



# A retrospective study of pyometra at five RSPCA hospitals in the UK: 1728 cases from 2006 to 2011

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**A retrospective cross-sectional study was used to analyse pyometra cases at five RSPCA Animal Hospitals across the UK from 2006 to 2011. A total of 1728 cases of pyometra were recovered from a female dog outpatient caseload of 78,469 animals, giving a total prevalence of 2.2 per cent over the study period. There was an annual increase in the incidence of pyometra within the population, while elective ovariohysterectomy caseload has declined. There were variations in breed and age at presentation. Bullmastiffs ( $P<0.0001$ ), golden retrievers ( $P=0.001$ ) and dogue de Bordeaux ( $P=0.008$ ) were over-represented in the pyometra population when compared with the female dog outpatient caseload. Mean age at presentation was 7.7 years. Some breeds presented at a significantly lower age, including dogue de Bordeaux (mean age 3.3 years) and bullmastiffs (mean age 5.4 years), while others presented as older dogs, including Yorkshire terriers (mean age 9.4 years) and border collies (mean age 10.3 years). Surgical mortality rate at the Greater Manchester Animal Hospital was 3.2 per cent. Pyometra is of significant welfare concern, and also has cost implications, particularly in charity practice. These results serve to highlight this condition so that future change in charity practice caseload can be anticipated and strategies can be directed to improve animal welfare.**

## Introduction Pyometra

Pyometra is a common, potentially life threatening condition, affecting entire female dogs. The disease is defined by accumulation of purulent material within the uterus, which manifests in both local and systemic symptoms, and demands costly surgical or medical intervention in order to resolve (Dow 1958, Sandholm and others 1975, Hagman and others 2011). Uterine exposure to progesterone during canine dioestrus plays a key role in the pathogenesis of the disease (Dow 1958). Progesterone induces changes in the uterus which prepare a suitable environment for early embryo development, including endometrial proliferation, increased uterine glandular secretions and decreased myometrial contractions, as well as a relaxation in normal uterine cellular immune defences (Teunissen 1952, Sugiura and others 2004, Noakes and others 2009). Consecutive oestrus cycles have a cumulative effect on the endometrium which can lead to the development of cystic endometrial hyperplasia which has been

shown to predispose for the development of pyometra (Dow 1958), however, the two conditions can occur independently (De Bosschere and others 2001).

## Prevalence/incidence

An accurate incidence of pyometra within the at-risk un-neutered female dog population is difficult to attain due to the large proportion of neutered dogs within the pet population. Egenvall and others (2001) reported an overall annual pyometra incidence of 2 per cent from a study of approximately 200,000 predominantly un-neutered Swedish dogs, with around 24 per cent of dogs having experienced pyometra by 10 years of age. A retrospective study of 3536 dogs in the UK reported an upper limit for pyometra incidence of 2 per cent per year within the at-risk population (Whitehead 2008), whereas, a study of 165 colony-reared beagles reported a prevalence of 15.2 per cent over the dogs' lives (Fukuda 2001).

## Age

Pyometra has consistently been shown to predominantly affect middle-aged to older dogs, with mean age at presentation ranging from 6.4 to 9.5 years (Dow 1958, Ewald 1961, Hardy 1974, Wheaton and others 1989, Sevelius and others 1990, Niskanen and Thrusfield 1998, Egenvall and others 2001, Fukuda 2001, Whitehead 2008, Igna 2011, Hagman and others 2011). The disease can occur from the time of the first season and has been reported in dogs as young as six months of age (Stone and others 1988).

The Royal Society for Prevention of Cruelty to Animals (RSPCA) has five charity animal hospitals around the UK which provide veterinary services to members of the public who are in receipt of specific state benefits and are unable to afford private treatment for their pets. In common with other animal welfare charities, the RSPCA is

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experiencing increasing demand for services in the face of greater competition for funds as a result of the economic downturn in recent years (RSPCA 2011). Pyometra is a common but preventable disease that is frequently presented at these hospitals. In situations where the owner is unable to pay for treatment, charity assistance may be the only alternative to euthanasia. It is therefore pertinent to review trends in the presentation of such diseases to charity practice so that action can be taken to improve animal welfare and anticipate changing caseloads in the future.

