found that 8 (or 9) out of 9 bitches had no symptoms of vaginitis after the first heat cycle (90%-100% resolution). The responding veterinarians gave similar answers: 75%-91%. In the study done by Johnson⁴, in six bitches, vaginitis resolved with the first heat cycle. In four bitches, the first heat cycle gave no resolution of symptoms, but the bitches also did not improve after ovariohysterectomy⁴. At the time of that study⁴, six bitches still had clinical signs of vaginitis: none of these six bitches had yet experienced a heat cycle. Only 4 of the 31 bitches were known to have experienced an estrous cycle before the resolution of signs⁴.

Vaginitis could be a welfare problem in bitches before the first heat cycle, which is supported by 38% of veterinarians. However, most veterinarians thought it did not impair welfare, as most symptoms went unnoticed by the owner and most dogs showed no discomfort from it.

Vaginitis could lead to cystitis. In our study, four of 25 bitches had vaginitis followed by cystitis after 21-58 days. In a study done by Johnson⁴, pollakisuria occurred in 10% of bitches with vaginitis, while we found that pollakisuria occurred in 16% (14/89) of bitches with vaginitis. In our study, 20% of the bitches with vaginitis also developed cystitis (6.0-18.6% according to questionnaire). In the study of Johnson⁴, 5 of the 34 (15%) mature bitches (>1 year of age) had recurrent urinary tract infection. Five (of 37) young bitches were also tested, but urinalyses were normal or urine cultures were sterile⁴. It was thought that altered vaginal microbiota (due to vaginitis) could predispose bitches to urinary tract infection (UTI). In a study done by Freshman et al.¹³, vaginitis was a risk factor for UTI with an odds ratio of 7.5. It had to be said that the numbers of this study were very small (exposed cases: 8, exposed controls: 0). Furthermore, an association between altered vaginal microbiota and development of recurrent UTI had been identified in women^{14,15}. Women with recurrent UTIs were more likely to have vaginal microbiota predominated by uropathogenic bacterial populations¹⁶. However, in a study done by Hutchins et al.¹⁶, the vaginal microbiota of spayed female dogs with recurrent UTI was similar to the control population of normal, spayed female dogs. Additionally, in a study by Johnson⁴, the organisms recovered from bitches with chronic vaginitis were qualitatively the same as the normal bacterial flora of the canine vagina. In prepubertal girls¹¹, vaginal microbiological flora was similar overall with (n=50) or without (n=50) vaginitis, and in a large majority of cases of premenarchal vulvovaginitis, no infectious cause could be identified¹¹.

We found that vaginitis could also be preceded by cystitis in bitches before the first heat cycle (6/25). In one study done by Romero et al.¹², one third (6/20) of the prepubertal girls with vaginitis had a previous urinary tract infection. However, in a study of Jones¹⁰, urinary infection did not appear to contribute to the aetiology of vulvovaginitis in prepubertal girls.

In our study, 2.3% of bitches developed cystitis (8.7%-20.6% questionnaire), with an annual incidence of 77 per 10 000. Uncomplicated canine bacterial urinary tract infection (UTI) was common and occurred in approximately 14% of dogs that visited a veterinarian in their lifetime¹⁷. In addition, recurrent or persistent UTIs were present in up to 4.5% of dogs with UTI or 0.3% of the canine hospital population¹⁸. In this study, fourteen of the 4452 (0.3%) of the bitches before the first heat cycle presented to the veterinarian clinic had persistent UTIs.

In a human study¹⁹, the Nationwide Emergency Department Sample was queried to assess temporal-trends in pediatric (age ≤17 years) emergency department visits for a primary diagnosis of UTI, subsequent hospital admission, and total charges. In 2011 the incidence was 844 visits per 100 000¹⁹, which was similar to the incidence we found.

We found that most (60%) bitches before the first heat cycle were diagnosed between 2-4 months of age, with an average age at diagnosis of 17 weeks. The youngest dog diagnosed with cystitis was 8 weeks old. In a study done by Hall et al.²⁰, dogs with UTIs were more likely to be younger than 3 years of age than dogs in the reference population. They identified a relatively high

proportion of dogs with anatomic disorders²⁰, which could explain that finding. However, we had excluded bitches with anatomic disorders from this study.

We found that American Staffordshire Terrier and Bouvier des Flandres were more frequently diagnosed with cystitis (9% and 7%, respectively). According to responders, the most often diagnosed breed was Labrador Retriever (15.9%). It was not possible to statistically determine which breeds were predisposed, because data about the exact dog population around the time of our study were not available. Most (68%) breeds had an adult weight over 25 kilograms.

In a retrospective study done by Hall et al.²¹, canine urine samples were reviewed. Common dog breeds with positive urine cultures were mixed breed (8.5%), Labrador Retriever (8.4%), German Shepherd dog (5.7%), and Boxer (4.8%). Dogs of all ages and male dogs were also included in this study. However, it was not certain what number of positive urine cultures were caused by a genuine urine tract infection or resulted from sample contamination.²¹

In another retrospective study done by Ling et al.²², in which urine samples were analyzed, the 10 breeds of dogs in the youngest quartile of average ages at diagnosis were Akita, Alaskan Malamute, English Bulldog, Golden Retriever, Great Dane, Newfoundland, Rottweiler, St. Bernard, Siberian Husky, and Vizsla. Several large or giant breeds were common among the youngest diagnostic groups of both genders. Newer breeds would be 'young' in any veterinary data file until these breeds had become well established among the population of dogs. The Akita, Dalmatian, and Rottweiler could be examples of the phenomenon, apparently they became more popular in recent decades. Norris et al.¹⁸ found similar data: common breeds with young average ages at first diagnosis of recurrent UTI were Rottweiler, Great Dane, Alaskan malamute, Dalmation, Golden Retriever, and Basset Hound. In a study done by Seguin et al.²⁰, they reviewed persistent UTIs and reinfections in 100 dogs. Common breeds within the UTI population included mixed-breed dogs (15%), Golden Retrievers (8%), Dachshunds (8%), Cocker Spaniels (6%), and Labrador Retrievers (5%).

