

# Owner-reported long-term outcomes, quality of life, and longevity after hospital discharge following surgical treatment of pyometra in bitches and queens

Sharon Pailler, PhD<sup>1\*</sup>; Emily D. Dolan, PhD<sup>1</sup>; Margaret R. Slater, DVM, PhD<sup>1</sup>; J'mai M. Gayle, DVM<sup>2</sup>; Sylvia M. Lesnikowski, DVM<sup>2</sup>; Camille DeClementi, VMD<sup>2</sup>

<sup>1</sup>Department of Strategy and Research, American Society for the Prevention of Cruelty to Animals, New York, NY

<sup>2</sup>American Society for the Prevention of Cruelty to Animals Animal Hospital, New York, NY

\*Corresponding author: Dr. Pailler (Sharon.pailler@aspca.org)

<https://doi.org/10.2460/javma.20.12.0714>

## OBJECTIVE

Investigate long-term complications, survival times, general health and quality of life (QoL) outcomes, and longevity in female dogs and cats (bitches and queens, respectively) following hospital discharge after ovariohysterectomy (OHE) for pyometra.

## ANIMALS

306 pet-owner-completed surveys and corresponding medical records for 234 bitches and 72 queens treated with OHE for pyometra at the American Society for the Prevention of Cruelty to Animals Animal Hospital between January 1, 2017, and December 31, 2019.

## PROCEDURES

A telephone and online survey was conducted to gather data about pet owners' perception of pet health and QoL following OHE for pyometra, and potential associations between survey results and medical record data were evaluated. Median survival time at a given age at OHE for pyometra was calculated with the use of maximum likelihood estimation of a survival-time regression model.

## RESULTS

72 of the 121 (60%) eligible owners of queens and 234 of the 390 (60%) eligible owners of bitches completed the survey. Most owners reported that at the time of the survey, their pet's health and QoL were better or the same as before pyometra. Reported health and QoL outcomes were similar for pets > 8 versus ≤ 8 years of age.

## CLINICAL RELEVANCE

Our findings indicated that bitches and queens undergoing OHE for pyometra at older ages and without other severe health issues can expect to live their full life span. Veterinarians in private practice could expect similar outcomes.

Pyometra is diagnosed in up to 20%<sup>1</sup> of sexually intact female dogs (bitches) before the age of 10 and in approximately 2%<sup>2</sup> of sexually intact female cats (queens) by the age of 13. Pyometra can be life-threatening and lead to severe complications such as sepsis and peritonitis.<sup>3,4</sup> Ovariohysterectomy (OHE) is the recommended treatment for non-breeding bitches and queens.<sup>4,5</sup> Surgical treatment of pyometra has low mortality rates (1% [4/315] to 8% [15/183]),<sup>6,7</sup> results in rapid improvements in health status, and has a good prognosis even when performed in a nonspecialty setting with high-quality basic supportive care.<sup>4,6-10</sup> However, health outcomes following OHE for pyometra are generally only documented for periods prior to<sup>6-8,11,12</sup> or within a few weeks after hospital discharge<sup>13,14</sup>; thus,

little information is available on long-term health and quality of life (QoL) outcomes. Heiene et al<sup>15</sup> surveyed 41 bitch owners regarding clinical signs of renal disease 8 years after OHE for pyometra and found that 2 bitches that were severely proteinuric at the time of surgery developed signs of renal disease within 3 years after surgery but most owners did not report signs of renal disease.

Although the prognosis of pyometra surgery is good, even for older animals, mortality rates and complications increase with age.<sup>3,16</sup> Pyometra has not been reported to influence life span<sup>17</sup>; however, the risk of illness (eg, heart disease or cancer) would be anticipated to increase over time<sup>18</sup>, and subsequent longevity is unknown. Likewise, older animals may have more age-related issues that influence

health and QoL outcomes following surgery, which would therefore influence pet owners' and veterinarians' decisions to treat pyometra.

