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Flea and tick treatment satisfaction, preference, and adherence reported by cat owners in the US, UK, or France who treated their cats with transdermal fluralaner

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Abstract

Background: Fluralaner (Bravecto®) is an isoxazoline class compound that is the only topically applied systemic ectoparasiticide approved for dosing at up to 12-week intervals for flea and tick control in cats.

Aim: To describe veterinarian recommendations for ectoparasiticide medications used in the UK and France along with veterinary recommendations previously reported from the US, as well as to assess cat owners' experience with a commercial transdermal spot-on fluralaner formulation administered to cats in the US and similarly describe the experiences of cat owners from the UK or France who administered fluralaner for feline flea and tick prevention.

Methods: Clients of participating veterinary practices in the US, UK, or France who were visiting the clinic for a routine wellness visit, were currently treating their cat with fluralaner (Bravecto®), and had purchased at least two doses were asked to complete a short two-page survey about their experience with flea and tick medications including fluralaner and other products they may have been administered.

Results: Owners in the US (451 cats), UK (512 cats), and France (520 cats) completed surveys. Most cat owners (66%–75%) had previously administered other flea and tick products. More than 94% of cat owners surveyed in each country were satisfied or very satisfied with fluralaner. The most frequently reported benefit of using fluralaner was the 12-week dosing interval, selected by 76% of respondents in the US, 82% in the UK, and 70% in France. 79%–88% of cat owners (depending on the country) thought that dosing with extended duration fluralaner was more convenient than dosing with monthly flea and tick products and 86%–89% of cat owners that had used other flea and tick products preferred fluralaner over the other flea and tick products.

Conclusion: Veterinarians in the US, UK, and France recommended 12 months of flea protection and 9–11 months of tick protection per year, even though, in this study, cat owners usually purchased 1–3 months of protection per year. A longer flea and tick dosing interval, as seen with fluralaner, correlates with higher user satisfaction and preference among cat owners. Owners identified the 12-week dosing interval and single dose efficacy as the top reasons for selecting the fluralaner product for their cat. In all three countries, most cat owners indicated that they were more likely to deliver doses of extended duration fluralaner on time, compared to flea and tick products dosed monthly.

Keywords: Cats, Ectoparasites, Fleas, Fluralaner, Ticks.

Introduction

Fleas are the most common and clinically important ectoparasites of cats worldwide (Rust and Dryden, 1997; Rust, 2005; Dryden *et al.*, 2013a). In North America and Europe, flea and tick control for cats is standard practice because of the health risks presented by these common and widespread ectoparasites. Investigators report an increase in flea-borne infections and their public health burden worldwide (Gage *et al.*, 2008; Bitam *et al.*, 2010), and believe that the incidence of flea- and tick-borne diseases is much greater than that generally assumed by the healthcare community (Bitam *et al.*, 2010). Cats in general have a high prevalence of ectoparasite infestation. A survey on flea infestation in

the UK found a 28.1% prevalence of flea infestation in cats ($n = 812$), significantly higher than the 14.4% prevalence in dogs (Abdullah *et al.*, 2019). In other European studies, domestic cats presented at veterinary clinics had considerably higher rates of flea infestation, exceeding 70% in some populations (Beugnet and Franc, 2010). Cats also harbor ticks, although less prevalent than flea infestations (Beugnet *et al.*, 2014), demonstrating the potential for transmission of vector-borne diseases to humans and other animals.

Flea-associated diseases account for approximately half of dermatologic cases presented to companion animal veterinarians (Rust and Dryden, 1997; Beugnet and Franc, 2010). Flea bites cause an allergic dermatitis,

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widely considered to be the single most common dermatologic condition affecting dogs and cats (Rust and Dryden, 1997; Dryden *et al.*, 2018), and are vectors for the *Dipylidium caninum* cestode and filarial endoparasites as well as protozoa and bacteria (Beugnet *et al.*, 2014) including toxoplasmosis, *Bartonella*, *Ehrlichia*, *Rickettsia*, and *Mycoplasma* (Lappin, 2018; Abdullah *et al.*, 2019). In one US study, as many as 80% of feral cats from various locations carried serological evidence for various zoonotic diseases, suggesting that cats could be an occupational health risk for veterinarians exposed to feline populations with heavy *Ctenocephalides felis* infestations (Lappin and Hawley, 2009). In the US, the Companion Animal Parasite Council (CAPC) recommends year-round treatment of dogs and cats for fleas and ticks (CAPC, 2017). Similarly, the European Scientific Counsel on Companion Animal Parasites (ESCCAP) advises that flea prevention may be necessary year-round, with tick prophylaxis used during the seasons in which ticks are active (ESCCAP, 2018).

