

Decision making and welfare assessment in canine osteoarthritis

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Abstract

Little has previously been described about how or why owners, veterinary nurses or veterinary surgeons make decisions about pets under their care. The Animal Welfare Act (2006) and the Royal College of Veterinary Surgeons' oath should ensure the health and welfare of pets in the United Kingdom (UK) is the central focus of those decisions. The aim of this thesis was to characterise the nature and basis of decisions made about the treatment and welfare of osteoarthritic dogs by owners, veterinary surgeons and veterinary nurses. Three studies were performed. Firstly, two rapid reviews identified and appraised the outcome measures used in the peer-reviewed literature to assess canine quality of life and canine osteoarthritis. Secondly, thirty-two interviews were performed with owners of dogs with osteoarthritis and five focus groups were performed with veterinary surgeons and veterinary nurses who manage osteoarthritic dogs. Thematic analysis performed on transcripts of those interviews and focus groups identified key themes. Thirdly, a prospective study was performed to test a novel home monitoring outcome measure for use by owners of osteoarthritic dogs, developed using data gathered in the previous studies.

The first study found outcomes assessed in the peer-reviewed literature focus predominantly on physical health. Those assessments are frequently unvalidated, may be subject to bias and neglect other aspects of the dogs' welfare impacted by osteoarthritis and its management. The second study identified four important themes in the interviews and focus group data in relation to decision making. Most owners were highly motivated to make good decisions about their dogs' welfare. However, many barriers to dog-focused decisions were recognised including: incorrect prior knowledge; ineffective veterinary consultations, in part due to different language used by owners and veterinary surgeons; the lack of available, relevant evidence on which to base decisions; an inability to reliably interpret canine behaviour; and risk aversion. A wide range of impacts of canine osteoarthritis on the welfare of the dogs, their owners and the veterinary professionals caring for those dogs were described. The third study identified several significant deficits in existing outcome measures designed for owners to assess their osteoarthritic dogs. Dogs with osteoarthritis may have day-to-day variations in their physical health and demeanour and owners appear to assess a complex mix of inputs to, and indicators of, their dogs' welfare when decision making. More work is needed to develop outcome measures that are relevant to owners and more accurately reflect all aspects of canine welfare.

This thesis is the first in-depth body of work using evidence synthesis and qualitative methods to characterise how decisions are made about osteoarthritic dogs under veterinary care. Most decisions about osteoarthritic dogs are made by owners using unvalidated assessments with little veterinary guidance. Valid, relevant and practical outcome measures are needed to collect information on which decisions can be based. Evidence does not exist to guide the majority of decisions made; the evidence that does exist appears to be poorly disseminated, particularly amongst owners. Relevant evidence must be created through well designed clinical trials to support those decisions then widely disseminated. Veterinary consultations are not always effective in making decisions focused on the best interests of osteoarthritic dogs, particularly in relation to their welfare; differences in language and perspectives may play a significant part in this. Future work in this field should involve collaboration between owners, veterinary professionals in general and specialist practice, animal welfare scientists and experts in dog behaviour. Methodological approaches taken and conclusions drawn from this thesis may be relevant to many other veterinary diseases.

We've been wrong about what our job is in medicine. We think our job is to ensure health and survival. But in reality it is larger than that. It is to enable well-being. And well-being is about the reason one wishes to be alive.

Atul Gawande from his book *Being Mortal*.

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Abbreviations

Act – Animal Welfare Act (2006)

AWF – Animal Welfare Foundation

BVA – British Veterinary Association

CAWC – Companion Animal Welfare Council

CBPI – Canine Brief Pain Inventory

CEVM – Centre for Evidence-based Veterinary Medicine

Codes - Codes of Practice developed in response to Section 14 of the Animal Welfare Act (2006)

COI – Canine Orthopedic Index

CSOM – Client-specific outcome measure

DF – Degrees of freedom

DJD – Degenerative joint disease

FAWC – Farm Animal Welfare Council

FG – Focus group number

GPS – Global Positioning System

HCPI – Helsinki Chronic Pain Index

HERG – Health Experiences Research Group

Int – Interview number

ISAE – International Society of Applied Ethologists

LA – Lucy Asher

LOAD – Liverpool Osteoarthritis in Dogs Index

NH – Naomi Harvey

NSAID - Non-steroidal anti-inflammatory drug

OA – Osteoarthritis

OMP – Outcome Measures Program

p. - Page

PDF – Portable document format

PDSA – People’s Dispensary for Sick Animals

QoL – Quality of life

RCVS – Royal College of Veterinary Surgeons

RD – Rachel Dean

RSPCA – Royal Society for the Prevention of Cruelty to Animals

SE – Standard error

SNoRE – Sleep and Nighttime Restlessness Index

SVMS – School of Veterinary Medicine and Science

UK – United Kingdom

USA – United States of America

Vet – Veterinary surgeon

ZB – Zoe Belshaw

Chapter 1. Literature review

1.1 Introduction

Decision making is “*the central task of clinical veterinary practice*” (McKenzie, 2014; p. 217). The focus of this thesis will be on the decisions made by veterinary surgeons, veterinary nurses and dog owners, independently and in collaboration, in relation to owned dogs with osteoarthritis in the United Kingdom (UK). Owned dogs live in a controlled environment and are unable to clearly articulate their own preferences. Consequently, their owners, veterinary surgeons and veterinary nurses need to act as proxies to ensure any problems are promptly and accurately recognised and as advocates to make sure that the best possible outcome is achieved. This is a process that potentially requires a large number of observations and decisions; some of these are summarised in Figure 1. To act as good proxies and advocates: regular, thorough assessments of the dog’s health and welfare should be made; any problems should be promptly recognised and accurately defined; decisions should be made with reference to the best available, relevant evidence; and assessments should be repeated after any change in management to ensure solutions relevant to the best interest of the dog have been achieved. The best decisions are likely to be made when priorities are clearly defined between all those involved in the decision. This thesis will describe the decisions that are made in relation to osteoarthritic dogs by owners, veterinary surgeon and veterinary nurses and whether those decisions are focused on the best interests of the dog.

1.2 The roles of, and legal protection for, owned dogs in the UK

No accurate records exist of the number of owned dogs in the UK and the few population estimates performed are at high risk of selection, non-response and measurement biases (Downes et al., 2013). However, those estimates, based on telephone surveys (Murray et al., 2010), Murray et al. (2015) and face-to-face interviews (Pet Food Manufacturers' Association, 2016), suggest approximately 25% of UK households owned a dog in 2015. Many owners identify their dogs as both pet and family member (RSPCA, 2008). It is likely most people derive some benefits from owning a dog. Using a variety of methods, Westgarth et al., (2009, 2012, 2013, 2014, 2015) demonstrated links of variable significance between dog ownership and improved physical health of their owners. Companionship from a dog, in this context termed the human-companion animal bond, has been demonstrated to improve the psychological health of healthy (Sanders, 1999) and ill adults (reviewed by Friedmann and Son, 2009, Ziebland and Ryan, 2015). Dogs may also provide valuable human healthcare assistance to their owners and others through roles such as hearing dogs (Guest et al., 2006) and in animal-assisted therapies (Audrestch et al., 2015).

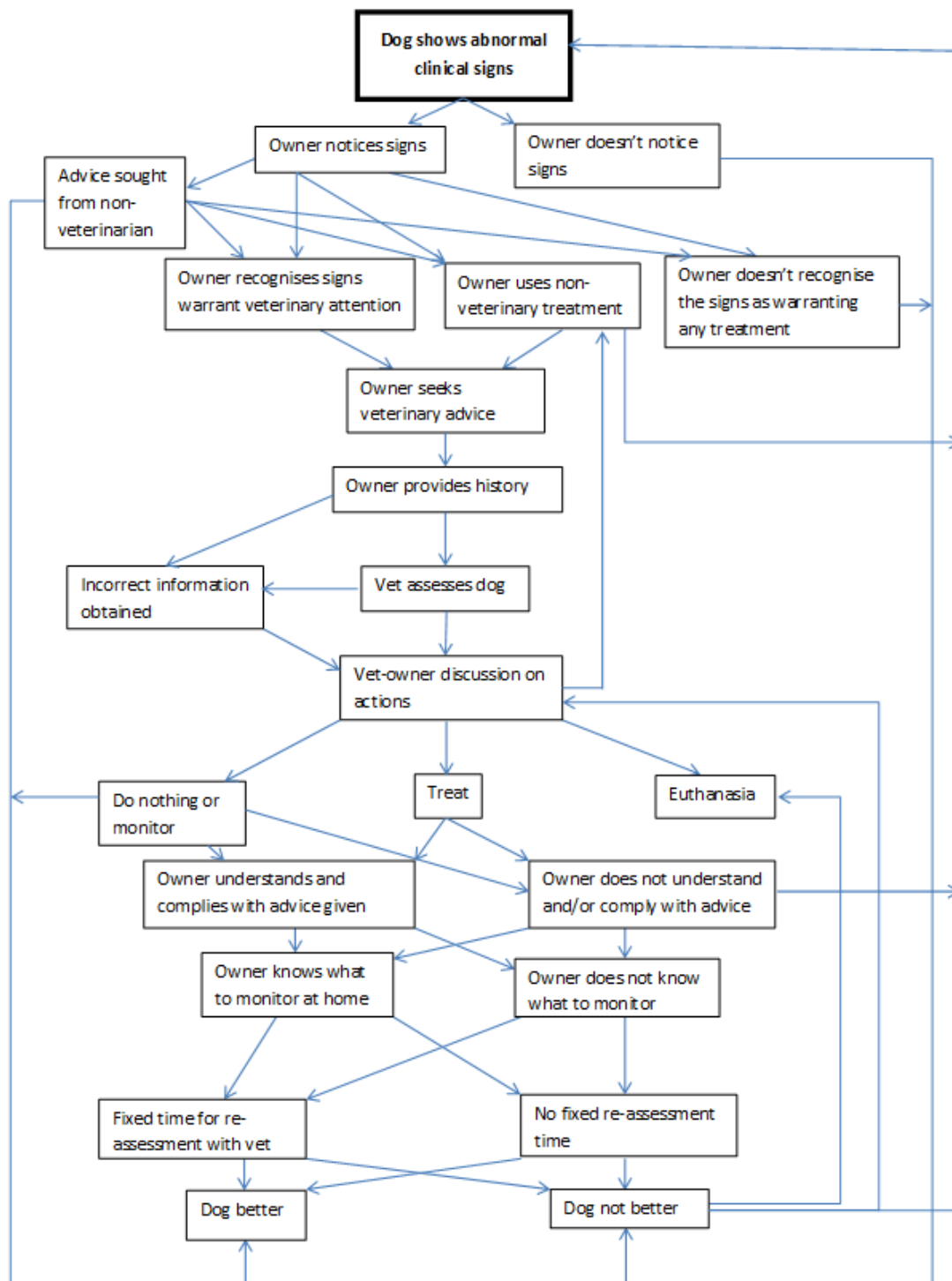


Figure 1. Flow diagram depicting an example of the possible processes undertaken during decision making in relation to a dog receiving veterinary treatment

The Animal Welfare Act (2006) should ensure owners in England, Wales and Scotland have a legal duty of care to protect the health and welfare of their dogs. The Act was hailed by Ben Bradshaw, the Minister then responsible for animal welfare, as “*the most fundamental piece of animal welfare legislation for nearly a century*” (Anon, 2016a; p. 152). Table 1 summarises its content relevant to this thesis.