The American Staffordshire Terrier and the Bouvier des Flandres, the breeds most often diagnosed with cystitis in our study, were not mentioned in previous mentioned studies^{18,20-22}. This could be because of the difference in dog populations and/or because the age and sex of the dogs were dissimilar, or because the breeds we frequently diagnosed were not significantly predisposed in population of dogs of our study.

According to our study, most bitches (92%) did not have symptoms of cystitis after the first heat cycle, although the numbers were very small (13). In the questionnaire, the veterinarians thought that more than half (52%-74%) of the dogs showed no symptoms after the first heat cycle. We could not support our data with other studies.

Cystitis could be a risk factor for pyelonephritis²³. This was also supported in another study²⁴: the frequency of pyelitis, pyelonephritis, renal perivasculitis, and renal cortical inflammation had been determined in 104 apparently normal dogs, 50 dogs with disease that were necropsied, and 20 dogs with experimentally induced cystitis. Abnormalities occurred least often (19%) in the apparently normal group and most often (55%) in the cystitis group.

In our study, the majority (72%) of responders had not encountered pyelonephritis, and pyelonephritis was diagnosed in 0.2% of bitches before the first heat cycle, with an annual incidence of 83 per 100 000. In an older study done by Bloom²⁵, the incidence of pyelonephritis in dogs had been estimated to be as high as 4% in necropsy cases. Another older study done by Christie²⁶, was paraphrased in a pathology book²⁷ It said²⁷: 'In another survey (Christie, 1973), the average incidence of pyelonephritis in dogs was reported to be 15 percent, with the disease occurring most frequently in young female dogs and in older dogs of either sex.' Unfortunately, the study done by Christie was not available to us. Therefore, we could not find out why the incidence was reported to be this high.

Vesicoureteral reflux (VUR) could lead to pyelonephritis in young children and young dogs. To prevent reflux of vesical contents into the ureter, the intravesical ureter has to have an oblique course as it enters the bladder, the length of the intramural ureter must be sufficient and it must have proper muscular attachments to the trigone and bladder wall³⁹. In men, length of the vesical ureter was correlated inversely with the incidence of VUR. Additionally, the length of the vesical

ureter increased almost linearly with age, and the muscular support for the submucosal portion of the ureter expanded³⁹. The occurrence of VUR was age-related: the highest figures were found in young children³⁹. The general occurrence of VUR in healthy children was around 1-2%⁴⁰. However, some studies³⁹ suggested that the prevalence rates were much higher (up to 35%).

The incidence of VUR in young puppies was higher than in young children. In a study done by Özkanlar et al.⁴⁰, the occurrence of VUR was determined in puppies of 2.5-3 months of age. They found that bilateral VUR was found in 64-68% and unilateral VUR in 6% of the dogs. The female puppies were more susceptible than male ones⁴⁰. Christie²⁶ studied in dogs that VUR was detected in 79% of puppies (3 months of age), 27% of adults (1 to 6 years of age) and 10% of old dogs (7 to older ages)⁴⁰. In another study done by Newman et al.⁴¹, the incidence of bilateral VUR was 15% in female mongrel dogs (ages unknown). In a study done by Kiruluta et al.⁴², forty puppies from birth to 6 months of age were studied. The incidence of VUR was decreased dramatically as adrenergic nerve fibers began to appear⁴². VUR was a common diagnosis in dogs and potentially disappeared with age. It was suggested that most untreated puppies with cystitis did not develop higher urine tract infections⁴⁰, which could be supported with our data because most (94%) bitches with cystitis did not develop pyelonephritis.

However, vesicoureteral reflux in combination with cystitis could still potentially lead to pyelonephritis²⁹. Ureteropelvic inflammatory lesions almost always occurred in early childhood and was linked to the concomitant presence of urinary tract infection and vesicoureteral reflux²⁸. Sterile reflux did not appear to be harmful²⁸. In a study done by St Clair et al.³⁰, the canine model for vesicoureteral was created. They found evidence that pyelonephritis was significantly more likely to develop in a kidney on the side of the reflux. In another experimental study done by Richie et al.³¹, vesicoureteral reflux was created in 16 dogs. In 83% of 12 kidneys connected to the reflux revealed pyelonephritis as compared to 7% of 14 kidneys not connected to the reflux.³¹

Polyuria and polydipsia, symptoms associated with upper urinary tract infection, could also be found in healthy, young bitches due to psychogenic polydipsia.³² In our study, more than half (71%, 27/38) of the bitches with polyuria and polydipsia had no pyelonephritis.

A retrospective study had its limitations. Its validity depended on the accuracy of the reports received from the practitioners. Different veterinarians could diagnose vaginitis and cystitis differently. This might explain why the prevalence differed within veterinary clinics. As with any retrospective study, the exact time of resolution of signs could not be determined because the intervals between examinations were not controlled. For example, some dogs diagnosed with cystitis were not examined by the veterinarian for over a year.

This study had another shortcoming: first heat cycles were not properly recorded. It was not possible to draw a conclusion from the data, because there were only nine records available. Furthermore, bitches could be falsely excluded or included in the study because of this.