Introduction in the 1990s of topical and oral veterinary ectoparasiticides given at monthly intervals led to progress toward flea and tick control with a single treatment administration, and greatly improved user convenience and potential for adherence to CAPC and ESCCAP recommendations (Dryden and Broce, 2002; Dryden *et al.*, 2013a, 2013b). Starting in 2014, the isoxazoline class of ectoparasiticide compounds became available in topical and oral formulations for canine and feline use (Dryden *et al.*, 2015; Kilp *et al.*, 2016). Fluralaner (Bravecto®, Merck Animal Health, Madison, NJ) is an isoxazoline that is the only topically administered and transdermally absorbed ectoparasiticide of any class approved for dosing at up to 12-week intervals for flea and tick control in cats (Williams *et al.*, 2014; Kilp *et al.*, 2016; Meadows *et al.*, 2017).

The objectives of this study were as follows:

1. To determine veterinarian recommendations for ectoparasiticide medications used in the UK and France and compare this with veterinary recommendations previously reported from the US (Lavan, *et al.*, 2021).
2. To describe cat owners' experience with a commercial transdermal spot-on fluralaner formulation administered to cats in the UK and France and along with the US cat owner surveys, describe the experiences of cat owners who administered fluralaner for feline flea and tick prevention. In order to have the minimum experience with topical fluralaner, owners were required to have purchased at least two doses prior to survey completion.
3. Surveys administered to owner in the three countries were very similar in structure, although some local demographic questions were modified for each country. The consistency of the survey responses were evaluated across the three countries

and used to understand cat owners' attitudes about using an extended duration option for flea and tick protection.

Materials and Methods

Survey population

Participating veterinary practices in three countries were enrolled in successive years: France in 2018, the UK in 2019, and the US in 2019–2020. These studies needed to be run in subsequent years because of the time it takes to set up study funding, hire support vendors, establish in-country logistics, run the study, and analyze the data. Companion animal practices in each country were identified by the professional services teams that prescribed fluralaner, were willing to take part in the survey, were large enough to recruit ≥ 20 clients per practice, and had someone who would accept the responsibility to be the in-clinic point person. The survey in France included 34 veterinarians from 28 practices and 510 cat owners in all administrative regions of the country. The UK survey included 46 veterinarians from 30 practices and 512 cat owners representing all geographic regions of the country. The US survey included 25 veterinarians from 26 practices and 451 cat owners in all geographic regions of the country. A goal was to get at least one veterinarian-completed questionnaire from each participating practice from each country. The veterinarian who was surveyed was either the managing veterinarian or the practice owner/co-owner. It is not known if, in clinics with more than one veterinarian, all veterinarians share the same opinion toward flea and tick protection for cats.

Each practice was asked to obtain completed surveys from 20 to 25 active, cat-owning clients who were currently administering topical fluralaner (Bravecto®) to their cats for flea and tick control, and who had purchased two or more doses of fluralaner from the practice. Attending veterinarians selected participating clients when they came in for a visit during the survey period. Only clients routinely taking their cat to the veterinary clinic for non-acute care visits, such as wellness exams or vaccinations, were enrolled. Clients who had previously used flea and tick products other than fluralaner could participate in the study and were used to create a subgroup that could compare experience with fluralaner and the other monthly flea and tick products.

Survey instruments

Participating veterinarians completed a brief questionnaire that asked their gender, years in practice, and recommendations for flea and tick control, including the number of months of treatment coverage recommended per year (Table 1). Cat owners were asked to complete a three-part survey: personal demographic information (Table 2), demographic information for their cat (Table 3), and questions on their use of and perspective on fluralaner and other flea and tick products, if applicable (Table 4). The survey

Table 1. Clinical practice experience of surveyed veterinarians in the US, UK, and France and their flea and tick control recommendations for feline patients.

Demographic parameter	Participating veterinarians and country of origin		
	US (n = 25)	UK (n = 46)	France (n = 34)
Years in practice (Mean)	16.8	15.0	18.9
% male/female	48/52	35/65	65/35
Flea control recommended months of coverage (Mean)	11.7	11.8	11.3
Tick control recommended months of coverage (Mean)	10.8	9.8	8.9
% recommending year-round flea coverage	90% (26/29) ^a	96% (44/46)	74% (25/34)
% recommending year-round tick coverage	79% (23/29) ^a	51% (23/45)	35% (12/34)

(^a) = 25 US veterinarians provided their gender and years in practice. Four additional veterinarians provided their annual flea and tick protection recommendation but not gender or years in practice information.

on fluralaner usage experience included 10 questions for owners in France or 11 questions for owners in the US or UK. These questions focused on satisfaction with, preference for, and adherence to treatment recommendations for fluralaner as a feline flea and tick control medication. The fluralaner tradename (Bravecto[®]) was used in survey questions because cat owners are more likely to be familiar with a commercial brand name rather than the active ingredient name. The cat owners' survey questions had minor variations among the three countries (Table 4) but all were tailored toward cat owners. Questions in France were in French, while the other two surveys were in English. The survey was a hardcopy document printed on both sides of a single sheet that could be completed in 5–10 minutes. Clients were asked to complete the survey on-site, with a veterinary practice staff member available to answer any procedural questions and encourage completion of all questions. Survey responses were compiled by different opinion-research companies in each country.

Ethical approval

Ethical approval was not required for this study because no live animals were used in the research. All participating cat owners signed a consent form agreeing to complete the survey without compensation.