Given there is little information available regarding health and QoL outcomes following pyometra surgery longer term, we surveyed pet owners whose pets underwent OHE for pyometra between January 1, 2017, and December 31, 2019, to investigate long-term complications, survival times, general health and QoL outcomes, and longevity in bitches and queens following hospital discharge after OHE for pyometra to better inform future treatment decisions.

## Materials and Methods

### Client survey

A telephone survey (**Supplementary Appendix S1**) was conducted from May 1, 2020, to May 24, 2020, to gather information about health and QoL for bitches and queens that had OHE for pyometra performed at the American Society for the Prevention of Cruelty to Animals Animal Hospital (AAH) between January 1, 2017, and February 8, 2019, and between January 1, 2017, and December 31, 2019, respectively, and were discharged with prescriptions for antimicrobials and analgesics.<sup>7,8</sup> Clients whose pets were included in the companion studies of this series constitute the survey sample.<sup>7,8</sup>

The survey consisted of questions about whether the pet was alive and still in the home, had any health problems after surgery, general health, overall QoL, and how likely the client would opt for such surgical treatment for an affected pet in the future. Interviewers were trained to administer the survey per a standard protocol. Spanish translations were provided in the survey, and 1 of the 3 interviewers was bilingual; therefore, surveys could be conducted in English or Spanish. The interviewers made up to 5 attempts to speak with clients by telephone across all 7 days of the week at various times of day (depending on interviewers' schedules). If clients were not reached by the fifth attempt, up to 3 text invitations were sent that included a link to take the full survey online. If a respondent reported a problem after surgery, a team of staff veterinarians reviewed the records to determine, in their medical opinion, whether the problem was related to the OHE for pyometra. This study was deemed exempt from Institutional Review Board (IRB) oversight by IntegReview IRB (April 22, 2020, 2018-03 Pyometra Study).

### Data collection

Responses to surveys administered by telephone (call surveys) or completed online by those who received a text-message link (online surveys) were merged into 1 data set. Additionally, data collected from medical records and merged with survey data for each patient included the patient's date of birth, date of OHE, presence or absence of heart disease (eg, murmur, arrhythmia, or radiographic cardiomegaly), and presence or absence of mammary

tumor (based on clinical examination). We calculated age at surgery and age at survey; for those that were reported to have died prior to the survey, we calculated age at death. Age of patients at surgery was classified as either  $\leq 8$  or  $> 8$  years old for consistency with other work.<sup>8,9,19</sup>

### Statistical analysis

For continuous variables, the means and SD (for normally distributed variables) or medians along with the first and third quartiles (1Q and 3Q, respectively) of the interquartile (25th to 75th percentile) ranges (IQRs; for data not normally distributed) were used; the Shapiro-Wilk test was used to assess normality. For categorical variables, counts and percentages were reported. The Fisher exact test was used to evaluate associations between survey responses (owner-reported medical issues related to pyometra, OHE, or both; general health of the pet since OHE; comparative health of the patient before pyometra versus after OHE; comparative QoL of the patient before pyometra vs after OHE; and how likely the client would be to opt for such surgical treatment for an affected pet in the future) and results for each of the following variables from the medical records: age  $> 8$  years old at the time of OHE (yes or no), presence of heart disease (yes or no), and presence of mammary tumor (yes or no). For all Fisher exact tests, values of  $P < 0.05$  were considered significant.

Maximum likelihood estimation of a survival time regression model with the use of a Weibull distribution was used to predict median survival times for given ages at the time of OHE for pyometra. Based on those results, the relationship between life span and body weight of affected bitches was explored further with the use of the Mann-Whitney test to compare results for those  $> 8$  versus  $\leq 8$  years of age at the time of surgery and body weight in kilograms. All statistical analyses were performed with commercially available software (Stata Statistical Software, release 15, StataCorp).