The questionnaire had a number of limitations. The questionnaire was not based on a random selection of veterinarians, but instead relied on veterinarians volunteering to answer the questionnaire. It was therefore accepted that this could have biased the study. The uncertainties in the data, because the responses needed to be classified, meant the information needed to be treated with caution and was not suitable for good statistical analysis.

Additionally, the questionnaire was considered too long, and some questions were suggestively phrased and some narrow in scope.

Furthermore, the questionnaire had too few answers for some questions and could therefore not be representative for all dogs in the Netherlands. There were 1.5 million dogs (150 000 pups) in the Netherlands in 2011. In the same year, 1.688 veterinarians were treating companion animals. It is not known how many companion animals were seen by a veterinarian on a yearly basis.³³ Based on this information, the questionnaire should ideally be completed by 314 companion animal veterinarians³⁴⁻³⁶. In our study we failed to reach those numbers; we had 263 veterinarians that

completed the questionnaire. Therefore, a non-response bias could be present due to the low response rate. Results should be interpreted in light of this.

6. CONCLUSION

Vaginitis in bitches before the first heat cycle was not a common diagnosis. It could be an underdiagnosed gynecological disorder because: veterinarians that found vaginitis during routine examination more often reported a higher incidence, puppy vaginitis was easily overlooked by the owner, not all owners visit a veterinary clinic and animal clinics had different incidences (as high as 29 times difference).

No breed predisposition was found, although the Labrador Retriever was most often reported with vaginitis and cystitis by the veterinarians (questionnaire). However, cystitis was more often found in the American Staffordshire Terrier.

Vaginitis resolved spontaneously in about 90% of bitches. Antimicrobial treatment gave no resolution of symptoms of vaginitis. It remains unclear if vaginitis and/or cystitis resolved after the first heat cycle due to limited data about the first occurrence of the heat cycle. However, the majority of young bitches recovered before experiencing a first heat cycle. Physical maturity, not necessarily sexual maturity, could be a factor for resolution.

Vaginitis and cystitis could occur independently in bitches before the first heat cycle. However, vaginitis could be a risk factor for cystitis, and vice versa, although no hard data were available. Cystitis (in combination with vesicoureteral reflux) could be complicated by pyelonephritis.

Pyelonephritis is a rare disease and, in this study, it could be over diagnosed, because in most bitches it was not an established diagnosis. Furthermore, most (72%) veterinarians had never encountered pyelonephritis in bitches before the first heat cycle. Polyuria and polydipsia, two symptoms associated with pyelonephritis, were often encountered in young and healthy bitches.

7. ACKNOWLEDGEMENTS

I am thankful for all veterinarians that filled out the questionnaire, especially those who completed it, as it could be tedious.

I am pleased with the ten small animal private practices for letting me search through their patient database, and also for letting me come over and work at their practice. I am happy with the help of Bob Carriere for asking animal clinics (Sterklinieken) to cooperate with us; and Gerco Bosch for explaining to me how to work with Animana.

I am Corilus grateful for the hospitality and Pieter Wout Duquesnoy and the other people who worked there for helping me out and explaining how to work with their software (VIVA).

And last, but certainly not least, I also thank my supervisor Jenny Buijtel for helping me out, her patience with me and her assistance in writing this research paper.

8. REFERENCES

1. Root Kustritz, M.V. *Small animal theriogenology – Vaginitis*. Consulted on 10/06/2014, <http://www.dcavm.org/11novnotes.pdf>.
2. Davidson, A.P. *Frustrating case presentations in canine theriogenology*. *Vet Clin North Am Small Anim Pract* 2001;31(2):411-420.
3. Nelson, R.W., Couto, C.G. *Small animal internal medicine – Disorders of the vagina and uterus*. Mosby Elsevier, 2009; 4th ed.:915-916.
4. Johnson, C.A. *Diagnosis and treatment of chronic vaginitis in the bitch*. *Vet Clin North Am Small Anim Pract* 1991;21(3):523-531.
5. Smee, N., Loyd, K., Grauer, G. *UTIs in Small Animal Patients: Part 1: Etiology and Pathogenesis*. *J Am Anim Hosp Assoc* 2013;49:1-7.
6. Feldman, E.C., Nelson, R.W. *Canine and Feline Endocrinology and Reproduction*. Saunders, 1996;655-659.
7. Sant'Anna, M.C., Fabretti, A.K., Martins, M.I.M. *Clinical approach to canine vaginitis*. *Semina: Ciências Agrárias, Londrina* 2012;33(4):1543-1554.
8. Root Kustritz, M.V. *The dog breeder's guide to successful breeding and health management – Disorders of the vagina and vulva*. Saunders Elsevier, 2006;254-268.
9. McGreal, S., Wood, P. *Recurrent Vaginal Discharge in Children*. *J Pediatr Adolesc Gynecol* 2013;26:205-208.
10. Jones, R. *Childhood vulvovaginitis and vaginal discharge in practice*. *Family Practice* 1996;13:369-372.
11. Jaquier, A. et al. *Vulvovaginitis: clinical features, aetiology, and microbiology of the genital tract*. *Arch Dis Child* 1999;81: 64–67.
12. Romero, P. et al. *Voiding Dysfunction: Another etiology of Vulvovaginitis in Young Girls*. *J Pediatr Adolesc Gynecol* 2011;24:189-191.
13. Freshman, J.L. et al. *Risk Factors Associated with Urinary Tract Infection in Female Dogs*. *Preventive Veterinary Medicine* 1989;7:59-67.
14. Hillebrand, L. et al. *Urinary tract infections in pregnant women with bacterial vaginosis*. *Am J Obstet Gynecol* 2002;186:916–917.
15. Harmanli, O.H., et al. *Urinary tract infections in women with bacterial vaginosis*. *Obstet Gynecol* 2009;95: 710–712.
16. Hutchins, R.G. et al. *Vaginal Microbiota of Spayed Dogs with or without Recurrent Urinary Tract Infections*. *J Vet Intern Med* 2014;28:300–304.
17. Ling, G.V. et al. *Therapeutic strategies involving antimicrobial therapy of the canine urinary tract*. *Journal of the American Veterinary Medical Association* 1984;185:1162–1164.
18. Norris, C.R., et al. *Recurrent and persistent urinary tract infections in dogs: 383 cases (1969–1995)*. *Journal of the American Animal Hospital Association* 2000;36:484–492.