Results

Attending veterinarian demographics

A demographic profile of participating veterinarians in each of the three countries of origin (Table 1) showed that the mean years of clinical experience in practice ranged from an average of 15.0 in the UK to 18.9 in France. In the US and UK, most participating veterinarians were female, while 65% of participating French veterinarians were male.

A majority of participating veterinarians in each country recommended year-round control for fleas, with an average recommended duration of protection more than 11 months per year. Fewer veterinarians in each country recommended year-round tick control and the average

duration of recommended treatment coverage for ticks was close to 9 months per year. A greater percentage of veterinarians in each country recommended year-round protection for fleas than for ticks in their feline patients, and this recommendation was not affected by gender or years in practice. Year-round control of ticks in cats was recommended by most veterinarians in the US and UK, and by a third of veterinarians in France.

Cat owners' demographics

More than 75% of surveyed cat owners in each country were female (Table 2). Approximately two-thirds of cat owners in the three countries were between 20 and 55 years of age, while at least 23% were older than 55 years. In the US and UK, participating owners averaged nearly 7 years as the primary care giver for their cats. This question was not asked in France.

At least half of the cat owners in each country had previously observed fleas on their cats, and 18% or more had previously observed fleas in their house, while smaller percentages observed fleas in the bed or on a family member. In the US and UK, at least 40% of participating owners had never observed fleas on their cats, the home environment, or on a family member. In France, around 34% of responding cat owners had never seen fleas in these locations. A smaller percentage of owners in the US and UK had observed ticks on their cats (18%–22%) or in environmental settings (<1%–6%). A greater percentage of owners in France (38%) had previously observed ticks on their cats compared with US and UK survey respondents.

Most cat owners in each country, 66% in the US and more than 70% in the UK and France, had used feline flea and tick products other than fluralaner.

Feline patient demographics

The feline patient population was evenly divided between male and female cats in the three countries surveyed (Table 3). Mean body weight across countries varied by ≤ 0.9 kg (4.2–5.1 kg) and mean age by ≤ 1.3 years. (6.7–8.0 years). More than 95% of the cats in each country were spayed or neutered. At least 80% of

Table 2. Demographics and flea and tick observation experience of cat owners participating in a treatment satisfaction and preference survey in the US, UK, and France.

Demographic parameter	Cat owners' country of origin		
	US (n = 451)	UK (n = 512)	France (n = 510)
Owner gender			
Male	98 (22%)	113 (22%)	126 (25%)
Female	350 (78%)	385 (75%)	384 (75%)
Unspecified	3 (1%)	14 (3%)	NA
Owner age distribution (years)			
<20	5 (1%)	5 (1%)	38 (8%)
20–35	109 (24%)	100 (20%)	86 (17%)
36–45	98 (22%)	113 (22%)	114 (22%)
46–55	99 (22%)	108 (21%)	132 (26%)
>55	105 (23%)	174 (34%)	140 (27%)
Unspecified	35 (8%)	12 (2%)	NA
Years as cat's primary caregiver (mean ± SD)	6.9 ± 3.1	6.9 ± 3.1	NA
Owner's flea observation			
Never	197 (44%)	223 (44%)	173 (34%)
On cat	243 (54%)	259 (51%)	326 (64%)
In house	81 (18%)	125 (24%)	99 (19%)
In bed	9 (2%)	24 (5.0%)	33 (7%)
On family member	15 (3%)	26 (5%)	32 (6%)
Owner's tick observation			
Never	343 (76%)	389 (76%)	303 (59%)
On cat	80 (18%)	110 (22%)	194 (38%)
In house	26 (6%)	14 (3%)	17 (3%)
In bed	4 (1%)	2 (<1%)	3 (<1%)
On family member	27 (6%)	12 (2%)	27 (5%)
Has owner used flea and tick products other than fluralaner?			
Yes	298 (66%)	362 (71%)	386 (76%)
No	122 (27%)	113 (22%)	108 (21%)
Don't know (or no response)	31 (7%)	37 (7%)	16 (3%)

NA = not applicable; SD = standard deviation.

the cats in each country surveyed lived in a house rather than a multi-unit dwelling. The percentage of cats living in an apartment varied by country, ranging from 5.7% in the UK to 10.2% in the US and 17.1% in France. Most cats in each country had some outdoor access, particularly in the UK and France where at least two-thirds of the cats had mostly outdoor or equal indoor–outdoor access. The outdoor access was lower in the US, where more than 70% of the cats were maintained mostly or exclusively indoors. More than 75% of the

owners surveyed in the US said that their cats lived in multi-pet households. Respondents indicated that slightly more than half of their cats lived with dogs, and 59% lived with other cats, averaging 2.3 cats per household. In the UK and France, respectively, slightly less than half of owners said their cats lived in multi-pet settings. Cats enrolled in the present study had multiple flea and tick exposure risk factors that were commonly recognized in the general cat population. These included living in multi-pet households (US = 77%; UK = 46%;

Table 3. Demographic profile of cats from owners surveyed in the US, UK, and France.

