

# Impact of collaborative care on survival time for dogs with congestive heart failure and revenue for attending primary care veterinarians

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## OBJECTIVE

To assess the effects of in-person collaborative care by primary care veterinarians (pcDVMs) and board-certified veterinary cardiologists (BCVCs) on survival time of dogs after onset of congestive heart failure (CHF) and on associated revenue for the attending pcDVMs.

## DESIGN

Retrospective cohort study.

## ANIMALS

26 small-breed dogs treated for naturally occurring CHF secondary to myxomatous mitral valve disease at a multilocation primary care veterinary hospital between 2008 and 2013.

## PROCEDURES

Electronic medical records were reviewed to identify dogs with confirmed CHF secondary to myxomatous mitral valve disease and collect information on patient care, survival time, and pcDVM revenue. Data were compared between dogs that received collaborative care from the pcDVM and a BCVC and dogs that received care from the pcDVM alone.

## RESULTS

Dogs that received collaborative care had a longer median survival time (254 days) than did dogs that received care from the pcDVM alone (146 days). A significant positive correlation was identified between pcDVM revenue and survival time for dogs that received collaborative care (ie, the longer the dog survived, the greater the pcDVM revenue generated from caring for that patient).

## CONCLUSIONS AND CLINICAL RELEVANCE

Findings suggested that collaborative care provided to small-breed dogs with CHF by a BCVC and pcDVM could result in survival benefits for affected dogs and increased revenue for pcDVMs, compared with care provided by a pcDVM alone. (*J Am Vet Med Assoc* 2016;249:72–76)

Veterinary medicine has witnessed a societal shift in the perception of companion animal care, with pets now commonly considered valued members of the family.<sup>1–4</sup> As a consequence of this evolving perception, demand is increasing for specialized care, as are expectations for state-of-the-art medicine within the veterinary profession.<sup>5–7</sup> The number of referral hospitals offering 24-hour emergency care is also increasing, and numerous specialty services are now being provided by board-certified specialists, resulting in a multitiered medical system similar to the human health-care model.<sup>8</sup>

## ABBREVIATIONS

pcDVM	Primary care veterinarian
BCVC	Board-certified veterinary cardiologist
CHF	Congestive heart failure
CI	Confidence interval
MMVD	Myxomatous mitral valve disease

The expectation in both veterinary and human medicine is that the focused breadth of study, extensive training, and cumulative clinical experience of veterinary specialists result in improved diagnostic accuracy, optimal treatment plans, and improved patient outcomes relative to those achieved by veterinarians lacking such a background. This expectation or presumption has been identified as one of the factors that influence a primary care physician's decision to refer a patient for specialist care,<sup>9</sup> but little objective evidence exists to support this presumption in veterinary medicine.<sup>10</sup>

Cardiology is a well-established specialty discipline within veterinary medicine. Myxomatous mitral valve disease is the most common condition diagnosed in dogs and treated in this field.<sup>11,12</sup> Long-term management of CHF secondary to MMVD requires a tiered polypharmacy approach, with abundant opportunities for collaboration and follow-up between the

attending veterinary cardiologist and pcDVM.<sup>13,14</sup> Collaboration in patient care between primary care family physicians and cardiologists improves outcomes for humans with CHF, compared with patient care by a primary care physician alone.<sup>15-18</sup> Despite this evidence, the rate of referral across human health care is variable because of the complex and diverse factors influencing a primary care physician's decision to refer a patient for specialized care.<sup>19-23</sup> In veterinary medicine, this concept has only recently been investigated objectively.<sup>9</sup>

Within the veterinary medical profession, the influence of financial considerations of clients and pcDVMs alike can affect the likelihood of patient referral to a specialist for care.<sup>9,23,24</sup> A perception also exists that referral could potentially lead to loss of follow-up information and associated revenue for pcDVMs, particularly when collaborative and referral-based medical ethics are not adhered to.<sup>8,25-27</sup> The purpose of the study reported here was to assess the effects of collaborative care by pcDVMs and BCVCs, both of whom meet with the clients and evaluate patients in person, on survival time of dogs after onset of MMVD-induced CHF, compared with the effects of care by pcDVMs alone. A secondary purpose was to evaluate the effect of referral and collaborative care on revenue of pcDVMs.

## Materials and Methods

### Dogs

The electronic medical and financial records of a multilocation primary care veterinary hospital group (Caring Hands Animal Hospital) for 2008 through 2013 were retrospectively reviewed to identify dogs for inclusion in the study. The 4 veterinary hospitals included in records database at the time of the study were located in the state of Virginia. The veterinary specialty group to which patients from these hospitals were referred for cardiac evaluation was CVCA-Cardiac Care for Pets, with several locations in Virginia near the referring hospitals.

