Collecting data and designing experiments

Planning involves deciding the details such as when the data collection will take place, who will collect the data, and where data collection will take place. Design, on the other hand, focuses on how the information required is going to be collected.

If done correctly all methods of data collection are capable of producing excellent results. Likewise, if done poorly, it is possible to collect data of no meaning or which cannot be analyzed. Therefore planning and designing the method of data collection for a research study is extremely important.

This article aims to explain the most common methods of data collection with examples of when their use may be appropriate within veterinary nursing research.

Quantitative or qualitative?
Quantitative studies involve the collection of numbers, percentages etc, whereas qualitative studies involve the collection of descriptive words and sentences (Blumberg et al, 2011). When deciding on how to collect data for research it is important to consider the type of data required to meet the research aim, whether this be quantitative, qualitative or a combination of both.

For example, a research study into the effect of different methods of maintaining body temperature post operatively would involve the collection of temperature readings and would be quantitative. However, a study regarding the reasons why clients choose a particular veterinary practice would involve the collection of data such as clients’ observations and opinions and would be qualitative. It is possible that some studies may lend themselves to a combination of quantitative and qualitative data collection. For example, collection of data such as the quantity and types of food sold within practice (quantitative) alongside discussing with clients why they purchase a particular food (qualitative).

Additionally, where appropriate, qualitative data can be converted into quantitative data, such as the use of body condition scores, pain scores, stress scores etc (Kessler and Turner, 1997; University of Glasgow Faculty of Veterinary Medicine, 2010). This technique of assigning a numerical value to observations allows for more straightforward analysis of such observations to be made during research. An example of this is a study by Kessler and Turner (1997) who used cat stress scores to compare a number of different boarding environments to ascertain which caused the least stress to the feline inhabitants.

Abstract
Planning is essential in any successful research project and deciding on what data to collect and how to collect it is not as simple as it may seem. There are many different methods available to collect data and the most suitable method will differ depending on the individual project. No matter which method is chosen sufficient time must be spent preparing and piloting the chosen method. This is to avoid situations where time and money have been spent and incorrect data, or data with no means of analysis have been collected. This article explains the use of some of the common methods of data collection (questionnaires, interviews, focus groups and experiments) giving examples of when their use might be appropriate within veterinary nursing research.

Keywords: nursing research, data collection, questionnaires, focus groups, interviews, experiment design
Another important consideration when designing a questionnaire is the type of questions to be asked; should they be open-ended, closed or a combination of the two? The type of question that is appropriate will depend on the intended aim of the research and the data that are required. Closed questions present the respondent with fixed responses and are easier to analyze statistically as answers have some direction and can be counted and grouped. Open-ended questions have no fixed responses and the respondent answers the question as they see fit. They are more difficult to analyze statistically due to the variation in responses received. Some examples of closed and open-ended questions can be seen in Table 1. For quantitative studies closed questions are required to allow answers to be tallied and comparisons made although the inclusion of a small number of open-ended questions may allow the collection of opinions etc, which could be of interest in the discussion of results.

There are multiple methods by which questionnaires can be administered: postal; face to face; telephone; and email or web based. All have various advantages and disadvantages some of which are shown in Table 2.

Table 1. Types of questions

<table>
<thead>
<tr>
<th>Closed questions</th>
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<tbody>
<tr>
<td>How often do you exercise your dog? (please tick one option)</td>
<td></td>
</tr>
<tr>
<td>Never □ Once weekly □ Once daily □ Twice daily □ More than twice daily □</td>
<td></td>
</tr>
<tr>
<td>How old (in years) is your pet?</td>
<td></td>
</tr>
<tr>
<td>In your opinion how important is puppy socialization? (please tick one option)</td>
<td></td>
</tr>
<tr>
<td>Very important □ Important □ Not important □</td>
<td></td>
</tr>
<tr>
<td>What is important when purchasing pet food? Please rank in order of importance from 1 (most important) to 3 (least important)</td>
<td></td>
</tr>
<tr>
<td>Cost ___ Health benefits ___ My pet likes it ___</td>
<td></td>
</tr>
<tr>
<td>Open questions</td>
<td></td>
</tr>
<tr>
<td>What changes/improvements would you like to see made at the practice?</td>
<td></td>
</tr>
<tr>
<td>Why did you choose to bring your pet to this veterinary practice?</td>
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</table>
Table 2. Advantages and disadvantages of different methods of delivering questionnaires