Demographic parameter	Cat owners' country of origin		
	US	UK	France
Cat gender			
Male	228 (51%)	257 (50%)	273 (54%)
Female	223 (49%)	252 (49%)	237 (46%)
No response	0 (0%)	3 (1%)	0 (0%)
Total survey population	451	512	510
Spayed or neutered	429 (95%)	496 (97%)	489 (96%)
Mean body weight (kg ± SD)	5.1 ± 0.9	4.2 ± 1.2	4.7 ± 1.2
Mean age (years ± SD)	7.1 ± 1.4	8.0 ± 4.5	6.7 ± 4.5
Cat's living environment			
Apartment	46 (10%)	29 (6%)	87 (17%)
House	395 (88%)	459 (90%)	423 (83%)
Unspecified	10 (2%)	24 (4%)	NA
Cat's environmental access			
Outdoor only or mostly outdoor	24 (10%)	79 (15%)	119 (23%)
Indoor–outdoor equally	45 (19%)	282 (55%)	230 (45%)
Mostly indoor	61 (25%)	126 (25%)	98 (19%)
Indoor only	109 (46%)	23 (5%)	63 (13%)
Cat has passed tapeworm segments			
Occasionally	82 (18%)	41 (8%)	NA
Often	5 (1%)	6 (1%)	NA
Never	364 (81%)	462 (91%)	NA
Cat's overall health			
Poor or fair	27 (6%)	NA	44 (9%)
Good	217 (48%)	NA	197 (38%)
Excellent	207 (46%)	NA	269 (53%)
No. of cats in multi-pet households (%)	349 (77%)	225 (46%)	251 (49%)
Lives with dogs, mean no. dogs in household	244 (54%), 1.8	127 (25%), 1.6	141 (28%), 1.1
Lives with other cats, mean no. cats in household	266 (59%), 2.3	130 (25%), 1.7	167 (33%), 1.6
Lives with other pet species	26 (6%)	10 (2%)	35 (7%)

SD = standard deviation.

France = 49%), outdoor access (55%; 95%; 88%), and owner-observed on-animal prior flea (54%; 51%; 64%) and tick infestation (18%; 22%; 38%).

US and UK surveys asked cat owners whether they had observed their cat pass tapeworm segments and 19% of US cat owners and 9% of UK cat owners reported occasional or frequent presence of tapeworm segments in feces. The US and France surveys asked owners to rate their cats' health status and more than 90% of

survey respondents in these two countries said their cats were in excellent or good health.

Cat owners' survey results

Cat owners' responses to the surveys in each of the three countries are summarized (Table 4), although the questions may have been ordered differently in the country-specific surveys. More than 94% of all cat owners responded that they were satisfied or very satisfied with fluralaner as a flea and tick control medication (Question 1), with a strong consensus across

Table 4. Cat owners' survey questions and responses in the US, UK, and France.

Survey question and response options	US (2020)	UK (2019)	France (2018)
Q1. What is your level of satisfaction with Bravecto®			
Very satisfied	65% (292/448)	66% (333/507)	63% (322/510)
Satisfied	31% (142/448)	30% (151/507)	31% (159/510)
Neutral	3% (12/448)	3% (17/507)	4% (20/510)
Unsatisfied or very unsatisfied	<1% (2/448)	1% (6/507)	2% (9/510)
Q2. Which Bravecto® benefits are important to you (select all that apply)?			
12-week dosing interval	76% (344/451)	82% (419/512)	70% (359/510)
Single-dose efficacy	55% (246/451)	72% (367/512)	53% (272/510)
Ease of use	34% (154/451)	39% (198/512)	47% (242/510)
Less stress for cat	53% (238/451)	64% (328/512)	37% (190/510)
Less stress for me	54% (243/451)	52% (265/512)	37% (186/510)
Recommended by veterinarian	57% (255/451)	63% (320/512)	NA
Q3. If you had to select one, which is the most important reason to use Bravecto® for cats?			
12-week dosing interval	36% (162/451)	33% (159/481)	38% (195/510)
Single-dose efficacy	24% (107/451)	37% (180/481)	21% (109/510)
Veterinarian recommended	15% (66/451)	10% (47/481)	NA
Less stress for cat	12% (54/451)	14% (67/481)	9% (46/510)
Kills fleas quickly	NA	NA	13% (66/510)
Q4. Compared to a monthly flea and tick product, which of the following have you experienced with Bravecto® (select all that apply)			
Can treat cat less often	63% (189/298)	54% (194/362)	56% (217/386)
Cat has fewer fleas	39% (116/298)	43% (157/362)	31% (119/386)
Cat has fewer ticks	17% (50/298)	15% (55/362)	19% (74/386)
12-week dosing easier to remember	36% (108/298)	41% (150/362)	41% (207/386)
Cat is protected when it matters most	NA	NA	35% (136/386)
More likely to apply on time so cat is better protected	31% (93/298)	46% (166/362)	NA
Less likely to forget to treat my cat	30% (89/298)	41% (150/362)	42% (163/386)
Q5. Do you give Bravecto® at its recommended dosing interval of 12 weeks? ^a			
Mostly on time	66% (293/448)	63% (319/506)	52% (267/510)
Delayed a few days	24% (108/448)	22% (110/506)	25% (129/510)
Delayed by weeks or months	10% (47/448)	15% (77/506)	23% (114/510)
Questions 6–11 were answered by cat owners with prior experience using monthly flea and tick products.			
Q6. Does Bravecto® provide more months of flea and tick protection per year compared to other products you have used?			
More months	37% (110/300)	42% (145/346)	57% (219/386)
Fewer months	26% (80/300)	28% (98/346)	11% (42/386)
Same number of months	37% (110/300)	30% (103/346)	32% (125/386)