Table 1. Summary of the content of the Animal Welfare Act (2006) relevant to this thesis

Section	Content summary
1 and 2	The Act applies to all owned vertebrates.
3	The person who owns the animal is always regarded as responsible for it
4	Permitting, through action or inaction, unnecessary suffering is an offence. Legitimate purposes for suffering are listed as suffering for the purpose of benefiting the animal or for protecting a person, their property or another animal. Any suffering must be “ <i>proportionate to the conduct concerned</i> ”. [Suffering is not defined]
5-8	Mutilation, docking of dogs’ tails, administration of purposefully injurious substances and fighting are detailed as specific offences.
9	A person must take reasonable steps to ensure the needs of an animal for which they are responsible are met to the extent required by good practice. Those needs are: (a) <i>its need for a suitable environment</i> , (b) <i>its need for a suitable diet</i> , (c) <i>its need to be able to exhibit normal behaviour patterns</i> , (d) <i>any need it has to be housed with, or apart from, other animals</i> , and (e) <i>its need to be protected from pain, suffering, injury and disease</i> .
10	Inspectors who perceive the needs listed in section 9 are not being met can issue notices of improvement, specifying the steps which must be undertaken in a defined period.
14	National authorities may issue and revise codes of practice for the purpose of providing practical guidance on the Act, and it is an offence not to comply with that code.
18-19	Inspectors or constables, where possible working with a veterinary surgeon, have a range of powers to seize, and if necessary, destroy, an animal they perceive to be suffering.
32-34	Details of the penalties for offences ranging from imprisonment for up to 51 weeks to disqualification from owning animals
51	Inspectors are defined as a person appointed to that post by an appropriate national or local authority

Species specific Codes of Practice (identified from now on as “Codes”) described in section 14 (Department for Environment Food and Rural Affairs, 2009, Department of Agriculture and Rural Development, 2010) provide varying detail in lay language about the five welfare “needs” described in section 9. These evolved from the Five Freedoms, developed by animal welfare scientists to describe the needs of farm animals kept in intensive systems following the 1965 Brambell report (discussed in Sandoe and Jensen, 2013). In those systems, ill animals are likely to be culled and diseases of old age are not relevant. The Codes therefore place a heavy emphasis on the welfare of healthy dogs; owners are advised to seek advice from a veterinary surgeon if their dog becomes ill. Therefore, the welfare of healthy dogs appears to be the responsibility of the owner, but the welfare of ill dogs is to an extent delegated to the veterinary surgeon. The Royal College of Veterinary Surgeons’ oath, which must

be sworn by all veterinary surgeons working in the UK, states "... *ABOVE ALL, my constant endeavour will be to ensure the health and welfare of animals under my care*" (RCVS, 2012, p.14). The health and welfare of owned dogs in the United Kingdom should therefore, in theory, be excellent.

1.3 Are owners and veterinary surgeons aware of these duties of care?

The 2015 People's Dispensary for Sick Animals (PDSA) Pet Animal Welfare report found awareness of the Animal Welfare Act (2006) amongst the pet owning public to be at an all-time low (PDSA, 2015). The RCVS oath's emphasis on the veterinary surgeons' responsibilities towards welfare should ensure that their role in teaching owners about the content of the Act is clear. This has been emphasised by the Companion Animal Welfare Council (2013) who suggested the Codes be converted to a "*five step plan to achieve health and happiness*" (p.7) delivered by vets and veterinary nurses. The PDSA has developed the "PetWise MOT" structured around the five welfare needs which has been delivered to over 100,000 owners. Early results are promising (PDSA, 2016) but the scheme is limited to owners who are registered with the PDSA and long-term benefits to welfare are unproven. However, a recent editorial in the Veterinary Record critiquing the Act did not discuss veterinary surgeons' role in its promotion to owners (Anon, 2016a); it is unclear how familiar veterinary surgeons outside the PDSA are with the Act or their responsibilities in relation to its content.

In 2001, Cambridge was the only UK veterinary undergraduate course in which animal welfare was taught (Donald Broom, personal communication). Broad RCVS day 1 competencies relevant to welfare and ethics have since been included in all UK veterinary curricula (reviewed by Main, 2010). However, animal welfare in UK veterinary schools remains a stand-alone subject (Main, 2010) taught predominantly by animal welfare scientists. Most animal welfare research funding is directed at improving the welfare of otherwise healthy farm animals (Department for Environment, Food and Rural Affairs, 2010) and this may be reflected in the subject material covered in the veterinary curriculum. Hewson (2004) acknowledged "*the preponderance of non-veterinarians in animal welfare science has probably contributed to the acknowledged lack of emphasis on health*" (p.257) and this remains true today.

How welfare is taught may affect how students perceive the subject. Attitudes towards welfare in Australian clinicians had a significant effect on their students (Pollard-Williams *et al.*, 2014) and the perceived importance of welfare decreased in New Zealand veterinary students as they progressed through the course (Cornish *et al.*, 2016). The Veterinary Record (Anon, 2007) reported a small survey of members of the British Veterinary Association (BVA) and the International Society for Applied Ethology (ISAE), the largest animal welfare society. The survey revealed 63% of BVA members answered "*no*" or "*not sure*" to the question "*Do vets have a complete understanding of animal welfare?*", whilst 96.1% ISAE respondents gave the same replies. It is not known how well this represents the views of the profession today but concerns have been raised that animal welfare remains distinct from clinical veterinary medicine (e.g. Knight, 2014, Mendl *et al.*, 2016). Tools to encourage discussion of animal welfare by academics in clinical practice are available (e.g. Mills, 2013) but their rates of adoption are unknown. Courses in

animal welfare and ethics are available for veterinary surgeons (reviewed by Knight, 2014) and increasing numbers of related articles are being included in veterinary journals. However, many are by the same key authors and the language used is not always easy to follow (Main, 2006, 2007, Yeates, 2010a, Yeates, 2010b, Yeates and Main, 2010, 2011a).

1.4 Defining key terms

Before examining in more detail the steps involved in making decisions about dogs, it is first important to define some key terms that will be used throughout this thesis. Yeates (2013; p.15) asserted “*rigid*” definitions of terms relating to welfare are not needed. However, it can be argued that definitions *are* needed since for something to be assessed it is important to know what should be included in that assessment. Therefore, existing definitions for key terms will be discussed and, where existing definitions do not appear to be suitable for the purpose of this thesis, operational definitions will be provided and justified.

The terminology relating to animal welfare is confusing. Often, terms are used in both veterinary and animal welfare science literature without clear definitions. Most animal welfare science research focuses on the impacts of intensive farming husbandry on the welfare of whole populations. Farm animals have limited lifespans; disease is largely considered preventable if the environment is suitable to meet their needs and husbandry is good. Definitions provided by animal welfare scientists often reflect this focus and many are not suitable for use in individual companion animals with spontaneously occurring diseases. It is not known how these terms are defined either by veterinary surgeons working in companion animal practice or by dog owners.

1.4.1 Welfare

Welfare is not defined in the Animal Welfare Act (2006), nor in the RCVS Code of Professional Conduct for Veterinary Surgeons (RCVS, 2016), despite being referred to in 139 separate places in that latter document. Definitions for welfare provided by animal welfare scientists have evolved over the years as their understanding of animals’ mental capacity has changed, leading Webster (2005a) to conclude in frustration “*welfare is used to mean whatever people want it to mean*”. Some of the key definitions or comments related to welfare definitions provided by animal welfare scientists are tabulated overleaf (Table 2).

Table 2. Definitions relating to animal welfare drawn from the relevant literature

Discussion of welfare definition	Author
Animals should have the freedom to “ <i>stand up, lie down, turn around, groom themselves and stretch their limbs</i> ”.	Farm Animal Welfare Council (1979; p.1)
Welfare is “ <i>an animal’s state as regards its attempts to cope with its environment</i> ”.	Broom (1991; p. 4167)
Play and exploration should be considered “ <i>luxury behaviours</i> ”.	Duncan (1998; p.1766)
Welfare should be defined as “ <i>are animals healthy and do they have what they want?</i> ”	Dawkins (2004; p.S3)
Welfare is “ <i>fit and feeling good</i> ”	Webster (2005a; p. 105)
“ <i>Welfare is not simply the absence of negative experiences, but is rather primarily the presence of positive experiences such as pleasure</i> ”.	Boissy <i>et al.</i> (2007; p.375)
Welfare should be considered in terms of positive and negative welfare outcomes.	Yeates and Main (2008)
“ <i>An animal’s death may be a welfare issue insofar as it leads to the exclusion of relative positive states.</i> ”	Yeates (2009; p.229)
Animals should lead a “ <i>life worth living</i> ”.	Wathes (2010; p.468)
Welfare is a “ <i>vague idea of what is in an animal’s interests, i.e. what is directly good or bad for them</i> ”	(Yeates, 2013; p.15)
The Five Freedoms assess “ <i>only a snapshot in time</i> ” and “ <i>a life worth living... is a value judgement made by us, rather than the animal in question</i> ”	Webster (2016; p.4)

Authors of publications listed in Table 2 suggest animals should be healthy to have good welfare; this perhaps reflects the definition used in humans for welfare of “*the state or condition or doing or being well*” (Oxford English Dictionary, 2016). This is problematic for veterinary surgeons; whilst we aim to keep animals well through preventative medicine (discussed in Robinson *et al.*, 2016), many companion animals will spontaneously develop diseases. In contrast, Yeates (2013) definition identifies humans’ responsibility to guard the health of owned animals, advocating limits should be placed on what animals can have if that is in their best interest. Further discussion of this contentious topic is outside the scope of this thesis. However, owners’ responsibilities to protect animals articulated in the Animal Welfare Act (2006) go some way to resolving this. The impact of diseases and their treatment on how an animal feels is discussed by Yeates (2013). Through the lens of positive and negative feelings, it starts to become clear how disease, veterinary treatment, the environment and owners’ actions can both positively and adversely affect these feelings. Therefore, welfare can be defined from both the viewpoints of the animal and those responsible for the care of that animal and consequently both are likely to be important when defining welfare in the context of dogs.

The capacity of animals to feel is recognised by European legislation; mammals in the European Union are legally considered to be sentient by the Lisbon Treaty (2009) (described in European Commission, 2016). Sentience is defined simply by Kirkwood (2006) as meaning they have “*the capacity to feel something*” (p.12). Evidence for dogs’ capacity to see, hear, and feel sensations such as pain and touch and to be able to make conscious choices is incontrovertible (reviewed by Silverman,

2008) and Panksepp (2011) described the neuroanatomic basis for the existence of emotional networks in mammals. Yeates (2013) listed many positive and negative feelings animals might experience. He eloquently explores how understanding that animals have emotions means we can infer deep similarities between what we and animals feel. For example, animals will be motivated to do what they enjoy; how they feel can relate to their surroundings and past experiences can shape how they feel about present circumstances.

