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Veterinary oncologists and pet owners differ in their perceptions of chemotherapy-related adverse events in cancer-bearing dogs

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OBJECTIVE
Chemotherapy is widely used in veterinary oncology but carries real and perceived risks of adverse events (AEs). Human cancer patients perceive AEs from chemotherapy as more severe than do their attending physicians. It is currently unknown whether this discrepancy exists in veterinary oncology. This survey study's aim was to assess differences in the ways that pet owners and veterinary oncologists perceive chemotherapy-related AEs. We hypothesized that veterinary oncologists would accept higher grade AEs and tolerate a greater risk of AEs of any grade than pet owners.

SAMPLE
152 pet owners and 111 veterinary oncologists.

METHODS
Separate surveys were derived for pet owners and veterinary oncologists. Respondents were asked to define maximally acceptable AE scores and risks of AEs given 3 hypothetical outcomes of treatment: (1) cure, (2) extension of life, and (3) improved quality of life. Statistical tests were used to compare responses between groups.

RESULTS
Veterinary oncologists accepted higher grade AEs if the hypothetical goal of chemotherapy was cancer cure (P = .003) or extension of life (P = .026), but owners accepted higher grade AEs if the goal of chemotherapy was to improve quality of life (P = .002). Owners accepted greater risk of moderate (P < .0001) or serious (P < .0001) AEs across the 3 treatment outcomes.

CLINICAL RELEVANCE
This was the first study to assess how pet owners and veterinary oncologists differ in their perception of chemotherapy-related AEs. These initial results may help to frame discussions with pet owners on the expectations of chemotherapy.

Keywords: oncology, quality of life, side effects, risk tolerance, patient-reported outcomes

Chemotherapy is widely used to treat pet dogs and cats with cancer. It is generally considered to be safe and tolerable for most pets. Anecdotal reports suggest that < 25% of pets experience chemotherapy-related adverse events (AEs) of any grade, with < 5% experiencing serious AEs resulting in hospitalization or death.[1,2] Although few evidence-based estimations of the frequency of chemotherapy-related AEs among cancer-bearing pets exist, a report[3] derived from retrospective medical record review suggested that AEs are experienced far more frequently, with 80% of chemotherapy-treated dogs experiencing at least 1 AE and 32.3% experiencing serious AEs (defined as those resulting in hospitalization, treatment delay, or death). Therefore, proper education of pet owners as to the likelihood and range of severity of AEs before instituting chemotherapy is important for establishing effective veterinarian-client-patient relationships. In particular, it is critical that veterinarians develop an initial understanding of how pet owners would perceive the severity of AEs in order to align their medical decisions with an owner's expectations regarding the tolerability of chemotherapy.

In human medicine, differences in how patients and physicians perceive chemotherapy-related AEs

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have been well characterized. Prior reports indicate that physicians underestimate the incidence and severity of symptoms in cancer patients—including symptoms related to AEs from chemotherapy—as well as how distressing these symptoms may be for the patient.[4,5] This creates a discordance between the patient's clinical experience and the physician's assessment of the patient's health and well-being. Disparities in how human patients and physicians view subjective physical symptoms of illness have been shown to cause rifts in the physician-patient relationship and may contribute to psychological distress and poor adherence to treatment plans.[6–9] These patterns may be accentuated in patients undergoing chemotherapy for cancer, during which the patient's psychological stress may be amplified if they feel that treatment-related AEs are unnoticed or underestimated in the eyes of their physician. It is important for physicians to understand and acknowledge this discordance to provide optimal care for their patients. The standardized criteria used for grading and reporting chemotherapy-related AEs in human medicine, the National Cancer Institute's Common Terminology Criteria for Adverse Events (CTCAE), has been modified to incorporate the patient's experience via the Patient-Reported Outcomes–CTCAE.[5,10,11] This tool is widely used for objectively monitoring AEs as perceived by both patient and physician alike.