## Results

### Survey results

**Bitches**—We identified 394 owners of bitches that had OHE for pyometra. Four were then excluded from survey participation because their bitch had been adopted by someone else ( $n = 3$ ) or there was no owner contact information on record (1). Therefore, the remaining 390 owners were eligible to participate in the survey, and 234 (60%) completed surveys. Of the 234 completed surveys, 213 were completed by telephone (call surveys) and 21 were completed online (online surveys). Twenty-three of the 213 (11%) call surveys were conducted in Spanish. The timing of survey participation ranged from approximately 15 to 40 months (mean  $\pm$  SD,  $27 \pm 7$  months) after OHE of respondents' pets. The age of bitches at the time of OHE ranged from 1 to 16 years (mean  $\pm$  SD,  $8 \pm 3$  years). One respondent's bitch did not have a birthdate listed in the medical

record, so this observation was omitted from age-related analyses.

For the 234 bitches with follow-up, 193 (82%) owners reported that the pet still lived with them, whereas 41 (18%) owners reported that the patient no longer lived with them, including 32 [78%] that had died and 9 [22%] no longer in the home for other reason (living elsewhere with an ex-partner or ex-spouse [ $n = 7$ ] or relinquished for reasons unrelated to OHE [2]).

For the 32 bitches that had died, 22 owners reported causes of death, including cancer ( $n = 10$ ), advanced age (7), heart condition (3), collapsed trachea (1), and gallbladder issue (1). Nine owners reported that they did not know the cause of death, and 1 owner did not provide a response. Three of the 10 bitches that reportedly died of cancer had mammary tumors at the time of surgery and reportedly died of a brain tumor ( $n = 1$ ), stomach tumor (1), or type of cancer not reported (1). Thirty-eight of the 234 (16%) bitches owned by respondents had mammary tumors at the time of surgery were still alive at the time of the survey. Three bitches had died of heart conditions, and 2 of the 3 animals had heart disease at the time of surgery (1 each with grade 2/6 or 4/6 heart murmur). Twenty-seven of the 234 (12%) bitches that had heart disease at the time of surgery were reportedly still alive at the time of the survey.

For survey question responses with 5 categories (ie, excellent, very good, good, fair, and poor; or extremely likely, likely, not sure, unlikely, and extremely unlikely), there were generally very few responses in the unfavorable or negative categories; therefore, these were collapsed into 3 categories for analysis (ie, excellent to very good, good, or fair to poor; or likely, not sure, or unlikely, respectively).

Twenty-three of 193 (12%) respondents whose pet was still in the home reported their bitch had a health problem after OHE. Three problems reported were determined to have been related to OHE (the sutures had opened and needed to be resutured, vaginal discharge, and urinary bladder weakness), 11 problems were determined to have been related to OHE and could have been anticipated (eg, signs of pain, signs of fatigue, or appetite changes within the month following surgery), 12 problems were determined to have been unrelated to the OHE (eg, pancreatic illness, ear infection, skin lumps, diarrhea, and gastrointestinal foreign body), and 2 problems (both urinary tract infections) were not possible to classify as related or unrelated to OHE.

Owners of the 193 bitches still in their original home reported that their pets' general health had been excellent to very good (151 [78%]), good (32 [17%]), or fair to poor (10 [5%]) since OHE for pyometra. When asked to compare their pet's health before pyometra versus at the time of the survey, 193 owners reported that their animal's comparative health was better (113 [59%]), the same (68 [35%]), or worse (11 [6%]) or that they were unsure (1 [1%]). Eight of the respondents who reported worse comparative health provided additional comments including that their pet had issues unrelated to

the surgery (eg, tracheal collapse;  $n = 3$ ), surgery helped (3), their bitch had incontinence issues (1), or surgery only somewhat helped (1). When asked about the QoL of their pets, 192 owners reported that their pet's QoL was better (96 [50%]), the same (84 [44%]), or worse (9 [5%]) at the time of the survey, compared with before pyometra or that they were unsure (3 [2%]). Seven of the respondents who reported worse QoL also reported worse health. Eight of those who reported worse QoL also provided additional comments: 4 reported that their pet had issues unrelated to the surgery, 2 reported that the surgery helped, 1 reported that their pet had incontinence issues, and 1 reported that the surgery only somewhat helped. When asked how likely they would be to have the surgery done again, 193 owners responded that they would be extremely likely (166 [86%]), somewhat likely (20 [10%]), or somewhat or extremely unlikely (3 [2%]), or that they were unsure (4 [2%]). Two of those who reported they would be unlikely to have the surgery performed again provided additional comments: 1 reported that their pet had urinary incontinence issues, and 1 reported that the surgery only somewhat helped.

