

## Evaluation of a Quality-of-Life Tool for Cats with Diabetes Mellitus

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**Background:** Success in management of diabetes mellitus (DM) is defined as improvement of blood glucose concentrations and clinical signs. However, the psychological and social impact of DM and its daily treatment regimen on quality of life (QoL) of both animal and owner is uncertain.

**Hypothesis/Objectives:** To design, validate, and apply a diabetic pet and owner-centered, individualized measure of impact of DM (DIAQoL-pet).

**Animals/Subjects:** Two hundred and twenty-one owners of insulin-treated diabetic cats were recruited to complete the DIAQoL-pet.

**Methods:** Discussions and pilot surveys with clinicians and owners of diabetic cats led to the design of 29 specific DM-associated QoL questions. Owners of diabetic cats completed the finalized survey. Each item was scored according to impact frequency and perceived importance. An item-weighted impact score (IWIS) for each item was calculated, as was an average-weighted impact score (AWIS) by averaging all IWISs. Principal component analysis and Cronbach's  $\alpha$  calculation assessed the measure's reliability. Two overview questions measured overall QoL and diabetes-dependent QoL.

**Results:** The DIAQoL-pet showed high reliability (Cronbach  $\alpha$  0.83). The AWIS was  $-1.76 \pm 2.4$  (mean  $\pm$  SD). Areas reported as most negatively impacting QoL included: "boarding difficulties" (IWIS  $\pm$  SD:  $-4.67 \pm 5.3$ ), "owner wanting more control" ( $-4.34 \pm 4.7$ ), "difficulties leaving cat with friends or family" ( $-4.21 \pm 4.7$ ), "worry" ( $-4.10 \pm 3.9$ ), "worry hypo" ( $-3.67 \pm 3.5$ ), "social life" ( $-3.48 \pm 3.9$ ), "costs" ( $-3.04 \pm 3.8$ ), and "work life" ( $-3.03 \pm 3.7$ ). Forty-one percent of owners believed their cat's life would be "a little better" without DM.

**Conclusions and Clinical Importance:** The DIAQoL-pet proved robust and identified specific areas most negatively impacting on diabetic cats and their owners' QoL. This tool warrants further investigation for use in clinical or research settings.

**Key words:** Behavior; Endocrinology; Feline; Owner; Psychometry.

Veterinary clinicians often focus on control of blood glucose concentrations in cats with diabetes mellitus (DM). Treatment success is usually defined as obtaining close to normal serial blood glucose concentrations, improving fructosamine or glycosylated hemoglobin values, or both, in conjunction with the resolution or at least amelioration of the key clinical signs generally attributed to DM (polyuria, polydipsia, polyphagia, and weight loss).<sup>1</sup> However, evaluating treatment success in diabetic pets should probably also include recording the psychological and social effects of the impact of DM and its relatively complex daily treatment regimen on quality of life (QoL) of both animal and owner, as well as the owner's perceptions of the disorder and its management. Indeed, should an owner perceive a particularly negative impact on his or her QoL or the QoL of their pet as a result of the DM, a decision to cease treatment could be the inevitable outcome regardless of the apparent clinical success. In spite of QoL being acknowledged as an im-

### Abbreviations

AWIS	average-weighted impact score
DM	diabetes mellitus
DSH	domestic short hair
HBGM	home blood glucose monitoring
IWIS	item-weighted impact score
PCA	principal components analysis
QoL	quality of life
VIN	Veterinary Information Network

portant outcome in its own right in human diabetology,<sup>2</sup> assessment of pet and owner QoL has not been reported in any great detail in veterinary diabetology. Additionally, the importance of interacting biopsychosocial factors in the management of chronic disorders is recognized in humans and probably should not be disregarded in animals.<sup>3</sup>

A diabetic animal and owner-centered, individualized measure of the impact of DM was designed and subsequently applied to describe owner-perceived QoL of their pet with DM and measure their individual feelings about the impact of its diagnosis and treatment on the pet's and owner's everyday lives. This tool, subsequently named DIAQoL-pet, was designed to identify and address specific and concrete areas in life (items) affected by DM and enabled application of a rating of these items in order to qualify and quantify their importance in the individual animal's and owner's lives.

