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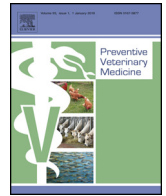
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# Common decisions made and actions taken during small-animal consultations at eight first-opinion practices in the United Kingdom



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## ABSTRACT

In order for veterinary surgeons to undertake an evidence-based approach to making decisions about their patients, it is important that new evidence is generated to support the clinical decision-making process. Many of the decisions are likely to be around the actions taken to treat or manage health problems discussed during the consultation, and little is currently known about the factors which affect the type of action taken. The aim of this study was to determine the decisions made and actions taken for health problems discussed during first-opinion small-animal consultations, as well as identifying factors which may affect the decision-making process.

Data were gathered during direct observation of small-animal consultations conducted by 62 veterinary surgeons in eight first-opinion practices in the United Kingdom. For each patient presented, data were gathered on all health problems discussed during the consultation. The decision made (whether an action was taken or not) and the action taken where applicable (e.g. therapeutic treatment with antibiotics) was also recorded. A three-level multivariable logistic-regression model was developed, with problem (Level 1) nested within patient (Level 2) nested within consulting veterinary surgeon (Level 3), and a binary outcome variable of action versus no action.

At least one action was taken for 69% ( $n = 2203/3192$ ) of all problems discussed. Therapeutic treatment was the most common action taken ( $n = 1286/3192$  problems; 40.3%), followed by management advice ( $n = 1040/3192$ ; 32.6%) and diagnostic work-up ( $n = 323/3192$ ; 10.1%). The most common therapeutic treatment was antibiotics ( $n = 386/1286$ ; 30%), while the most common management advice given was dietary advice ( $n = 509/1040$ ; 48.9%). The three explanatory variables remaining in the final model were whether the problem was a presenting or non-presenting problem, the type of diagnosis made, and the body system affected. Explanatory variables which did not remain in the final model were patient signalment, problem history, consultation type, clinical examination type, and who raised the problem (veterinary surgeon or owner).

For over two-thirds of problems discussed, an action was taken which suggests these problems may be seen as important by the veterinary surgeon and/or pet owner. No action was taken for almost a third of cases which could represent 'watchful waiting', which has been highlighted as important in human healthcare. Future research should focus on the common actions taken, further exploring the complex decision-making process, and examining the effect of the decisions made on long-term patient outcomes.

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## 1. Introduction

Evidence-based Veterinary Medicine (EVM) has been defined as 'the use of the best relevant evidence, in conjunction with clinical expertise, to make the best possible decision about a veterinary

patient. The circumstances of each patient, and the circumstances and values of the owner, must also be considered when making an evidence-based decision' (Dean et al., 2015). Previous research has highlighted the complexity of veterinary decision-making and suggested that EVM resources are needed to help veterinary surgeons make the best decisions for their patients (Everitt, 2011). Vanderweerd et al. (2012) suggested that veterinary surgeons may not always follow an evidence-based approach when making clinical decisions, and that there needs to be greater efforts to bridge the

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**Table 1**

The 10 most common actions or combination of actions taken for 3192 health problems discussed during first-opinion small-animal consultations. Data were gathered during real-time direct observation of consultations involving 1901 patients conducted by 62 veterinary surgeons in eight practices between April 2011 and June 2012.

Action type	n	%
Action	2203	69.0
Therapeutic treatment	703	22.0
Management	545	17.1
Therapeutic treatment/Management	402	12.6
Work up only	147	4.6
Therapeutic treatment/Work up	118	3.7
Other <sup>a</sup>	101	3.2
Euthanasia only	64	2.0
Therapeutic treatment/Management/Work up	27	0.8
Management/Work up	19	0.6
Another combination of actions	77	2.4
No action	989	31.0
Total	3192	100.0

<sup>a</sup> Actions classed as 'Other' were mostly problems where the owner wished to consider the options further, where the animal was not presented by the owner, or where the veterinary surgeon decided to seek advice from another source.

gap between research and practice. In order for EVM to progress, future research should focus on answering the questions important to practicing veterinary surgeons when making decisions about their patients. These questions could be around the approach to a particular clinical presentation or the diagnosis, treatment or prevention of a particular disease.