**Queens**—We identified 126 owners of queens that had OHE for pyometra. Five were then excluded from survey participation because their queen had been adopted by someone else ( $n = 4$ ) or there was no owner contact information on record (1). Therefore, the owners of the remaining 121 queens were eligible for inclusion in the survey and were contacted to participate. Of these 121 owners, 72 (60%) completed the survey: 68 call surveys and 4 online surveys. Eight of the 68 (12%) call surveys were conducted in Spanish. The timing of survey participation ranged from 5 to 40 months (mean  $\pm$  SD, 23  $\pm$  11 months) after OHE of respondents' queens. The age of queens at the time of surgery ranged from 1 to 16 years (median, 7 years; IQR, 3 to 10 years).

For the 72 queens with follow-up, 65 (90%) were in their original home, 7 (10%) were no longer living in the home, 6 (86%) had died, and 1 (14%) was living with an owner's parent. Owners of 5 of the 6 queens that died reported the cause of death as diabetes ( $n = 2$ ), kidney disease (2; neither queen had high serum creatinine concentration at intake for treatment of pyometra), or cancer (1). The 1 queen that reportedly died from cancer had a mammary tumor present at the time of surgery; 2 other queens had mammary tumors and were still alive at the time of the survey. Ten of the 65 (15%) respondents whose pets were still in the home reported that their queen had a health problem after OHE. Two problems reported were determined to have been related to OHE (required revision surgery, cystic stump), whereas 5 others were determined to have been surgically-related problems that could have been anticipated (eg, signs of pain, signs of fatigue, or appetite changes within the month following OHE). Three reported problems were considered unrelated to pyometra or OHE and included diarrhea ( $n = 2$ ) and polyuria combined with polydipsia that began 3 to 4 months after OHE (1).

Overall, owners of the 65 queens still in their original home reported that their queen's general health since OHE had been excellent to very good (54 [83%]), good (9 [14%]), or fair to poor (2 [3%]). Sixty-four owners reported about their queens' health at the time of the survey, compared with the time before pyometra, with owners reporting that their queens' comparative health was better (36 [56%]), the same (25 [39%]), or worse (2 [3%]) or that they were unsure (1 [2%]). The 2 respondents who reported worse comparative health provided additional comments: 1 reported the queen was older and had cancer, and the other reported that OHE was a life-saving surgery. When asked about QoL, 65 owners reported that their queen's QoL at the time of the survey, compared with the time before pyometra, was better (42 [65%]), the same (21 [32%]), or worse 1 (2%) or that they were unsure (1 [2%]). The 1 owner who reported a worse QoL also reported worse health and that the queen was older and had cancer. Sixty-four owners responded to the question of whether they would choose to have the surgery again: 57 (89%) reported they would be extremely likely, 2 (3%) reported they would be somewhat likely, and 5 (8%) reported they were unsure.

## Univariable associations

**Bitches**—One hundred of 233 (43%) bitches were older than 8 years at the time of OHE, 35 (15%) had heart disease, and 50 (21%) had a mammary tumor. There were no significant associations between age > 8 years at the time of OHE and whether there was a pyometra-related issue after OHE, whether there was a pyometra-related issue after OHE with anticipated problems, owner-reported general health, owner-reported QoL after OHE, or whether the owner would do the surgery again ( $P = 0.52$ ). However, there was a significant ( $P = 0.03$ ) association between age > 8 years and owner-reported comparative health (ie, before pyometra vs at the time of the survey). Eleven respondents identified their bitch's health as worse at the time of the survey, compared with before pyometra; 8 of these bitches were older than 8 years old at the time of surgery. Two of the 8 owners reported incontinence after surgery, 1 reported a decrease in activity (the owner attributed this to age), 1 reported a tracheal issue, 1 reported a pancreatic issue, 1 reported a gastrointestinal foreign body, and 1 did not provide additional information. There were no significant associations between the presence of heart disease or mammary tumor at the time of OHE and the aforementioned survey responses of owners.