The primary aim of this study was to investigate the prevalence and incidence of pyometra presentation at RSPCA hospitals, and to document trends in demand for veterinary resources over the course of the economic downturn. Secondary aims were to document variations in the breeds and ages of dogs presented with pyometra nationally, and the outcomes of treatment at Greater Manchester Animal Hospital (GMAH).

## Materials and methods

### Study population

Data were gathered from electronic records of animals from five RSPCA hospitals around the UK; Birmingham Animal Hospital (BAH), GMAH, Harmsworth Animal Hospital (HAH), Merthyr Tydfil Clinic (MAC), and Putney Animal Hospital (PAH). The period of study was between January 1, 2006 and December 31, 2011.

### Case definition

Only dogs presented to the hospitals by members of the public were included. Dogs which were presented from RSPCA kennels were not included due to the lack of a control population. The dataset for each animal included: individual case number, date of procedure, date of birth and breed. Three populations of dogs were compared as defined below:

#### 1. Pyometra

All female dogs which had been invoiced for 'pyometra spay' during the study period were included as pyometra cases. Three cases were omitted from age calculations because a date of birth was not recorded. Two further cases had ages of less than six months, and were therefore excluded as it was considered likely these were subject to error in recording of their age.

#### 2. Elective ovariohysterectomy (OVH)

All female dogs invoiced for elective OVH during the study period were identified as a comparator population. Animals which had undergone OVH for non-elective reasons, such as caesarean or treatment of pyometra, were excluded.

#### 3. Female dog outpatient (FDO) population

All owned female dogs presenting to the hospitals as outpatients, for any reason, were included in this comparator population. If a dog was presented more than once in a year, its first visit was included and any subsequent visits excluded.

### GMAH case reviews

Clinical case notes from pyometra cases at GMAH were individually reviewed and information gathered regarding presentation and outcome. This included death as a result of pyometra related disease, any record of mammary masses, complications at surgery and follow-up for suture removal. Animals which died or were euthanased in the perioperative period or within the first 14 days of surgery as a result of pyometra-related disease were included in estimation of surgical mortality rate. Whether the animal had been referred from a private veterinary practice, whether or not the animal had previously visited the hospital, and financial information regarding owner contribution to veterinary fees were also recorded.

### Data analysis

Data of each group was collated into a spreadsheet (Excel V.5.0; Microsoft) and duplicate case numbers were removed. Breeds were defined by categories set in the hospital database. All crossbreeds were grouped into a single category for breed data analysis. Incidence and prevalence were calculated using the FDO population as the denominator.

Prevalence was calculated for each year, and a total period prevalence was calculated for the study period. The prevalence was also calculated for each breed, to allow interbreed comparison. Incidence was similarly calculated as a yearly rate.

Analyses were carried out in SPSS V.16.0 for Windows. Significance was set at  $P < 0.05$ . For estimation of breed differences in prevalence of pyometra presentation, the proportion of that breed present in the pyometra population was compared with the proportion of the same breed present in the FDO population, and the  $\chi^2$  test for proportions (with Yates's correction) applied.

For comparison of the different ages at which different breeds were presented for pyometra, the Bonferroni correction was used so that 98.8% (1 to 0.05/22) CIs were calculated, in order to correct for the effect of repeated comparisons.

## Results

### Prevalence

A total of 1728 cases presented with pyometra in the six-year period of study, and 8374 dogs underwent OVH. The total FDO population was 78,469 dogs. Table 1 summarises the results for each hospital. The overall period prevalence of pyometra was 2.2 per cent.