19. Sood, A. et al. *Incidence, admission rates, and economic burden of pediatric emergency department visits for urinary tract infection: Data from the nationwide emergency department sample, 2006 to 2011*. J Pediatr Urol 2015;S1477-5131(14):00340-4.
20. Seguin, M.A. et al. *Persistent Urinary Tract Infections and Reinfections in 100 Dogs (1989–1999)*. J Vet Intern Med 2003;17:622–631.
21. Hall, J.L. et al. *Prevalence and antimicrobial resistance of canine urinary tract pathogens*. Veterinary Record 2013;173:549.
22. Ling, G. et al. *Interrelations of organism prevalence, specimen collection method, and host age, sex, and breed among 8,354 canine urinary tract infections (1696-1995)*. Journal of veterinary medicine 2001;15:341-347.
23. Thomsen, M.K, Svane, L.C, Poulsen, P.H. *Canine urinary tract infection. Detection, prevalence and therapeutic consequences of bacteriuria*. Nord Vet Med 1986;38:394–402. Abstract
24. Crowell, W.A., Finco, D.R. *Frequency of pyelitis, pyelonephritis, renal perivasculitis, and renal infarction in dogs*. Am J Vet Res 1975;36(1):111-4. Abstract
25. Bloom, F. *The Pathology of the Dog and Cat. The Genito-urinary System, with Clinical Considerations*. American Veterinary Publications Inc Evanston Illinois 1954.
26. Christie, B.A. *The occurrence of vesicoureteral reflux and pyelonephritis in apparently normal dogs*. Investigative urology 1973;10(5):359-66.
27. Benirschke, K., Garner, F.M., Jones, T.C. *Pathology of Laboratory Animals*. Springer Science & Business Media 2012;1(3).
28. Guignard, J.P. *Importance of vesico-ureteral reflux in the pathogenesis of chronic pyelonephritis*. Schweiz Med Wochenschr 1983;113(6):223-8. Abstract
29. Lloyd Harrison, M.D. et al. *Experimental pyelonephritis in dogs. Result of urinary infection and vesicoureteral reflux*. Urology 1973;1(5):439–443. Abstract
30. St Clair, S.R., Hixson, C.J., Ritchey, M.L. *Enterocystoplasty and reflux nephropathy in the canine model*. J Urol 1992;148(2 Pt 2):728-32. Abstract
31. Richie, J.P et al. *The effect of reflux on the development of pyelonephritis in urinary diversion: An experimental study*. Journal of Surgical Research 1974;16(3):256-261. Abstract
32. Olenick, C.L. *Congenital renal dysplasia and psychogenic polydipsia in a Bernese mountain dog*. Can Vet J 1999;40(6):425-426.
33. Hogeschool HAS Den Bosch. *Feiten & Cijfers Gezelschapsdierensector 2011*. HAS Kennistransfer 2011;2nd ed.
34. Marktonderzoek. *Berekening steekproefgrootte*. URL created on: 11/12/2006, consulted on 12/06/2014, <http://marktonderzoek.punt.nl/content/2006/12/berekening-steekproefgrootte>.
35. Arya, R., Antonisamy, B., Kuma, S. *Sample Size Estimation in Prevalence Studies*. Indian J. Pediatr. 2012;79(11):1482–1488.
36. Naing, L., Winn, T., Rusli, B.N. *Practical Issues in Calculating the Sample Size for Prevalence Studies*. Archives of Orofacial Sciences 2006;1:9-14.

37. Dei, M. et al. *Vulvovaginitis in childhood*. Best Practice & Research Clinical Obstetrics and Gynaecology 2010;24:129–137.
38. Ocampo, D. et al. *Vulvovaginitis in a pediatric population: relationship among etiologic agents, age and Tanner staging of breast development*. Arch Argent Pediatr 2014;112(1):65-74.
39. Venhola, M. *Vesicoureteral Reflux in Children*. Univesity of Oulu, Faculty of Medicine, Institute of Clinical Medicine, Department of Paediatrics 2011.
40. Özkanlar, Y. et al. *Detection of vesicoureteral reflux in healthy puppies*. Ankara Üniv Vet Fak Derg 2006;53:41-45.
41. Newman, L. et al. *Incidence of Naturally Occurring Vesicoureteral Reflux in Mongrel Dogs*. Investigative Radiology 1973;8:354-356.
42. Kiruluta, H.G., Fraser K., Owen L. *The significance of the adrenergic nerves in the etiyology of vesicoureteral reflux*. J Urol, 1986;136:232-235.

9. APPENDIX

TABLE 1. Questionnaire: containing questions about vaginitis before the first heat cycle and answers (in percentage or absolute numbers). No. = number of responders, C. = closed-ended question, O. = open-ended question, S. = semi-closed-ended question.