### Material and Methods

#### Design of the DIAQoL-Pet

Qualitative research was conducted to ensure that the items were diabetes centered and valid to diabetic pets and their owners. Detailed

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discussions were held with veterinary surgeons ( $n = 21$ ) and nurses ( $n = 33$ ) (both in primary practice and in referral practice), 2 human DM QoL survey designers, a human diabetology lecturer and consultant, a clinical epidemiologist and owners of diabetic pets ( $n = 23$ ). Studies using questionnaires for children with diabetes were also used as a basis for the tool's design.<sup>2,4</sup>

This initial phase allowed the identification of 29 specific DM QoL issues or items, leading to the design of 29 corresponding specific DM-associated QoL questions and corresponding multiple-choice answers (DIAQoL-pet).

Subsequently, the DIAQoL-pet was digitalized and publicized online by the software package Questionmark Perception Manager.<sup>a</sup> An initial pilot trial was conducted among 19 veterinary surgeons, 11 veterinary nurses, and 9 owners of diabetic companion animals in order to identify areas of confusion and assess the questions' validity. Feedback was used to finalize the DIAQoL-pet, before subsequent application of this final version (Table 1) in the larger population of owners of diabetic cats.

### Description of the DIAQoL-Pet Survey

To ensure an individualized and quantitative character of the tool, each item was scored according to frequency at which it impacted on owner's and pet's lives and how important the item is in the individual owner's and pet's lives (Fig 1).

Multiplying frequency and importance ratings for each item provided a so-called item-weighted impact score (IWIS).<sup>3</sup> In case of a particular item or issue never occurring in response to questions about the owner's, pet's, or either, life (ie, score 0) this automatically resulted in an IWIS of 0, regardless of the chosen importance rating of the item. Similarly, in case of an item being regarded as "not at all important" by an owner, a score of 0 would also be reached, regardless of a possible high frequency of occurrence of the issue.

Table 1 contains the description of each item and shows the abbreviations that will be used in the remainder of this paper. Most items represent areas of the owner's and pet's lives potentially

**Table 1.** Overview of DIAQoL-pet items and abbreviations.

Item Number	Abbreviation	Item
A	General QoL pet	I feel that the quality of my pet's life is
B	Diabetes-dependent QoL pet	If your pet did not have diabetes, his/her quality of life would be:
1	Worry	Do you worry about your pet's diabetes?
2	No treats	Do you ever feel you want to give your pet treats but you don't because of the diabetes?
3	Injections restrict life	Do you feel your life is restricted because of the daily insulin injections?
4	Injection pain	Does your pet ever react annoyed or in pain when injected?
5	Injection worries	Do you ever worry about whether you have given the insulin correctly?
6	Resent inject	Do you resent having to give your pet insulin injections?
7	Restrict your activities	Do you ever find the diabetes of your pet restricts or limits what you are doing or what you want to do, like going on holidays, away for weekends, away for the day/night, working?
8 <sup>a</sup>	Extra things	Do you ever give your pet extra things, like snacks, treats, extra attention or extra walks because of the diabetes?
9	More control	Do you ever feel you want to take more control of the diabetes on your own, without the help from vets and other people?
10	Pet's moods	Do you think the diabetes affects your pet's moods?
11	Pet unwell	Does your pet ever feel unwell, tired or in any other way negatively affected since treatment with insulin was started?
12	Boarding kennels	Do you ever choose <i>not</i> to put your pet into boarding kennels because of the diabetes?
13	Friends and family	Do you ever choose <i>not</i> to leave your pet to stay with friends or family because of the diabetes?
14	Hypoglycemia	Does your pet ever show signs of a low blood sugar? (eg, wobbliness, collapse)
15	Active day	Do you ever choose <i>not</i> to take your pet with you on an active day (eg, walking longer distances, going to the beach, etc.) because of the diabetes?
16	Drinking	Does your pet still drink more than before the diagnosis?
17	Hungry	Is your pet still hungrier than before the diagnosis?
18	Urinate	Does your pet still urinate more than before the diagnosis?
19	Weight loss	Is your pet still losing weight since treatment has begun?
20	Future care	Do you ever feel worried you will not be able to take care of your pet in the future because of the diabetes?
21	Worry hypo	Do you ever feel worried about your pet suffering from an episode of low blood glucose?
22	Worry DKA	Do you ever feel worried about your pet suffering from an episode of ketoacidosis?
23	Worry vision	Do you ever worry about your pet getting vision problems because of cataracts or did you worry about this before your pet suffering from such problems?
24	Play less	Are you <i>less</i> inclined to play with your pet now that he/she has diabetes?
25 <sup>a</sup>	Play more	Are you <i>more</i> inclined to play with your pet now that he/she has diabetes?
26	Social life	Do you ever find you need to fit your pet's diabetes into your social life? (eg, carrying needles, food, insulin, providing food on time)
27	Working life	Do you ever find you need to fit your pet's diabetes into your working life? (eg, having to make special arrangements when you need to work late or need to start working earlier)
28 <sup>a</sup>	Special bond	Do you feel you have a more special bond with your pet now that you are managing his/her diabetes?
29	Costs	Do you ever worry about how much money your pet's diabetes costs you and your family?