**Queens**—Of 72 queens, 28 (39%) were older than 8 years at the time of surgery, 7 (10%) had heart disease, and 3 (4%) had small mammary tumors. There were no significant associations between age, presence of heart disease, or presence of mammary tumor at OHE and the aforementioned survey responses of owners, except that there were significant associations between the presence of a mammary tumor and owner-reported comparative health ( $P = 0.03$ ) and owner-reported QoL ( $P = 0.01$ ). Only 2 of 3

owners of queens with mammary tumors responded to questions about queens' QoL and health after OHE. One of the 2 respondents provided additional information, and indicated that their queen had cancer, was older, and therefore had a lower QoL and poorer health compared with before pyometra and OHE treatment.

## Longevity

**Bitches**—Thirty-two of 233 (14%) bitches were reported to have died after discharge. The mean  $\pm$  SD age at surgery was significantly ( $P < 0.001$ ) older for those that had died after hospital discharge ( $9.7 \pm 3$  years), compared with bitches that were still alive at the time of the survey ( $7.3 \pm 3$  years). The median time to death after OHE was 1.5 years (IQR, 1 to 2 years). On the basis of results for maximum likelihood estimation of a survival time regression model with the use of Weibull distribution analysis, the means of the median predicted survival time and predicted life expectancy after OHE for pyometra at given ages of bitches were compiled (**Table 1**). The predicted number of years of survival after OHE for pyometra decreased with increasing age. The estimated total life expectancy at a given age of OHE for pyometra decreased to age 6 to 7 years old and thereafter increased with age. Mann-Whitney test results indicated that median body weight was significantly ( $P = 0.01$ ) lower for bitches treated for pyometra with OHE at an age > 8 years old (9.4 kg) versus  $\leq$  8 years old (5.7 kg).

**Queens**—Only 6 of 72 (8%) queens died after hospital discharge. The mean  $\pm$  SD age at OHE did not differ significantly between queens that died after surgery ( $9.7 \pm 1.9$  years; median, 9 years; IQR, 8 to 12 years) and those still alive at the time of the survey ( $6.7 \pm 3.9$  years; median, 7 years; IQR, 3 to 10 years). The median time to death after surgery was 2 years (IQR, 1 to 3 years). The means of the median predicted survival time and predicted life expectancy after OHE for pyometra at given ages of queens were compiled, as mentioned earlier for bitches (Table 1). The predicted number of years of survival after OHE for pyometra unsurprisingly decreased with increasing age. The estimated total life expectancy at a given age of OHE for pyometra generally increased with age at surgery.

## Discussion

The results of the survey data coupled with medical record data suggested that the long-term outcomes of OHE for pyometra are very good. None of the patient deaths after hospital discharge were related to pyometra or OHE, and only 3 bitches and 2 queens had complications after hospital discharge that were related to pyometra or OHE. Most respondents reported positive health and QoL outcomes. Most owners reported that their pet's health and QoL were better or the same as prior to the pyometra infection and that they would be likely to do the surgery again.



**Table 1**—Predicted number of years and total life expectancy (years) based on survival time maximum likelihood estimation of 233 bitches and 72 queens after ovariohysterectomy for pyometra at a nonspecialty veterinary hospital between January 1, 2017, and December 31, 2019.

Age at surgery (y)	Bitches		Queens	
	Mean of median predicted years' survival after surgery	Total life expectancy (y)	Mean of median predicted years' survival after surgery	Total life expectancy (y)
1.0	15.0	16.0	11.2	12.2
2.0	13.1	15.1	10.0	12.0
3.0	11.5	14.5	8.9	11.9
4.0	10.0	14.0	8.0	12.0
5.0	8.8	13.8	7.1	12.1
6.0	7.7	13.7	6.3	12.3
7.0	6.7	13.7	5.6	12.6
8.0	5.9	13.9	5.0	13.0
9.0	5.2	14.2	4.5	13.5
10.0	4.5	14.5	4.0	14.0
11.0	4.0	15.0	3.6	14.6
12.0	3.5	15.5	3.2	15.2
13.0	3.0	16.0	2.8	15.8
14.0	2.6	16.6	2.5	16.5
15.0	2.3	17.3	2.3	17.3
16.0	2.0	18.0	2.0	18.0