<table>
<thead>
<tr>
<th>Method</th>
<th>Advantages</th>
<th>Disadvantages</th>
</tr>
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<tbody>
<tr>
<td>Postal/web based/e-mail</td>
<td>Can send large number easily</td>
<td>Potentially poor answers as researcher not present to answer any queries</td>
</tr>
<tr>
<td></td>
<td>May get more honest answers as more anonymous</td>
<td>Low response rate</td>
</tr>
<tr>
<td></td>
<td>Allows for large geographic coverage and access to hard to reach respondents</td>
<td>Cannot be too long or complex</td>
</tr>
<tr>
<td>Web based allows rapid data collection</td>
<td>Questions may be altered or answers coached by interviewer</td>
<td>Allows inclusion of illiterate respondents</td>
</tr>
<tr>
<td>Face to face/telephone</td>
<td>Better response rate</td>
<td>Respondents more likely to get embarrassed about answers speaking directly to someone</td>
</tr>
<tr>
<td></td>
<td>Face to face requires access to respondents therefore more difficult to cover wide geographic region</td>
<td>Faculte to face requires access to respondents therefore more difficult to cover wide geographic region</td>
</tr>
</tbody>
</table>

(Source: from Blaxter et al, 2010; Blumberg et al, 2011)

Layout is also an important consideration in questionnaire design, as Brace (2008) states the success of a questionnaire often reflects its appearance and user friendliness. The questionnaire must not discourage respondents from partaking in the research for example if the questionnaire is too long, if layout is poor and cramped, or if unnecessary personal questions are asked. The following points should be considered when designing a questionnaire:

- How long will it take to complete (consider the type of questions: closed questions will be quick to complete, open-ended questions will take much longer).
- Think about the order of the questions. Leave open-ended questions until the end of the questionnaire; they take longer to complete and require the respondent to think more about their answer.
- Wording of questions (use appropriate language for the respondents, i.e. if asking the general public do not use technical terminology).
- Ensure there are clear instructions as to how the questions are to be answered (i.e. tick one box only/tick all that apply).
- If postal then attach a covering letter introducing the researcher and the aim of the research to the respondent. If face to face/telephone the researcher should start by introducing themselves.
- It should include contact details should respondents want to contact the researcher regarding the research.
- If postal it should include a pre-paid envelope.
- Thank respondents at the end of the questionnaire (Brace, 2008; Blaxter et al, 2010).

Finally, as Davies (2007) states, after considering the above and when the questionnaire design is complete it is advisable to pilot the questionnaire. It is suggested that the minimum any questionnaire should be subjected to is an informal pilot with the possibility of larger scale pilots if time and funds allow. An informal pilot is when a small number (minimum 3–5) of respondents (target subjects or colleagues) are asked to complete the questionnaire and then feedback is obtained. The purpose of this is to:

- Ensure questions are understood by respondents and answered accurately
- Identify ambiguous questions
- Gauge how long the questionnaire will take to complete
- Assess whether the layout is clear and easy to follow.

This allows problems in the questionnaire, which might have affected analysis or the reliability or validity of the results, to be rectified. Moving on from this, a larger scale pilot is where 50 or more respondents of the target population are used. Statistical analysis can be conducted on the responses to ensure the data obtained are suitable for analysis, and are appropriate to meet the aim of the investigation (Brace, 2008). In large scale investigations this can be valuable to ensure appropriate data are being collected prior to implementing the full scale investigation.

Interviews and focus groups

Interviews are when respondents are directly asked questions or involved in discussion with the researcher either face to face or over the telephone. They may follow a specific structure and form part of quantitative research (delivering a set of closed questions in person), or be semi-structured or unstructured and form part of qualitative research (Blaxter et al, 2010). Semi-structured interviews begin with set questions which then lead the respondent into areas of discussion, whereas unstructured interviews have no set questions just topic areas to be discussed.