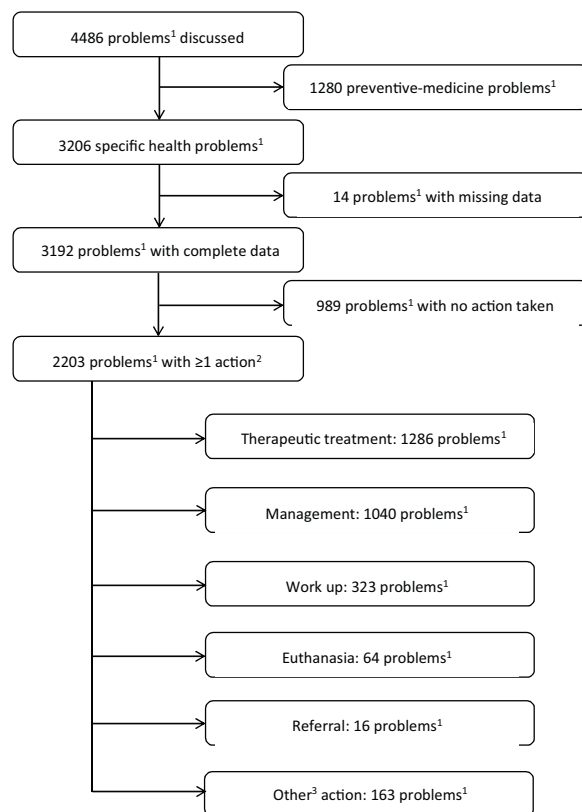
Ebell et al. (2013) asked practicing veterinary surgeons to record the clinical questions they had about their cases during small-animal consultations, and found that over half of the questions related to treatment or management. A further 20% of questions were about diagnosis, with many of these being about diagnostic testing. This suggests that many of the decisions made by veterinary surgeons during the consultation relate to actions they may take to investigate, manage or treat health problems in their patients. There have been recent initiatives to collate the best available evidence on actions taken (e.g. treatment) by veterinary surgeons, in order to help with evidence-based decision-making (Dean et al., 2015; VetSRev, 2016; Banfield, 2016). The evidence available is often limited, of poor quality or of little relevance to clinical practice, so new, high quality, relevant evidence is clearly needed in order to support the decision-making process. Determining the common decisions made and actions taken during first-opinion small-animal consultations, as well as the factors which influence this, will help direct future research towards areas where new evidence is needed.

The first aim of this study was to determine the decisions made and actions taken by veterinary surgeons and clients for all problems discussed during a convenience sample of observed small-animal consultations. The second aim was to examine the effect of various factors which may influence the decisions made and actions taken.

## 2. Materials and methods

### 2.1. Practice selection

A convenience sample of eight first-opinion independently-owned veterinary practices was recruited to the study (Robinson et al., 2015a). Practices recruited were those involved in a previous study (Dean et al., 2013), or those who had expressed interest in working with the Centre for Evidence-based Veterinary Medicine (CEVM). Eight practices in total were chosen as this was considered to be the maximum number of practices which could feasibly



**Fig. 1.** Flow chart showing the actions taken for all health problems discussed during real-time direct observation of small-animal consultations conducted by 62 veterinary surgeons in eight practices between April 2011 and June 2012.

<sup>1</sup> Presenting and non-presenting problems included.

<sup>2</sup> Individual actions total more than the 2203 problems with an action as some problems had more than one action taken.

<sup>3</sup> Actions classed as 'Other' were mostly problems where the owner wished to consider the options further, where the animal was not presented by the owner, or where the veterinary surgeon decided to seek advice from another source.

be studied using the methods selected. Six practices were located in England (three in the Midlands and three in the South) and two practices were located in Scotland. Five practices treated small animals only, while three practices also treated farm and equine patients. Three practices were single branch only, while five practices had two or more branches. The median number of veterinary surgeons carrying out small-animal consultations per practice was 8 (range 3–20, Interquartile range (IQR) 5–9). The median years qualified of all veterinary surgeons observed was 14.3 (range 1–40 years, IQR 6.5–21.0 years). Of the 62 veterinary surgeons observed, 12 (19.4%) were RCVS certificate holders.

### 2.2. Data-collection tool

A data-collection tool consisting of a paper form with a series of open and closed questions was developed to allow the collection of complex data by real-time direct observation during small-animal consultations at participating practices. The tool was able to gather data on the characteristics of the patient and consultation, including signalment of the animal(s) presented, type of consultation, and type of clinical examination, as well as data on all problems discussed during the consultation. A problem was defined as 'any two-way discussion between owner/carer and vet regarding any aspect of the patient's health and wellbeing'. The reason for presentation (as stated by the owner) or first problem raised where the reason was not stated, was considered to be the 'presenting problem'; each additional problem discussed was considered to be

**Table 2**

Significant results of chi-square analysis comparing decision made with various consultation, patient, and problem characteristics (definitions for each category within these variables can be found in Appendix A). Data were gathered on 3192 health problems affecting 1901 patients presented during real-time direct observation of small-animal consultations conducted by 62 veterinary surgeons in eight practices between April 2011 and June 2012.