To qualify for inclusion, dogs were required to be > 9 years of age and weigh < 15 kg (33 lb), have a recorded diagnosis of CHF that was retrospectively confirmed by a BCVC (BKL), have no concurrent metabolic disease requiring treatment at the point of inclusion, and have a recorded date of death or euthanasia resulting from cardiac disease, including refractory CHF. Confirmation of CHF required documentation in records of clinical signs of cough or shortness of breath, a systolic murmur graded as  $\geq 4/6$  that was loudest over the mitral valve, and verification of interstitial edema with a vertebral heart score  $\geq 11.0$  on thoracic radiographs or of a left atrium-to-aortic root ratio > 2.0 with severe mitral valve regurgitation and degenerative mitral valve lesions on echocardiographic images. Exclusion criteria included survival for < 7 days after onset of CHF, concurrent clinical lower airway disease (long-standing cough or diagnosis of collapsing trachea or tracheobronchitis), known neo-

plasia at time of CHF diagnosis, or metabolic or endocrine disease requiring concurrent treatment.

### Data collection

For each included dog, data extracted from the medical record included signalment, body weight, thoracic radiographs, medical history, survival time from onset of CHF (confirmed by a BCVC), total pcDVM revenue (US dollars) from onset of congestion to time of death or euthanasia, and reason for euthanasia when performed. Because of the 5-year study period, revenue was normalized to 2013 values by use of the US Bureau of Labor Statistics consumer price index inflation calculator.<sup>a</sup> Dogs were considered to have received collaborative care involving a BCVC if they had been referred to and physically evaluated by a BCVC within 1 month after the CHF diagnosis and that care was continued throughout the remainder of the dog's life, as verified via review of the collaborating BCVC's medical records. Continued collaborative care was defined as  $\geq 1$  in-person recheck evaluation with either the pcDVM or the BCVC and communication between the 2 as well as with the dog owner regarding clinical findings. Dogs were then assigned to collaborative care (pcDVM and BCVC) and primary veterinarian care (pcDVM alone) cohorts accordingly.

### Statistical analysis

Statistical analysis was performed with commercially available statistical software.<sup>b</sup> Differences between the 2 dog groups in age, body weight, sex, and breed at the time of inclusion were examined. For normally distributed data, bivariable comparisons were performed with the 2-sample *t* test. For comparisons involving nonnormally distributed data, a nonparametric test (Wilcoxon rank sum test) was used. The primary outcome was interval from onset of CHF to death (ie, survival time). The secondary outcome was revenue generated for the pcDVM from caring for affected dogs. The primary exposure of interest was type of care (collaborative vs pcDVM alone).

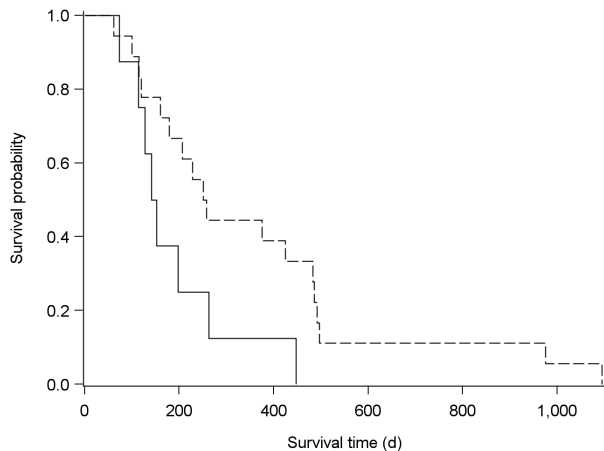
Normal probability plots revealed that survival time and body weight were skewed, whereas revenue and age were normally distributed. Survival time was therefore summarized as median (95% CI), body weight as median (range), revenue and age as mean (SD), and sex and breed as proportions. Bivariable comparisons between types of care were performed with the 2-sample *t* test (age and revenue), Wilcoxon rank sum test (body weight), log-rank test (survival time), and Fisher exact test (sex and breed). The effect of type of care on survival time was also assessed in a multivariable Cox regression model with adjustments for age, body weight, and sex. Correlation between survival time and revenue was assessed by calculation of the Spearman nonparametric correlation coefficient ( $\rho$ ). Values of  $P < 0.05$  were considered significant.