An animal's personality may also affect how they feel. The multitude of definitions of personality in dogs and how they can be assessed were subject of the thesis by Harvey (2014). She identified within a single dog breed, personality can vary, and personality can also change over time. A link between dog morphology and behaviour (this would be described by Harvey as personality) was investigated by Stone *et al.* (2016). Results suggested dogs' levels of affection, fear and playfulness appeared to be linked to their size, which may have been a surrogate marker for breed. There appears to be considerable overlap in terminology relating to emotion, feelings, personality and behaviour which has yet to be resolved. For the purpose of this thesis, welfare will be operationally defined as "*how an animal feels*". Based on the literature above, the inputs affecting how an animal feels are shown in Figure 2. These inputs should be useful when examining how welfare can be affected by illness and its treatment and should help identify what is in the animals' best interests. The link between feelings and behaviour are discussed in 1.4.5.

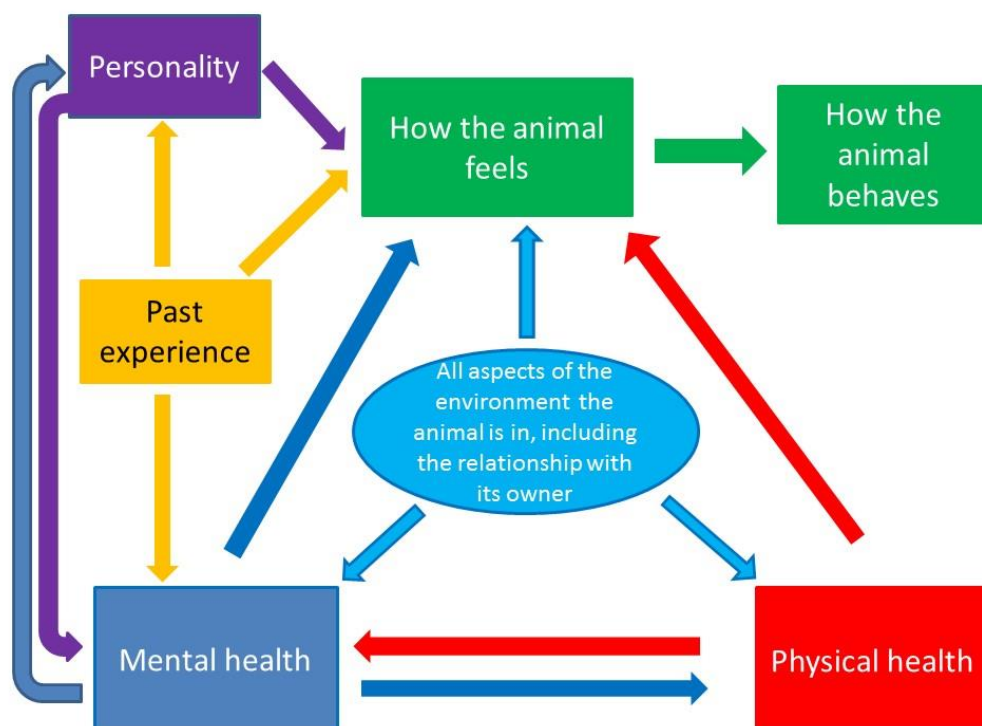


Figure 2. Factors that may influence how an animal feels and behaves

1.4.2 Suffering

Suffering is also poorly defined in the relevant legislation. Section 62(1) of the Animal Welfare Act (2006) defines suffering as “*meaning physical or mental suffering*” and a definition is not provided in the Guidance of the Operation of the Animals (Scientific Procedures) Act 1986 (Home Office, 2014) in relation to animal experimentation. Baumgaertner *et al.* (2016) described the wide ranging terms used by 42 veterinary surgeons to identify unnecessary suffering in their capacity as expert witnesses in court. They identified disputes amongst experts regarding definitions of suffering; 28 experts described negative physical states, 27 described negative mental states and very few referred to the actions of the owner in relation to suffering. Those authors also found little consensus on definitions of suffering in an extensively literature review.

Dawkins (2008) and Weary (2014) criticised a historical conflation of suffering with pain or with all ill health by animal welfare scientists. Both identify a value in using human narratives to understand suffering. From these narratives, it appears suffering is a feeling which may be transient or permanent; it is therefore a subset of welfare. Öhman *et al.* (2003) performed phenomenological analysis on narratives of 10 people with severe, chronic illness. Those patients described suffering as a very negative state of mind related to physical pain and the incapacity this caused; many felt their body was a hindrance and articulated fear and isolation as key components of suffering. However, not all pain leads to suffering. Narratives of patients with severe osteoarthritis talk about their ability to use “*mind over matter*” (p.909) to continue doing what they want (Gignac *et al.*, 2006), and people vary in their tolerance of the same stimulus (Turk *et al.*, 2008). Based on those narratives and my own perceptions, suffering will be defined for this thesis as “*an all-consuming desire to escape one’s current state*”. In this definition, suffering may be induced by any combination of the inputs to welfare described in Figure 2. The specific causes of suffering and the magnitude of suffering induced may be highly individual. In a state of suffering, the individual is likely to seek means to escape that suffering, and this may manifest in their behaviour, for example through stereotypy (Ijichi *et al.*, 2013) or an inability to participate in activities other than those directly related to survival (Öhman *et al.*, 2003). Improvement in other inputs may help to reduce suffering but are unlikely to remove it altogether (Öhman *et al.*, 2003).

1.4.3 Quality of life

Quality of life is a term increasingly used in veterinary medicine, seemingly as a synonym for welfare. The desire to use an alternative term may be due to the confusion created by the dual definitions of welfare described previously. Yeates and Main (2009, p.274) identified quality of life as “*central component of veterinary practice*”, but recognised structured evaluations are uncommon. This may be due to a lack of definition of the term. Quality of life is rarely defined by either animal welfare scientists or veterinary surgeons, and where definitions are provided (e.g. McMillan, 2000, Wojciechowska and Hewson, 2005, Wiseman-Orr *et al.*, 2006) they may be too long or complex to be of practical use. It is not known how general practitioners or dog owners might define quality of life.

Origins of the term quality of life are suggested to extend back to Plato and Aristotle (Zuna, 2009). The World Health Organisation (WHO, 1996) defines quality of life as: “*the individuals’ perception of their position in life in the context of the culture*

and value systems in which they live and in relation to their goals, expectations, standards and concerns” (p.5). Whilst culture and standards are not relevant to animals, this definition demonstrates challenges to applying quality of life to animals; many of these are discussed by McMillan (2000, 2005, 2006, 2007) and Taylor and Mills (2007). The definition provided by the WHO appears to require an evaluation of how an individual feels in relation to how else it might feel in other contexts at other times. However, time frames are not usually placed on quality of life assessments designed for companion animals (e.g. Budke *et al.*, 2008) and animals’ capacity to perform such evaluations is unclear (discussed by McMillan, 2007, Yeates, 2016). This led Broom (2007) to suggest quality of life is “*a subset of welfare*” (p.45). The scope of quality of life assessments is also unclear; there is an increasing trend in both human and veterinary medicine to discuss health-related quality of life, where quality of life is framed by the impact of disease. Human surgeon and author Atul Gawande (2016) suggests this is harmful since it may lead to decisions based only on the impact of disease without considering the other components of quality of life; it is unclear how much this is true in animals. The operational definition for quality of life that will be used in this thesis is: “*an individual’s satisfaction with its welfare*”.

1.4.4 Disease, pain and injury

The Animal Welfare Act (2006) says owners must protect their dogs from disease, pain and injury. In all cases, existing definitions can be utilised without adaptation. Disease is defined in the Oxford English Dictionary (2016) as “*a condition of the body, or some part or organ of the body, in which functions are disturbed or deranged*”. Pain is defined by the International Association for the Study of Pain (2016) as “*an unpleasant sensory and emotional experience associated with actual or potential tissue damage*”. Injury is defined by the Oxford English Dictionary (2016) as “*hurt or loss caused to or sustained by a person or thing*”.

1.4.5 Behaviour

Behaviour has a variety of definitions in the Oxford English Dictionary (2016), reflecting the different ways in which the term is used in relation to animals. Yeates (2016) discusses behaviour from the point of view of causative states, but this terminology is somewhat impenetrable. Behaviour can be used as a synonym for movement which could be defined using an ethogram (e.g. Ladha *et al.*, 2013). The movement may be for the purpose of travel from one place to another, but may also include movements directed towards objects, including the animal’s own body. This way of using the term is common when describing behaviours undesirable to people, such as barking, biting and chewing. Behaviour is also used to determine how an animal feels by interpreting conscious and unconscious movements of its whole body or parts of their body in relation to a specific stimulus. For example, posture or facial movements may reflect pain (e.g. the rat grimace scale; Sotocinal *et al.*, 2011). However, using the definition of welfare from earlier, how an animal feels and therefore behaves may be affected by a variety of simultaneous stimuli. An operational definition for behaviour in this thesis to reflect this will be “*the physical movement of any part of animal or the whole animal which may reflect how it feels*”.

1.5 The decision making process

In his essay on veterinary decision making, McKenzie (2014) identified three levels at which a clinical situation must be appraised: making a diagnosis and subsequent treatment plan; understanding the priorities of the owner; and considering the problem from the perspective of the patient. Figure 1 suggests this may be oversimplistic. A more detailed examination of the decision making process from the perspectives of both owner and veterinary professional are presented below.

1.5.1 Recognising problems

The decision making process starts when it is recognised that there is a decision to be made. For owners to recognise problems in the health and welfare of their dogs, they must be aware of what “normal” looks like. Unfortunately, PDSA Pet Animal Welfare reports (2012, 2015) suggest many owners fail to provide adequate nutrition, exercise, company and preventative healthcare for their dogs. Education about all aspects of animal care and welfare has largely been left to the animal charities such as the PDSA and the Royal Society for the Protection of Animals (RSPCA); no Governmental resources have been provided and the lack of clarity around the role of the veterinary surgeon in education was discussed in 1.3.