Questions about vaginitis	No.	Answers									
C. Which percentage of bitches presented to you do you diagnose with vaginitis before the first heat cycle?	378	0-10%	11-30%	31-50%	51-70%	71-90%	91-100%				
		70%	23%	4%	1%	2%	0.3%				
C. Do you diagnose vaginitis more often at a certain age? Multiple answers are possible.	378	<2 months		2-4 months		4-6 months		>6 months		No	
		5%		52%		41%		10%		24%	
C. Do you diagnose vaginitis more often at a certain adult weight? Multiple answers are possible.	378	<10 kg			10-25 kg			>25 kg		No	
		7%			33%			33%		45%	
O. Which breeds do you mainly diagnose with vaginitis?	197	Labrador Retriever	Golden Retriever	Boxer	Retriever breed	Staffordshire Bull Terrier	Shepherd breed	Mixed breed	Dog breed	Other	
		25%	7%	6%	6%	5%	4%	3%	3%	40%	
S. Which problems do the bitches presented to you have? Multiple answers are possible.	360	Vaginal purulent discharge		Licking vulva		Inflammation around vulva		Incidental finding		Other	
		76%		61%		29%		41%		11%	
C. At which percentage of bitches presented to you is vaginitis an incidental finding during (routine) examination?	358	0%	1-10%	11-25%	26-50%	51-75%	76-100%				
		25%	37%	9%	10%	10%	10%				
S. Which symptoms do you find during examination when vaginitis is an incidental finding?	246	Vaginal purulent discharge			Inflammation around vulva			Other			
		81%			31%			12%			
C. How often are the symptoms of vaginitis continuously present (not intermittent)? (percentage)	337	0-10%	11-25%	26-50%	51-75%	76-100%					
		39%	13%	23%	16%	9%					
C. Do you treat bitches with vaginitis before the first heat cycle?	337	Never			Sometimes			Always			
		27%			64%			9%			
O. Why do you treat the bitches sometimes?	212	Severity		UTI symptoms		Owner		Duration		Age	
		183		30		33		20		5	
C. Which percentage of bitches with vaginitis do you treat?	212	1-10%	11-25%	26-50%	51-75%	76-99%					
		56%	26%	14%	3%	0.5%					

ESTIMATION OF INCIDENCE OF THE VAGINITIS/CYSTITIS COMPLEX IN PUPPIES

S. What does your treatment consist of?	243	Antibiotics		Antibiotics and other		Other		
		62%		16%		22%		
O. What does your treatment consist of in addition to antibiotics?	93	Painkillers		Ointment	Cleaning of vagina/vulva		Other	
		29		33	31		13	
C. Do you give antibiotics topically or systemically?	181	Topical		Systemic		Combination		
		5%		82%		13%		
O. Which types of antibiotics do you prescribe?	181	Amoxicillin (with clavulanic acid)		TMP/S		Other		
		169		11		23		
O. What is the duration of your treatment?	232	<5 days		5-7 days	7-10 days	10-14 days	≥14 days	
		12		108	84	20	7	
C. How often do you have to repeat your treatment? (percentage)	232			0-10%	11-25%	26-50%	51-75%	76-100%
		Never		19%	10%	10%	24%	37%
		Once		51%	28%	16%	4%	2%
		Twice or more		82%	9%	5%	3%	1%
C. How often is there resolution of symptoms after the first heat cycle? (percentage)	323	Never	1-10%	11-25%	26-50%	51-75%	76-99%	Always
		1.5%	3%	1%	4%	8%	55%	28%
O. What is your advice when vaginitis is present after the first heat cycle?	227	Additional diagnostics (unspecified)		Castration		Treatment (antibiotics)		Expectative
		97		76		43		18
C. Do you encounter vaginitis in bitches castrated before three months of age?	314	Yes		No				
		5%		95%				
C. At which age is there resolution of symptoms in bitches castrated before three months of age?	14	1 Year of age		2 Years of age		3+ Years of age		No resolution
		10		1		0		3
C. Do you think vaginitis impairs welfare?	302	Yes		No				
		38%		62%				
O. Why do you think vaginitis (does not) impair(s) welfare? (optional)	233	Severity of symptoms	Irritation	UTI risk	Annoyance owner / surroundings	Abnormal behaviour	Other	
		140	93	23	19	10	21	

ESTIMATION OF INCIDENCE OF THE VAGINITIS/CYSTITIS COMPLEX IN PUPPIES

TABLE 2. Questionnaire: containing questions about cystitis before the first heat cycle and answers (in percentage or absolute numbers). No. = number of responders, C. = closed-ended question, O. = open-ended question, S. = semi-closed-ended question.