Items A and B: separate overview questions; items 1–29: DIAQoL-pet items.

<sup>a</sup>Positive items.

QoL, quality of life.

7.a. Do you ever find the diabetes of your pet restricts or limits what you are doing or what you want to do, like going on holidays, away for weekends, away for the day/night, working?
<input type="radio"/> All the time <input type="radio"/> Often <input type="radio"/> Occasionally <input type="radio"/> Never
7.b. For me and my pet this issue is:
<input type="radio"/> Very important <input type="radio"/> Important <input type="radio"/> Moderately important <input type="radio"/> Low importance <input type="radio"/> Not at all important

**Fig 1.** Example DIAQoL-pet question with corresponding multiple choice answers. All the time = 3, often = 2, occasionally = 1, never = 0. Very important = 4, important = 3, moderately important = 2, low importance = 1, not at all important = 0.

negatively impacted by the DM and their frequency scores are therefore negative or 0 (range -3 to 0). However, 3 items with possible positive impact were also entered in the DIAQoL-pet and these were therefore given positive frequency scores or 0 (range 0-3).

An average-weighted impact score (AWIS) was calculated to provide a single quantitative measure of diabetes-dependent QoL by dividing all IWISs by the number of items, ie 29.

Two separate overview questions measured current overall QoL, as well as diabetes-dependent QoL (Table 1). These were not included in calculating the AWIS and were analyzed separately.

Additionally, the 3 following hypothetical questions were asked: "If your pet had not been insured for the treatment of diabetes, would you have been willing or able to go ahead with treatment?"; "In the unfortunate event that another one of your pets were to get diabetes, would you treat this pet with insulin too?"; and "Would you recommend friends and family with pets diagnosed with DM to go ahead with insulin injection treatment on the basis of your experiences with your pet?"

Finally, a free comments section served for cognitive feedback and queried if owners had anything else they would like to report about their experiences of life with a diabetic pet receiving insulin injections.

### Recruitment of Respondents

The aim was to recruit a large number of owners of diabetic cats whose pets were receiving insulin injections at the time the survey was completed. The survey-based tool DIAQoL-pet was made available online through the URL <http://www.rvc.ac.uk/diabetes>. In order to prevent malicious participation influencing the results of the surveys, the web link was purposely not advertised openly on the World Wide Web. Diabetic pet owners were only indirectly contacted through their veterinary clinicians and not directly through open-access websites designed for diabetic pet owners. The internet protocol (IP) address of each respondent was recorded with each entry allowing subsequent identification and deletion of duplicate entries by the same IP address, a possible sign of malicious participation. A collaboration was established with the world-wide online veterinary community "Veterinary Information Network" (VIN<sup>b</sup>; <http://www.vin.com>) allowing the survey links to be sent directly to all VIN members (>40,000). Subsequently, the survey introduction

and survey link were also sent to the UK-based Vetsurgeon.org on-line community (approximately 2,500 members), as well as being advertized through various other electronic and nonelectronic veterinary media outlets, veterinary interest groups, national and international congresses, and continuous education events. Also over 400 veterinary practices in the United Kingdom, Belgium, and the Netherlands were individually approached via email. Finally, within the United Kingdom, the charity practice chain the People's Dispensary for Sick Animals was approached and consented to advertizing the survey among their hospitals. The presented data were voluntarily provided by owners of diabetic cats in the full knowledge that this information facilitated the study of QoL of diabetic pets and their owners; as such, protocol at the Royal Veterinary College does not necessitate additional specific approval of its ethics and welfare committee.

### Statistical Analysis

Principal components analysis (PCA) was used to validate the DIAQoL-pet by assessing the unidimensionality of the survey, ie, does it measure diabetes-related QoL or does it measure additional latent variables.<sup>5,6</sup> It was also used to identify critical and noncritical items within the scale, thereby providing the possibility of reducing the number of items without negatively impacting on the function of the tool, as well as reassessing the meaning of each item or factor in light of its relation with the latent variable. As part of the PCA, extraction communalities were calculated. Extraction communalities indicate the amount of variance in each variable that is accounted for by all other variables or items. A small value indicates that the item does not correspond well to the other items and should possibly be dropped from the analysis unless further arguments exist to retain the item. Low communalities across the set of items indicate the variables are little related to each other and indicate a poor quality measure.