### Prevalence within breed

Fig 1 summarises the period prevalence of pyometra within breeds with 10 or more pyometra cases. Prevalence of pyometra over the six years of study was highest in bullmastiffs and golden retrievers at 6.4 per cent and 5.4 per cent, respectively. bullmastiffs, golden retrievers and dogue de Bordeaux had a significantly higher prevalence of pyometra than the general population ( $P < 0.0001$ ,  $P = 0.001$  and  $P = 0.003$ , respectively).

### Incidence

The annual incidence for pyometra and OVH were calculated as a percentage of FDO (Fig 2). The pyometra incidence increased annually from 1.8 per cent of the FDO in 2006 to 2.9 per cent in 2011. Within individual hospitals, the incidence of pyometra increased over the study period at GMAH, HAH and PAH, while staying constant at MAC and decreasing slightly at BAH. Other than PAH, the rate of elective OVH, as a percentage of FDO, decreased at all hospitals over the study period with an overall decrease from 11.7 per cent to 9.1 per cent.

### Age

The mean age at presentation for pyometra was 7.7 years, with a range of 0.6–19 years, as shown in fig 3. There was variation in the age at presentation within breeds. Dogue de Bordeaux ( $n=14$ ) had a mean age at presentation of 3.3 years (99.8% CI 2.3 to 4.3), and bullmastiffs ( $n=45$ ) presented at a mean age of 5.4 years (99.8% CI 4.3 to 6.6). Conversely, the mean age of Yorkshire terriers ( $n=63$ ) was 9.4 years of age (99.8% CI 8 to 10.9), and border collies was 10.3 years (98.8% CI 8.8 to 11.9). Fig 4 shows a box-and-whisker plot of age at pyometra presentation within breeds with 10 or more cases, covering 1586 dogs.

### GMAH results

The records of 699 cases invoiced for pyometra within the study period at GMAH were reviewed individually. Table 2 summarises the main findings. Surgical mortality rate was 3.2 per cent. Mammary masses were reported in the clinical histories of 11.7 per cent of pyometra cases. The proportion of cases received as referrals from private practice fluctuated over the study period, however, there was an overall increase from 26 per cent to 36 per cent. The mean cost to the client for treatment of pyometra was £100.65. A total of 39 per cent of fees charged to the client were not recovered, resulting in a total loss through non-payment of £27,847.04.

## Discussion

### Prevalence/incidence

This study has found a steady annual increase in canine pyometra incidence in RSPCA hospitals from 2006 to 2011, while there was a concurrent decrease in the uptake of elective neutering.

TABLE 1: Table of female dog outpatient (FDO), pyometra (Pyo) and ovariectomy (OVH) numbers for each of the five RSPCA animal hospitals from 2006 to 2011

Year	GMAH			PAH			HAH			BAH			MAC			
	FDO	OVH	Pyo	FDO	OVH	Pyo	FDO	OVH	Pyo	FDO	OVH	Pyo	FDO	OVH	Pyo	
2006	4882	607	77	2842	234	61	2505	198	53	2268	283	43	797	237	9	
2007	4990	556	83	3049	338	67	2480	163	57	2001	231	33	676	182	5	
2008	5094	629	106	2983	363	72	2539	167	49	1885	197	30	664	148	9	
2009	5343	558	132	3055	387	67	2540	155	50	1863	223	17	637	133	9	
2010	4848	442	151	3043	350	95	2633	145	62	1805	205	27	603	116	9	
2011	4903	348	150	3011	320	85	2463	165	92	1482	171	22	585	123	6	
Total	30,060	3140	699	17,983	1992	447	15,160	993	363	11,304	1310	172	3962	939	47	
				Mean pyo prev=2.3			Mean pyo prev=2.5			Mean pyo prev=2.4			Mean pyo prev=1.5			Mean pyo prev=1.2

BAH, Birmingham Animal Hospital; GMAH, Greater Manchester Animal Hospital; HAH, Harmsworth Animal Hospital; MAC, Merthyr Tydfil Clinic; PAH, Putney Animal Hospital; Pyo prev, prevalence of pyometra, using FDO population as the denominator; RSPCA, Royal Society for Prevention of Cruelty to Animals; FDO, female dog outpatient; OVH, ovariectomy