Questions about cystitis	No.	Answers								
C. Which percentage of bitches presented to you do you diagnose with cystitis before the first heat cycle?	291	0%	1-10%	11-30%	31-50%	51-70%	71-90%	91-100%		
		5%	61%	23%	6%	2%	2%	1%		
C. Do you diagnose cystitis more often at a certain age? Multiple answers are possible.	274	<2 months		2-4 months		4-6 months		>6 months	No	
		2%		38%		30%		14%	41%	
C. Do you diagnose cystitis more often at a certain adult weight? Multiple answers are possible.	274	<10 kg			10-25 kg		>25 kg		No	
		6%			26%		27%		57%	
O. Which breeds do you mainly diagnose with cystitis?	119	Labrador Retriever	Retriever breed	Mixed breed	Golden Retriever	Boxer	Staffordshire Bull Terrier	Other		
		16%	12%	8%	7%	6%	5%	47%		
S. Which problems do the bitches presented to you have? Multiple answers are possible.	273	Pollakisuria		Dysuria		Stranguria		Hematuria	Not housetrained	Other
		66%		34%		51%		72%	61%	4%
C. Do you perform urinalysis?	273	Yes			Yes, only when relapse			No		
		96%			4%			0%		
C. What is the manner in which urine is obtained? Multiple answers are possible.	272	(Midstream) catch			Catheter			Cystocentesis		
		96%			7%			42%		
S. What kind of urinalysis do you perform? Multiple answers are possible.	272	Specific gravity		Microscopic analysis sediment		Urine dipstick		Culture		Other
		95%		96%		99%		31%		20%
C. When do you perform a urine culture?	272	Never			Sometimes		Only when relapse		Always	
		3%			6%		87%		4%	
C. Where is the urine culture performed?	265	At home			Lab			Combination		
		17%			61%			22%		
O. Why do you sometimes perform it at home or sometimes let it perform in an external laboratory?	58	If bacterial culture growth to lab		Length and gravity of problems		Home laboratory check		Other		
		33		8		9		13		
S. What does your treatment consist of?	272	Antibiotics			Antibiotics and other			Other		
		31%			50%			18%		

ESTIMATION OF INCIDENCE OF THE VAGINITIS/CYSTITIS COMPLEX IN PUPPIES

O. What does your treatment consist of in addition to antibiotics?	187	NSAID	Diet	Antispasmodic drug	Other		
		159	36	9	11		
O. Which types of antibiotics do you prescribe?	221	Amoxicillin (with clavulanic acid)	TMP/S		Other		
		192	64	13			
O. What is the duration of your treatment?	271	<5 days	5-7 days	7-10 days	10-14 days	≥14 days	
		0	25	95	117	33	
C. How often is there resolution of symptoms after your treatment? (percentage)	271	0-10%	11-25%	26-50%	51-75%	76-100%	
		1%	1%	4%	34%	60%	
S. What does your treatment consist of in case of a relapse?	271	Antibiotics	Antibiotics and other		Other		
		22%	40%	38%			
O. What does your treatment consist of in addition to antibiotics in case of a relapse?	209	On basis of antibiogram	NSAID	Diet	Diagnostic imaging	Additional diagnostics (unspecified)	Other
		80	79	64	46	26	29
O. Which types of antibiotics do you prescribe in case of a relapse?	163	On basis of antibiogram	Amoxicillin (with clavulanic acid)		TMP/S	Other	
		127	39	8	13		
O. What is the duration of your therapy in case of a relapse?	264	<2 weeks	2-3 weeks	3-4 weeks	4-6 weeks	≥6 weeks	Depends on cause of symptoms
		58	74	33	36	13	49
C. How often is there resolution of symptoms after the first heat cycle? (percentage)	264	0-10%	11-25%	26-50%	51-75%	76-100%	
		8%	5%	17%	25%	45%	

ESTIMATION OF INCIDENCE OF THE VAGINITIS/CYSTITIS COMPLEX IN PUPPIES

TABLE 3. Questionnaire: containing questions about vaginitis and cystitis before the first heat cycle and answers (in percentage or absolute numbers No. = number of responders, C. = closed-ended question, O. = open-ended question, S. = semi-closed-ended question).

Questions about vaginitis and cystitis	No.	Answers						
C. Which percentage of bitches presented to you do you diagnose with vaginitis and cystitis before the first heat cycle?	275	0%	1-10%	11-30%	31-50%	51-70%	71-90%	91-100%
		33%	51%	10%	3%	2%	0.4%	0%
C. Which percentage of bitches with vaginitis also develop cystitis subsequently?	182	0-10%	11-30%	31-50%	51-70%	71-90%	91-100%	
		71%	21%	4%	3%	1%	0%	
C. Do you diagnose vaginitis and cystitis more often at a certain age? Multiple answers are possible.	182	<2 months	2-4 months	4-6 months	≥6 months	No		
		3%	32%	33%	7%	52%		
C. Do you diagnose vaginitis and cystitis more often at a certain adult weight? Multiple answers are possible.	182	<10 kg	10-25 kg	>25 kg	No			
		8%	28%	26%	57%			
O. Which breeds do you mainly diagnose with vaginitis and cystitis?	78	Labrador Retriever	Retriever breed	Boxer	Mixed breed	Golden Retriever	Other	
		23%	11%	7%	7%	5%	46%	
S. Which problems do the bitches presented to you have? Multiple answers are possible.	178	Purulent vaginal discharge	Licking vulva	Inflammation around vulva	Pollakisuria	Dysuria		
		73%	78%	43%	61%	41%		
		Stranguria	Hematuria	Not housetrained	Other			
		58%	69%	62%	7%			
C. Do you perform urinalysis?	178	Yes	Yes, only when relapse	No				
		89%	10%	0.6%				
C. What is the manner in which urine is obtained? Multiple answers are possible.	177	(Midstream) catch	Catheter	Cystocentesis				
		85%	10%	49%				
S. What kind of urinalysis do you perform? Multiple answers are possible.	177	Specific gravity	Microscopic analysis sediment	Urine dipstick	Culture	Other		
		93%	98%	98%	41%	8%		
C. When do you perform a urine culture?	177	Never	Sometimes	Only when relapse	Always			
		3%	7%	81%	9%			
C. Where is the urine culture performed?	171	At home	Lab	Combination				
		13%	64%	23%				