In a veterinary context, owners are often relied upon as proxies to identify problems that require veterinary intervention; again, to be able to do this, owners must be able to distinguish normal from abnormal. Veterinary surgeons may also adopt the role of proxies if owners have not recognised problems; Robinson (2014) identified this was common in consultations she observed. Many factors have been identified through small interview and survey studies that may influence owners’ decisions to seek veterinary advice when a problem is recognised. These include: the owner’s prior experience and perception of the importance of the clinical signs to their pet’s welfare, quality of life, comfort or survival (Bronden *et al.*, 2003, Oyama *et al.*, 2008, Boland *et al.*, 2014, Scantlebury *et al.*, 2014, Stoewen *et al.*, 2014); access to information (Kogan *et al.*, 2008, Scantlebury *et al.*, 2014, Stoewen *et al.*, 2014); finances (Coe *et al.*, 2007, Klingborg and Klingborg, 2007, Coe *et al.*, 2009, Boland *et al.*, 2014); their bond with the pet (Lue *et al.*, 2008, Christiansen *et al.*, 2013, Christiansen *et al.*, 2016) which may decline as it ages (Mongillo *et al.*, 2013); their degree of empathy with that pet (Ellingsen *et al.*, 2010); the relationship with veterinary surgeons (Adams and Frankel, 2007, Scantlebury *et al.*, 2014, Christiansen *et al.*, 2016); and awareness of potential treatment options (Boland *et al.*, 2014, Scantlebury *et al.*, 2014). This suggests there may be core components to owner decision making independent of species, disease or country. The mixed methods study by Scantlebury *et al.* (2014), investigating how British horse owners make decisions about whether to seek veterinary attention for colic, is particularly helpful. That study identified owners have three clear choices when they suspect an abnormality in their horse: do nothing; seek help from a non-veterinary surgeon; or seek veterinary advice. Those options are likely to be relevant to owners making decisions about any animal with any condition.

1.5.2 Making assessments of health and welfare

Veterinary surgeons are highly skilled in assessing physical health and it is likely that many owners are reliant on them to make these assessments. However, veterinary

surgeons' expertise in assessing welfare is less clear, as discussed in 1.3. This is important since the RCVS oath places equal weighting on health and welfare when describing a veterinary surgeon's duty of care. Yeates (2013) suggests companion animal welfare should be assessed using “*inputs*” and “*indicators*” (p.58) though this framework has not been practically tested. Since welfare is how an animal feels, inputs were described previously as: physical health, mental health, the environment, personality and past experience (Figure 3). A suitable environment is described in the Codes (e.g. Department for Environment Food and Rural Affairs, 2009), and a practical tool exists to promote discussion of this aspect of welfare in the veterinary consulting room (Yeates *et al.*, 2011). Dog personality assessments have been developed (e.g. Harvey, 2014), though these are not suitable for use in a practice setting. Experience is probably best assessed from the point of view of the owner. Assessments of mental health are usually performed only by veterinary surgeons with specific training in that field (Roshier and McBride, 2012). This demonstrates the challenge of performing an assessment of all the inputs to welfare in any dog.

The most widely used non-invasive indicator for welfare is behaviour, as depicted in Figure 2. However, there is a high risk of subjectivity and anthropomorphism in behavioural assessments (Yeates, 2013). Measures of behaviour developed by different groups may assume a perturbation in only one input at a time; animal welfare scientists may consider the environment to be the only variable, whilst veterinary surgeons have been criticised for having a focus only on physical health (Yeates and Main, 2009). In reality, dogs' behaviour may simultaneously be affected by all five inputs, and it may be challenging to identify which is responsible for any given change in behaviour. For example, Dawson *et al.* (2016) identified 85 different factors that might impact the welfare of a healthy animal in a veterinary clinic and their home environment. Assessing the behaviour of an animal relative to its physical or mental health is therefore likely to be extremely difficult. Behavioural assessment also requires some knowledge of what “normal” behaviour looks like, either for that individual or the species as a whole (Wojciechowska and Hewson, 2005). Even with this knowledge, different animals may respond in different ways to the same stimuli; for example, personality has been suggested to affect the likelihood of adoption of stereotypic behaviours in animals kept in a poor environment (Ijichi *et al.*, 2013). “Normal” behaviour may change as an animal ages; this has been discussed in relation to cats (Bellows *et al.*, 2016) but not dogs.

It is likely that welfare indicators and inputs are best assessed by a collaboration between owners and veterinary surgeons (McMillan, 2007, Yeates, 2013) but the efficacy of this decision making interaction has received little previous attention. Owners' confidence in their ability to make health or welfare assessments has not been described but their evaluations are seen to be particularly valuable by veterinary surgeons in assessments of quality of life (e.g. Craven *et al.*, 2004, Budke *et al.*, 2008, Levine *et al.*, 2008, Niessen *et al.*, 2012). However, owners' ability to perform this task is very difficult to determine; studies investigating the ability of people to make proxy assessments of each other's quality of life suggest it may be challenging. For example, scores were discordant when both parents of a child with juvenile idiopathic arthritis scored that child's quality of life (Mulligan *et al.*, 2009) and parents' scores were also discordant with the scores provided by their child (Shaw *et al.*, 2006). A phenomenon called response shifting means as peoples' circumstances change, they readjust what is important to them. Schwartz *et al.* (2007) describe how after a serious illness, people may rate their quality of life in a very similar way to how it was before despite a huge change in their circumstances. Narratives of elderly

people demonstrate determinants of a good quality of life change as they age (Farquhar, 1995). It is not known whether the same might be true for dogs. The possibility individual animals might place different value on the same experiences, whilst seemingly obvious, has only just started to receive attention (Yeates, 2015). Finally, recent events are recognised to skew people's perceptions of quality of life (Suh *et al.*, 1996).

1.5.3 Making evidence-based decisions

Veterinary surgeons should be experts in making decisions about the health of their patients and those decisions should be made on the basis of the best possible evidence. The Centre for Evidence-based Veterinary Medicine (CEVM), University of Nottingham, defines evidence-based veterinary medicine as "*the use of best relevant evidence in conjunction with clinical expertise to make the best possible decision about a veterinary patient*" (CEVM, 2016a). The "best" form of evidence depends on the specific clinical question. Evidence is frequently categorised into a hierarchical pyramid with evidence with the highest inherent risk of bias (personal and expert opinion) at the bottom and that with the lowest risk of bias (evidence syntheses) at the top. The validity of the pyramid, the types of evidence included and their relative order remains an ongoing subject of debate (reviewed by Shaneyfelt, 2016).

Veterinary surgeons interviewed by Everitt (2011) described referring to university lecture notes, textbooks, colleagues and friends when making decisions with only a few referring to published peer-reviewed journal articles. Those veterinary surgeons felt that peer-reviewed evidence was difficult to access and was often not relevant to what they were doing. Nielsen *et al.* (2015) surveyed veterinary surgeons about the sources of information they used to make decisions and identified that the top two sources of evidence read by small animal clinicians were non peer-reviewed publications. The abstract and conclusion were the main sections read in peer-reviewed papers, and Google or colleagues were frequently cited sources of information. These sources of evidence are all at high risk of bias (Dohoo, 2014) and information contained may be inaccurate (Nielsen *et al.*, 2015) leading to poorly evidenced decisions.

Other studies have identified that both human medical practitioners (Gabbay and May, 2004) and veterinary surgeons (Vandeweerd *et al.*, 2012a, Vandeweerd *et al.*, 2012b, Vandeweerd *et al.*, 2012d, McKenzie, 2014) make many decisions based only on memorised information. Gabbay and May (2004) call memorised knowledge "mindlines", defined as "*collectively reinforced, internalised tacit guidelines*" (p.3). Mindlines are created by interactions with colleagues, key opinion leaders, patients and pharmaceutical representatives as well as brief references to texts. These form a knowledge base to which doctors can refer during consultations to save having to continually use other information sources which will slow them down. The term mindlines has previously not been applied in a veterinary context but it is likely to be relevant. This use of memorised information is in-keeping with the dual process theory of decision making described by Kahneman (2011), reviewed in a veterinary context by McKenzie (2014). In that theory, system 1 decisions are rapid, unconscious and intuitive whereas system 2 decisions are conscious, more deliberate and evaluative. If the sources on which mindlines are built are inaccurate, outdated or biased, practitioners using that information may make poor system 1 and 2 decisions. This could have a direct, negative impact on their patients (reviewed by Vandeweerd

et al., 2012b, Vandeweerd *et al.*, 2012d, Vandeweerd *et al.*, 2012e, McKenzie, 2014, Larson and White, 2015).

Gabbay and May (2004) called for doctors to be taught how to critically appraise evidence, but neither veterinary surgeons nor doctors have time to identify and critically appraise every journal article relevant to each clinical question. An alternative solution is to produce evidence syntheses that critically appraise and summarise the strength of systematically collected evidence relevant to a specific clinical question (O'Connor and Sargeant, 2015). Forms of evidence synthesis include systematic reviews, rapid reviews, scoping reviews, critically appraised topics (CATs) and best evidence topics (BETs); terminology for the different types of evidence synthesis is confusingly inconsistent between publications (Grant and Booth, 2009, Straus, 2009). Evidence syntheses should make it easy for a practitioner to access the best quality evidence, but they are not without flaws. Systematic reviews may be out of date before publication (Crequit *et al.*, 2016); their narrow focus means they can have limited relevance (Waters *et al.*, 2003); they may be subject to bias (Page *et al.*, 2014); they may fail to produce conclusive recommendations for the clinician (Williams, 2014); and they fail to recognise many patients have multiple diseases (Greenhalgh *et al.*, 2014). Other forms of evidence synthesis are faster to produce so are at less risk of going out of date but the other flaws are the same. In human medicine, thousands of systematic reviews have been created by the Cochrane Collaboration (2016a).

An equivalent of Cochrane does not exist in veterinary medicine but evidence syntheses have been produced by individual clinicians. The CEVM have collated these (CEVM, 2016b), and with others have created evidence syntheses such as BETs and promoted their use (Dean *et al.*, 2015). Efforts are also underway to improve the skills of veterinary practitioners in appraising evidence (e.g. Dean, 2013, White and Larson, 2015) and evidence-based methods such as clinical reasoning now feature in veterinary curricula (May, 2013). However, few evidence syntheses that have been published are relevant to general practitioners (CEVM, 2016b). Additionally, those publications are of variable methodological quality and rarely lead to a firm conclusion. Flaws in the primary studies on which the syntheses draw including small sample sizes (Giuffrida, 2014), poor reporting (Sargeant *et al.*, 2010) and the measurement of heterogeneous outcomes (e.g. Bergh and Budberg, 2014) contribute to this. The poor quality of evidence on which many veterinary decisions can be based led Mills (2015) to question the ethical basis of evidence-based medicine. This incorrect interpretation of evidence-based medicine as the need to use the peer-reviewed evidence irrespective of its quality has also been discussed in human medicine by Greenhalgh *et al.* (2014). It is not known how widely evidence syntheses are used by veterinary surgeons in general practice, or how aware those practitioners are of the poor quality of evidence on which they draw.

The use of evidence by owners to make animal health decisions has not been widely explored. Kogan *et al.* (2008) reported veterinary surgeons, family, friends and the internet were American pet owners' most accessed sources of information about pet health. The British Veterinary Association (2014) reported 98% of 700 members surveyed thought owners' decisions were affected by their use of the internet. Jehn *et al.* (2003), Kuhl (2014) and Taggart *et al.* (2010) respectively identified websites about canine osteoarthritis, pedigree dog health and canine cruciate disease to be of variable quality; the situation may have subsequently improved. UK owners' preferred source of information has not been ascertained.