As an additional component of the PCA, a factor matrix was generated, recording the factor loadings for each variable. The factor loadings represent the correlation between the item and the latent variable. Small values indicate items that do not correspond well to a latent variable. Kline suggested 0.3 as an appropriate cut-off level.<sup>6</sup> In the present study inclusion/exclusion decisions were based on a subjective decision advised by a combination of theory behind the item, communalities, loading factors, and reliability analysis.

Cronbach's  $\alpha$ , a statistic, commonly used as a measure of the internal consistency of a psychometric instrument, was also determined. Cronbach's  $\alpha$  measures how well a set of variables or items measures a single, unidimensional latent construct. An acceptable minimum  $\alpha$  can be 0.7-0.8.<sup>7</sup>

Cronbach's  $\alpha$  is defined as

$$\alpha = \frac{N}{N-1} \left( 1 - \frac{\sum_{i=1}^N \sigma_{Y_i}^2}{\sigma_X^2} \right)$$

with N representing the number of components (items),  $\sigma_X^2$  the variance of the observed total test scores, and  $\sigma_{Y_i}^2$  the variance of item  $i$ .

Additionally Cronbach's  $\alpha$  was calculated when each item was left out of the scale in order to identify items that markedly negatively influence the scale's reliability as a whole.

Finally, corrected item-total correlations were calculated and correlations were thought acceptable if  $\geq 0.2$ .<sup>5</sup>

Correlations between DIAQoL-pet and answers to general and diabetes-related QoL questions (item A and B, Table 1) were assessed by performing a 2-tailed nonparametric Spearman's  $\rho$ , and correlations were considered to be significant when  $P$ -value was  $< .05$ .

All statistical analyses were performed by the statistical software package SPSS Statistics for Windows 17.0.<sup>c</sup>

## Results

### Demographical Data

Two hundred and twenty-one owners of insulin-treated diabetic cats completed the survey. Respondents originated from the United Kingdom ( $n = 49$ ), United States ( $n = 137$ ), Canada ( $n = 15$ ), Australia ( $n = 3$ ), the Netherlands ( $n = 4$ ), France ( $n = 4$ ), Germany ( $n = 3$ ), Finland ( $n = 1$ ), or unknown ( $n = 5$ ). The cats' mean ( $\pm$ SD) age was  $12.4 \pm 3.1$  years (range 2–16 years); body weight  $5.69 \pm 1.9$  kg (range 2–15 kg); 98 (44%) were recorded as domestic short hairs (DSH), 39 (18%) as cross breeds, 22 (10%) as domestic long hair, 10 (5%) as Maine Coon, 9 (4%) as British short hair, 4 (2%) as Burmese, 4 (2%) as Siamese, 24 (11%) as “other,” and 11 (5%) as “unknown.” Average insulin dose was  $0.55 \pm 0.5$  IU/kg (range 0.02–4.3) and 182 (89%) received insulin 12 hourly, the remainder, 23 (10%) once daily. Eighty-seven were receiving PZI, 50 were receiving glargine, 42 vetsulin/caninsulin, 27 “other,” 12 Novolin N/humulin N, 9 Insulet Lente, 2 Humulin L, and 8 “don't know” or blank. Twenty-three (10%) owners reported injecting varying numbers of units each day: 8 of whom specifically reported determining the daily dose of insulin according to daily home blood glucose measurements. One hundred and thirty-two cats were receiving a special diabetic diet (59.7%). One hundred and fifty-three owners (70%) reported “never” checking urine glucose concentration at home, 52 (24%) checked “occasionally,” 10 (5%) “often,” and 3 (1%) checked “all the time.” One hundred and seventy-five owners (58%) reported “never” checking urine ketone concentration at home, 87 (29%) checked “occasionally,” 31 (10%) “often,” and 9 (3%) checked “all the time.” Sixty owners (27%) reported “never” checking blood glucose concentration at home, 26 (12%) checked “occasionally,” 26 (12%) “often,” and 109 (49%) checked “all the time.” Seven cats (3%) were completely covered by insurance for their disease; 7/221 (3%) were partially insured for this condition, while the majority (207/221; 94%) were not insured.