An additional form of interview is a focus group where the researcher brings together a group of people and interviews them together. This allows for interaction between the group members to gain further insight into the topic being discussed (Blaxter et al, 2010).

In general (apart from structured interviews) this
Form of data collection is used for qualitative research, although it may be useful prior to commencement of quantitative research to gain a better understanding into the topic area of choice.

Examples of veterinary research topics where the use of interviews and focus groups might be appropriate include:

- Investigating the use of nurse clinics in newly diagnosed diabetics — interview the client afterwards to see how useful the clinics are, how the owner felt afterwards etc.
- Investigating how the practice is perceived by clients/what clients want from the practice — organize a focus group with a number of clients to discuss their perceptions etc.

Although the aim of interviews/focus groups is to enable the respondents to do most of the talking, planning is still important. The following points need to be considered:

- What are the discussion topics to be covered in order to meet the research aim?
- Who will be interviewed/invited to the focus group? And how will they be contacted?
- Where will it be held?
- How to ensure the interviewer remains un-biased throughout the interview/focus group, directing the flow of the conversation without influencing it.
- How to ensure all respondents get to contribute equally.
- How is the interview being recorded? Written notes or tape recorded?
- How will issues of confidentiality be dealt with?
- Will all respondents feel comfortable discussing all topic areas within a group? Or would an anonymous questionnaire be more suitable for certain aspects (Davies, 2007; Blaxter et al, 2010)?

**Experimental research and design**

As termed by Blumberg et al (2011) an experiment involves measurement of a particular variable when one or more variables are altered by the researcher. This is to determine any relationships present between variables.

Experimental research is useful within veterinary research to determine relationships between treatments and outcomes and therefore decide which treatments are best. For example the measurement of pain following two different methods of performing a surgical procedure (i.e. flank versus midline neutering in cats), allowing veterinary practitioners to determine which method leads to the least post-operative pain or if there is no difference between methods.

**Experiment design**

**Hypothesis testing**

When designing an experiment Davies (2007) explains that the starting point is the hypothesis, which is a statement of relationship between two variables. The terms null hypothesis (H0) and alternative hypothesis (H1) are often used, the first representing no relationship between two variables and the latter representing the presence of a relationship. For example:

- H0 = the method of neutering has no effect on the amount of pain felt post operatively.
- H1 = the method of neutering has an effect on the amount of pain felt post operatively.

The next step is to design an experiment to test the hypothesis. The statistical analysis of the results gained will determine whether the null hypothesis should be accepted (and the alternative hypothesis rejected), or rejected (and the alternative hypothesis accepted).

**Controls**

In order to make a comparison, something to compare with is required. It cannot be said that a new treatment is better if it has not been compared with the standard treatment or with no treatment at all. A control group is therefore a group that has received the standard treatment (positive control) or no treatment (negative control) (Petrie and Watson, 2006). In the example discussed it may be that midline neutering is the standard treatment and the flank approach is the new treatment, therefore midline approach is a positive control. An example of a negative control may be investigating the use of dressings to improve wound healing post surgery. No dressing is the negative control and with dressing is the new treatment. Using a negative control in such a case establishes if the period of time has the effect on the wound healing, or the application of the dressing.

It is only ethical to use a negative control if no positive control exists, or if subjecting an animal to no treatment will not lead to adverse effects (Petrie and Watson, 2006).

**Variables**

Blumberg et al (2011) state that in every experiment there are one or more independent variables and one dependent variable. The independent variable is the element of the experiment which is purposely different between groups of individuals creating different treatment groups (i.e. midline or flank surgical approach). The dependent variable is the element that is measured by the researcher (pain felt post opera-
Sufficient planning and piloting of data collection methods is essential in any successful research project. Independent variables should be randomly assigned to cases to prevent bias (Petrie and Watson, 2006). This could be the case of the researcher randomly assigning treatments to cases if it is ethical to do so. In the example discussed comparing two neutering methods, it is not ethical to randomly assign neutering methods to cases for the purpose of research. In this case collecting data from a number of practices who use different surgical approaches to neutering cats would be appropriate.