The overall period prevalence of pyometra within the female dog population was 2.2 per cent. This is similar to previously reported values (Egenvall and others 2001, Whitehead 2008). The yearly increase in pyometra cases at RSPCA hospitals could be related to a number of factors. It may be that as the economic recession progresses, more pet owners may be relying on veterinary charities for treatment of unexpected, expensive conditions such as pyometra. Alternatively, there

may be a genuine increase in the incidence of pyometra within this population as a result of a historic decrease in neutering, giving rise to a larger at-risk population.

It is clear that in the RSPCA hospital population, at least, elective neutering has decreased over recent years. One might expect neutering uptake in charity practice, where neutering has a lower cost to the owner, to increase in a time of economic recession as people with financial constraints seek alternative avenues to private practice. The reported decrease in elective OVH in this study may represent a shift in public perception of neutering, or a decreased priority when finances are limited. At GMAH, there has been an increase in the amount of off-site neutering performed over the study period (unpublished data), which may explain reduced numbers of OVH performed at the hospital. Capacity for elective neutering throughput at each hospital would also be affected by hospital factors such as staffing and budget. The PDSA Animal Wellbeing Report 2012 estimated that 32 per cent of dogs in the UK are un-neutered, however, this had decreased from 34% in the PDSA PAWS Report 2011 (PDSA and YOUNGOV 2011, 2012). Personal belief and wanting to breed from their pet were primary factors given by dog owners for electing not to neuter, however, awareness of the risk of reproductive-related problems and their financial and welfare consequences were not evaluated. Owner education is essential, so that an informed decision regarding neutering can be made, and potential future reproductive problems can be anticipated and planned for. This is especially important given how commonly such problems occur; for example, in a study of predominantly un-neutered female dogs, around 24 per cent of them had experienced pyometra, and 13 per cent had developed mammary tumours by the age of 10 years (Egenvall and others 2001, Egenvall and others 2005).

The majority of cases presented to RSPCA hospitals are first presentations, with 51.2 per cent of cases of pyometra at GMAH being neither registered at GMAH nor referred from another veterinarian. These may be pet owners who had been previously registered at another veterinary practice, or owners who had no previous veterinary contact. In a survey of over 3900 pet owners, the PDSA Animal Wellbeing Report 2012 reported that 7 per cent of dogs were not registered with a veterinary practice, and 14 per cent had never received a primary course of vaccinations, however, this is likely to be higher in areas of low income (PDSA and YOUNGOV 2012). There is particular concern for the welfare of these animals and it is challenging to evaluate this population, as they are not in contact with the veterinary profession until there is a problem. The PDSA Animal Wellbeing Report does, however, document an overall positive trend in the uptake of preventative medicine and registration to veterinary practices since 2011 (PDSA and YOUNGOV 2012).

There was an increased prevalence of pyometra within bull-mastiff, golden retriever and dogue de Bordeaux, when compared with the presence of these breeds in the FDO population. A genetic predisposition for pyometra has not been demonstrated, however, a number of studies have described over-representation within certain breeds, including rottweiler, golden retriever and Cavalier King Charles spaniel (Krook and others 1960, Niskanen and Thrusfield 1998, Egenvall and others 2001). Other breeds which have inconsistently been described as being over-represented include Saint Bernard, bernese mountain dog, rough collie, miniature schnauzer, great Dane, chow chow, pointer, Irish terrier and French bull dog (Krook and others 1960, Ewald 1961, Niskanen and Thrusfield 1998, Egenvall and others 2001). On the other hand, dachshunds have repeatedly been reported to have decreased incidence of pyometra (Krook and others 1960, Ewald 1961, Niskanen and Thrusfield 1998, Egenvall and others 2001). The pyometra population in this study may be skewed by an increased likelihood of referral of large breed dogs to charity practice due to the higher cost of surgery compared with smaller breeds. Further investigation would be needed to assess whether this indicated a true breed predisposition.