### Descriptive Statistics

All negative items confirmed negative weighted impact of diabetes, whereas positive items indicated positive impact of diabetes (Table 2, Fig 2). Areas reported as most negatively impacting QoL (based on IWIS) were: “boarding difficulties,” “owner wanting more control over DM,” “difficulties leaving cat with friends/family,” “worry about cat's DM,” “worry hypo,” “adapting social life,” “DM-related costs,” and “adapting work life.”

The least severe negative impact of diabetes was felt for: “play less,” “active day,” “resent injection,” “injection pain,” and “hypoglycemia.” Diabetes had positive impact on: “special bond,” “play more,” and “extra things.”

Analysis of answers to the separate overview questions revealed that although most owners of diabetic cats (94.5%) rated their cat's QoL as “fairly good” (17%), “good” (26%), or “as good as it could possibly be” (52%), 69% reported a negative impact of the DM on

**Table 2.** Descriptive statistics of the DIAQoL-pet items applied to a population of diabetic cats and their owners.

Item Number	Abbreviation	% Never	% All the Time	% Very Important	IWIS (Mean $\pm$ SD)
1	Worry	8.1	21.7	17.2	$-4.10 \pm 3.91$
2	No treats	49.8	6.3	13.6	$-1.58 \pm 2.54$
3	Injecting restrict life	16.3	5.4	7.2	$-2.26 \pm 2.59$
4	Injection pain	53.4	0.9	21.3	$-1.10 \pm 1.77$
5	Injection worries	45.2	2.7	25.3	$-1.97 \pm 2.60$
6	Resent inject	78.3	2.3	12.7	$-0.61 \pm 1.83$
7	Restrict your activities	14.0	9.0	12.2	$-2.81 \pm 3.09$
8 <sup>a</sup>	Extra things	30.3	11.3	12.2	$+3.02 \pm 3.60$
9	More control	37.1	21.7	31.2	$-4.24 \pm 4.66$
10	Pet's moods	23.5	5.4	20.4	$-2.87 \pm 2.88$
11	Pet unwell	35.3	0.5	28.1	$-2.32 \pm 2.36$
12	Boarding kennels	43.4	41.2	36.7	$-4.67 \pm 5.30$
13	Friends and family	33.9	31.7	31.7	$-4.21 \pm 4.65$
14	Hypoglycemia	64.7	0.0	51.6	$-1.28 \pm 1.88$
15	Active day	86.9	7.7	5.9	$-0.58 \pm 2.26$
16	Drinking	32.6	6.8	23.5	$-2.43 \pm 2.90$
17	Hungry	39.8	9.5	22.2	$-2.37 \pm 3.27$
18	Urinate	28.5	9.5	26.7	$-2.78 \pm 3.24$
19	Weight loss	62.9	1.8	31.2	$-1.49 \pm 2.44$
20	Future care	52.5	5.4	35.7	$-2.29 \pm 3.31$
21	Worry hypo	27.6	7.2	45.2	$-3.66 \pm 3.55$
22	Worry DKA	41.6	6.8	36.2	$-2.70 \pm 3.32$
23	Worry vision	57.9	3.6	18.1	$-1.75 \pm 2.86$
24	Play less	93.7	0.5	23.5	$-0.24 \pm 1.18$
25 <sup>a</sup>	Play more	35.3	8.1	20.8	$+3.07 \pm 3.49$
26	Social life	26.7	16.3	19.5	$-3.48 \pm 3.93$
27	Working life	33.5	12.7	19.5	$-3.03 \pm 3.71$
28 <sup>a</sup>	Special bond	12.7	45.2	42.1	$+6.62 \pm 4.72$
29	Costs	29.0	11.8	19.9	$-3.04 \pm 3.78$

<sup>a</sup>Positive item; possible range IWIS  $-12$  to  $0$  (negative items) and  $0$  to  $+12$  (positive items).

IWIS, item-weighted-impact-score.