Outcomes for older (> 8 years of age) pets were generally good, and their results for reported health issues after surgery, comparative health or QoL, or whether the owner would likely do the surgery again did not meaningfully differ for bitches and queens > 8 versus ≤ 8 years of age at the time of OHE for pyometra. Although clients with bitches > 8 years old at the time of OHE were significantly more likely to report that their pet's health was worse after versus before pyometra, in all cases, this was due to conditions that emerged later and were unrelated to pyometra or OHE treatment of it. Most older pets survived for a substantial period after OHE treatment of pyometra, with owners reporting similar or better QoL after versus before pyometra.

Outcomes for bitches and queens with uncomplicated heart disease or mammary tumors were also generally good in the present study. Among our sample, the frequency of concurrent heart disease and mammary tumors was lower in queens than bitches. The percentage of bitches with heart disease (15% [35/233]) among our sample was similar to findings reported elsewhere<sup>12</sup>; however, the percentage with mammary tumors (22% [50/233]) was greater than reported elsewhere (10% to 15%).<sup>20</sup> For the most part, health and QoL outcomes were similar for bitches and queens with versus without heart disease or mammary tumor, except for 1 (a queen with a mammary tumor) for which its owner reported subsequent reduced QoL and health due to factors related to cancer, not pyometra or OHE.

Our results importantly indicated that OHE for pyometra did not appear to reduce life expectancy for animals that did not have other severe health issues, even at older ages. This reinforced findings of prior work<sup>17</sup> that shows no significant reduction in longevity after pyometra in Rottweilers. In bitches, we found the estimated total life expectancy at a

given age at surgery decreases until approximately age 7 and then increases with increasing age at surgery. This result is not surprising given that older bitches treated for pyometra at AAH were smaller and thus expected to have a longer life span. In addition, bitches that survive to 8 or 10 years of age without other severe health issues are then likely to have good longevity. On the basis of our findings, if a bitch were to survive to age 12 or 13 and then develop pyometra and undergo OHE treatment for it, that bitch would likely be smaller and expected to live another 3 to 4 years. In queens, life expectancy increased with increasing age at surgery, especially at older ages. Our findings indicated that a queen that undergoes OHE for pyometra at an older age would have a predicted longer life span, compared with a queen that has OHE for pyometra at a young age. That is likely due to the queen having good enough health to have survived to an older age prior to diagnosis of pyometra.

Our findings that OHE for pyometra at older ages does not reduce life expectancy and that older animals and animals with uncomplicated heart disease or mammary tumors generally have similar health and QoL outcomes after surgery are important. Age and the presence of comorbidities are important considerations in any treatment decision, and our results indicated that age or the presence of heart disease or mammary tumor does not adversely affect recovery from OHE for pyometra. In general, once a queen or bitch recovers from pyometra after OHE, the pet can be expected to live a normal life span with a similar QoL as before pyometra, even if the pet is at an advanced age.

Although health and QoL outcomes were overwhelmingly positive for most of our sample, owners of older bitches were more likely to report worse health at the time of the survey, compared with prior

to the pyometra, and owners of queens with mammary tumors were more likely to report worse health and quality of life. Decreased health and QoL were attributed to age or comorbidities, not due to pyometra or OHE. Although OHE for pyometra may not influence owner-reported health or QoL outcomes, the likelihood that a pet will experience health issues increases with age and with the presence of comorbidities such as feline mammary tumors. This factor is important to consider, not only in treatment decisions for pyometra, but for any treatment decisions for an older pet with comorbidities.