## Age

In the present study, the mean age at pyometra presentation of 7.7 years is consistent with previous studies (Dow 1958, Ewald 1961, Wheaton and others 1989, Sevelius and others 1990, Niskanen and Thrusfield 1998, Egenvall and others 2001, Hagman and

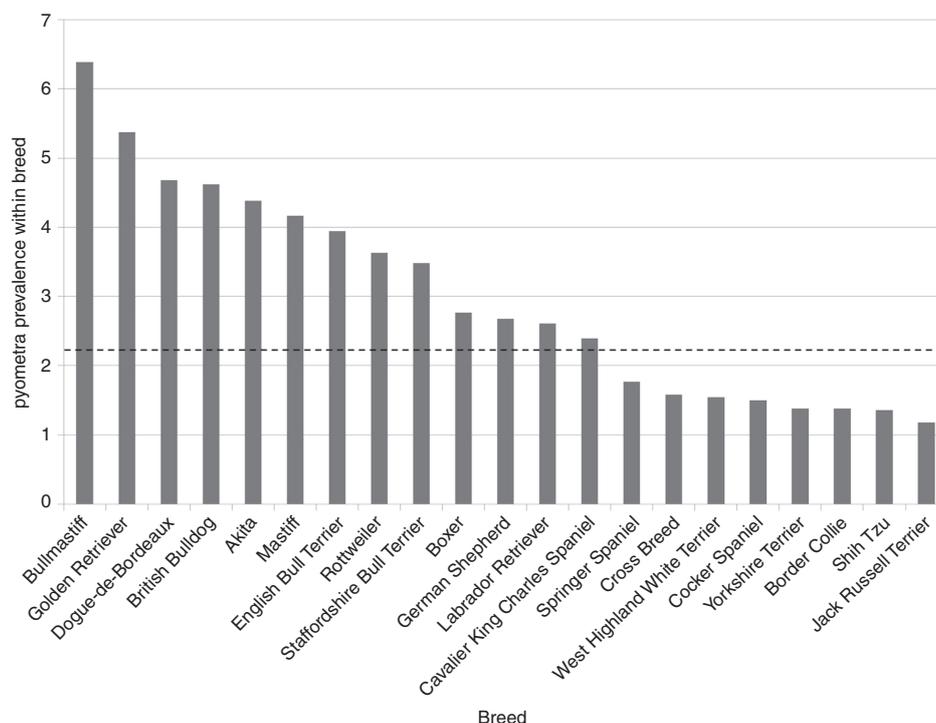


FIG 1: Prevalence of pyometra within breed in female dogs presenting to five Royal Society for Prevention of Cruelty to Animals animal hospitals from 2006 to 2011. Breed prevalence was calculated using number of dogs presenting with pyometra as the numerator, and female dog outpatient population for each breed as denominator, which encompassed any female dog presenting at the hospitals for any reason. The dotted horizontal line denotes overall period prevalence in the study population (2.2 per cent)

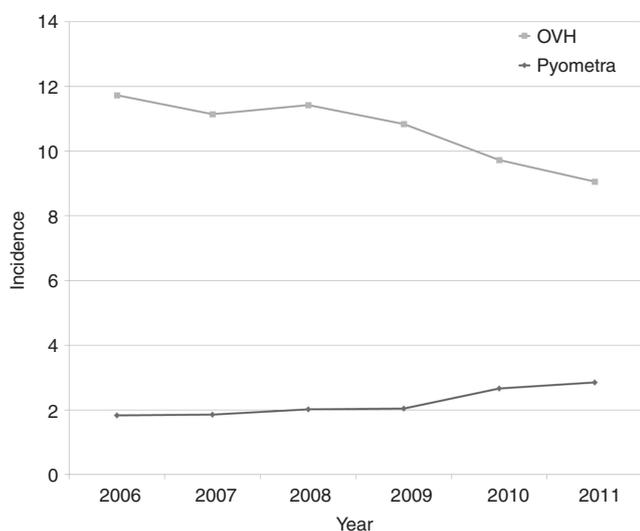


FIG 2: Incidence of pyometra and elective ovariohysterectomy in five Royal Society for Prevention of Cruelty to Animals animal hospitals from 2006 to 2011. Incidence was calculated using the total female dog outpatient population as a denominator, which encompassed any female dog presenting at the hospitals for any reason