1.5.4 Identifying and assessing outcomes

Every planned treatment or management change (an intervention) should be led by an outcome of interest. An outcome is “*a component of a participant's clinical and functional status after an intervention has been applied that is used to assess the effectiveness of an intervention*” (Cochrane Collaboration, 2016b). Outcomes may be specific to a single intervention (e.g. prevalence of a certain side effect) or common to multiple diseases or interventions (e.g. quality of life or survival time; for a discussion of the use of survival times in veterinary medicine see Belshaw and Dean, 2015). The outcomes chosen should be relevant to the individual(s) and should be reliably and consistently measurable within, and where relevant, between individuals (Glasziou *et al.*, 2005, Heneghan *et al.*, 2017). In both clinical practice and clinical research, multiple outcomes may be assessed.

An outcome measure describes a defined methodology to measure a specific outcome; an outcome instrument is a questionnaire designed for completion by a patient or their proxy. Multiple outcome measures may exist for the same outcome tailored to the context and the equipment available. A rigorous design process for any outcome measure is necessary to ensure it captures all the relevant data without unnecessary detail, can be completed without ambiguity or offence and minimises bias (reviewed in Streiner and Norman, 2008a). Once an outcome measure has been designed, it is important to determine whether it measures what it has been designed to measure repeatedly, reliably and preferably objectively through the process of validation. Validation is performed iteratively following a rigorous, clearly defined methodology (reviewed in Streiner and Norman, 2008b). If an outcome measure is not validated, there can be no certainty it is fit for purpose.

Reviews of the validity and quality of outcome measures for specific outcomes such as quality of life have been performed in the human medical literature (Gill and Feinstein, 1994, Cremeens *et al.*, 2006, Locker and Allen, 2007); these can be used by clinicians and researchers to identify the best outcome measure(s) for their setting. The outcomes assessed and outcome measures used for that purpose have not previously been reviewed in any aspect of veterinary medicine, nor has the quality of the measures developed for a specific outcome been appraised. However, problems with outcomes have been identified. Sargeant *et al.* (2010) reviewed the quality of reporting of clinical trials in dogs and cats and identified 84/85 publications reviewed assessed more than one outcome yet only 6 of those publications identified a primary outcome of interest. Nine of the publications did not report the results of all outcomes listed. Outcome assessment has received particular attention in the field of canine osteoarthritis. This will be discussed further in 1.6.7.

When any intervention is instigated, it is vital to know whether it is effective or harmful. This assessment is made through the process of monitoring. Glasziou *et al.* (2005) describe five phases of monitoring: establishment of the need to treat; collection of baseline data; initial dose titration; maintenance; re-establishment of control if it is lost; and cessation of treatment once a cure is achieved or the intervention ceases to be efficacious. Use of predefined outcomes combined with monitoring the efficacy of any intervention should permit rational, effective treatment decision making. In human medicine, parameters to be monitored and ideal response ranges are often set by guidelines. However, there is evidence guidelines may not always be beneficial to individual patients and are not always strictly

adhered to by doctors (e.g. Gabbay and May, 2004, Greenhalgh *et al.*, 2014). In canine medicine, guidelines including clear parameters are unusual, but some consensus statements are now being produced (e.g. glomerular disease, Brown *et al.*, 2013c). The impact of these on decision making in clinical veterinary practice is not yet clear.

1.5.5 Ensuring the decisions made and outcomes assessed are in the best interests of the dog

The duty of owners and veterinary surgeons to advocate for the best possible welfare for a dog once problems have been identified is described in the Animal Welfare Act (2006) and the RCVS Code of Professional Conduct (RCVS, 2012). A series of barriers to advocacy have been identified from the perspective of the veterinary surgeon; few have been explored from the perspective of the owner.

Ethical conflict between the desires of the owner and what the veterinary surgeon thinks is the best thing for an animal's welfare were described by Arkow (1998), Mullan and Main (2001) and Christiansen *et al.* (2016). The RCVS Code of Professional Conduct (RCVS, 2012) may lead some veterinary surgeons to feel they cannot advocate for the dog if this contradicts the wishes of the owner. Section 9.3 states "... *veterinary surgeons should accept that their own preference for a certain course of action cannot override the client's specific wishes, other than exceptional welfare grounds*". Unfortunately, these exceptional grounds are not exemplified, leaving the threshold to be set by individual veterinary surgeons. The interviews with Danish owners by Christiansen *et al.* (2016) were the first to investigate owners' perceptions of the role of the veterinary surgeon in helping them to make decisions about ill dogs. Those twelve owners expressed great concern about the welfare of their dogs and were extremely worried that both decisions and inaction might lead their dogs to suffer. Many identified a role for the veterinary surgeon in helping owners with decision making.

Everitt (2011) describes veterinary decision making as "*a negotiated activity, relying on social context, which takes account of the animals' and owners' circumstances, as well as biomedical information*" (p.i). In that study, subsequently published in Everitt *et al.* (2013), video-recorded consultations were revealed to be complex, iterative and highly interactive with the owner's concerns and priorities playing a significant role in the structure of the consultation. The observational study of small animal consultations performed by Robinson (2014) also highlighted the role of the owners in bringing up specific "problems" to be discussed, where a problem is defined as "*any two-way discussion between owner/carer and vet regarding any aspect of the patient's health and wellbeing*" (Robinson *et al.*, 2015a; p.2). This style of consultation where the concerns of the owner are recognised and prioritised is variably described in the veterinary literature as relationship centred care (Abood, 2007), shared decision making (Cornell and Kopcha, 2007) or collaborative decision making (Carson, 2007); these terms appear to be used interchangeably. "*Client*" rather than "*owner*" is used in these publications, reflecting their business-centred focus on client satisfaction. Even where the term "*patient-centred care*" is used in the veterinary literature (e.g. Nogueira Borden *et al.*, 2010), the focus remains on client satisfaction, not the best welfare outcomes for the animal. This may be because the Calgary-Cambridge model, the dominant model used to teach veterinary communication skills in the UK (discussed in Silverman, 2007), was developed for use by doctors where only the views of the patient need to be considered (discussed

by Everitt, 2011). Whether this really is the desired consultation style for owners or whether they would prefer an increased emphasis on the dog's treatment rather than their own satisfaction with the interaction has not been explored in the UK.

The ethical dilemmas posed by the owner-client as animal welfare guardian and revenue source have been unresolved for many years (Woods, 2013). Favouring the client's wishes over welfare is an ongoing source of criticism of the profession (Yeates, 2013). The frequency with which UK dog owners present ethical dilemmas and how veterinary surgeons make decisions about what constitutes "*exceptional welfare grounds*" has not been described. However, the variety of definitions used by expert witnesses for suffering identified by Baumgaertner *et al.* (2016) suggests there may be little consistency. This has the potential to be a huge issue for the welfare of those animals and identifies a need for clearer guidance. Batchelor *et al.* (2015) identified the moral reasoning abilities of 65 practicing veterinary surgeons were the same as members of the public when presented with the same fictional ethical dilemmas. Whilst only a pilot study, this lack of ability to morally reason, if widespread, may have serious implications for animal welfare. The negative impacts of being unable to resolve these dilemmas on veterinary staff's mental health and wellbeing have been described by Rollin (2011) as "moral stress".

1.5.6 Decisions made by owners following the consultation

Veterinary surgeons and nurses can make recommendations to owners and prescribe medications, but it is up to the owners to follow that advice (depicted in **Error! Reference source not found.**). Whether owners agree with advice given during a consultation, and their subsequent actions, have not been thoroughly explored. However, it is reported that compliance with advice given is typically poor (Wayner and Heinke, 2006). Much emphasis has been placed on the roles of good communication skills and the importance of treatment costs in increasing adherence to recommendations (Abood, 2007). Recently, alternative causes for poor compliance have started to emerge that demonstrate decisions made by owners are not related simply to understanding and recalling the information given. A survey from the pharmaceutical company Zoetis Inc. (2013) determined the commonest cause for dogs not receiving an analgesic tablet was that the owner did not think that the dog needed it; veterinary surgeons surveyed had overwhelmingly assumed that the reason was cost-based. This demonstrates the importance of ascertaining the reasons behind decisions made directly from the decision-makers.

Factors underlying other decisions made by owners about the health and welfare of their dogs may be much more complex. For example, euthanasia decisions appear to be affected by owners' desire and ability to manage an ill animal. Forty owners of dogs with severe chronic spinal injury surveyed by Freeman *et al.* (2013) reported they spent a median of 14 hours per week managing their dog; two reported it had led to serious family problems, and one reported a negative impact on their own quality of life. Eighty-five percent of owners surveyed by Niessen *et al.* (2012) reported negative impacts of managing their dog's diabetes on their own quality of life. These included worry, difficulty leaving their dogs with family members, impacts on their social life and concerns about what might happen in the future. Danish owners of chronically ill dogs interviewed by Christiansen *et al.* (2013, 2016) also identified many of these concerns, suggesting the impacts of owning an ill dog may have consistent, detrimental effects on their owners. Alternatively, owners with

a very strong bond to their dog may delay euthanasia. For example, 201 owners of dogs with heart failure surveyed by Oyama *et al.* (2008) were very concerned about their pet suffering, but 14% favoured quantity over quality of life. Danish owners interviewed by Christiansen *et al.* (2016) highlighted that veterinary surgeons may need to play a more proactive role in advising owners on euthanasia. The perspectives of practicing veterinary surgeons on their role in these interactions and the rationale for other decisions made by owners outside the consulting room have not been explored thoroughly in any context.

1.6 Canine osteoarthritis

This thesis set out to understand how veterinary surgeons and owners made decisions in owned dogs. Canine osteoarthritis was chosen as the population to study for this thesis for a variety of reasons: it was considered prevalent in the canine population; would be sufficiently chronic for cases to be followed over time; and might present a risk to welfare.

1.6.1 What is osteoarthritis?

Osteoarthritis, often synonymously termed degenerative joint disease in the veterinary literature (e.g. Innes 2012), is more accurately classified as a subset of degenerative joint diseases. Osteoarthritis is defined as “*a clinical syndrome of joint pain accompanied by varying degrees of functional limitation and a reduced quality of life*” (National Institute of Health and Care Excellence, 2014). “*Syndrome*” reflects the range of genetic, metabolic, traumatic and developmental factors, both local and systemic, that culminate in a final common pathway of osteoarthritis in humans (Hawker and Stanaitis, 2014). It is likely these factors and other are also relevant in dogs (reviewed by Innes, 2012). Osteoarthritis is commonly classified in terms of its aetiology as primary (idiopathic) or secondary to an underlying cause. Whilst subtypes of human osteoarthritis with different aetiologies are now recognised (Waarsing *et al.*, 2015), canine osteoarthritis is thought predominantly to be secondary to poor joint conformation or trauma (Pettitt and German, 2015) though inciting causes are frequently not identified (Innes, 2012). The resulting disease is characterised by localised damage to articular cartilage in one or more joints followed by failed repair and inflammation. This changes the structure and composition of multiple components of the synovial joint “organ” (Loeser *et al.*, 2012), culminating in a breakdown of cartilage and bone which ultimately leads to pain and disability (Berenbaum, 2013).