A limitation to the present study was that most bitches (228/404 [56%])<sup>9</sup> and queens (63/126 [50%])<sup>8</sup> owned by survey respondents who had initially taken their pet to another practice were referred to the AAH due to the owner's financial constraints. Therefore, the pets of our survey sample may have had a longer duration of clinical signs and potentially worse outcomes expected, compared with bitches and queens with standard access to veterinary services and expedited treatment.

Our high-response rate to the survey decreased the likelihood of substantial nonresponse bias. However, those that did not respond to the survey may have had pets that died after discharge or may have reported worse health and QoL outcomes.

Our findings indicated that the long-term complications and mortality attributable to pyometra were low. In the present study, only 2% (3/193) of complications among bitches, 3% (2/65) of complications among queens, and none of the deaths were considered attributable to pyometra or OHE treatment for it. Literature describing pyometra reports complications occurring in up to 20%<sup>4</sup> of surgically treated patients and mortality rates up to 8% (15/183).<sup>7</sup> However, the number of complications or deaths for the study period could have been comparably lower because our evaluations were for those after hospital discharge. The purpose of the survey was to investigate how well bitches and queens did in the home following OHE for pyometra; therefore, any complications or deaths that occurred in the hospital prior to discharge were not considered in the present study. In addition, our findings for the numbers of complications and deaths could have been low because pets with pyometra must first have been given a good prognosis to receive financial support for surgical treatment at AAH. Our sample thus excluded bitches and queens with underlying conditions that did not receive surgery due to a poor prognosis.

Clinical signs following discharge were reported by owners. Although these reports were subsequently reviewed by veterinarians and classified as related or unrelated to pyometra or OHE treatment for it, veterinarians did not directly observe the pets. It is possible that owners may not have noticed signs of complications when they were present or described the clinical signs in such a way that reviewing veterinarians misclassified complications as related when they were not (or vice versa).

The focus of the present report was to identify any complications, evaluate owner-reported health and QoL outcomes, and determine longevity after hospital discharge following OHE for pyometra. We found there were very few complications that occurred after hospital discharge and that nearly all respondents reported at least the same, if not improved, health and QoL for their pets after hospital discharge. We also found that overall longevity did not decrease with age and that older pets and pets with uncomplicated heart disease or mammary tumors generally had similar positive health and QoL outcomes as younger pets.

Knowing the long-term health and QoL outcomes and expected longevity following OHE for pyometra, especially among older pets or those with comorbidities, helps veterinarians and pet owners make important treatment decisions when faced with pyometra. Given that OHE for pyometra was highly effective and had excellent long-term outcomes for bitches and queens, including older ones, in the present study, veterinarians can feel comfortable offering this important procedure. If this OHE for pyometra were widely available in general practice, more pets could receive treatment for this life-threatening disease.

## Acknowledgments

No external funding was used in this study. The authors declare that there were no conflicts of interest.

The authors thank Melanie Segal, Shirley Castro, Daniel Tang, and Sam Rosoff for their assistance in implementing the survey.

## References

1. Jitpean S, Hagman R, Ström-Holst B, Höglund OV, Pettersson A, Egenvall A. Breed variations in the incidence of pyometra and mammary tumours in Swedish dogs. *Reprod Domest Anim*. 2012;47(Suppl 6):347-350. doi:10.1111/rda.12103
2. Hagman R, Ström-Holst B, Möller L, Egenvall A. Incidence of pyometra in Swedish insured cats. *Theriogenology*. 2014;82(1):114-120. doi:10.1016/j.theriogenology.2014.03.007
3. Hagman R. Canine pyometra: what is new? *Reprod Domest Anim*. 2017;52:288-292. doi:10.1111/rda.12843
4. Hagman R. Pyometra in small animals. *Vet Clin North Am Small Anim Pract*. 2018;48(4):639-661. doi:10.1016/j.cvsm.2018.03.001
5. Davidson J, Black D. Small animal pyometra. In: Aronson LR, ed. *Small Animal Surgical Emergencies*. 1st ed. Oxford, UK: Wiley; 2016:397-402.
6. Jitpean S, Ström-Holst B, Emanuelson U, et al. Outcome of pyometra in female dogs and predictors of peritonitis and prolonged postoperative hospitalization in surgically treated cases. *BMC Vet Res*. 2014;10(1):6. doi:10.1186/1746-6148-10-6
7. Kenney KJ, Matthiesen DT, Brown NO, Bradley RL. Pyometra in cats: 183 cases (1979-1984). *J Am Vet Med Assoc*. 1987;191(9):1130-1132.
8. Pailler S, Slater MR, Lesnikowski SM, et al. Findings and prognostic indicators of outcomes for queens with pyometra treated surgically in a nonspecialized hospital setting. *J Am Vet Med Assoc*. 2022;260(S2):S42-S48.