Variable	Categories	Decision made				p
		Action		No action		
		n	%	n	%	
Problem type	Presenting	1127	93.3	81	6.7	<0.001
	Non-presenting	1076	54.2	908	45.8	
Problem history	New	1103	64.7	601	35.3	<0.001
	Pre-existing	1100	73.9	388	26.1	
Consultation type	Preventive medicine	515	55.3	417	44.7	<0.001
	Specific health problem	1688	74.7	572	25.3	
Species	Dog	1476	68.4	682	31.6	<0.001
	Cat	603	69.1	270	30.9	
	Rabbit	83	76.9	25	23.1	
	Other	41	77.4	12	22.6	
Clinical exam	None	135	89.4	16	10.6	<0.001
	Focused	691	80.1	172	19.9	
	Full	1363	63.0	801	37.0	
Raised by	Vet	862	72.3	330	27.2	0.002
	Owner	1333	67.1	653	32.9	
Diagnosis type	Definitive	482	74.0	169	26.0	<0.001
	Working/Presumed	367	68.3	170	31.7	
	Open	453	52.9	403	47.1	
	Previous	874	79.5	226	20.5	
Body system	Skin	555	68.7	253	31.3	<0.001
	Gastrointestinal	280	78.7	76	21.3	
	Musculoskeletal	223	82.3	48	17.7	
	Dental	165	63.0	97	37.0	
	Eyes	135	61.6	84	38.4	
	Respiratory	84	67.2	41	32.8	
	Cardiovascular	54	45.0	66	55.0	
	Behaviour	73	62.9	43	37.1	
	Neurological	70	61.9	43	38.1	
	Non-specific	436	72.9	162	27.1	
	Other	128	64.3	71	35.7	

a 'non-presenting problem'. No numerical order was given to non-presenting problems. Each presenting and non-presenting problem was further defined as either relating to preventive medicine or to a specific health problem. Each consultation was also defined as being a preventive-medicine consultation or a specific health-problem consultation, depending upon whether the presenting problem was relating to preventive medicine or to a specific health problem. All presenting and non-presenting specific health problems were included in analysis. All presenting and non-presenting preventive-medicine problems were excluded from analysis, as these problems were fundamentally different from, and resulted in different types of actions, than specific health problems.

Additional data collected on the characteristics of each health problem included the problem history (i.e. whether it was a new problem or pre-existing problem), who had raised the problem initially (the owner or veterinary surgeon), the body system affected, whether any diagnostic tests were performed, and type of diagnosis reached (Definitive, Working, Presumed, Open, Previous; for definitions see [Robinson et al. \(2016a\)](#)).

To ensure consistent coding, definitions were developed for type of consultation, type of clinical examination, problem history, body system affected, and diagnosis type (Appendix A). Following initial development of the tool, pre-test and pilot studies were conducted between August 2010 and March 2011. An inter-rater reliability study of the tool was carried out in May 2012 and the results are reported in [Robinson et al. \(2016b\)](#). Development, testing, and utilisation of the data-collection tool has been described in more detail previously ([Robinson et al., 2015a](#); [Robinson et al., 2015b](#)).

### 2.3. Decision made

The decision made, defined as 'action' or 'no action' for each problem (presenting and non-presenting) was recorded using a closed field. 'No action' was defined as no treatment or advice being given, other than non-specific monitoring, while 'action' involved treatment, advice or another action beyond basic non-specific monitoring. Problems which resulted in 'action' were then further categorised as to what type of action was taken. The categories were defined as follows:

- Therapeutic treatment: administration or application of a remedy to a patient in an attempt to alleviate and/or cure a clinical sign, disease or injury e.g. administration of a non-steroidal anti-inflammatory to alleviate the signs of osteoarthritis
- Management: any change in husbandry and/or animal care advised which may assist in reducing the severity and/or frequency of a condition e.g. restriction of calorie intake in a dog with obesity
- Work Up: any diagnostic test or further investigation excluding history-taking and routine clinical examination, for which the results are not available by the end of the consultation and which could help to identify the underlying cause of the presenting complaint e.g. chest radiography in a dog with a chronic cough. Tests undertaken in the consultation were not included in this as the results would have been available by the end of the consultations.
- Referral: any problem for which the animal is referred, either to an external specialist, or internally to another member of staff

**Table 3**  
Explanatory variables remaining in the final three-level logistic-regression model. Data were gathered for 3031 health problems affecting dogs and cats presented during real-time direct observation of consultations in eight practices between April 2011 and June 2012. The outcome variable for the model was binary with action coded as 1 and no action coded as 0. Problem at Level 1 was clustered within patient (Level 2) which was clustered within consulting veterinary surgeon (Level 3).