In veterinary oncology, where patients cannot self-report AEs related to cancer or its treatment, the burden of perceiving and reporting these events is shouldered by the animal caregiver (ie, pet owner). A somewhat similar situation exists in human oncology among pediatric patients, in which the child's caregiver (ie, parent or guardian) frequently observes and reports treatment-related AEs to the child's physician. As in adult cancer patients, pediatric oncology studies have confirmed a discordance between how the severity of AEs is perceived by the physician and child, whereas the perceptions of children and their caregivers show a greater degree of agreement.[12,13] This emphasizes the importance of the caregiver in observing and reporting AEs in oncology patient populations that may lack the autonomy to self-report, including veterinary patients.

To the authors' knowledge, no studies have assessed how veterinary oncologists and pet owners perceive the acceptability of chemotherapy-related AEs. There may be disparities in what pet owners and veterinary oncologists consider acceptable AEs, as well as in their willingness to accept the risk of AEs when different clinical outcomes are expected. Various studies have found that a key element to how veterinary services are perceived is effective communication.[14–17] If pet owners and veterinary oncologists perceive chemotherapy-related AEs to be of differing severity or seriousness, rifts in the veterinarian-client relationship may form and owner trust may wane as a result of ineffective or incomplete communication regarding an owner's expectations of their pet's quality of life while receiving chemotherapy. The aim of this study, therefore, was to assess whether differences exist between how veterinary oncologists and pet owners perceive the acceptability of chemotherapy-related AEs. An additional aim of our study was to assess whether baseline measures of physical and emotional health, caregiver burden, and emotional attachment to a dog are associated with pet owners' perceptions of chemotherapy-related AEs. The final aim of the study was to assess the willingness of veterinary oncologists and pet owners to accept the risk of AEs of any severity in pets receiving chemotherapy. We hypothesized that (1) veterinary oncologists would accept AEs of a higher grade than pet owners; (2) a decreased tolerance of AEs would be associated with increased measures of poor physical or mental health, increased caregiver burden, and increased emotional attachment to a dog; and (3) veterinary oncologists would be willing to accept a higher overall risk of AEs than pet owners.

Methods

Separate surveys were generated for pet owners and veterinary oncologists. Both surveys were reviewed by the Purdue Institutional Review Board prior to distribution. The Institutional Review Board approved the pet owner survey but considered the veterinary oncologist survey exempt from regulatory oversight, as no questions in the survey were designed to elicit the veterinary oncologists' personal opinions about themselves. Thus, written consent for participation in this study was obtained from all pet owners but not from veterinary oncologists.

Prior to distribution of the final versions of the surveys, draft versions were distributed online to 2 focus groups composed of 42 nonveterinarian pet owners and 25 veterinarians, all of whom worked within our home institution. Responses from these focus groups were collected between September 2021 and December 2021. Respondents within these focus groups were asked to provide feedback on the length, clarity, and ease of use of the surveys. The final versions of both surveys were modified on the basis of feedback from the focus groups.

A finalized online survey was distributed to the owners of dogs presenting to the medical oncology service at the Purdue University Veterinary Hospital between March 2022 and March 2023. To be eligible to take the survey, the owner had to have a dog with a histopathologically or cytologically confirmed diagnosis of cancer, be at least 18 years of age, and provide written informed consent for study participation. The survey was offered to all pet owners presenting their dogs for care during the study period, regardless of whether they were presenting their dogs for ongoing care or initial consultation. Dogs did not need to have a cancer for which chemotherapy was indicated in order for their owners to participate in the survey. The survey was open to owners of dogs currently receiving chemotherapy, owners of dogs that had received chemotherapy in the past, as well as owners of dogs that had never received chemotherapy. Thus, the survey population included pet

owners that both had and had not ultimately elected to treat their dogs with chemotherapy. A separate survey was distributed to board-certified veterinary oncologists using an email listserv, accessible only to veterinary oncologists, between May 2022 and June 2022. The content of both surveys relating to the acceptability of chemotherapy-related AEs and tolerance for risk of AEs was identical, although the language of the pet owner survey was modified to suit a lay audience.

The pet owner survey collected demographic information, including owner age, gender, education, race, household income, and number of people and pets in their household at the time of survey completion. Owners were also asked whether their dog was currently receiving chemotherapy, or whether they had owned a dog that had received chemotherapy in the past. The demographic information collected in the veterinary oncologist survey included age, gender, race, practice setting, geographic location of practice, year that board certification was attained, and number of cancer-bearing dogs treated with chemotherapy weekly. Copies of both surveys are provided for review elsewhere **(Supplementary Materials S1 and S2)**.