others 2011). Significant variation in age at pyometra presentation between breeds has not been previously reported, however, in this study, dogue de Bordeaux and bullmastiffs presented at a significantly younger age than other breeds. Egenvall and others (2001) reported no significant difference in the age at which dogs of different breeds presented with pyometra, however, the study only included dogs up to the age of 10 years, and so these figures may be skewed for breeds which have a higher mean age of pyometra presentation. It was

discussed that in some breeds the risk of pyometra may increase more and at a younger age than others, potentially as a result of a genetic predisposition (Egenvall and others 2001). Interestingly, in the present study, border collies and Yorkshire terriers were presented at a significantly higher age than the population mean. Hagman and others (2011) found no correlation between risk of pyometra and short inter-oestrus interval, early fertility or irregular oestrus cycles, indicating that the number of seasons an animal is exposed to during its lifetime does not relate to risk of pyometra. This may suggest a physiological reason for increased susceptibility in some breeds, such as variation in uterine secretion, myometrial contractions or uterine immune response during dioestrus.

#### Clinical outcomes at GMAH

The mean mortality rate of dogs undergoing surgical treatment of pyometra at GMAH was 3.2 per cent (range 2.0–5.2 per cent), which is in line with previous estimates of 0 per cent, 5 per cent and 17 per cent mortality reported in studies of surgical cases in the 1980s (Hardy 1974, Stone and others 1988, Wheaton and others 1989) and 4.3 per cent (death or euthanasia) reported by Egenvall and others (2001). Although pyometra mortality rate is relatively low, morbidity through duration of disease, hospitalisation and surgery also have welfare implications. In a study of 116 cases of pyometra, Hardy and others reported a mean duration of illness of 12 days (range 1–180), with a number of studies documenting depression (73–86 per cent), anorexia (72–79 per cent) and vaginal discharge (74–88 per cent) as the most frequent clinical signs (Hardy 1974, Wheaton and others 1989, Hagman and others 2011). Polydipsia, polyuria, pyrexia, vomiting, diarrhoea, azotaemia and urinary tract infection have also been frequently reported as common sequelae to pyometra (Ewald 1961, Hardy 1974, Sandholm and others 1975, Stone and others 1988, Wheaton and others 1989, Sevelius and others 1990).

Treatment of pyometra inevitably carries a significant financial duty to the owner. The cost of treatment at GMAH is subsidised by the RSPCA, however, clients are still charged a proportion of the