Parameter	Median	95% credible interval		Odds ratio
		Lower	Upper	
Intercept ( $B_0$ )	-0.212	-0.418	-0.008	
Problem type				
Non-presenting	Reference			
Presenting	2.773	2.479	3.090	16.007
Diagnosis type				
Open	Reference			
Working/Presumed	0.528	0.233	0.832	1.696
Definitive	1.576	1.266	1.898	4.850
Previous	1.297	1.035	1.570	3.658
Body system				
Other	Reference			
Skin	-0.729	-0.970	-0.492	0.482
Dental	-1.110	-1.476	-0.748	0.330
Eyes	-1.136	-1.534	-0.735	0.321
Cardiovascular	-1.238	-1.792	-0.698	0.290
Neurological	-1.175	-1.796	-0.549	0.309

with expertise or a special interest in a particular field e.g. referral of a dog with a history of seizures to a neurologist for assessment

- Euthanasia: any case where the animal is euthanized during the consultation
- Other: any action which does not fit into another category

More than one 'Action Type' category could be selected for each problem, for example a dog with osteoarthritis might be prescribed non-steroidal anti-inflammatories (Action: 'therapeutic treatment') and also given advice about exercise (Action: 'manage'), so two categories would be selected.

#### 2.4. Specific action

The specific action taken within each category, for example prescription or administration of an antibiotic, where applicable, was also recorded in an open field and later coded. To ensure consistent coding, records were kept detailing how cases were coded, which could be referred back to when coding subsequent similar cases to ensure the same terminology was used. Where queries arose surrounding the categorisation and coding of data, discussions with colleagues in the CEVM and veterinary surgeons in participating practices were used to decide how data should be coded. A record was kept of these discussions to ensure similar cases were coded in the same way.

Specific actions were grouped by class or type, for example, administration of enrofloxacin would be coded as 'Antibiotic' whilst taking a blood sample to determine T4 levels would be coded as 'Blood test'.

#### 2.5. Data collection

Data were collected during two separate one-week periods at each of the sentinel practices (Robinson et al., 2015a). The primary investigator observed consultations by a number of different vets during regular weekday consulting hours between April 2011 and June 2012. Where multiple veterinary surgeons were consulting simultaneously, selection of consultation stream to observe was based on convenience and feasibility (e.g. consultation room size), however an effort was made to ensure some time was spent observing each veterinary surgeon during the data-collection period.

#### 2.6. Statistical analysis

Descriptive statistics, including pivot tables to generate frequency data, were carried out using IBM® SPSS® Statistics 21. Where species data is shown, data will be presented for the three

most frequently presented species (dog, cat, and rabbit). Where specific actions are listed, the 10 most frequently recorded actions will be reported. The chi-square test was used to compare categorical variables, for example species and decision made (i.e. whether an action was taken or not). The Mann Whitney *U* test was used to compare numerical (non-parametric) and binary variables, for example patient age and decision made. Statistical significance was initially set at the 0.05 level, with a Bonferroni correction carried out to account for multiple comparisons (Petrie and Sabin, 2009).

A multi-level multivariable logistic-regression model was built to investigate the factors associated with any decision made for a particular problem. A binary outcome variable for decision made was used, with 'Action' coded as 1 and 'No action' coded as 0. Only data collected for dogs and cats were included in the model, due to the small number of problems discussed for other species. The model was developed in MLwiN version 2.10 and was a three-level model with problem (Level 1) nested within patient (Level 2) nested within consulting veterinary surgeon (Level 3). Due to the small number of practices, practice could not be included as a fourth level and was instead added into the model as an explanatory variable at Level 3. The model took the following form:

$$\text{Decision}_{ijk} \sim \text{Binomial}(n_{ijk}, \pi_{ijk})$$

$$\text{logit}(\pi_{ijk}) = \beta_{0jk} + \beta_1 \times 1_{ijk} + \beta_2 \times 2_{ijk} + \beta_3 \times 3_{ijk} + \beta_4 \times 4_{ijk} \dots + \beta_k \times k_{ijk}$$

$$\beta_{0jk} = \beta_0 + v_{0k} + u_{0jk}$$

Decision<sub>ijk</sub> denotes the outcome for the *i*th problem discussed for the *j*th patient presented to the *k*th veterinary surgeon,  $u_{0jk}$  is the random effect for patient *j* presented to veterinary surgeon *k* and  $v_{0k}$  is the random effect for veterinary surgeon *k*.  $\beta_1 \times 1_{ijk}$ ,  $\beta_2 \times 2_i$ , and so on are explanatory variables and their associated coefficients.