Pet owner questionnaire

A 4-item inventory was created, denoted as the Pet Owner's Perception of the Acceptability of Side Effects of Chemotherapy in Dogs with Cancer survey, to assess tolerance for chemotherapy-related AEs of varying severity. The language of this inventory was based on the Veterinary Cooperative Oncology Group–CTCAE (VCOG-CTCAE) following chemotherapy or biological antineoplastic therapy in dogs and cats version 1.1.[18] This inventory has not been previously validated. In each item related to acceptability of chemotherapy-related AEs, owners were asked to denote the highest grade of AE for vomiting, diarrhea, loss of appetite, and fatigue they would be willing to tolerate in their dog if it was undergoing chemotherapy to treat cancer. These AEs were specifically chosen because of the relatively high frequency at which they occur (compared to other AEs), the ease with which owners can observe them, and our perception that these are the AEs that cause the greatest concern among owners of pets undergoing chemotherapy. The AE grades were based on the VCOG-CTCAE, with grade 1 to 4 AEs offered as possible answer selections and explained in terms understandable to a lay audience. Grade 5 AEs (ie, death) were not offered as an answer selection, as it was assumed this AE would not be acceptable to any pet owner. These questions were repeated in 3 hypothetical scenarios: (1) assuming that the dog's therapy would cure its cancer, (2) assuming that therapy would prolong life but not cure cancer, and (3) assuming that therapy would improve quality of life but neither prolong life nor cure cancer.

In addition to the 4-item inventory described above, several previously described scales were used to measure various aspects of the pet owners' physical and mental health, as well as tolerance for risk of chemotherapy-associated AEs. The abbreviated Zarit Burden Interview (ZBI) was used to assess caregiver burden.[19] The original ZBI[20] includes a 22-item inventory in which the caregiver subjectively rates negative experiences related to caring for a family member on a 5-point scale from "never" (0) to "nearly always" (4). A summed score of 20 on the original ZBI is indicative of clinically meaningful caregiver burden. This inventory was altered for use in pet owners as described by Spitznagel et al[21] in 2017 and validated as an 18-item inventory. The current survey questionnaire used a further abbreviated 7-item inventory, which was validated by Spitznagel et al[19] in 2019.

The SF-12 Health Survey[22] was used to assess the impact of pet owners' health on their everyday lives. It is a 12-item inventory assessing how several domains of physical and mental health affect the respondent's ability to carry out the activities of daily living. The test generates separate summary scores for physical (PCS-12) and mental (MCS-12) components of health. These scores are reported as a difference from the US population average in terms of number of SDs above or below the average for either component of health. For the US population, the average (mean) score is 50 for both the PCS-12 and MCS-12 and the SD is 10.

The Monash Dog Owner Relationship Scale (MDORS)[23] was used to assess the quality of the owner's perceived relationship with their dog. The MDORS is a 28-item inventory evaluating 3 specific domains of the dog-owner relationship: emotional closeness, dog-owner interaction, and perceived costs of dog ownership. For each question, the respondent provides an answer of 1 through 5, with higher values indicating a more positive relationship between the owner and the dog.

A modified version of a risk tolerance questionnaire was used to assess the level of risk of AEs that owners were willing to accept when pursuing chemotherapy for their dog.[24] This 11-item inventory was initially used to assess risk tolerance among physicians in family practice. Our study utilized a 5-item inventory that assessed the respondent's tolerance for risk of mild, moderate, serious, or permanent (including death) AEs as possible outcomes of chemotherapy. Respondents were asked to rank the level of risk they were willing to assume in a 5-item inventory, ranging from a < 1 in 100 chance of a given AE to at least a 1 in 2 chance of the AE. The level of risk the respondents were willing to take was also assessed in the 3 hypothetical treatment outcome scenarios: cure, extension of life, or improved quality of life. This modified risk tolerance questionnaire has not been previously validated.