Q7. Are you more likely to give Bravecto® on time compared to monthly flea and tick products?			
Yes	62% (186/300)	65% (231/357)	59% (225/386)
No	<1% (2/300)	3% (11/357)	7% (28/386)
About the same	33% (100/300)	30% (106/357)	28% (109/386)
Don't know	4% (12/300)	2% (9/357)	6% (24/386)
Q8. Is it more convenient to give repeat doses of Bravecto® compared to a monthly flea and tick product?			
More convenient	86% (259/300)	89% (317/358)	80% (308/386)
About the same	13% (37/300)	10% (39/358)	19% (73/386)
Less convenient	1% (4/300)	1% (2/358)	1% (5/386)
Q9. Is dosing with Bravecto® easier than dosing with a monthly flea and tick product?			
Easier	78% (233/300)	86% (309/358)	NA
About the same	21% (64/300)	13% (48/358)	NA
Less easy	1% (3/300)	<1% (1/358)	NA
Q10. Do you prefer Bravecto® for cats compared to other flea and tick products you have used?			
Yes	87% (260/300)	88% (315/360)	89% (344/386)
No	2% (97/300)	1% (2/360)	2% (9/386)
No preference	11% (33/300)	11% (43/360)	9% (33/386)
Q11. Would you go back to using a monthly product?			
Yes	7% (20/300)	4% (10/250)	NA
No	71% (214/300)	96% (240/250)	NA
Don't know	22% (66/300)	NA	NA

NA = not applicable. (°) = In the France survey, this question was phrased: “When you give a dose of Bravecto® for cats, do you renew the prescription after 12 weeks?”

the three countries. A few ($\leq 4\%$) cat owners were neutral (neither satisfied nor unsatisfied), while $<1\text{--}2\%$ were unsatisfied or very unsatisfied with fluralaner. Satisfaction with fluralaner was also calculated for respondents in each country who reported prior experience with other flea and tick medications. Among these cat owners, the percentage of respondents who were satisfied or very satisfied with fluralaner was $>95\%$: 96.6.0% (288/298) in the US, 95.5% (344/362) in the UK, and 95.3% (368/386) in France.

Satisfaction with fluralaner was high among cat owners who had reported prior direct observation of fleas or ticks on their cats. Cat owners in each country for whom fleas and ticks were a known threat also expressed high levels of satisfaction with fluralaner. Survey respondents in the US who previously observed fleas and ticks on their cats had the highest satisfaction level among the three countries: 97.5% (237/243) who observed fleas on their cat and 98.8% (79/80) who had observed ticks on their cat were satisfied or very satisfied with fluralaner. Among the UK survey respondents, 96.9% (251/259) who previously observed fleas on their cat and 93.6% (103/110) who previously observed ticks on their cat were satisfied or very satisfied with fluralaner. Among the French survey respondents, 95.3% (311/326) who had observed on-animal fleas and 94.3% who had

observed on-animal ticks (183/194) were satisfied or very satisfied with fluralaner.

Cat owners were surveyed to identify their perceived benefits of using fluralaner, including the identification of all benefits that applied (Question 2) and the most important benefit if only one could be selected (Question 3). The most frequently selected of all benefits was the 12-week dosing interval, selected by 76% of respondents in the US, 82% in the UK, and 70% in France (Table 4). Cat owners asked to select the single most important benefit chose the 12-week dosing interval most often in the US (36%) and France (38%). UK cat owners surveyed reported single-dose efficacy as the single most important fluralaner benefit (37%), followed by 12-week dosing interval (33%). In the US (23%) and France (21%), cat owners reported single-dose efficacy as the second most important benefit.

Cat owners were asked if an extended duration ectoparasiticide had benefits over flea and tick products that are dosed monthly. The most frequently selected response was that a cat could be treated less often, with other response choices having a varied ranking in the different countries (Table 4). A recurring owner-experience pattern reported in the three countries was that a 12-week dosing interval resulted in a greater likelihood of on-time dosing; dosing that was easier

to remember; and a lower likelihood of forgetting to administer treatment. These responses reflect an improved level of adherence to on-time dosing and avoidance of missed doses with a 12-week dosing interval compared to outcomes experienced with monthly flea and tick dosing.

The majority of owners (89% in the US, 85% in the UK, 78% in France) reported that they administered fluralaner mostly on time or with a few days delay (Question 5). A smaller proportion of surveyed cat owners reported that follow-up doses would be delayed by weeks or months (US = 11%; UK = 15%, France = 22%).