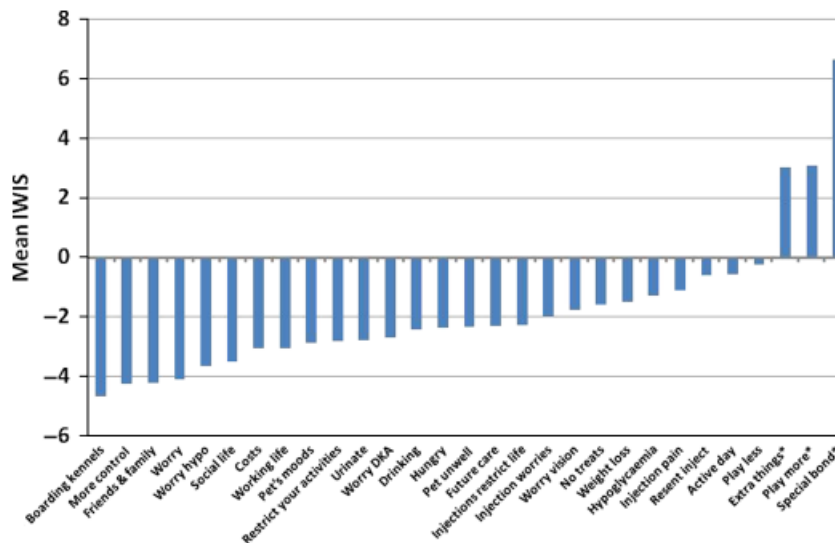
QoL with 8% reporting their pet's life would be “a great deal better,” 20% “quite a lot better,” and 41% “a little better” without the DM (Table 3).

### PCA

All items had extraction communalities  $\geq 0.5$ , indicating all items were reasonably related to each other (Table 4). Factor matrix analysis revealed 5 items (“resent injection,” “more control,” “boarding kennels,” “hypoglycemia,” and “play less”) to have loadings below 0.3 (cut-off suggested by Kline<sup>6</sup>) (Table 4). However, all 5 factors contributed to overall scale reliability according to Cronbach's  $\alpha$  (see below and Table 4), indicating that inclusion would not detract significantly from the validity of the DIAQoL-pet.

### Internal Consistency Reliability

Cronbach's  $\alpha$  proved satisfactory at a level of 0.83 ( $N = 221$ ). All corrected item-total correlations were  $> 0.2$ ,



**Fig 2.** Mean item-weighted impact scores (IWIS) of the 29 items of the DIAQoL-pet for diabetic cats and their owners. \*Positive items.

apart from factors 6 (“resent injection”), 9 (“more control”), and 14 (“hypoglycemia”), which showed a correlation of 0.182, 0.164, and 0.185, respectively (Table 4). However, deletion of these factors from the scale did not result in an increase in the  $\alpha$  coefficient and the factors were therefore left in. In fact, deletion of none of the 29 factors resulted in an increase in  $\alpha$ .

### AWIS

AWIS was  $-1.88 \pm 2.04$ , consistent with a negative effect of the DM and its treatment on QoL of cat and owner.

### Correlation of DIAQoL-Pet and General Measures of QoL

There was a moderate correlation between DIAQoL-pet AWIS and the overview item A (general QoL pet;  $\rho = 0.36$ ,  $P < .001$ ). The correlation with overview item B was higher (diabetes-dependent QoL;  $\rho = 0.48$ ,  $P < .001$ ).

### Additional Questions

When asked “If your pet had not been insured for the treatment of diabetes, would you have been willing or able to go ahead with treatment”? Three of 221 (1%) of respondents answered “no,” 14/221 (6%) “don’t know,” 36/221 (16%) did not answer this question, and 168/221 (76%) answered “yes.”

**Table 3.** Descriptive statistics of DIAQoL-pet overview items for diabetic cats and their owners.

Item Name	Mean $\pm$ SD	Range
A General QoL pet	$+1.62 \pm 1.38$	–2 to 3 <sup>a</sup>
B Diabetes-dependent QoL pet	$-1.55 \pm 1.14$	–3 to 2 <sup>a</sup>

<sup>a</sup>Maximal range –3 to 3.  
QoL, quality of life.

When asked “In the unfortunate event that another one of your pets were to get diabetes, would you treat this pet with insulin too”? Eighteen of 221 (8%) of respondents answered “probably,” 3/221 (1%) “not sure,” 1/221 (0.5%) “definitely not,” 0/221 (0%) did not answer, and 199/221 (90%) reported “without a doubt.”

Finally, when asked “Would you recommend friends and family with pets diagnosed with DM to go ahead with insulin injection treatment on the basis of your experiences with your pet”? Twenty-three of 221 (10%) of respondents answered “probably,” 4/221 (2%) “not sure,” and 194/221 (88%) “without a doubt.”

### Free Comments Section

One hundred and fifty-two owners of diabetic cats provided an entry into the free comments section. Comments mostly emphasized areas already covered by the DIAQoL-pet. Three areas were mentioned by 3 or more respondents and were not directly covered by the DIAQoL-pet. Twenty-three respondents reported lack of veterinary advice or support, as well as poor understanding or knowledge of their veterinarian, particularly with regards to diet and home monitoring of blood glucose. Forty-two owners made additional comments on blood glucose testing at home with 19 owners of insulin-treated diabetic cats specifically reporting being less worried now that they performed such monitoring; while 3 owners of diabetic cats emphasized the burden of the monitoring and stabilization process because of the time and money investment. Eight owners reported finding support on various websites helpful in dealing with the DM of their cat.