## Results

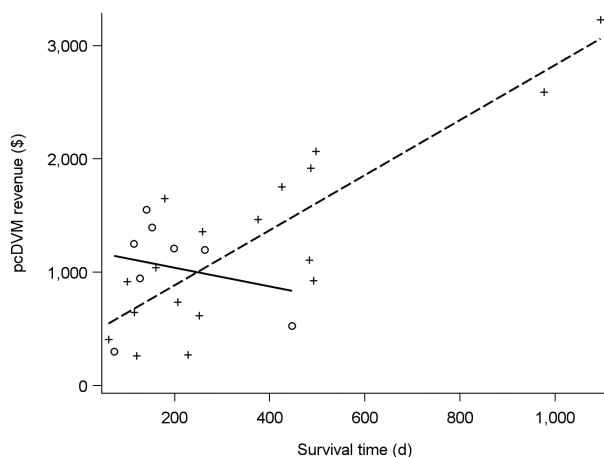
### Dogs

Initial review of pcDVM records revealed 107 small-breed dogs that had a diagnosis code of CHF.

Of those dogs, 18 (10 females and 8 males) met the criteria for inclusion in the group that received collaborative care from a pcDVM and BCVC and 8 (3 females and 5 males) fulfilled the criteria for inclusion in the group that received care from a pcDVM alone. Fourteen breeds of dogs were represented, the most common of which were Chihuahua ( $n = 4$ ), Cocker Spaniel (3), Pomeranian (3), Yorkshire Terrier (3), and mixed (3).



**Figure 1**—Kaplan-Meier plots of the probability of small-breed dogs with CHF surviving over time after confirmed onset of CHF, depending on whether they received collaborative care from the pcDVM and a BCVC (dashed line;  $n = 18$ ) or care from their pcDVM alone (solid line; 8). Dogs that received collaborative care had a significantly ( $P = 0.045$ ) longer median survival time (254 days [95% CI, 160 to 483 days]) than did dogs that received care from a pcDVM alone (146 days [95% CI, 73 to 263 days]).



**Figure 2**—Scatterplot of the effect of survival time of small-breed dogs after confirmed onset of CHF on pcDVM revenue from caring for those dogs, on the basis of whether the dogs received collaborative care from the pcDVM and a BCVC (plus signs;  $n = 18$ ) or care from the pcDVM alone (circles; 8). The dashed line represents the linear regression line of the significant ( $P < 0.001$ ) correlation between revenue and survival time for dogs that received collaborative care ( $\rho = 0.73$ ). The solid line represents the regression line of the nonsignificant ( $P = 0.71$ ) correlation for dogs that received care from the pcDVM alone ( $\rho = -0.17$ ).

## Comparisons between care groups

The 2 care groups did not differ significantly in age or body weight. Mean (SD) age at confirmed onset of CHF for dogs that received collaborative care was 10.7 (1.9) years, compared with 12.0 (3.5) years for dogs that received care from the pcDVM alone ( $P = 0.22$ ). Median body weight at onset of CHF for dogs that received collaborative care was 6.6 kg (14.5 lb; range, 2.8 to 11.8 kg [6.2 to 26.0 lb]), compared with 4.5 kg (9.9 lb; range, 2.6 to 13.1 kg [5.7 to 28.8 kg]) for dogs that received care from the pcDVM alone ( $P = 0.10$ ). Similarly, the groups did not significantly differ in proportions of various breeds or sexes.

Median survival time from confirmed onset of CHF for dogs that received collaborative care was 254 days (95% CI, 160 to 483 days), which was significantly ( $P = 0.045$ ) longer than that for dogs that received care from the pcDVM alone (146 days [95% CI, 73 to 263 days]; **Figure 1**). After adjusting for age, body weight, and sex, dogs that received collaborative care had a significantly ( $P = 0.012$ ) longer survival time than did dogs that received care from the pcDVM alone (hazard ratio, 0.2 [95% CI, 0.1 to 0.7]).

No significant ( $P = 0.45$ ) difference was identified in mean pcDVM revenue from caring for affected dogs between dogs that received collaborative care (\$1,323.98 [\$841.61]) and those that received care from the pcDVM alone (\$1,082.16 [\$432.59]). However, a significant ( $P < 0.001$ ) positive correlation was identified between survival time and revenue for dogs that received collaborative care ( $\rho = 0.73$ ), and this correlation was also significant ( $P < 0.001$ ) when non-adjusted revenue data were used ( $\rho = 0.76$ ). These correlations did not achieve significance ( $P = 0.71$ ) for dogs that received care from the pcDVM alone ( $\rho = -0.17$ ; **Figure 2**).