Cat owners were asked whether fluralaner provided more months of flea and tick protection per year compared to the way that they dosed monthly products (Question 6). Cat owners usually indicated that they thought that their cat received more months of coverage with fluralaner, although this proportion was variable among the three countries.

Most survey respondents in all countries (62% in the US, 65% in the UK, 58% in France) reported that they are more likely to administer fluralaner on time compared to monthly flea and tick products (Question 7). About one-third of respondents thought that they dosed fluralaner on time as often as they dosed monthly products on time with fewer than 8% reporting that they were less likely to dose on time.

Most (80%–89%) of the cat owners from the three countries reported that fluralaner was more convenient to administer compared to monthly flea and tick products (Question 8). Most cat owners in the US (78%) and UK (86%) also reported that the 12-week dosing with fluralaner was easier than dosing with monthly flea and tick products (Question 9). The survey in France did not ask about the ease of 12-week fluralaner dosing compared to monthly dosing.

Cat owners were asked for their preference between fluralaner and monthly flea and tick products (Question 10). Nearly 90% of the owners reported a preference for fluralaner that was consistent across the three countries, varying less than 3%. A few cat owners in the US (7%) and UK (4%) reported a preference for a monthly flea and tick product (Question 11).

Discussion

This survey in three separate countries found that surveyed cat owners of different linguistic and cultural background had a consistent high level of satisfaction with and preference for the long duration flea and tick product. All cat owners were required to have purchased at least two doses of topical fluralaner in order to have the minimum experience with the product. The responses of cat owners from all three countries with regard to attitudes toward an extended duration flea and tick product were generally positive and fairly consistent. A very similar result was previously seen when dog owners from the US, UK, and Australia were asked to provide their opinions comparing extended duration ectoparasiticide

administration with products dosed monthly (Lavan *et al.*, 2020a). Pet owners in these studies prefer the convenience of longer duration medications over shorter duration medications as long as the efficacy continues to be high (Lavan *et al.*, 2017a). Dogs and cats prescribed longer duration ectoparasiticides also gain the benefit of more months per year of flea and tick protection, on average, when compared with pets prescribed ectoparasiticides that require monthly dosing (Lavan *et al.*, 2017b, 2018a, 2018b, 2020b).

Cat owners reported high satisfaction with fluralaner, with more than 94% of cat owners indicating that they were very satisfied or satisfied with their experience and the impact of a longer dosing interval on this satisfaction is supported by responses to other questions. For example, 72%–82% of cat owners identified the 12-week duration of fluralaner as the most important benefit. A similar proportion of cat owners (72%–84%) thought that using an extended duration product was more convenient than monthly dosing and 86%–89% preferred using fluralaner over the monthly products that they had used previously. Cat owners in the US and UK reported that fluralaner was easier to use compared with monthly flea and tick products.

Most owners reported that fluralaner efficacy following a single dose was an important benefit. The 12-week duration of fluralaner provides enough flea protection to completely eliminate a flea infestation with a single dose (Dryden *et al.*, 2013a; Halos *et al.*, 2014; Taenzler *et al.*, 2014; Dryden *et al.*, 2015; Ranjan *et al.*, 2018). Monthly flea and tick products must have three doses administered consecutively and without delay to obtain this same effectiveness. In this study, cat owners in all three countries recognized the second most frequent benefit of fluralaner as single-dose efficacy.

Medicating a cat can be stressful for the cat and often for the owner as well. A veterinary care usage study found that stress for feline patients and their owners is an important factor in avoiding veterinary care visits, especially as the cat ages (Volk *et al.*, 2011). Gaining 12 weeks of flea and tick protection following administration of a single dose of fluralaner means that the owner treats once for this period compared with the three treatments required for monthly dosed flea and tick medications. A reduced number of doses equate to reduced stress for the cat and owner, and by cat owners in this study recognized this benefit associated with fluralaner.

Veterinarians cannot easily determine whether cat owners are in fact administering medication at home according to their recommended schedule. Forgetfulness was overwhelmingly cited as a reason for non-adherence in a survey of epilepsy patients (see, for example, Groenewegen *et al.* 2014). The present survey assessed whether cat owners can re-treat on time when dosing at 12-week intervals is required. Most cat owners in the three countries reported administering fluralaner on time (or delayed by only a few days)

and that they are more likely to administer fluralaner on time compared to monthly flea and tick products. Therefore, a 12-week dosing interval does not appear to be a deterrent to on-time administration compared with monthly dosing.

There are some steps that veterinary practices can take to promote adherence. A client reminder program for timely purchase and administration of flea and tick treatment is beneficial. Home delivery of medication provides the owner with one or more doses at the time that it needs to be applied. Additionally, veterinarians can help pet owners to understand the importance of parasite prevention in a tailored program based on a complete understanding of risk.

Cat owners indicated that efficacy (Questions 2–4: single dose to remove a flea infestation) and convenience (Question 8: less frequent dosing) contributed to user preference for fluralaner (Questions 10 and 11) compared to monthly flea and tick products. There is an inverse relationship between dosing frequency and adherence across various drug classes in both human and veterinary medicine (Claxton *et al.*, 2001; Adams *et al.*, 2005) with longer acting medications having better patient preference and adherence to medical dosing recommendations. Cat owners in the US and UK were asked if they would revert to using monthly flea and tick products if given the choice. Most would not (US = 71%; UK = 96%), although a few would (4%–7%).