### Discussion

The DIAQoL-pet was developed to quantify the perceived impact of DM and its treatment on QoL of both diabetic pets and their owners. Robustness (validity, unidimensionality, reliability) of the tool was

**Table 4.** Principal components analysis (extraction communalities and loadings) and reliability analysis of the DIAQoL-pet.

Item Number	Item Name	Communalities (Extraction)	Factor Matrix (Loading)	Corrected Item – Total Correlation	Cronbach's $\alpha$ if Item Deleted
1	Worry	0.605	0.690	0.574	0.792
2	No treats	0.582	0.530	0.426	0.801
3	Injections restrict life	0.683	0.559	0.525	0.798
4	Injection pain	0.717	0.487	0.387	0.804
5	Injection worries	0.627	0.619	0.538	0.797
6	Resent inject	0.564	0.232	0.182	0.808
7	Restrict your activities	0.744	0.606	0.556	0.795
8 <sup>a</sup>	Extra things	0.487	−0.354	−0.200	0.826
9	More control	0.713	0.252	0.164	0.814
10	Pet's moods	0.655	0.653	0.531	0.797
11	Pet unwell	0.709	0.584	0.482	0.800
12	Boarding kennels	0.520	0.262	0.200	0.815
13	Friends and family	0.615	0.439	0.383	0.802
14	Hypoglycemia	0.657	0.220	0.185	0.808
15	Active day	0.589	0.346	0.335	0.804
16	Drinking	0.706	0.401	0.370	0.802
17	Hungry	0.701	0.408	0.338	0.803
18	Urinate	0.762	0.506	0.465	0.798
19	Weight loss	0.565	0.348	0.313	0.805
20	Future care	0.610	0.616	0.516	0.796
21	Worry hypo	0.638	0.616	0.513	0.795
22	Worry DKA	0.640	0.644	0.477	0.797
23	Worry vision	0.540	0.494	0.395	0.802
24	Play less	0.641	0.284	0.207	0.808
25 <sup>a</sup>	Play more	0.934	−0.444	−0.203	0.826
26	Social life	0.658	0.554	0.475	0.797
27	Working life	0.619	0.626	0.574	0.792
28 <sup>a</sup>	Special bond	0.934	−0.444	−0.203	0.826
29	Costs	0.489	0.497	0.452	0.798

<sup>a</sup>Positive item.

proven by PCA, Cronbach's  $\alpha$  assessment and large-scale testing.

Although some items showed lower communality than others, this coefficient should be interpreted carefully. For instance, the communality of “costs” (0.489) in the DIAQoL-pet is one of the lowest of all items, yet proves quite meaningful when looking at its impact on the latent variable (IWIS:  $-3.04 \pm 3.78$ ), indicating necessity of inclusion in the QoL tool. Similarly, some items with relatively low loadings were purposely left in the scale. For instance, the loading of “boarding kennels” (0.262) is relatively low, yet has the highest IWIS ( $-4.67 \pm 5.30$ ) of all items. This is a commonly accepted procedure where arguments exist to retain the low-scoring item. Such arguments usually relate to the theory behind the initial item's inclusion and this is generally deemed to overrule any arbitrary cut-off level of loading scales, as long as the item does not significantly lower the tool's reliability.<sup>2</sup>

Data obtained in any study should be interpreted in light of the demographics and characteristics of the studied population. Indeed, the majority of cat owners originated from the United States and United Kingdom and represented owners of uninsured diabetic cats. Extrapolation to other populations of diabetic pets with different characteristics should therefore be performed cautiously.

The current study's results could have been influenced by the survey being only available online. The participating owners had to have internet access to complete the survey, thereby potentially lowering the proportion of elderly or underprivileged owners completing the survey. Conversely, the United Kingdom, the United States, as well as all other countries of origin are societies with high internet access availability. Seventy percent of households in the United Kingdom had internet access in 2009 and 74% of the population in North America were online regularly in 2008.<sup>8,9</sup> Furthermore, it is likely that owners of diabetic cats who are willing and able to treat their pet are probably more likely to belong to a more privileged socioeconomic subset of society with also higher internet access levels.