ESTIMATION OF INCIDENCE OF THE VAGINITIS/CYSTITIS COMPLEX IN PUPPIES

S. What does your treatment consist of?	177	Antibiotics		Antibiotics and other		Other				
		35%		55%		10%				
O. What does your treatment consist of in addition to antibiotics?	114	NSAID	Diet	Stimulating water uptake	Ointment (for vulva)	Cleaning of vagina/vulva	Other			
		90	24	6	6	5	14			
O. Which types of antibiotics do you prescribe?	158	Amoxicillin (with clavulanic acid)		TMP/S		On basis of antibiogram		Other		
		135		39		18		6		
O. What is the duration of your treatment?	175	<5 days		5-7 days		7-10 days		10-14 days	≥14 days	
		0		11		44		77		36
C. How often is there resolution of symptoms after treatment? (percentage)	175	0-10%		11-25%		26-50%		51-75%		76-100%
		1%		2%		6%		33%		58%
C. How often do you have to repeat your treatment? (percentage)	175	Never		Once		Two+ times		Continuous medicaion		
		51%		41%		8%		0%		
C. How often is there resolution of symptoms after the first heat cycle? (percentage)	175	Never	1-10%	11-25%	26-50%	51-75%	76-99%	Always		
		3%	2%	2%	11%	13%	53%	17%		
O. What is your advice when vaginitis and cystitis are present after the first heat cycle?	144	Additional diagnostics (unspecified)		Castration		Antibiotics on basis of antibiogram		Other		
		110		35		10		11		

ESTIMATION OF INCIDENCE OF THE VAGINITIS/CYSTITIS COMPLEX IN PUPPIES

TABLE 4. Questionnaire: containing questions about pyelonephritis before the first heat cycle and answers (in percentage or absolute numbers). No. = number of responders, C. = closed-ended question, O. = open-ended question, S. = semi-closed-ended question.

Questions about pyelonephritis	No.	Answers								
C. Which percentage of bitches presented to you do you diagnose with pyelonephritis before the first heat cycle?	264	0%	1-10%	11-30%	31-50%	51-70%	71-90%	91-100%		
		72%	27%	0.8%	0%	0%	0%	0%		
C. Is there a prior diagnosis of vaginitis and/or cystitis?	74	Yes		Sometimes		No				
		23%		61%		16%				
O. Which breeds do you mainly diagnose with pyelonephritis?	50	Boxer		Retriever breed		Labrador Retriever		Other		
		27%		15%		12%		46%		
S. Which problems do the bitches presented to you have? Multiple answers are possible.	72	General illness		Polyuria/polydipsia		Emesis		Other		
		67%		88%		21%		29%		
C. Do you perform urinalysis?	72	Yes				No				
		99%				1%				
C. What is the manner in which urine is obtained? Multiple answers are possible.	71	(Midstream) catch			Catheter		Cystocentesis			
		62%			10%		80%			
C. What kind of urinalysis do you perform?	71	General urinalysis			Culture		Combination			
		14%			9%		78%			
O. Based on which problems do you diagnose pyelonephritis?	264	Abnormal findings diagnostic imaging		Positive urine culture		Malaise		Polyuria/polydipsia		Abnormal findings blood analysis
		118		86		85		75		71
		Abnormal findings urine analysis		Fever		Abdominal pain		Abnormal symptoms (unspecified)		Ongoing symptoms of cystitis
		71		63		42		33		28
		Hematuria		Leukuria			Decreased urine specific gravity		Other	
19		19			15		57			
O. Which types of antibiotics do you prescribe?	72	On basis of antibiogram		Amoxicillin (with clavulanic acid)		TMP/S		Other		
		43		47		5		3		
O. What is the duration of your therapy?	72	<2 weeks		2-3 weeks		3-4 weeks		4-6 weeks		≥6 weeks
		9		13		16		22		7

ESTIMATION OF INCIDENCE OF THE VAGINITIS/CYSTITIS COMPLEX IN PUPPIES

When answered 0% to first question					
C. Are bitches presented to you with polyuria/polydipsia before first heat cycle?	192	Yes		No	
		69%		31%	
C. Do you perform urinalysis in case of polyuria/polydipsia?	134	Yes		Sometimes	No
		93%		7%	0%
C. Is bacteriuria sometimes present?	133	Yes		No	
		45%		55%	

TABLE 5. Questionnaire: containing personal questions and answers (in absolute numbers). No. = number of responders, C. = closed-ended question, O. = open-ended question, S. = semi-closed-ended question.

Remaining questions	No.	Answers				
C. In what type of veterinary clinic do you work?	263	Companion animals			Mixed	
		196			67	
C. Which animals do you currently treat?	261	Companion animals (CA)	CA, horse (H)	CA, farm animals (FA)	CA, H, FA	
		228	10	11	12	
C. What is your gender?	262	Male			Female	
		82			180	
C. In which age category do you belong?	262	<30 years	30-40 years	41-50 years	51-60 years	>60 years
		21	100	69	61	11

TABLE 4.1.1. Breed distribution of reported dogs having vaginitis before their first heat cycle.

Breed group	Total (n=273)
Labrador Retriever	68
Golden Retriever	19
Boxer	17
Retriever breed	17
Staffordshire Bull Terrier	14
Shepherd breed	11
Mixed breed	9
Dog breed	8
Rottweiler	7
Shih Tzu	6
Dogue de Bordeaux	5
Maltese	5
Boerboel	4
French Bulldog	4
Others (≤ 3)	79*

* Includes the following breeds and number of dogs for each breed: American Bulldog, American Staffordshire Terrier, Bernese Mountain Dog, Bulldog breed, Bullmastiff, Drentsche Patrijshond, German Shepherd, Hunting dog breed, Pit Bull, Rhodesian Ridgeback, Spaniel breed (n=3), Basset Hound, Beagle, Cane Corso, Cavalier King Charles Spaniel, Collie breed, Dachshund, Doberman Pinscher, English Bulldog, Mastiff breed, Poodle, Stabyhoun (n=2), Appenzeller Sennenhund, Berger Blanc Suisse, Border Collie, Briard, Cocker Spaniel, Dalmatian, English Bulldog, Entlebucher Mountain Dog, Flatcoated Retriever, German Shorthaired Pointer, Great Dane, Jack Russell Terrier, Keeshond, Leonberger, Markiesje, Munsterlander, New Foundland, Nova Scotia Duck Tolling Retriever, Pug, Samoyed, Schnauzer, St. Bernard, Terrier breed, Vizsla (n=1)

TABLE 4.1.2. Breed distribution of reported dogs having cystitis before their first heat cycle.