Most surveyed veterinarians in the US, UK, and France recommend year-round flea control, although a variable number recommended year-round tick control (US = 79%; UK = 51%; France = 35%) (Table 1). Year-round tick control may not be universally recommended because of regional climate-associated variations in ectoparasite risk. Veterinarians recommended flea and tick control averaging ≥ 9 months of the year, quite close to institutional recommendations for year-round flea and tick control in all canine and feline patients (CAPC, 2017; ESCCAP, 2018). Ectoparasite risks could potentially increase with milder winter temperatures and it may be expected that veterinarians will recommend more months of protection in future when this becomes apparent.

These cat owners' survey results were consistent with results from prior published treatment-satisfaction surveys of dog owners based on a similar methodology (Lavan *et al.*, 2017a, 2020a). Dog owners in the US, UK, and Australia also strongly preferred a 12-week dosing interval and 94%–96% of surveyed dog owners reported they were satisfied or very satisfied with the fluralaner oral chew. Dog owners reported that an extended 12-week dosing interval does not hinder user recall and contributes to on-time product administration and avoidance of gaps in treatment coverage. The consistency in multiple results across separate survey populations, companion animal species, countries, and timeframes supports the conclusion that a 12-week dosing interval combines a high level of ectoparasite efficacy with stronger pet owner satisfaction, greater product preference, and improved

treatment adherence compared to historical experience with products with a monthly dosing interval.

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Conflict of interest

The authors are employees of Merck Animal Health, Madison, NJ, which manufacture Bravecto (fluralaner) products and provided the funding for the study.

Authors' contributions

All authors participated in designing or administering the study.

REFERENCES

- Abdullah, S., Helps, C., Tasker, S., Newbury, H. and Wall, R. 2019. Pathogens in fleas collected from cats and dogs: distribution and prevalence in the UK. *Parasit. Vectors* 12, 71.
- Adams, V.J., Campbell, J.R., Waldner, C.L., Dowling, P.M. and Schmon, C.L. 2005. Evaluation of client compliance with short-term administration of antimicrobials to dogs. *J. Am. Vet. Med. Assoc.* 226, 567–574.
- Beugnet, F., Bourdeau, P., Chalvet-Monfray, K., Cozma, V., Farkas, R., Guillot, J., Halos, L., Joachim, A., Losson, B., Guadalupe, M., Otranto, D., Renaud, M. and Rinaldi, L. 2014. Parasites of domestic owned cats in Europe: co-infestations and risk factors. *Parasit. Vectors* 7, 291.
- Beugnet, F. and Franc, M. 2010. Results of European multicentric field study of fipronil-(S)methoprene combination on flea infestation of dogs and cats during 2009 summer. *Parasite* 17, 337–342.
- Bitam, I., Dittmar, K., Parola, P., Whiting, M.F. and Raoult, D. 2010. Fleas and flea-borne diseases. *Int. J. Infect. Dis.* 14, e667–e676.
- Claxton, A.J., Cramer, J. and Pierce, C. 2001. A systematic review of the associations between dose regimens and medication compliance. *Clin. Ther.* 23, 1296–1310.
- CAPC. 2017. Companion Animal Parasite Council: guidelines fleas for cats. Available via <https://capcvet.org/guidelines/fleas/> (Accessed 20 April 2020).
- Dryden, M.W. and Broce, A.B. 2002. Integrated flea control: flea control for the 21st century. *Comp. Cont. Educ. Pract. Vet.* 24(suppl), 36–39.
- Dryden, M.W., Canfield, M.S., Bocon, C., Phan, L., Niedfeldt, E., Kinnon, A., Warcholek, S.A., Smith, V., Bress, T.S., Smith, N., Heaney, K., Royal, C., Normile, D., Armstrong, A. and Sun, F. 2018. In-home assessment of either topical fluralaner or topical selamectin for flea control in naturally infested cats in West Central Florida, USA. *Parasit. Vectors* 11, 422.
- Dryden, M.W., Payne, P.A., Smith, V., Chwala, M., Jones, E., Davenport J, Fadl, G., Martinez-Perez