Veterinarian questionnaire

The same 4-item inventory administered to pet owners was adapted for administration to veterinary oncologists and denoted as the Veterinary Oncologist's Perception of the Acceptability of Side Effects of Chemotherapy in Dogs with Cancer survey. While the content of the 2 inventories was essentially identical,

the language of the survey administered to veterinary oncologists was modified to directly reflect that of the VCOG-CTCAE version 1.1, including a description of AE grades. As with the inventory administered to pet owners, respondents were asked to denote the highest grade (range, 1 to 4) of vomiting, diarrhea, loss of appetite, and fatigue they would find acceptable in a dog they were treating as a patient. These questions were repeated in light of 3 different hypothetical scenarios: assuming that the dog's therapy would cure its cancer; assuming that therapy would prolong life, but not cure cancer; and assuming that the therapy would improve quality of life but neither prolong life nor cure cancer. As with the owner version of this inventory, this portion of the questionnaire has not been previously validated.

The same general approach used to develop the 5-item inventory to assess risk tolerance among pet owners was adapted for use among veterinary oncologists. Again, the content of the 2 surveys was essentially the same, although the precise language of the questions in the survey distributed to veterinary oncologists was modified to reflect the oncologists' expected familiarity with the VCOG-CTCAE version 1.1.

Statistical analysis

t Tests were used to compare responses between the 2 groups to determine whether there were significant differences between pet owners and veterinary oncologists with respect to their tolerance of chemotherapy-associated AEs and risk of AEs. ANCOVA analysis was also performed for the potential covariates of gender and age, but neither covariate was associated with any dependent variables in the analyses. A correlation analysis was performed to identify potentially significant relationships between SF-12, MDORS, and ZBI scores and pet owner scores for AE acceptability and tolerance for risk of AEs. Cronbach α was used to measure the internal consistency of responses in both surveys. A P value ≤ .05 was considered a significant difference for all tests.

Results

The survey was distributed to 464 pet owners; 152 completed it, yielding a response rate of 32.8%. At the time the survey was distributed online to veterinary oncologists, the American College of Veterinary Internal Medicine acknowledged a total of 488 active board-certified oncologists; 111 completed the survey, yielding a response rate of 22.7%. In both groups of respondents, females outnumbered males **(Tables 1 and 2)**, although the proportion of female respondents was significantly greater among veterinary oncologists (84% vs 61%; $P < .0001$). The mean age of pet owners was significantly greater than that of veterinary oncologists (49.7 vs 44.2 years; $P = .003$), while the mean number of years of education of veterinary oncologists was significantly greater than that of pet owners (20.0 vs 15.3; $P < .0001$). Among pet owners, 80 acknowledged that their dog was currently receiving chemotherapy or that they had owned another dog that had received chemotherapy in the past, whereas 46 respondents denied previous experience with a dog that had received chemotherapy (26 declined to respond to this question). Other demographic data for the 2 populations of respondents are presented (Tables 1 and 2). The survey measures of AE acceptability and risk tolerance showed good-to-excellent internal consistency (Cronbach α, 0.88 to 0.99) across both populations.

Responses for acceptance of AE grades for vomiting, diarrhea, loss of appetite, and fatigue were

Table 1—Demographic characteristics of 152 pet owners completing the survey.

Age (mean ± SD)	49.7 ± 14.3
Sex (% of sample)	
Male	35 (23.0%)
Female	93 (61.2%)
Nonbinary	1 (0.7%)
Prefer not to answer	23 (15.1%)
Race/ethnicity (% of sample)	
White/Caucasian	117 (78.3%)
Asian American	3 (2.0%)
Hispanic, Latino (a/x), or Spanish origin	2 (1.3%)
Prefer not to answer	28 (18.4%)
Education (% of sample)	
High school/GED	13 (8.6%)
Trade/technical school	5 (3.3%)
Some college	17 (11.2%)
College graduate	48 (31.6%)
Some graduate school	9 (5.9%)
Graduate/professional	35 (23.0%)
Prefer not to answer	25 (16.4%)
Annual household income (% of sample)	
< $25,000	3 (2.0%)
$25,000–$49,999	8 (5.3%)
$50,000–$74,999	15 (9.9%)
$75,000–$150,000	41 (27%)
> $150,000	38 (25.0%)
Prefer not to answer	47 (30.9%)
Adults in household (% of sample)	
1	21 (13.8%)
2	89 (58.6%)
3	9 (5.9%)
4	3 (2.0%)
Prefer not to answer	30 (19.7%)
Children in household (% of sample)	
0	84 (55.3%)
1	24 (15.8%)
2	9 (5.9%)
3	2 (1.3%)
Prefer not to answer	33 (21.7%)
Animals in household (% of sample)	
1	36 (23.7%)
2	50 (32.9%)
3	23 (15.1%)
4	10 (6.6%)
5	3 (2.0%)
6	1 (0.7%)
7	3 (2.0%)
Prefer not to answer	26 (17.1%)
Treated previous or current dog with chemotherapy? (% of sample)	
Yes	80 (52.6%)
No	46 (30.3%)
Prefer not to answer	26 (17.1%)