Variables added into the model consisted of characteristics of the problem (see above), signalment data about the patient and consultation characteristics such as type of consultation and type of clinical examination. Only variables which had a *p* value <0.2 on initial chi-square and Mann Whitney *U* analysis were added into the model. All variables were categorical with the exception of patient age, which was centred around the grand mean upon addition to the model. The Box-Tidwell test was conducted to test the assumption that the logit of the outcome variable had a linear relationship to patient age (Hosmer and Lemeshow, 1989). An interaction term between patient age and its natural log was added to the model and examined for significance, which would suggest a non-linear relationship. Problem number was added as a categorical variable, with categories consisting of 1 problem, 2 problems,



**Table 4**

The 10 most frequently recorded types of therapeutic treatment, management, and work up across 3192 problems affecting 1901 patients. Data were gathered during real-time direct observation of small-animal consultations conducted by 62 veterinary surgeons in eight practices between April 2011 and June 2012.

Action type	Total no. of problems	Specific actions	n	% <sup>a</sup>
Therapeutic treatment	1286	Antibiotics	386	30.0
		NSAIDs <sup>b</sup>	330	25.7
		Topical treatment	214	16.6
		Steroid	118	9.2
		Pain relief	82	6.4
		Hormone control (non-repro) <sup>c</sup>	61	4.7
		Soft tissue surgery	51	4.0
		Fluid therapy	49	3.8
		Dental procedure	36	2.8
		Empty anal glands	35	2.7
Management	1040	Dietary advice	509	48.9
		Bathing/cleaning	134	12.9
		Exercise advice	132	12.7
		Nutraceutical	76	7.3
		Ear cleaner	69	6.6
		Dental hygiene	54	5.2
		Buster collar	52	5.0
		Grooming/coat brushing	38	3.7
		Behavioural modification	36	3.5
		Bandaging	30	2.9
Work up	323	Blood test	194	60.1
		Radiography	47	14.6
		Urinalysis	46	14.2
		Ultrasound	26	8.0
		Histopathology	19	5.9
		Swab (culture and sensitivity)	13	4.0
		Fine needle aspirate	8	2.5
		Swab (in-house microscopy)	7	2.2
		Faecal examination	7	2.2
		Endoscopy	6	1.9

<sup>a</sup> Percentages shown are based on each action (n column) divided by the total number of problems (Total no. of problems column).

<sup>b</sup> NSAIDs = Non-steroidal anti-inflammatory drugs.

<sup>c</sup> Hormone control (non-repro) = Therapeutic control of non-reproductive hormones.

3 problems, and 4 or more problems, to avoid making assumptions about linearity. Body system was added to the model as a categorical variable with the ten most frequently affected body systems as separate dummy variables. The remaining body systems, which often had very small numbers, were grouped into a single reference category which was called 'Other'. For the variable diagnosis type, working and presumed diagnoses were combined into a single category due to the small number of problems reaching a working diagnosis. Cross-tabulations were performed for all explanatory variables prior to building the model, and examined for evidence of strong collinearity. Forward selection was initially used to build the model, with variables added one at a time. Random-intercept models were fitted first then random-slope models examined for each variable. Two-way interaction terms were then evaluated for all explanatory variables, including those not retained as main effects. Iterative generalised least squares (IGLS) were used for initial parameter estimates with significance calculated using the Wald test (Hox, 2010). Markov-chain Monte Carlo (MCMC) simulations with 50,000 iterations and a burn-in length of 5000 were then used for final parameter estimates, using IGLS estimates as starting values and with diffuse prior distributions specified for model parameters. MCMC estimation was used because it produces more reliable estimates (Browne and Draper, 2006) particularly where there are smaller sample sizes within level 2 units (i.e. where only a small number of consultations were recorded for some veterinary surgeons, or only a small number of problems were discussed for some patients). Deviance information criterion (DIC) was used as a measure of goodness-of-fit, with decreasing DIC representing improved model fit, and so the final model selected was that with the lowest DIC. Variance at the patient level (Level 2) and consulting-veterinary-surgeon level (Level 3) was estimated using the latent-variable approach (Goldstein et al., 2002).

## 2.7. Ethical approval

Approval was obtained from the ethics committee at the School of Veterinary Medicine and Science, The University of Nottingham for the collection of data through direct observation, and subsequent analysis of these data. Details of how informed consent was obtained and how data were anonymised have been detailed in a previous manuscript (Robinson et al., 2015a).

## 3. Results

A total of 1720 consultations were observed with 62 different veterinary surgeons and data were recorded for 1901 animals presented. In total, 4486 presenting and non-presenting problems were discussed for these 1901 patients, of which 3206 problems related to a specific health problem and so were included in the analysis (as opposed to preventive-medicine problems, which were excluded from further analysis) (Fig. 1).