- de Zeiders, M.F., Heaney, K., Ford, P. and Sun, F. 2013a. Evaluation of indoxacarb and fipronil (s)-methoprene topical spot-on formulations to control flea populations in naturally infested dogs and cats in private residences in Tampa, FL, USA. *Parasit. Vectors* 6, 366.
- Dryden, M.W., Payne, P.A., Smith, V., Heaney, K. and Sun, F. 2013b. Efficacy of indoxacarb applied to cats against the adult cat flea, *Ctenocephalides felis*, flea eggs and adult flea emergence. *Parasit. Vectors* 6, 126.
- Dryden, M.W., Smith, V., Bennett, T., Math, L., Kallman, J., Heaney, K., and Sun, F. 2015. Efficacy of fluralaner flavored chews (Bravecto®) administered to dogs against the adult cat flea, *Ctenocephalides felis felis* and egg production. *Parasit. Vectors* 8, 364.
- ESCCAP. 2018. ESCCAP Guideline 3: control of ectoparasites in dogs and cats. Available via https://www.esccap.org/uploads/docs/mjy50wev_0720_ESCCAP_Guideline_GL3_v9_1p.pdf (Accessed 13 Feb 2021).
- Gage, K.L., Burkot, T.R., Eisen, R. J. and Hayes, E.B. 2008. Climate and vector-borne diseases. *Am. J. Prev. Med.* 35, 436–450.
- Groenewegen, A., Tofighty, A., Ryvlin, P., Steinhoff, B.J. and Dedeken, P. 2014. Measures for improving treatment outcomes for patients with epilepsy—results from a large multinational patient-physician survey. *Epilepsy Behav.* 34, 58–67.
- Halos, L., Beugnet, F., Cardoso, L., Farkas, R., Franc, M., Guillot, J., Pfister, K. and Wall, R. 2014. Flea control failure? Myths and realities. *Trends Parasitol.* 30, 228–233.
- Kilp, S., Ramirez, D., Allan, M.J. and Roepke, R.K. 2016. Comparative pharmacokinetics of fluralaner in dogs and cats following single topical or intravenous administration. *Parasit. Vectors* 9, 96.
- Lappin, M.R. 2018. Update on flea and tick associated diseases of cats. *Vet. Parasitol.* 254, 26–29.
- Lappin, M.R. and Hawley, J. 2009. Presence of *Bartonella* species and *Rickettsia* species DNA in the blood, oral cavity, skin and claw beds of cats in the United States. *Vet. Dermatol.* 20, 509–514.
- Lavan, R., Normile, D., Armstrong, R. and Vaala, W. 2021. Flea and tick treatment satisfaction, preference, and adherence of US cat owners prescribed topical fluralaner (Bravecto® Topical Solution for Cats). *Open Vet. J.* 11, 80–88.
- Lavan, R., Armstrong, R., Lipworth, K., Normile, D. and Newbury, H. 2020a. Flea and tick treatment satisfaction, preference and adherence of dog owners in the United States, United Kingdom, and Australia who treated their dog with fluralaner. *Open Vet. J.* 10, 135–143.
- Lavan, R.P., Armstrong, R., Normile, D., Zhang, D. and Tunceli, K. 2017a. Results from a dog owner survey on the treatment satisfaction and preference for fluralaner against flea and tick infestations. *J. Vet. Sci. Technol.* 8, 3.
- Lavan, R., Tunceli, K., Zhang, D., Normile, D. and Armstrong, R. 2017b. Assessment of dog owner adherence to veterinarian's flea and tick prevention recommendations in the United States using a cross-sectional survey. *Parasit. Vectors* 10, 284.
- Lavan, R., Armstrong, R., Burgio, F. and Tunceli, K. 2018a. Duration of annual canine flea and tick protection provided by dog owners in Spain. *Parasit. Vectors* 11, 458.
- Lavan, R.P., Armstrong, R., Tunceli, K. and Normile, D. 2018b. Dog owner flea/tick medication purchases in the USA. *Parasit. Vectors* 11, 581.
- Lavan, R., Armstrong, R., Normile, D. and Vaala, W. 2020b. Adherence to veterinary recommendations for ectoparasiticides purchased by cat owners in the USA. *Parasit. Vectors* 13, 541.
- Meadows, C., Guerino, F. and Sun, F. 2017. A randomized, blinded, controlled USA field study to assess the use of fluralaner topical solution in controlling feline flea infestations. *Parasit. Vectors* 1, 37.
- Ranjan, S., Young, D. and Sun, F. 2018. A single topical fluralaner application to cats and to dogs controls fleas for 12 weeks in a simulated home environment. *Parasit. Vectors* 11, 385.
- Rust, M.K. 2005. Advances in the control of *Ctenocephalides felis* (cat flea) on cats and dogs. *Trends Parasitol.* 21, 232–236.
- Rust, M.K. and Dryden, M.W. 1997. The biology, ecology, and management of the cat flea. *Ann. Res. Entomol.* 42, 451–473.
- Taenzler, J., Wengenmayer, C., Williams, H., Fourie, J., Zschiesche, E., Roepke R.K.A. and Heckerroth, A.R. 2014. Onset of activity of fluralaner (BRAVECTO™) against *Ctenocephalides felis* on dogs. *Parasit. Vectors* 7, 567.
- Volk, J.O., Felsted, K.E., Thomas, J.G. and Siren, C.W. 2011. Executive summary of the Bayer veterinary care usage study. *J. Am. Vet. Med. Assoc.* 238, 1275–1282.
- Williams, H., Young, D.R., Qureshi, T., Zoller, H. and Heckerroth, A.R. 2014. Fluralaner, a novel isoxazoline, prevents flea (*Ctenocephalides felis*) reproduction in vitro and in a simulated home environment. *Parasit. Vectors* 7, 275.