Table 2—Demographic characteristics of 111 board-certified veterinary oncologists completing the survey.

Age (mean ± SD)	44.2 ± 9.2
Sex (% of sample)	
Male	18 (16.2%)
Female	69 (62.2%)
Nonbinary	0 (0.0%)
Prefer not to answer	24 (21.6%)
Race/ethnicity (% of sample)	
White/Caucasian	79 (71.2%)
Hispanic, Latino (a/x), or Spanish origin	5 (4.5%)
Asian American	3 (2.7%)
Prefer not to answer	24 (21.6%)
Practice setting (% of sample)	
Private practice	62 (55.9%)
Academia	24 (21.6%)
Industry	1 (0.9%)
Retired	1 (0.9%)
Prefer not to answer	23 (20.7%)
Geographic region of practice (% of sample)	
United States	78 (70.3%)
Canada	4 (3.6%)
Europe	3 (2.7%)
Australia/New Zealand	2 (1.8%)
Asia	1 (0.9%)
Multiple regions	1 (0.9%)
Prefer not to answer	22 (19.8%)
Year board certification attained (% of total)	
Prior to 1990	1 (0.9%)
1990–1999	9 (8.1%)
2000–2009	19 (17.1%)
2010–2019	44 (39.6%)
2020 or later	11 (9.9%)
Prefer not to answer	27 (24.3%)
No. of dogs treated with chemotherapy each week (% of sample)	
0–15	13 (11.7%)
16–30	36 (32.4%)
31–45	23 (20.7%)
> 45	16 (14.4%)
Prefer not to answer	23 (20.7%)

pooled for initial statistical analysis. In this analysis, when chemotherapy was expected to cure a dog's cancer or extend life, veterinary oncologists were willing to accept higher grade AEs than pet owners (P = .003 and .026, respectively). However, when chemotherapy was expected only to improve quality of life, pet owners were willing to accept higher grade AEs than veterinary oncologists (P = .002; **Table 3**).

When evaluating the acceptability of specific AEs, pet owners accepted higher grade fatigue and inappetence than veterinarians when chemotherapy was expected to improve quality of life (P < .0001). Veterinary oncologists accepted higher grade vomiting and diarrhea than pet owners when chemotherapy was expected to cure the pet (P < .0001) or extend life (P < .0001; **Table 4**). The greatest acceptable grades of all other specific AEs did not differ significantly between the 2 groups of respondents.

When evaluating risk tolerance for AEs of a given grade across all 3 treatment outcomes (cure, extension of life, improvement of quality of life), there was a general trend among both veterinary oncologists and pet owners to accept a lower risk of AEs as their severity increased **(Table 5)**. The mean risk acceptance scores for mild AEs were 4.06 for pet owners and 4.26 for veterinary oncologists, each corresponding to an acceptance of at least a 1 in 4 chance of the AE. As shown (Table 5), the risk acceptance scores become progressively smaller among both groups with each incremental increase in AE severity. In the case of permanent AEs (including death) from chemotherapy, the mean risk acceptance scores were 2.15 for pet owners and 2.27 for veterinary oncologists, each corresponding to an acceptance of an approximately 1 in 100 chance of the AE. Pet owners were willing to accept significantly greater risk of moderate (P < .0001) or serious (P < .0001) AEs across the 3 treatment outcomes. The tolerance for risk of mild or permanent AEs did not differ significantly between the 2 groups of respondents.