1.6.2 Canine osteoarthritis prevalence

Estimates of the prevalence of osteoarthritis in the dog population are useful to understand the potential risk to welfare posed by osteoarthritis. However, such estimates remain very challenging to calculate. Johnston (1997) reported a 1996 telephone survey of 200 American veterinary surgeons conducted by Pfizer Animal Health which led to an estimate of 20% of dogs over 1 year old affected. Unfortunately, no details of the study are available (Zoetis, personal communication May 2013). This figure is likely to be highly unreliable due to the method used to generate the data but, surprisingly, this remains by far the most cited estimate in veterinary publications. Using electronic patient record data collected from UK general practices in 2009-2013, O'Neill *et al.* (2014) estimated the prevalence of

degenerative joint disease in 148,741 dogs in the United Kingdom to be 6.6%. However, the accuracy of these data depends on how reliably veterinary surgeons are correctly recording their clinical data and that has yet to be ascertained. A survey conducted by the Kennel Club during 2014 completed by 43,207 pedigree dog owners estimated 3.5% were affected by “arthritis”. Finally, osteoarthritis was recorded as a diagnosis in 5% of the 2148 general practice consultations involving dogs observed by Robinson (2014). The discrepancy between estimates is likely to be related to the different methods used to collect data.

All these prevalence estimates include only dogs diagnosed with osteoarthritis by a veterinary surgeon; it is likely some dogs will never achieve a diagnosis, but data on these dogs is inaccessible. All prevalence estimates are therefore likely to under-represent the true figure. However, using the lowest of the UK dog population estimates described in section 1.2 of 8.55 million, if 5% of dogs in the UK are affected by osteoarthritis (the mean value from the three studies above), this equates to a rough estimate of 425,000 dogs in the UK living with osteoarthritis. Osteoarthritis can affect any synovial joint but good data on the most commonly affected joints are difficult to obtain. Data from 16 veterinary teaching hospitals in the United States of America (USA) in 1980-1989 suggested the hip, shoulder and elbow were the most affected canine joints (Johnson *et al.*, 1994). However, the presence of osteoarthritis in smaller joints may not have been determined and the population of dogs may not be comparable with those currently alive in the UK. Estimates of the number of joints affected per dog or the average length of time individuals live with the disease are not available.

1.6.3 Risk factors for developing canine osteoarthritis

Increasing age, high birth weight, male sex and possibly spending time on a slippery floor surface at a young age have been suggested to increase the risk of development of canine osteoarthritis; the weak evidence for these is reviewed by Innes (2012). Obesity is the single factor for which evidence has been described as “*compelling*” (Innes, 2012). There is mounting evidence of the deleterious effects on joint cartilage of inflammatory cytokines produced by adipocytes; this will be exacerbated in obesity (German *et al.*, 2010, Frye *et al.*, 2016). The canine osteoarthritis evidence comes from a series of publications from a longitudinal cohort study of 48 Labradors from seven litters fed either ad libitum or a restricted diet (Kealy *et al.*, 1992, Kealy *et al.*, 1997, Kealy *et al.*, 2000, Smith *et al.*, 2006). Dietary restriction led to a lower cumulative prevalence of hip osteoarthritis on radiography over the dogs’ lifespan compared to the ad lib group, but no differences in elbow osteoarthritis (Huck *et al.*, 2009). However, the groups were very small, the dogs were kennelled in a controlled environment, the radiographic scoring scheme used was not validated, the use of an ad-lib control groups may not be relevant to most dogs, the significance of radiographic changes in osteoarthritis has been questioned (Gordon *et al.*, 2003, Akerblom and Sjostrom, 2007, Runge *et al.*, 2008, Goldhammer *et al.*, 2010) and no outcomes assessing the impact on the dog of the radiological changes were included. It is therefore difficult to know the relevance of this cohort to other dogs.

1.6.4 Diagnosis

It is likely almost all dogs with canine osteoarthritis are managed in general practice rather than by specialists in canine orthopaedics. In an observational study conducted in UK general practices, Robinson (2014) found only 0.8% of all dogs diagnosed

with musculoskeletal disease were referred to specialists, though the number was small and may not be generalizable. Reports of how dogs with osteoarthritis are diagnosed and managed in general practice are not available. The evidence comes mainly from review articles written by specialists who may be describing a different population of dogs to those managed in general practice (e.g. Innes, 2012, Pettitt and German, 2015). These reviews report owner history to be important in recognising the disease. “*Inactivity stiffness*” (Pettitt and German, 2015; p.1), whereby lameness is reported to be more severe after a period of rest, is reported to be the most common manifestation of osteoarthritis noticed by owners, though a reference for this assertion is not provided. Other changes reported to be noticed by owners include reduced willingness to jump, exercise intolerance and aggression (Innes, 2012). Osteoarthritis may be diagnosed using a combination of clinical examination, (typically including assessments of range of motion, pain on limb manipulation and visual gait scoring) and diagnostic tests such as radiography or synovial fluid analysis (Pettitt and German, 2015). Radiography has been described as the “*mainstay*” of diagnosis of osteoarthritis in clinical practice (Pettitt and German, 2015; p.2) though Robinson *et al.* (2015b) suggest this might not reflect cases managed in general practice. In referral centres, alternative diagnostic techniques such as computed tomography or arthroscopy may be employed but equipment and expertise to do this may not exist in many general practices.

1.6.5 Treatment

An extensive review of the treatments available for canine osteoarthritis and the evidence for their efficacy is beyond the scope of this introduction. These include: analgesics e.g. non-steroidal anti-inflammatory drugs (NSAIDs), paracetamol, tramadol, amantadine and gabapentin; structural modifying drugs e.g. pentosan polysulphate; joint supplements (also called nutraceuticals); therapies including acupuncture, physiotherapy and hydrotherapy; surgery including joint replacement or fusion; exercise modification; and dietary management (for narrative reviews of those treatments see Innes, 2012, Pettitt and German, 2015). It is not known which treatment or combination of treatments are the most effective for managing any form of canine osteoarthritis. Good quality randomized controlled trials comparing treatments using the same outcomes have not been performed. Systematic reviews of the efficacy of different treatments for canine osteoarthritis (Aragon *et al.*, 2007, Sanderson *et al.*, 2009, Vandeweerd *et al.*, 2012c, Bergh and Budsberg, 2014) identified NSAIDs as the only treatment for which there is strong evidence of efficacy in minimising the signs of canine osteoarthritis but it was not possible for their authors to recommend one NSAID over another. Further conclusions were limited by the poor quality of primary studies on which these reviews drew; other treatments may be effective but the evidence is very weak. It is not known how well this information has been disseminated to veterinary surgeons working in general practice. Whilst analgesics and some structural modifying drugs can be obtained only through veterinary surgeons, many nutraceuticals and alternative therapies are available from pet shops and internet pharmacies. It is not reported how widely treatments obtained from these sources are used by owners, or whether there is a population of dogs with osteoarthritis managed entirely outside veterinary care.

1.6.6 Management

Weight loss in overweight dogs is one of the few positive recommendations for management of canine osteoarthritis (Innes, 2012, Pettitt and German, 2015) but the

evidence is equivocal. Mlacnik *et al.* (2006) compared a weight loss program of caloric restriction to caloric restriction plus intensive physical therapy involving massage, increasing walk lengths and use of a transcutaneous electrical nerve stimulation machine in dogs with osteoarthritis. The authors concluded the best outcomes were achieved by dogs in the exercise group, but this is confounded by the lack of blinding in the study design. Impellizeri *et al.* (2000) monitored changes in gait in nine dogs with hip osteoarthritis that weighed 11-12% more than recommended at baseline and found lameness improved significantly as they lost weight. The study is at risk of bias since the lead author performed all assessments and the lameness score was not validated. Marshall *et al.* (2010) assessed the effect of weight loss using a prescription diet on the gait of 14 obese dogs with radiological signs of osteoarthritis using a visual lameness examination and forceplate gait analysis. Visual lameness examination improved significantly but again the study was not blinded so results may be biased. Improvements in gait using the force plate gait analysis were much less clear, and the validity of force plate gait analysis in studies involving weight change has been questioned by Moreau *et al.* (2010). Wide-ranging benefits of exercise in people with osteoarthritis are well established (reviewed by Runhaar *et al.*, 2015, Gay *et al.*, 2016) but only Greene *et al.* (2013) have assessed the relationship between exercise and any outcomes in canine osteoarthritis. Whilst that case series suggested lameness was less severe in dogs that exercised more, there are no clear guidelines for how much or what type of exercise is beneficial for canine osteoarthritis.

1.6.7 Outcome assessments in canine osteoarthritis

Budsberg (1997) described the problem of growing numbers of treatments for canine osteoarthritis claiming to be efficacious without rigorously reporting the research behind those claims. Systematic reviews of the evidence for efficacy of a range of treatments for canine osteoarthritis performed by Aragon *et al.* (2007) and Sanderson *et al.* (2009) confirmed poor reporting of clinical trials was a problem. Vandewerd *et al.* (2012c) further emphasised the problem in a systematic review looking only at the evidence for efficacy of nutraceuticals in canine osteoarthritis. They classified the types of outcome measures used as subjective, semi-objective and objective, but did not specifically examine the validity of the measures used. Interestingly, outcomes assessed by owners were classified as subjective whilst those assessed by veterinary surgeons were classified as semi-objective; in the absence of a detailed appraisal of the outcome measurements used, little evidence exists to support that classification. Nevertheless, only 3/35 outcomes were described as objective and 16/35 were described as semi-objective.

In 2006, a group of veterinary surgical experts formed the Outcome Measures Program (OMP) to promote the use of identified outcomes and validated outcome measures in veterinary orthopaedic research and practice (Cook, 2007). This led to a series of articles in the peer-reviewed journal *Veterinary Surgery* (Brown, 2007, Innes, 2007, Kapatkin, 2007, Schulz, 2007) explaining the value of outcome measures and standardised terminology for use in veterinary orthopaedic research. However, Sharkey (2013) discussed the challenges associated with recognising chronic pain in dogs with osteoarthritis due to the lack of validated outcome measures for that purpose, suggesting those articles had achieved little impact. A review of the initiative by Cook (2014) provides no compelling evidence for their impact, but the OMP had led to the development of a novel, validated instrument for the assessment of canine osteoarthritis (Brown, 2014 a,b,c).

It remains unclear how widely adopted such an instrument will be by the research community or practicing veterinary surgeons. The observational study of general practice consultations by Robinson (2014) suggests use of validated outcome measures is very rare, though this study did not include many dogs with osteoarthritis. It is not known which outcomes are important to owners and veterinary surgeons managing dogs with osteoarthritis, whether those outcomes are relevant to the dog's welfare, whether outcomes are routinely assessed using validated outcome measures or what monitoring is performed on dogs with osteoarthritis in clinical practice.