When measuring dependent variables it is important to remember that experimental research is quantitative and therefore concerned with the collection of numerical data. This may be simply the collection of temperatures or heart rates, but some projects may not be so straightforward. In the example used the dependant variable to be measured is pain (non-numerical) and therefore a method of recording such variables numerically should be established i.e. pain scores such as those designed by University of Glasgow Faculty of Veterinary Medicine (2010).

Having set independent and dependant variables the next step is to make sure all other variables are controlled (as far as is reasonably possible). This is to minimize the influence of other such variables on the dependant variable. This process of controlling all other variables can be challenging within a veterinary environment and may mean that some experiments are too impractical to implement. This may be because there is no means of controlling certain variables, or the possibility of gaining an appropriate number of controlled cases within the time scale of the research is low. For example for research into the effectiveness of weight loss diets, participating patients should be of similar age, degree of obesity, breed, with no other health problems, given a set diet and nothing else, with a set exercise regimen etc. Would this be practical to implement within a veterinary environment and ensure client compliance? Additionally it may be unethical to control certain variables for the purpose of research such as medications administered, unless there was a license granted by the Home Office (see below).

Once variables are set and experimental design is complete, as with any research, a pilot study is recommended. This will help reveal problems/difficulties in the design so they can be rectified before the final experiment takes place (Petrie and Watson, 2006).

Other considerations

Analysis

It is worth considering at the design stage of a research project how the data collected is going to be analyzed. This will help avoid situations where time and money have been spent collecting data that is not suitable for analysis or to meet the research aim.

Ethical considerations

Ethics have to be considered prior to conducting any research and if the project is deemed unethical then it should not be undertaken. In the case of questionnaires, interviews and focus groups participants must be made fully aware of the research taking place, give their consent to be involved and be able to cease participating at any point if they wish (Davies, 2007). The confidentiality or anonymity of respondents and their responses must also be taken into account (Blaxter et al, 2010). In the case of experimental research involving the use of animals further considerations are required including:

- Animal welfare
- Gaining informed consent from the owner
- Application of the 3 R’s principle:
  - Replacement of the animal subjects such as with the use of tissue cultures
  - Reduction of the number of animals used. Experimental design should be such that the least number of animals are used to gain results of the desired level of accuracy
  - Refinement of the procedure to reduce the negative effect on the animals involved (Mepham, 2005)
- The use of invasive acts (blood sampling/biopsy etc) for the purpose of research is prohibited unless a license has been gained under the Animals (Scientific Procedures) Act 1986

Key Points

- Sufficient planning and piloting of data collection methods is essential in any successful research project.
- There are multiple methods for collecting data in research studies. The most suitable method will differ for each individual project but all are capable of producing excellent results.
- Questionnaires can be used in both quantitative and qualitative research. Design is important to ensure maximum response rates and collection of suitable data to meet the research aim.
- Focus groups and interviews are useful in qualitative research where discussion of topics helps the researcher gain better insight into the topic of interest.
- Experiments are used within veterinary research to establish relationships between treatments and outcomes.
Animals (Scientific Procedures) Act 1986

In certain cases a license may be required under the Animals (Scientific Procedures) Act 1986. Procedures requiring a license are those which could cause the animal pain, suffering, distress or lasting harm. Procedures are exempt from this if they are carried out for the purpose of husbandry or veterinary practice and are of benefit to the animal. This includes procedures undertaken for the purpose of diagnosis (i.e. blood sampling), treatment (i.e. injecting medication), or husbandry practices (such as castration). In summary procedures that might have an adverse effect on an animal cannot be carried out solely for the purpose of research unless a license is gained.

Conclusion

There are many methods by which data can be collected for research purposes. This article has covered the most common methods but there are other methods available. Different types of research will lend themselves to different data collection methods although there are no definite right or wrong answers as to which is the best method for each project. Ultimately it is sufficient planning and design that will determine the success of each research project.

References