Descriptive statistics regarding the ZBI and MDORS scores are reported **(Table 6)**. During data analysis, we discovered that a question from the SF-12 had been inadvertently omitted from the survey. Thus, SF-12 results were excluded from the analysis of covariates for AE acceptability or risk tolerance. A significant correlation was found between pet owners' tolerance for the risk of mild AEs and the MDORS score related to perceived costs of pet ownership (P = .009). All other correlations with ZBI and MDORS scores were nonsignificant. There were also no significant differences when accounting for the pet owner's gender, age, racial identity, household income, or level of education.

Table 3—Acceptability of chemotherapy-related adverse events (AEs) of any type among owners of cancer-bearing dogs and veterinary oncologists. Both groups were asked to select the maximum AE grades (range, 1 to 4) they would be willing to accept in 3 hypothetical scenarios: if chemotherapy was expected to cure the dog's cancer, extend life, or improve quality of life. Grade 1 AEs are most mild (1) and grade 4 AEs are most severe (4).

	Pet owners			Veterinary oncologists				
Scenario	**N**	**M**	**SD**	**N**	**M**	**SD**	**T**	***P* value**
Cure	137	2.91	0.97	93	3.24	0.62	–2.94	.003
Extend life	138	2.63	0.82	93	2.84	0.5	–2.24	.026
Improve QOL	136	2.31	0.74	93	2.03	0.48	3.15	.002

M = Mean AE grade. N = Number of participants. QOL = Quality of life. T = T-statistic.

Table 4—Acceptability of chemotherapy-related fatigue, vomiting, diarrhea, and inappetence among owners of cancer-bearing dogs and veterinary oncologists. Both groups were asked to select the maximum AE grades (range, 1 to 4) they would be willing to accept in 3 hypothetical scenarios: if chemotherapy was expected to cure the dog's cancer, extend life, or improve quality of life. AEs evaluated were fatigue, vomiting, diarrhea, and loss of appetite. Significant results were found only for fatigue and vomiting, which are reported here. Grade 1 AEs are most mild, and grade 4 AEs are most severe.

Scenario	Pet owners			Veterinary oncologists				
Fatigue	N	M	SD	N	M	SD	T	*P* value
Cure	137	3.01	0.97	93	3.04	0.62	−0.25	.800
Extend life	138	2.81	0.87	92	2.77	0.56	0.38	.297
Improve QOL	135	2.45	0.83	93	1.92	0.52	5.46	.000
Vomiting								
Cure	136	2.82	1.03	91	3.42	0.73	−4.75	.000
Extend life	136	2.49	0.91	91	3.03	0.62	−5.01	.000
Improve QOL	134	2.17	0.81	91	2.07	0.68	1.02	.301
Diarrhea								
Cure	136	2.93	0.99	91	3.47	0.64	4.56	.000
Extend life	137	2.65	0.89	91	3.09	0.53	−4.23	.000
Improve QOL	135	2.32	0.78	91	2.47	0.60	−1.59	.112
Inappetence								
Cure	136	2.98	0.99	91	3.03	0.90	−0.76	.444
Extend life	137	2.65	0.89	91	2.51	0.72	1.29	.200
Improve QOL	135	2.32	0.78	91	1.67	0.68	6.44	.000

See Table 3 for key.

Table 5—Tolerance for risk of chemotherapy-related AEs by grade among owners of cancer-bearing dogs and veterinary oncologists. Level of risk ranged from a < 1 in 100 chance of the adverse event (risk acceptance score 1) to at least a 1 in 2 chance (risk acceptance score 5) of the AE if mild, moderate, serious, or permanent (including death) AEs were expected.

	Pet owners			Veterinary oncologists				
AE level	**N**	**M**	**SD**	**N**	**M**	**SD**	**T**	***P* value**
Mild	133	4.06	0.98	88	4.26	0.66	−1.63	.104
Moderate	130	3.72	1.08	88	2.82	0.68	6.94	.000
Serious	129	3.11	1.18	88	2.46	0.88	4.36	.000
Permanent	127	2.15	1.12	88	2.27	0.33	−0.95	.342

See Table 3 for key.