1.6.8 How might canine osteoarthritis cause welfare problems?

It is not known how welfare is assessed in dogs with osteoarthritis by either owners or veterinary surgeons. Canine welfare may be affected by owners and veterinary surgeons failing in their role as proxies and advocates, and by decisions based on poor evidence. Canine osteoarthritis compromises physical health by causing pain, stiffness and reduced mobility (Brown *et al.*, 2008, Brown, 2014a). The pathophysiology of pain associated with osteoarthritis is extremely complex and remains poorly understood (narratively reviewed by Perrot, 2015), perhaps due in part to the use of suboptimal animal models in that research (Malfait and Little, 2015, McCoy, 2015). The role of the brain in unconsciously modulating the experience of chronic pain is increasingly recognised (narratively reviewed by Mitsi and Zachariou, 2016) and the negative impacts of the conscious awareness of pain related to osteoarthritis on both physical function and mental health in people are highlighted in qualitative research (Harding *et al.*, 2005, Hendry *et al.*, 2006, Ryan *et al.*, 2013, Malterud *et al.*, 2015). It is likely the same will be true for dogs, so there are clear physical and mental health risks to welfare posed by osteoarthritis.

Stiffness appears to be subject to surprisingly little discussion in human osteoarthritis. Its aetiology is increasingly thought to be related to synovial fibrosis which is in turn linked to pain (Remst *et al.*, 2015). Little description exists in the medical literature about the relationship between stiffness, function and pain in osteoarthritis, though stiffness is included in a Japanese instrument to assess the difficulties in daily life experienced by patients with knee osteoarthritis (Tanimura *et al.*, 2011). In humans, pathophysiological change is frequently advanced before the patient reports symptoms related to the disease of pain, stiffness and functional impairment (Glyn-Jones *et al.*, 2015). This distinction between functional ability and pain perception is highly relevant when it comes to assessing the impact of osteoarthritis on non-verbal mammals. Canine models of osteoarthritis pain have been criticised for using physical function such as altered gait and locomotion to assess pain (Malfait *et al.*, 2013). Similar outcomes have been recommended for owned dogs (Innes, 2012) but it remains unclear how physical function, pain and gait are linked in canine osteoarthritis.

Other potential welfare impacts of osteoarthritis are likely to be due to the management of the disease. Whilst some treatments appear to improve some outcomes in canine osteoarthritis (e.g. Brown *et al.*, 2013a), it is unlikely full physical function will be restored. NSAIDs are recognised to cause adverse events in dogs (Hunt *et al.*, 2015) which may further compromise physical health and repeated veterinary visits to monitor for these may be a source of stress (Dawson *et al.*, 2016).

Reduced mobility may lead to challenges for the dogs to cope in their physical environment. Reduced walk lengths may lead to increased isolation and potentially boredom if alternative strategies are not put in place to keep dogs occupied; this is likely to be a risk particularly in younger dogs or more active breeds. These aspects of the welfare impacts of canine osteoarthritis have received little attention.

1.7 Thesis aims and overview

The aim of this thesis is to characterise the nature and basis of decisions that are made about the treatment and welfare of osteoarthritic dogs by owners and veterinary professionals (veterinary surgeons and veterinary nurses). Three studies were performed to achieve this aim.

In the first study, two rapid reviews were performed to critically appraise the type and quality of outcome measures published in the peer-reviewed literature in relation to canine osteoarthritis and quality of life assessment.

The second study involved collection and thematic analysis of qualitative data through interviews and focus groups to explore the type and nature of decisions made by owners of osteoarthritic dogs and veterinary professionals and to identify any challenges faced by those decision makers.

The third study sought to further explore how owners of osteoarthritic dogs made day-to-day assessments of their dogs' condition using a novel outcome measure based on data gathered in Chapter 4 designed to overcome flaws identified in owner-specific outcome measures described in Chapter 2.

1.8 Thesis layout

Chapter 2 describes two rapid reviews performed to identify which outcomes are assessed in the peer-reviewed literature relevant to canine osteoarthritis and canine quality of life.

Chapter 3 describes the methods used to perform a qualitative study to explore the nature of decisions made by owners and veterinary professionals managing osteoarthritic dogs and the outcomes used to make those decisions. Participants' demographic data are also presented.

Chapter 4 describes and discusses the results of thematic analysis of the owner interviews and veterinary professional focus groups described in chapter 3.

Chapter 5 describes the development and pilot trial of a novel outcome measure for completion by owners of osteoarthritic dogs developed using owner interview data described in Chapter 4.

Chapter 6 brings together the results of the study findings together with recommendations for future work.

Chapter 2. Evidence syntheses to determine how quality of life is assessed in dogs and which outcomes are measured in canine osteoarthritis

Chapter 1 identified that it is not known which outcomes are assessed by veterinary surgeons in dogs with osteoarthritis or whether those assessments are relevant to canine welfare. This chapter reports two evidence syntheses performed using systematic methods to describe the outcome measures used in the veterinary peer reviewed literature. Data included in this chapter has been published in two open access peer-reviewed publications (Belshaw *et al.*, 2015, Belshaw *et al.*, 2016a).

2.1 Introduction

The advantages of evidence syntheses were described in 1.5.3. Evidence syntheses can be used to appraise any aspect of medicine from the success of interventions in achieving specific outcomes (e.g. Zhang *et al.*, 2007) to factors influencing clinical decisions (e.g. Everink *et al.*, 2016). The process of evidence syntheses starts with a well-defined research question and follows a comprehensive search strategy to identify all potentially relevant studies, thereby minimising the inclusion bias that can occur in narrative reviews. Inclusion and exclusion criteria are rigorously and systematically applied to ensure only studies relevant to the research question are included.

Systematic reviews are recognised to be the strongest form of evidence synthesis; their disadvantages were discussed in 1.5.3. Alternative forms of evidence synthesis are appropriate where time or the number of available publications is limited. A rapid review is described as a type of knowledge synthesis in which components of the systematic review process are simplified or omitted to produce information in a short period of time (Khangura *et al.*, 2012). Rapid reviews search fewer sources and produce less generalizable results than systematic reviews, but they can be performed by a few people in weeks to months. However, “rapid review” describes a variety of methodologies leading to reviews of variable standards (Tricco *et al.*, 2015). Rapid reviews are helpful in establishing what is already known in a specific area defined by the search terms by highlighting evidence gaps and making recommendations for future studies. For these reasons, a rapid review methodology was used in this study to systematically evaluate outcome measures in peer reviewed veterinary clinical studies. The importance of using validated outcome measures was discussed in 1.5.4. Many reviews of the validity and quality of outcome measurement tools exist in the human medical literature, with groups such as Outcome Measures in Rheumatology (OMERACT, 2016) and Osteoarthritis Research Society International (OARSI, 2016) leading initiatives to develop rigorously validated outcome assessment tools and promoting their adoption.

2.1.1 Aims and objectives

The overarching aim of the two reviews presented was to identify which outcomes are assessed in the peer-reviewed literature relevant to canine osteoarthritis and canine quality of life.

Review 1 aimed to find peer-reviewed outcome measures used for quality of life assessment in any dog and to appraise their quality. For each outcome measure, the validation and assessment of reliability performed in all publications describing its use were appraised using a checklist and its quality was appraised. The objective was to perform a repeatable, rapid review of all novel, peer-reviewed English language methods for assessing quality of life or wellbeing in dogs. The significance of quality of life and wellbeing as synonyms for welfare in veterinary medicine were highlighted in 1.4. Canine quality of life outcome measures have previously been reviewed in a narrative form (e.g. McMillan, 2000, Yeates and Main, 2009) but the quality and validity of these measures has not been appraised in a systematic manner.

Review 2 aimed to describe the range of outcome measures in the peer-reviewed literature on canine osteoarthritis. The objective was to record and categorize the outcome measures used in dogs with naturally occurring osteoarthritis by systematically reviewing the peer-reviewed publications on osteoarthritis in dogs. Several systematic reviews of canine osteoarthritis interventions have highlighted the wide variety and poor reporting of the outcomes assessed in canine osteoarthritis clinical trials (Aragon *et al.*, 2007, Sanderson *et al.*, 2009, Vandeweerd *et al.*, 2012c, Bergh and Budberg, 2014). In medicine, a systematic review of the outcomes assessed in hip and knee osteoarthritis trials led to consensus on a standardised set of outcomes to be used in all hip and knee osteoarthritis clinical trials (Dobson *et al.*, 2013). A similar review of canine osteoarthritis outcome measures has not previously been conducted.

2.2 Review 1: materials and methods

2.2.1 Definitions

The specification of a quality of life outcome measure was: (1) any question, or set of questions, directed to a veterinary surgeon, clinical investigator, owner or caretaker, used to assess, or comment on, canine quality of life; or (2) any other methodology used to gather directly observed data for the same purpose. An item described a single question such as “*How do you rate your dog’s quality of life?*” and a domain described a specified area under assessment, such as pain, measured by collating responses to multiple question items. Recall period was the specific time a respondent was instructed to reflect upon to answer a question, for example the previous seven days.

For an outcome measure to be described as validated, at least one aspect of validation must have been intentionally achieved. An unvalidated outcome measure was defined as one where no evidence of intentional validation is provided. A novel outcome measure was defined as one had not been previously published in a peer-reviewed journal.

2.2.2 Search methods

A search of CAB Abstracts (1910-2013) and MEDLINE In Process and Non-Indexed Citations and OVID Medline (1946-2013) using the OVID interface was performed in July 2013. The search included all papers available in the database at the time the search was performed. The abstract, title, original title, broad terms and heading words were searched using terms relevant to dogs (dog, dogs, canine, canines or

canis), wellbeing (wellbeing, well-being, well being) and quality of life (quality of life, QoL, quality-of-life). The searches were linked with Boolean terms as (dog OR dogs OR canine OR canines OR canis) AND (wellbeing OR well-being OR well being OR quality of life OR QoL OR quality-of-life).

2.2.3 Inclusion criteria

The inclusion criteria were that the publication must: (1) be English language; (2) be in an accessible peer-reviewed journal; (3) contain one of the keywords in the abstract; (4) contain an outcome measure for the assessment of quality of life; (5) be the first published report of that outcome measure; (6) be available in full. Where an outcome measure had several parts and only one was novel, just the novel part was reviewed. For publications where the full publication or outcome measure was not available, a search for was conducted online. If the publication or outcome measure was not found, authors were contacted by email in order: first; last; any. Where email addresses were not in the publication, they were obtained, where possible, by internet searching. Authors were given 4 weeks to reply; the publication was excluded if not provided by its authors within this period.

2.2.4 Exclusion criteria

The exclusion criteria were publications: (1) not in the English language; (2) not published in a peer-reviewed journal; (3) that did not contain the keywords in the abstract; (4) that did not contain an outcome measure; (5) that had been published in an earlier publication found by this search; (6) unavailable for review.