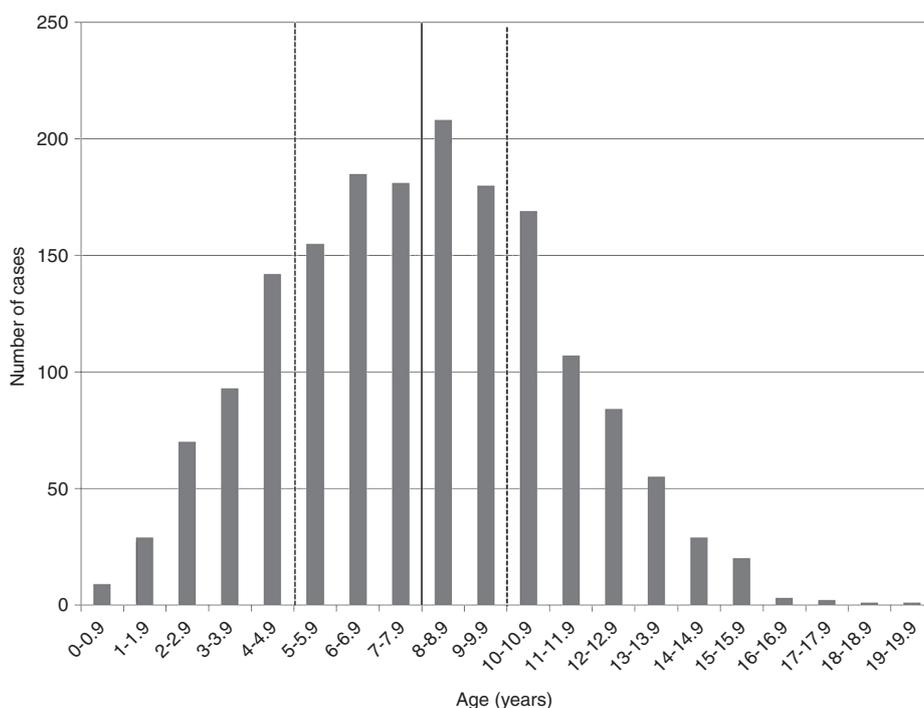


FIG 3: Age at pyometra presentation in 1723 cases of pyometra presented at five Royal Society for Prevention of Cruelty to Animals animal hospitals from 2006 to 2011. The solid vertical line denotes median age (7.9 years). The dotted lines denote lower quartile (5 years) and upper quartile (10 years). Five cases were excluded from the total of 1728 as age data was not available.

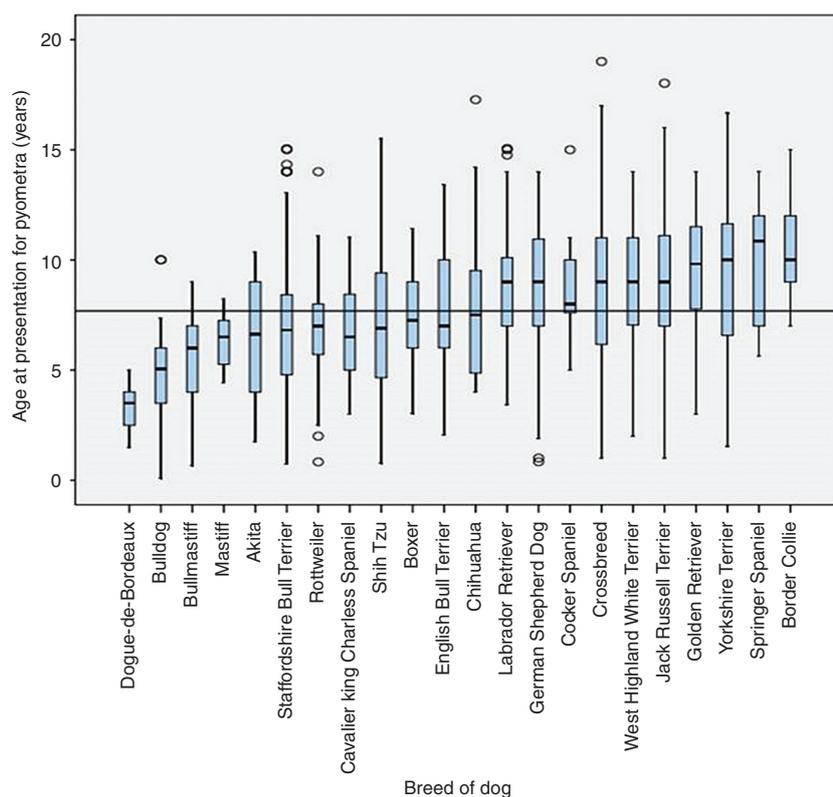


FIG 4: Box-and-whisker plot of age at presentation of pyometra within breed in female dogs presented to Royal Society for Prevention of Cruelty to Animals animal hospitals from 2006 to 2011. Only breeds with group sizes greater than ten are shown ( $n=1586$  in 22 breeds). The boxes show the mean and 99.8% CIs, and the whiskers show the range. The horizontal line indicates the population mean (7.7 years)