Table 6—Descriptive statistics of the SF-12 Health Survey, abbreviated Zarit Burden Inventory (ZBI), and Monash Dog Owner Relationship Scale (MDORS) survey results among owners of cancer-bearing dogs.

	Median	Range	IQR	Mean	SD
ZBI	12	7–25	5.75	12.98	3.98
MDORS Part 1 (dog-owner interaction)	36	15–46	5	35.46	4.57
MDORS Part 2 (emotional closeness)	43	17–50	10	41.48	7.00
MDORS Part 3 (perceived costs)	14	9–34	6	15.57	4.91

Discussion

The results of this survey suggest that veterinary oncologists will accept higher grade AEs overall than pet owners when cure or extension of life is an expected outcome of cancer chemotherapy. This aligns with our hypothesis and may be consistent with the observation in human medicine that oncologists frequently consider treatment-related AEs to be less severe than do the patients experiencing them.[4,5,12,13] However, these results may also derive from the understanding among veterinary oncologists that cancer cure or extension of life are best achieved by delivering a chemotherapy drug at its maximum tolerated dose and schedule (ie, dose intensity).[25,26] Increased severity of AEs is an expected consequence of increased dose intensity, a consequence that veterinary oncologists generally understand and accept. Pet owners are less likely to possess this nuanced understanding of the relationship between chemotherapy dose and probability of cure. These results therefore reinforce the need to discuss the probability and severity of chemotherapy-related AEs in the context of the expected benefit to be derived from treatment. Prescribing therapy with a primary focus on survival may conflict with the tolerance of pet owners for AEs if they have an incomplete understanding of the cost-benefit tradeoffs involved.

Interestingly, pet owners accepted higher grade AEs than veterinary oncologists when improved quality of life was the expected outcome of therapy (Table 3). This was an unexpected finding inconsistent with our hypothesis. It may have resulted from

a discrepancy in how the pet owners and veterinary oncologists completing this survey viewed and defined "quality of life." Since higher grade AEs would logically be assumed to impart poorer quality of life, it is possible that some pet owners may have viewed these AEs as transient, outweighed by a more lasting goal of overall improved quality of life when AEs were not clinically apparent. Pet owners lacking background knowledge in clinical oncology may not understand that, in many settings, chemotherapy does not meaningfully prolong or improve quality of life. This lack of understanding is well documented among human cancer patients.[27] It should be noted that the absolute magnitude of the difference in the mean AE acceptability scores between pet owners (2.31) and veterinary oncologists (2.03) in this clinical scenario was not substantial; both scores translate to a VCOG-CTCAE grade between 1 and 2. It is possible that the difference in these scores, though statistically significant, does not imply a clinically meaningful difference in the degree of AEs veterinary oncologists and pet owners would find acceptable in a setting akin to palliative or hospice-style care. Nevertheless, this finding should emphasize the need for veterinary oncologists to understand a pet owner's goal when initiating chemotherapy and clearly communicate the extent to which that goal is attainable.

With respect to risk tolerance, we found that pet owners accepted a greater risk of moderate and serious AEs, when averaged across all treatment outcomes, than veterinary oncologists. This finding was also unexpected and ran contrary to our hypothesis. It was particularly surprising, given that pet owners indicated an overall lower tolerance than veterinary oncologists for higher grade AEs from chemotherapy, except in the setting of expected improvement in quality of life. These results may indicate that the owners of cancer-bearing dogs, if clearly informed of the expected benefits of therapy, may be willing to take on a greater risk of moderate or severe AEs than many veterinary oncologists would expect. Findings consistent with this stance were reported recently in a survey study of human patients with stage III and IV melanoma, which found that patients were willing to accept significantly higher levels of risk of pyrexia from therapy if the benefit of therapy was known as opposed to unknown.[28]