### 3.1. Decision made

Data on the decision made were missing for 14 problems, therefore data were available for 3192/3206 problems (99.6%). Almost one third of problems resulted in no action (n = 989/3192; 31.0%) while the remaining 69.0% (n = 2203/3192) resulted in at least one action (Fig. 1).

For problems resulting in an action, only one action type was recorded for 1560/2203 (70.8%) problems while more than one action type was recorded for 643/2203 (29.2%) problems. The most common action, or combination of actions taken, were therapeutic treatment, management, and therapeutic treatment/management in combination (Table 1).

**Table 5**  
The 10 most frequently recorded specific actions recorded for health problems affecting dogs, cats, and rabbits. Data were gathered during real-time direct observation of small-animal consultations conducted by 62 veterinary surgeons in eight practices between April 2011 and June 2012.

Species	Total no. of problems	Specific action	n	% <sup>a</sup>
Dog	2158	Dietary advice	359	16.6
		Antibiotic	233	10.8
		NSAIDs <sup>b</sup>	216	10.0
		Topical treatment	176	8.2
		Exercise control	121	5.6
		Blood test	107	5.0
		Bathing/cleaning	92	4.3
		Steroid	85	3.9
		Nutraceutical	67	3.1
		Ear cleaner	64	3.0
Cat	873	Antibiotic	130	14.9
		Dietary advice	117	13.4
		NSAIDs <sup>b</sup>	99	11.3
		Blood test	87	10.0
		Bathing/cleaning	35	4.0
		Steroid	33	3.8
		Topical treatment	28	3.2
		Hormone control (non-repro) <sup>c</sup>	28	3.2
		Fluid therapy	24	2.7
		Pain relief	24	2.7
Rabbit	108	Dietary advice	27	25.0
		Antibiotic	16	14.8
		NSAIDs <sup>b</sup>	15	13.9
		Topical treatment	10	9.3
		Burr teeth	8	7.4
		Bathing/cleaning	6	5.6
		Radiography	1	0.9
		Swab (c + s) <sup>d</sup>	1	0.9

<sup>a</sup> Percentages shown are based on each action (n column) divided by the total number of problems (Total no. of problems column).

<sup>b</sup> NSAIDs = Non-steroidal anti-inflammatory drugs.

<sup>c</sup> Hormone control (non-repro) = Therapeutic control of non-reproductive hormones.

<sup>d</sup> Swab (c + s) = Swab sent to an external laboratory for culture and sensitivity testing.

The Bonferroni correction resulted in an adjusted significance level of  $p = 0.003$ . Initial chi square analysis and Mann-Whitney  $U$  tests revealed that decision made did not vary significantly with sex ( $p = 0.184$ ), neutering status ( $p = 0.855$ ), breed ( $p = 0.185$ ), whether the patient was weighed ( $p = 0.022$ ) or patient age ( $p = 0.062$ ). Decision made did vary significantly with number of problems discussed ( $p < 0.001$ ) as well as with various other consultation, patient, and problem characteristics (Table 2).

Data for 3031 problems in total affecting dogs and cats were included in the three-level multivariable model. All 8 variables were tested and used on the Bonferroni correction. There was no evidence of any strong collinearity between the any of the explanatory variables, including those subsequently excluded from the final model. No random slopes or interaction terms were retained within the model. The interaction term between patient age and its natural log was not significant when added to the model, so the assumption of linearity was not violated. Body system dummy variables for Musculoskeletal, Behaviour, Gastrointestinal, Respiratory, and Non-specific problems were not significant, so a new body system variable was coded with these non-significant body systems now included in the 'Other' reference category. Skin, Dental, Eyes, Cardiovascular and Neurological body systems were all significant, so remained as separate dummy variables, and the model was checked to ensure this did not result in a change in model fit. The three explanatory variables remaining in the final model were whether the problem was a presenting or non-presenting problem, the type of diagnosis made, and the body system affected. Explanatory variables which did not remain in the final model were practice, number of problems discussed, patient signalment variables (species, breed, age, and sex), problem history, consultation type, clinical examination type, and who raised the problem.

Presenting problems and problems which received any kind of diagnosis (as opposed to the diagnosis remaining open) were more likely to result in an action, even when accounting for other problem, patient, and consultation characteristics (Table 3). Skin, dental, eye, cardiovascular, and neurological problems were less likely to result in an action being taken than problems affecting other body systems, when accounting for other variables. The proportion of unexplained variation attributable to patient (Level 2) and veterinary surgeon (Level 3) differences combined was 12.96%.

### 3.2. Specific actions

Medications including antibiotics ( $n = 386/1286$ ; 30.0%) were among the most common therapeutic treatments, while dietary advice ( $n = 509/1040$ ; 48.9%) was the most common management advice given (Table 4). Blood tests were the most common type of diagnostic work up ( $n = 194/323$ ; 60.1%).