## Discussion

A struggle for many pcDVMs is deciding when and what type of patients would benefit from referral to a specialist.<sup>21–26,28</sup> The study reported here revealed that for small-breed dogs with CHF caused by MMVD, referral to and in-person evaluations by a BCVC along with ongoing active collaborative care between the pcDVM and BCVC resulted in a longer survival time. **Dogs lived 74% longer when they received collaborative care, compared with the survival time of dogs that received care from the pcDVM only.** These findings paralleled those in human medicine<sup>15–18</sup> and, to the authors' knowledge, represented the first such findings reported in veterinary medicine.

A primary directive of collaborative care is improved quality of life for patients, which has been shown to be one of the most important factors affecting decisions regarding euthanasia for dogs with CHF.<sup>29</sup> Median survival times from onset of CHF in both groups of the present study were comparable to the results of other studies<sup>14,30</sup> of survival times or treatment failure in similar patient populations.

A secondary focus of the present study was to determine the financial impact of collaborative care on pcDVM revenue. Our hypothesis was that the pcDVM would benefit financially from a collaborative approach in caring for dogs with CHF. This was in stark contrast to the concerns raised in 2006 to 2007 during an American Animal Hospital Association forum on veterinarian and veterinary specialist referral issues.<sup>25</sup> That forum and subsequent market research brought to light the perception in the veterinary practice community of competition for patients between pcDVMs and specialists, including the potential that pcDVMs may be concerned with potential loss of income when patients are referred to specialists.<sup>8,25,26</sup>

The study reported here showed that collaborative patient care can provide a positive outcome for both patients and their pcDVM. The longer that dogs survived, the greater the revenue generated for the pcDVMs. That revenue increased by 22% when pcDVMs collaborated with a BCVC, and survival time of the dogs they cared for improved as well. The 22% difference was not significant, likely because of the small number of dogs. However, these benefits to dogs and pcDVMs supported the notion that referral and collaborative medicine are revenue generating for pcDVMs, which is in contrast to previously reported concerns with veterinary specialty medicine.<sup>8,25,26</sup>

The pcDVM practice group used in the present study was chosen because the pcDVMs routinely and appropriately refer patients to veterinary specialists.<sup>31-34</sup> The veterinary cardiology practice group to which the pcDVMs referred patients encourages owners to continue bringing their pets to their pcDVMs for comanaged care. As veterinary medical care evolves to meet the increasing expectations of companion animal owners, guidelines regarding what constitutes optimal care need to be clarified.<sup>3,5,6,9</sup> Developing partnerships between pcDVMs and veterinary specialists who provide collaborative care and evaluating the outcomes of those partnerships will be important as the industry works to define the roles of primary and specialty care providers.<sup>8,22-25</sup>

Although the results reported here supported a positive effect of collaborative care on dogs with CHF, additional studies are warranted to investigate outcomes and financial impacts of early detection and management of heart disease in dogs and cats as well as collaborative care involving other types of veterinary specialists. Additionally, more in-depth evaluation of the differences in treatment regimens and follow-up schedules between the 2 care approaches may also be valuable for identifying best practices.

The retrospective nature of the study reported here represented a primary limitation. Dogs were selected on the basis of strict inclusion and exclusion criteria, but their selection was dependent on the completeness and accuracy of their medical records. Our initial record review identified 107 potential dogs with CHF for inclusion, but only 26 (24%) met the inclusion criteria. Reasons for exclusion of dogs primar-

ily consisted of lack of completeness of pretreatment diagnostic tests, inability to discern presence or absence of concurrent disease, or lack of radiographic documentation of CHF. The resultant small sample size and geographic breadth of included dogs were additional limitations that could affect repeatability of the results. Another important limitation was the lack of an ability to control for variability among dog owners in financial resources and interest in pursuing referral care, both of which could have had an effect on choice of diagnostic tests, treatment provided, and time to euthanasia. Additionally, we were unable to evaluate the consistency of recommendations for referral to BCVCs by pcDVMs because of the limitations inherent in the review of medical records; however, in clinical practice, no means exist to control or account for such variables.

Regardless of the aforementioned limitations, the present study provided evidence that a collaborative approach to companion animal care improved outcomes for patients and their attending pcDVMs. Additional investigation of the impact of a collaborative approach between pcDVMs and veterinary specialists of all disciplines on the clinical outcomes of companion animals as well as the economic consequences of comanaged care to pcDVMs is warranted.

## Footnotes

- a. CPI Inflation Calculator, Bureau of Labor Statistics, US Department of Labor, Washington, DC. Available at: [www.bls.gov/data/inflation\\_calculator.htm](http://www.bls.gov/data/inflation_calculator.htm). Accessed Jan 11, 2015.
- b. SAS/STAT software, version 9.4, SAS Institute Inc, Cary, NC.

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