The discordance observed in perceptions of chemotherapy-related AEs among the 2 groups of survey respondents points to a need to adopt principles of shared decision-making (SDM) when discussing cancer treatment options with owners. Shared decision-making is a philosophical approach to guiding patients through health-care decisions that emphasizes joint involvement of the patient and physician in making medical choices that best reflect the patient's goals, preferences, and personal values.[29] Human cancer patients who participate in SDM with their physicians report a higher degree of satisfaction with their care and have a more positive perception of patient-physician communication. Greater self-determination of care can be particularly important in the context of serious, life-threatening illnesses or end-of-life scenarios, in which it has been shown that patients' desires and doctors' decisions regarding patient care are often at odds with one another, with physicians frequently making decisions for aggressive treatment that they would not choose for themselves in the same situations.[30] Although few formal analyses of the impact of SDM in veterinary medicine have been published, a recent report[31] showed that a majority (64.9%) of pet owners in a general practice setting preferred the SDM approach during veterinary consultations. This same report also showed a significant correlation between consultation satisfaction and results of a modified version of the SDM-Q-9 questionnaire, which quantifies the patient's perspective of the SDM process. The survey used in the current study was unable to identify associations between perceptions of chemotherapy-related AEs and owner-reported measures of caregiver burden (ZBI), physical and mental health of the pet owners (SF-12), and quality of their relationship with their dog (MDORS). However, the survey was constructed around hypothetical scenarios and not designed to elicit information on the attitudes and values owners have when making real-life medical decisions for their individual dogs. Given the results of the current study, further investigation of how the medical consultation process affects dog owners' decisions to pursue chemotherapy appears warranted.

There were limitations to the current study. First, the survey questionnaire had not been previously validated, although the internal consistency of responses among both groups of respondents was strong. Respondent attrition was noted, as some participants did not fully complete the questionnaire. Missing values (approx 13% of all data points) were replaced with the mean of the scale items for statistical analyses. The pet owner questionnaire was completed at a tertiary referral hospital, and thus the survey results were likely impacted by referral bias. At the time of the survey, median household income in the state of Indiana was $61,944 and 27.8% of Indiana residents over the age of 25 reported having attained a bachelor's degree or higher level of education.[32] In contrast, 52% of respondents to the current survey acknowledged a household income ≥ $75,000 and 60.5% had attained a bachelor's degree or higher level of education (Table 1). Thus, the socioeconomic status and education level of the survey respondents differed substantially from that of residents of the state of Indiana at large, so the degree to which these results are generalizable to other populations of pet owners is uncertain. Finally, the survey elicited responses based on hypothetical situations rather than real-life circumstances. Although over half of the survey respondents acknowledged that their dog was currently receiving chemotherapy or that they had cared for a dog that received chemotherapy in the past, the survey did not collect information on the nature and grade of the AEs experienced by these dogs. The results of this survey may have been different if the survey respondents had been questioned in the context of an individual pet/patient that was experiencing AEs from chemotherapy.

Some future directions to consider include administering this survey separately to other populations of pet owners, particularly those where cultural

values or attitudes toward specialized veterinary care and animal welfare may differ from those of the current survey respondents. In these future separate studies, we may be able to assess whether the differences in perceptions of chemotherapy-related AEs noted in the present study are generalizable to the US dog-owning population at large, or whether these perceptions vary among different subpopulations of pet owners. Allowing this survey to be administered to families that are seen at primary care facilities may allow for a broader population to be represented, including individuals of varying socioeconomic and educational backgrounds. This survey may also be applied and modified to other areas of veterinary practice; this may help assess whether there are potential differences in AE acceptance related to therapies for conditions other than cancer. This could help assess further factors that may lead to cognitive dissonance in pet owners, which might be a contributing factor to caregiver burden, stress, and noncompliance.

In summary, this study was the first to assess potential differences in how chemotherapy-related AEs are perceived by pet owners and veterinary oncologists. Veterinary oncologists accepted higher grade AEs than pet owners when cure or extension of life was expected from therapy. Pet owners accepted higher grade AEs than veterinary oncologists when improved quality of life was expected. Pet owners accepted greater risk of moderate to serious AEs across a full range of possible outcomes from chemotherapy. These results can help shape client conversations regarding goals and expectations of chemotherapy and may help form a foundation for further research in effective communication with owners of cancer-bearing dogs.

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Supplementary Materials

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