The signalment of diabetic cats was similar to recent reports.<sup>10,11</sup> Most animals were middle aged to elderly DSH. Most cats were treated with twice daily injections, according to the latest recommendations. A high proportion of owners of diabetic cats (49%) practiced home blood glucose measurement. This relatively high proportion might be explained by this survey being more likely to be completed by pet owners who are more proactive and involved than those who do not necessarily engage as intensively with their cat's DM and leave measurement of blood glucose concentration to their veterinary team.

The top 10 items with the most negative impact are a testament to the importance of recording the impact of treatment on the owner's life in addition to the, usually more attention receiving, animal's QoL. Indeed, 9 of these 10 items were more associated with the owner's QoL than the pet's QoL. Interestingly, items specifically related to injecting insulin did not feature in the top 15 most negatively impacting items. In fact the 1st item of this nature documented the restriction exerted by insulin injections on the owner's life rather than the actual injecting itself, while items such as "injection worries," "injection pain," and "resent injections" featured even lower on the list. All items related to classical clinical signs associated with DM ("drink," "hunger," "urinate," and "weight loss") featured outside the top 10 of most negatively impacting items. This may suggest most animals in the current study were fairly well controlled (judging from the low frequency ratings for these signs). Perhaps their IWIS would have been higher if a group of uncontrolled animals and their owners had been surveyed.

A discrepancy was identified between the perceived high impact of worrying about hypoglycemia ("worry hypo":  $-3.67 \pm 3.5$ ) and the perceived lower impact of hypoglycemia actually occurring ("hypo":  $-1.28 \pm 1.88$ ). It is understandable that owners are concerned about the possible occurrence and consequences of overdosing and hypoglycemia, and 35% of owners did report hypoglycemic episodes to possibly have been occurring at least occasionally. This information suggests a cautious approach to the current trend toward application of more aggressive, remission focused, insulin protocols, because, if associated with an increased frequency of hypoglycemia, the associated anxiety could discourage owners from treating the DM.

Additionally, clinicians might, in light of this discrepancy, want to consider to more actively advising owners to further reduce the chances of occurrence of these episodes, as well as to promote owners' confidence in early recognition and adequate management. These measures could markedly reduce anxiety levels among owners and increase QoL. For example, individual owners who experience a major level of anxiety over this particular issue could be introduced to home blood glucose monitoring (HBGM). Entries into the free comments section of the DIAQoL-pet, confirm the anxiety-reducing potential of HBGM, although some owners might in fact perceive this as an unwanted increase in responsibilities.

In recent years, and in contrast with the situation in dogs with DM, various different treatment protocols have been developed in feline DM treatment, instigated particularly by the advent of glargine insulin, HBGM devices and protocols, the increasing popularity and perceived benefits of low carbohydrate diets, and the desire to induce diabetic remission.<sup>12–16</sup> Additionally, more and more owners are also suffering from DM, or know people with DM, and therefore notice the difference in treatment approaches in human and veterinary clinical diabetology. Both these developments have led to different schools of thought on the ideal protocol for managing a diabetic cat, both within and outside the

veterinary community and have undoubtedly led to seemingly confusing and, at times, contradictory advice being offered to owners by veterinarians, fellow diabetic pet owners, and certain self-help veterinary, as well as nonveterinary, feline diabetes websites and groups. This might well be reflected by both the item "more control" achieving a high score in the DIAQoL-pet (cat) (2nd place; IWIS  $-4.24 \pm 4.66$ ), as well as the relatively frequent negative comments with regards to the "support from the veterinary team" in the free comments section.

In view of the comments made in the free comments section, consideration will be given to include items regarding "support from the veterinary team," "HBGM," "monitoring and stabilization process," "concurrent disease," and "support from non-veterinary sources, such as websites" into future adaptations of the QoL tool.

In conclusion, the DIAQoL-pet was able to reliably quantify diabetes-dependent QoL of diabetic cats and their owners and identified specific areas impacted by DM and its treatment. The tool could be used by clinicians and diabetic pet owners to assess and seek to improve QoL and treatment success, alongside clinical signs, BG, and fructosamine measurement. Application of the DIAQoL-pet in a population of diabetic dogs and their owners is also planned. The DIAQoL-pet may also prove useful in clinical trials of new diabetic treatment options, alongside measures of biological effect, as is routinely the case in human DM research.<sup>17,18</sup>

## Footnotes

<sup>a</sup> Copyright Questionmark Corporation, London, UK

<sup>b</sup> VIN, Davis, California

<sup>c</sup> SPPS Inc, Chicago, IL

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