cost of treatment. The average charge to the client was £100.65 per pyometra case in this study. Despite this subsidised cost to the owner, GMAH was unable to recover 39 per cent (£27,760) of fees charged to clients for treatment of pyometra over the six-year study period, something which would not be sustainable in private practice. This gives an insight into the scale of the problem of pyometra, especially in areas of low income, and raises the question of what might happen

to these animals if charitable veterinary care were to become less available in the future. One of the major findings of the PDSA Pet Welfare Report 2012 was a lack of awareness of the cost of pet ownership, and this was cited as the primary concern of practitioners relating to pet care (PDSA and YOUNGOV 2012). It is therefore essential that efforts are made to ensure that pet owners are aware of potential future costs and how they can be planned for through insurance, preventative

TABLE 2: Analysis of GMAH pyometra population (n=699)

	2006	2007	2008	2009	2010	2011
Number of pyometra cases	77	83	106	132	151	150
Died (%)	5.2	2.4	2.8	3.8	2.0	3.3
GMAH 1st presentations (%)	90.9	83.1	74.5	81.8	74.8	78.0
PV ref (%)	26.0	15.7	26.4	36.4	28.5	36.0
Average cost per case to client (£)	88.5	89.6	91.6	98.3	112.9	123.1
Total loss through non-payment (£)	2496.73	4175.41	3890.89	3873.95	6343.11	7066.95

GMAH 1st presentation, animals which had not previously presented to the Greater Manchester Animal Hospital; PV ref, referral cases from private veterinary practice

medicine and responsible pet ownership in order to avoid compromising welfare later in the animal's life. Further research is warranted into the demand for charity veterinary services, particularly relating to preventable problems, such as pyometra, as well as investigating effective methods of owner education in areas of poor veterinary compliance.

### Limitations

The limitations of this study need to be considered when interpreting the results. The pyometra population may have been underestimated by searching invoiced procedures, as the data would not include animals which presented with pyometra, but were not invoiced for 'pyometra spay'. This would include cases which were euthanased or died prior to having surgery, or those which were managed medically, however, pyometra was routinely treated surgically at the hospitals in the study. This would also result in an underestimation of calculated pyometra mortality rate. Furthermore, the mortality rate calculation would not include animals whose death was not recorded in the GMAH medical notes, for example, any that died at home or represented to the referring veterinary practice for postoperative complications.

The neuter status within the FDO population was not reliably recorded in the computer system, and so the control population contained both neutered and entire female dogs. Therefore, the reported incidence of pyometra is likely to be an underestimate of the actual incidence, as the denominator includes spayed female dogs (which would not be at risk of pyometra). On the other hand, the total at-risk population is likely to be larger than the hospital population, as many animals will only be presented to veterinary practice when they become unwell; as is the case with pyometra. The ideal control group would be a wider population of dogs from the hospital catchment areas, although sampling this population would be difficult as they have no known previous veterinary contact.

Breed data may have been affected by high incidence of breed-related (non-pyometra) disease within the FDO population. For example, a high number of cases presenting for skin disease within a specific breed would relatively reduce incidence of pyometra. Additionally, there may be a larger proportion of un-neutered female dogs within certain breeds due to variation in owner perception of OVH or intention to preferentially breed certain types of dogs, therefore resulting in a greater proportion of females at-risk of pyometra.

### Conclusion

Pyometra is a preventable disease, and veterinary treatment is required if an affected animal is to survive. As the recession continues, efforts need to be made to ensure that animal welfare within the pet population does not deteriorate, however, reaching populations that are outside of veterinary guidance will be particularly challenging. Therefore, the authors believe that it is essential to educate new owners to the potential risk of pyometra, especially those who are likely to rely heavily on charities for veterinary care. Further research is required to identify potential breed predispositions, and investigate effective ways of promoting responsible pet ownership in underprivileged areas of the UK.

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## **A retrospective study of pyometra at five RSPCA hospitals in the UK: 1728 cases from 2006 to 2011**

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