Dietary advice, antibiotics, and non-steroidal anti-inflammatory drugs were the three most common specific actions for all three species (Table 5).

## 4. Discussion

For the majority of health problems discussed during the consultation, the decision was made to take an action, or a combination of actions, although for almost a third of problems, a decision was made to take no action. These actions encompass a wide range of different approaches including medications, advice, and diagnostic tests.

Multiple different actions were often taken for each problem discussed, and data published previously from this work has suggested that multiple problems are frequently discussed during a

single consultation (Robinson et al., 2015a). This supports previous findings that the clinical decision-making in veterinary consultations is highly complex (Everitt, 2011; Vanderweerd et al., 2012). When considering future research on decision-making, priorities should not only focus on therapeutic treatments of disease, but also on management advice, particularly dietary advice which was the most common recommendation made. This is perhaps unsurprising given that overweight/obese and periodontal disease have previously been identified as among the most commonly diagnosed conditions (Lund et al., 1999; O'Neill et al., 2014a; O'Neill et al., 2014b; Robinson et al., 2015b). Given that management advice was given almost as frequently as therapeutic treatment, this has important implications for veterinary practice, particularly from a business perspective in terms of managing client expectations. In human healthcare, previous research examining patient expectations of their general practitioner in the UK has suggested that medical treatment and diagnostic tests are less of a priority to patients than receiving information and an explanation of the problem (Williams et al., 1995). It is currently unclear whether veterinary client expectations are similar to those of patients in human healthcare. In the UK, the majority of veterinary patients are seen in private practice, while the human healthcare predominantly takes place under the National Health Service, which is free at the point of care, therefore expectations of these two different services may be considerably different. Understanding owner expectations of a consultation with their veterinary surgeon would be a useful topic for further research, and would allow veterinary practice to manage clients' expectations, and emphasise the value of veterinary advice in addition to prescribed treatment if necessary.

The decision to take no action was made for almost one-third of problems. The final model would suggest that non-presenting problems, problems without a diagnosis, and problems affecting certain body systems (e.g. skin problems and dental problems), are more likely to result in no action being taken. The type of problem seemed to most affect whether an action was taken or not, as a presenting problem was most likely to have an action taken. It may be that problems within these categories are less likely to be prioritised by decision makers compared to presenting problems or problems affecting other body systems. If an order was given to the non-presenting problems it may have been possible to explain further why some were more likely than others to have an action. This was done as the order in which non presenting problems arise is related to a number of issues e.g. how a clinician does a clinical examination, what questions the client asks etc which do not necessarily reflect their importance. Alternatively it may be that in many cases, the decision to take no action was the result of weighing up the benefits and risks of taking an action. It is possible that there may have been a plan to re-evaluate at a later date but it is not possible to capture this information using this data collection method as the complexity of this decision-making would require qualitative data. In clinical decision-making in human healthcare, actions are often thought about in terms of withholding treatment, testing prior to treatment, or treating without further testing, depending upon the probability of a patient having a particular disease (Pauker and Kassirer, 1980). Withholding treatment (often termed 'watchful waiting') is now often seen to be useful both in terms of aiding diagnosis and avoiding unnecessary intervention, particularly for conditions which may be self-limiting or for which overtreatment may be a concern (McCormick et al., 2005; Holmberg et al., 2012; Kendall and Murray, 2006). It remains unclear whether veterinary surgeons in the current study actively decided to use watchful waiting, or whether others factors such as owner preference or time constraints (Robinson et al., 2014) resulted in no action being taken for some problems. To understand 'watchful waiting' in veterinary medicine further consultations may need to be specifically studied for problems where no action was taken and if a future plan

was made for each particular problem. Future research could focus on identifying problems for which watchful waiting may be useful, either to aid the diagnostic process, or to avoid overtreatment which is currently topical in human healthcare (Godlee, 2012).

The diagnosis type does appear to have an impact on the decision made, even when accounting for other characteristics of the individual health problem discussed, for example body system affected. However, it is currently unclear how making a diagnosis, and the decision made based upon this, influences the longer term outcome of the case. It has been suggested that making a diagnosis is simply an intermediary step which helps guide the clinician towards the best way to treat and manage a patient (Del Mar et al., 2006). In human healthcare, it is recognised that for certain problems this intermediary step is often unnecessary, for example antibiotics are likely to resolve dysuria in women regardless of the results of a urine dipstick test (Del Mar et al., 2006). Understanding whether making a diagnosis ultimately improves treatment success and survival, or reduces recurrence, will give a better idea of how important making a diagnosis is in the decision-making process.