Breed group	Total (n=132)
Labrador Retriever	21
Retriever breed	16
Mixed Breed	10
Golden Retriever	9
Boxer	8
Staffordshire Bull Terrier	6
Bernese Mountain Dog	5
Bulldog breed	5
Other (≤ 3)	52*

* Includes the following breeds and number of dogs for each breed: American Staffordshire Terrier, Beagle, Dog breed, Drentsche Patrijshond, German Shepherd, Jack Russell Terrier, Shepherd breed, Shih Tzu (n=3), Bouvier des Flandres, Bull Terrier, Cavalier King Charles Spaniel, Dachshund, Hunting Dog breed, Maltese, Rottweiler, Terrier breed (n=2), Berger Blanc Suisse, Cane Corso, Cocker Spaniel, Dalmatian, Flatcoated Retriever, German Shorthaired Pointer, Leonberger, Markiesje, Pug, Schapendoes, Springer Spaniel, Vizsla

TABLE 4.1.3. Breed distribution of reported dogs having vaginitis and cystitis before their first heat cycle.

Breed group	Total (n=94)
Labrador Retriever	22
Retriever breed	10
Boxer	7
Mixed Breed	7
Golden Retriever	5
Bulldog Breed	4
Staffordshire Bull Terrier	4
Other (≤ 3)	35*

* Includes the following breeds and number of dogs for each breed: Shephard breed (n=3), Beagle, Bernese Mountain Dog, Dog Breed, Dogue de Bordeaux, Drentsche Patrijshond, Hunting Dog Breed, Pug, Shih Tzu, Terrier Breed (n=2), Cane Corso, Cocker Spaniel, Dachshund, Dalmatian, English Mastiff, Flatcoated Retriever, German Shepherd, German Shorthaired Pointer, Jack Russell Terrier, Maltese, Nova Scotia Duck Tolling Retriever, Poodle Breed, Rottweiler, Sennenhund Breed (n=1)

TABLE 4.1.4. Breed distribution of reported dogs having pyelonephritis before their first heat cycle.

Breed group	Total (n=26)
Boxer	7
Retriever breed	4
Labrador Retriever	3
Other (≤1)	12*

* Includes the following breeds and number of dogs for each breed: Bernese Mountain Dog, Bulldog Breed, Cane Corso, English Mastiff, Hunting Dog Breed, Jack Russell Terrier, Leonberger, Newfoundland, Poodle Breed, Shepherd Breed, Shetland Sheepdog, Staffordshire Bull Terrier (n=1)

TABLE 4.2.1. Distribution of dog breeds having vaginitis before their first heat cycle.

Breed group	Total (n=88)
Mixed breed	16
Labrador Retriever	10
American Staffordshire Terrier	7
Bernese Mountain Dog	4
Boxer	4
Golden Retriever	4
Belgian Shepherd Dog	3
Rottweiler	3
American Pit Bull Terrier	2
Beagle	2
Bouvier des Flandres	2
Bull Terrier	2
Maltese	2
Shih Tzu	2
Other (≤1)	25*

* Includes the following breeds: Airedale Terrier, American Cocker Spaniel, Beauceron, Berger Blanc Suisse, Cane Corso, Curly Coated Retriever, Doberman Pinscher, Drentsche Patrijshond, Dutch Shepherd Dog, English Mastiff, Flat-Coated Retriever, French Bulldog, Galgo Español, German Shorthaired Pointer, Hovawart, Irish Wolfhound, Jack Russell Terrier, Kelpie, Landseer, Maremma Sheepdog, Newfoundland, Schapendoes, Scotch Collie, Standard Poodle, Weimaraner.

TABLE 4.2.2. Distribution of dog breeds having cystitis before their first heat cycle.

Breed group	Total (n=100)
Mixed breed	13
American Staffordshire Terrier	9
Bouvier des Flandres	7
Bernese Mountain Dog	5
Labrador Retriever	5
Rottweiler	5
Staffordshire Bull Terrier	5
American Bulldog	4
German Shepherd Dog	3
Other (≤2)	44*

* Includes the following breeds and number of dogs for each breed: Bull Terrier, Boxer, Cane Corso, English Cocker Spaniel, French Bulldog, German Shorthaired Pointer, Golden Retriever, Hovawart, Kelpie, Maltese, Newfoundland (n=2); American Pit Bull Terrier, Belgian Shepherd Dog, Boerboel, Border Collie, Border Terrier, Cairn Terrier, Clumber Spaniel, Dachshund, Doberman Pinscher, English Bulldog, English Mastiff, Giant Schnauzer, Jack Russell Terrier, Keeshond, Nova Scotia Duck Tolling Retriever, Perro de Presa Canario, Peruvian Hairless Dog, Polish Tatra Sheepdog, Rhodesian Ridgeback, Shih Tzu, Tibetan Mastiff, Vizsla (n=1).