9. Pailler S, Slater M, Lesnikowski S, et al. Findings and prognostic indicators of outcomes for bitches with pyometra treated surgically in a nonspecialized setting. *J Am Vet Med Assoc.* 2022;260(S2):S49-S56.
10. McCallin AJ, Hough VA, Kreisler RE. Pyometra management practices in the high quality, high volume spay-neuter environment. *Top Companion Anim Med.* 2021;42:100499. doi:10.1016/j.tcam.2020.100499
11. Conti-Patara A, de Araújo Caldeira J, de Mattos-Junior E, et al. Changes in tissue perfusion parameters in dogs with severe sepsis/septic shock in response to goal-directed hemodynamic optimization at admission to ICU and the relation to outcome. *J Vet Emerg Crit Care (San Antonio).* 2012;22(4):409-418. doi:10.1111/j.1476-4431.2012.00769.x
12. Lee JA, Kim IH, Kang TK, Hwang DY, Kang HG. Determination of possible prognostic indicators in dogs with pyometra. *J Vet Clin.* 2020;37(4):191-197. doi:10.17555/jvc.2020.08.37.4.191
13. Dąbrowski R, Kostro K, Lisiecka U, Szczubiał M, Krakowski L. Usefulness of C-reactive protein, serum amyloid A component, and haptoglobin determinations in bitches with pyometra for monitoring early post-ovariohysterectomy complications. *Theriogenology.* 2009;72(4):471-476. doi:10.1016/j.theriogenology.2009.03.017
14. Bartoskova A, Vitasek R, Leva L, Faldyna M. Hysterectomy leads to fast improvement of haematological and immunological parameters in bitches with pyometra. *J Small Anim Pract.* 2007;48(10):564-568. doi:10.1111/j.1748-5827.2007.00345.x
15. Heiene R, Kristiansen V, Teige J, Jansen JH. Renal histomorphology in dogs with pyometra and control dogs, and long term clinical outcome with respect to signs of kidney disease. *Acta Vet Scand.* 2007;49(1):13. doi:10.1186/1751-0147-49-13
16. Egenvall A, Hagman R, Bonnett BN, Hedhammar Å, Olson P, Lagerstedt AS. Breed risk of pyometra in insured dogs in Sweden. *J Vet Intern Med.* 2001;15(6):530-538. doi:10.1111/j.1939-1676.2001.tb01587.x
17. Waters DJ, Kengeri SS, Maras AH, Suckow CL, Chiang EC. Life course analysis of the impact of mammary cancer and pyometra on age-anchored life expectancy in female Rottweilers: implications for envisioning ovary conservation as a strategy to promote healthy longevity in pet dogs. *Vet J.* 2017;224:25-37. doi:10.1016/j.tvjl.2017.05.006
18. Bonnett BB, Egenvall A, Hedhammar Å. Mortality in over 350,000 insured Swedish dogs from 1995-2000 : I. Breed-, gender-, age- and cause-specific rates. *Acta Vet Scand.* 2005;46(3):105-120. doi:10.1186/1751-0147-46-105
19. Cozzi B, Ballarin C, Mantovani R, Rota A. Aging and veterinary care of cats, dogs, and horses through the records of three university veterinary hospitals. *Front Vet Sci.* 2017;4:14. doi:10.3389/fvets.2017.00014

## Supplementary Materials

Supplementary materials are posted online at the journal website: [avmajournals.avma.org](http://avmajournals.avma.org)