Euthanasia was a relatively rare action, which is consistent with previous findings that 3.8% of all consultations result in euthanasia (Evans et al., 1974), and that UK veterinary surgeons conduct on average just 5.8 euthanasia procedures per month (Dickinson et al., 2014). However, euthanasia consultations may have been under-represented, as only a proportion of all consultations each day were recorded and euthanasia consultations may have been booked in with other veterinary surgeons. Referral was also a rare action, which may in part be due to the fact that around one fifth of the veterinary surgeons observed were certificate holders, therefore some more complex procedures or investigations may not have required referral outside the practice. However, the most recent RCVS Survey of the Veterinary Profession (Buzzeo et al., 2014) found that 18.4% of respondents held an RCVS certificate, suggesting that the veterinary surgeons observed may be similar to the rest of the UK veterinary profession in terms of further qualifications. Much previous veterinary research has gathered data from referral practice, and the results of the current study suggest that concerns raised regarding referral bias (Bartlett et al., 2010) may be justified. While such studies may provide useful information on referral caseload for that particular centre, they are unlikely to be representative of cases seen in first-opinion practice, particularly as so few are referred. In recent years, there has been a growing effort to conduct research in a first-opinion practice setting in the UK, with projects such as VetCompass (2016) and SAVSNET (2016), and the Nottingham Equine Colic Project (Freeman and Curtis, 2015) publishing new evidence of direct relevance first-opinion veterinary surgeons.

Antibiotics were prescribed more frequently for problems affecting cats than problems affecting dogs, though they were among the most common specific actions taken for all species. This is consistent with findings by Radford et al. (2011), who examined electronic clinical records of 16 practices in England and Wales and found 35.1% of dogs were prescribed antimicrobials, compared with 48.5% of cats. However, Radford et al. (2011) only included animals presented for the investigation of a health problem, while the current study included health problems discussed during preventive-medicine consultations, and examined actions taken at a problem, rather than animal, level. Usage of these drugs and concerns about antimicrobial resistance in companion animals has caused recent controversy (Bhumbra, 2012). This has led to the PROTECT guidelines being developed (Battersby, 2011) and veterinary surgeons being urged to become 'antibiotic guardians' as part of the European Antibiotic Awareness Day (Woodmansey, 2015).

Now that the current study has identified common specific actions for the most frequently presented species, the evidence base for each of these actions needs to be examined to identify knowledge gaps. In human healthcare, the James Lind Alliance



(JLA, 2016) conducts priority setting meetings to determine which unanswered questions about interventions are most important to clinicians and patients. This method has previously been adapted to veterinary medicine, with a priority setting meeting conducted to identify important questions about the treatment of chronic kidney disease in cats (Dean, 2015). As well as using knowledge gaps to identify diseases for which future research questions need to be prioritised, the JLA (2016) also look at variability in the management of a disease between practitioners to identify areas of treatment uncertainty. In veterinary medicine, variability in treatment and management has already been identified for congestive cardiac failure (Davies et al., 2015) and keratoconjunctivitis sicca (Brennan et al., 2015). Examining in more detail how individual diseases are currently managed by practitioners may help to identify diseases where there is uncertainty or disagreement surrounding the best treatment, highlighting areas in which prioritisation of future research would be useful.

There are many potential limitations to this research, some of which have been discussed previously (Robinson et al., 2015a; Robinson et al., 2016b). The practices recruited were a convenience sample of practices and therefore the results may not be generalizable to all UK veterinary practices. However, all variables remaining within the model were at the problem level, and only a small proportion of unexplained variance remained in the higher levels of the model, suggesting decisions around actions taken may vary more with the type of problem than with the individual veterinary surgeon or practice. Additionally, the data does not explain why the decisions were made and actions taken. Only the final decision and resulting action, and not alternative actions which were discussed as an option but not eventually taken, were recorded. It must also be remembered that it is not possible to record from this dataset which of the planned actions e.g. blood tests actually happened as none of the consultations could be followed up. All that could be recorded was what was advised in the consultation. Previous research has suggested decision-making is influenced by the owner to a large extent (Everitt, 2011) and so further work is required to capture the full complexity of the decision-making process in the veterinary consultation. Qualitative research methodologies could also be employed to better understand the decision-making process in the veterinary consultation.

## 5. Conclusions

Therapeutic treatment, management advice, and no action, which may represent 'watchful waiting', were all common actions taken as a result of decisions made during these veterinary consultations. Characteristics of the problem, such as body system affected, appeared to play an important role in determining whether an action was taken for a particular problem. Future research should be prioritised around the common actions taken, but should also seek to further understand the complex decision-making process that takes place during the consultation, as well as examining the effect of the decisions made on long-term patient outcomes.

## Conflict of interest

None.

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## Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.prevetmed.2016.12.002>.

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