2.2.5 Application of inclusion and exclusion criteria

A single author (ZB) performed the initial search and applied inclusion and exclusion criteria to all publications. To ensure consistency, a random sample of 20% of all publications which met the first three inclusion criteria were independently appraised according to the other inclusion/exclusion criteria by a second author (RD). Information on outcome measure purpose, design and use was extracted from all publications that met the inclusion criteria.

2.2.6 Evaluation of reliability, validity and quality

Using the complete manuscripts, presence or absence of validation, and the type of validation performed were independently scored by two authors (ZB, NH) using checklists developed for the purpose (Table 3), adapted from Taylor and Mills (2006) and Harvey (2014) by ZB and NH. Each criterion in the checklist was scored as present absent, or not applicable. Where ZB and NH did not agree on a score, a third author (LA) scored the criterion in question and three-way discussion permitted a consensus. For each of the outcome measures with some evidence of validation, the Scopus database was checked in January 2014 for citations of the publication containing it to determine whether subsequent validation had been performed. The same checklist of reliability and validity was applied to these publications and any additional validation was independently recorded for each outcome measure by ZB and NH. Where there was disagreement between the two scorers, a third scorer, LA was asked to make the final decision.

The quality of the validated outcome measures was assessed by one author (ZB) using 10 criteria (Table 4) adapted from those developed for the purpose in human quality of life outcome measure appraisal (Gill and Feinstein, 1994, Guyatt *et al.*, 1997, Locker and Allen, 2007). Each validated outcome measure was scored against the questions with the possible results of: Yes/No/Not stated/Not applicable.

Table 3. Assessment criteria for reliability and validity of quality of life outcome measures modified from Taylor and Mills (2006) and Harvey (2014) by ZB and NH.

Test	Aim of test	Criterion	Legend for table 6
Intra-rater reliability	To assess reliability in scoring when one person repeat-scores the animal	Does the same person repeatedly score the same animal under the same conditions within a short time period?	1
		Is that time period is clearly stated?	2
		Is the gap between repeat scores a minimum of one week, ideally a minimum two weeks?	3
		Is the consistency of scoring between first and subsequent assessments is compared? (Tests for comparison are typically correlation coefficients such as the intra-class correlation coefficient, Kappa coefficient, Pearson's, Spearman's Rank or Kendall's tau-b)	4
		Have reliability statistics been assessed against a stated threshold?	5
Inter-rater reliability	To assess reliability in scoring when scorers simultaneously score the same animal	Do multiple people simultaneously score the same animal?	6
		Does the methodology describe a situation which ensures that the scores of each rater are independent and unbiased by each other?	7
		Is the consistency of scores between raters compared? (Tests for comparison are typically correlation coefficients such as the intra-class correlation coefficient, Kappa coefficient, Pearson's, Spearman's Rank or Kendall's tau-b)	8
		Have reliability statistics been assessed against a stated threshold?	9
Test-re-test reliability	To assess consistency in scoring remains when a long period of time has elapsed	Does the same person score the same animal under the same conditions after a considerable time interval? (Length of interval may be constrained by the health condition; see criterion 14)	10
		Is the time period clearly stated?	11
		Is the gap between repeat scores a minimum of two weeks? (Longer time periods are preferred)	12
		Is the consistency of scores compared? (Tests for comparison are typically correlation coefficients based upon rank order consistency such as the intra-class correlation coefficient, Spearman's Rank or Kendall's tau-b)	13
		Where relevant, is it acknowledged that for rapidly changing health conditions, this assessment is not always possible, or that time intervals may need to be shorter?	14
		Have reliability statistics been assessed against a stated threshold?	15
Internal consistency	To assess whether, if questions are grouped in any form, there is a correlation between questions within the groups	Has an attempt been made to determine whether correlations exist between questions that are grouped together?	16
		Is the method of grouping the questions stated?	17
		Is the method of grouping appropriate? (Methods include factor analysis and principal component analysis; each have their own criteria for appropriate use)	18
		Has an analysis been performed to look for correlations between questions within groups, factors or components?	19
		Is the method of analysis appropriate? (Methods of analysing within group correlations include Cronbach's Alpha and intra-class correlation coefficients)	20

Test	Aim of test	Criteria	Legend for table 6
Content validity (face validity is a form of this)	To assess whether individual questions really ask what they are meant to be asking	Has an attempt been made to ensure the questions in the outcome measure truly ask what they should be? (e.g. do questions in the area of comfort truly ask about comfort?)	21
		Is the method by which this has been performed described?	22
		Is the method appropriate? (Methods include consultation with a panel of experts which in this context may be veterinary surgeons, dog owners, behaviour experts etc.)	23
Construct validity	Whether questions, or groups of questions, ask what they are meant to be asking. This is assessed by comparing constructs which are hypothesised to be related. A construct is something which cannot be proved or objectively measured, e.g. quality of life, happiness.	Has an attempt been made to statistically check whether questions truly assess the broad area that they were designed to assess by comparing the relationships between questions/groups, or between questions/groups and other observable responses? (e.g. questions about comfort should be negatively associated to questions about pain level; comfort scores should be negatively associated with sleep quality; pain scores should positively associate with reduced movement)	24
		Have hypotheses about expected positive (convergent) and/or negative (divergent) associations between tested measures been clearly stated before analysis? This is critical to the assessment of construct validity.	25
		Is the method by which the assessment has been made described?	26
		Is this method appropriate? (Potential methods are numerous but include comparing the distribution of scores to other observable measures, or comparisons between scores within the outcome measure)	27
Criterion (concurrent) validity	How this outcome measure compares to an independent 'gold standard' measure. A criterion is something which can be objectively and definitively measured, e.g. age, a hip score. A measurement of a construct should not be used as the comparator in criterion testing.	Has the outcome measure been compared to a different outcome measure/measurement (criterion measure, standard reference test, gold standard) measuring the same thing?	28
		Do the authors state that the criterion method used has been validated, or provide a reference?	29
		Have hypotheses about expected associations between the outcome measure and the comparison measure been clearly stated, including the directionality of the expected correlation, before being tested? This is critical to the assessment of criterion validity.	30
		Has the time when the criterion measurement was performed been clearly stated? (Typically at the same time as concurrent validity)	31
		Did the outcome measure produce results comparable to a gold standard?	32
Criterion (known groups)	Whether the outcome measure can distinguish between groups of patients, e.g. dogs with different severities of heart disease, or dogs given placebo versus treatment	Has the outcome measure been assessed for its ability to distinguish clinically relevant differences between known groups?	33
		Have hypotheses about expected associations between the outcome measure and the comparison measure been clearly stated, including the directionality of the expected correlation, before being tested? This is critical to the assessment of criterion validity.	34
		Is the time when the assessment of know group was performed clearly stated?	35
		Has the outcome measure been shown to distinguish between different populations or groups?	36

2.3 Review 1: results

The initial search returned 1,145 unique publications, of which 151 met inclusion criteria one to four and were assessed at the level of the whole publication (Figure 3). Fifty of these publications were excluded, as despite commenting on quality of life in the abstract, no details of the method of its assessment were provided, and a further 22 were excluded because the outcome measure was not novel. Thirty-six publications included an incomplete description of a quality of life outcome measure. Contact details were obtained for authors of 33 of these 36 publications. Fourteen of the 33 contacted authors responded to email requests for additional details, resulting in inclusion of nine additional outcome measures. Three responded to say they had not used a replicable outcome measure, and two outcome measures were unavailable. After systematically excluding publications that did not meet the inclusion criteria, 52 remained. Publications dated from 1987 to 2013, with the majority published since 2003. Publications appeared in 19 unique journals with the highest number of outcome measures in *Journal of Small Animal Practice* (n=12), and *Journal of the American Veterinary Medical Association* (n=10).

2.3.1 Unvalidated outcome measures

Forty-one of the 52 publications described a study where a novel quality of life outcome measure had been used as a clinical outcome measure without any evidence of its prior validation. Only ten of these 41 publications contained any detail on of why the chosen items were included in the outcome measure; the rest gave no details of how or why the outcome measure was designed. Craven *et al.* (2004) was the only publication to define quality of life or wellbeing. Fourteen of the 41 outcome measures had been used in the assessment of veterinary oncology patients; six were used in each of cardiology and neurology. Thirty-four of the 41 outcome measures were fully reproduced, adequately described or referenced; the rest had to be obtained directly from the author. Thirty-five of the 41 outcome measures were for completion by an owner, five by a veterinary surgeon, and one by both veterinary surgeon and owner. Outcome measures ranged from a single question such as “*What is your pet’s quality of life now?*” (e.g. Craven *et al.*, 2004; p.337) to long multi-item questionnaires (Lord and Podell, 1999). Twenty of the outcome measures required the person completing it to recall the dog’s condition at least 3 months previously, with some outcome measures requiring recall of over 2 years. Potential sources of bias were not discussed in the majority of publications.

2.3.2 Validated outcome measures

Eleven of the 52 publications (21%; Table 5) described some evidence of validation of a novel quality of life outcome measure. One outcome measure (Schneider *et al.*, 2010) was for generic canine quality of life assessment. Eight outcome measures were for validated for use in a specific disease type; the other two outcome measures (Mullan and Main, 2007, Yeates *et al.*, 2011) were designed to highlight potential welfare considerations to dog owners. Four of the eleven outcome measures were completely reproduced with the publication allowing for immediate appraisal and further use. Outcome measures varied in length from five items (Yeates *et al.*, 2011) to 88 items (Schneider *et al.*, 2010). In contrast to the unvalidated outcome measures, recall periods were typically short and well defined. Potential sources of bias were acknowledged in four of the 11 publications (Budke *et al.*, 2008; Favrot *et al.*, 2010;

Schneider *et al.*, 2010; Iliopoulou *et al.*, 2013). Based on the results of the Scopus search (Table 5), the only peer-reviewed publications in which most of the outcome measures had been used were additional publications by its original authors.

Assessments of validity, reliability and consistency demonstrated in original publications and those citing it are summarised in Table 6. While many of the outcome measures had demonstrated some evidence of validity, documented assessment of reliability and consistency was infrequent, and no outcome measure had been assessed across all criteria. Reporting of the methodology of validation was frequently incomplete. For example, without a stated hypothesis when testing construct and criterion validity, the validity of the test result is unclear. The format of the outcome measure designed by Budke *et al.*, (2008) meant inter-rater reliability was not applicable.

The quality of these outcome measures was also assessed (Table 4). Most outcome measures had a few of the attributes associated with quality in the medical literature, with the outcome measure designed by Lynch *et al.* (2010) meeting 6 of the 10 criteria. Poor reporting may have been a factor in other outcome measures not demonstrating the evidence of these quality guidelines, and not all questions were applicable to all the outcome measures due to their design. Three publications defined keywords, while a further five discussed existing definitions or domains that should be assessed without stating their own definition. Few outcome measures had been designed with constructive input of owners either in the question design or pilot phases. The outcome measure designed by Budke *et al.*, (2008) was the only one that allowed owners to choose and weight the domains they perceived relevant to their dog. Four of the eleven outcome measures included a global quality of life rating, perceived to be a useful inclusion in human quality of life outcome measures.

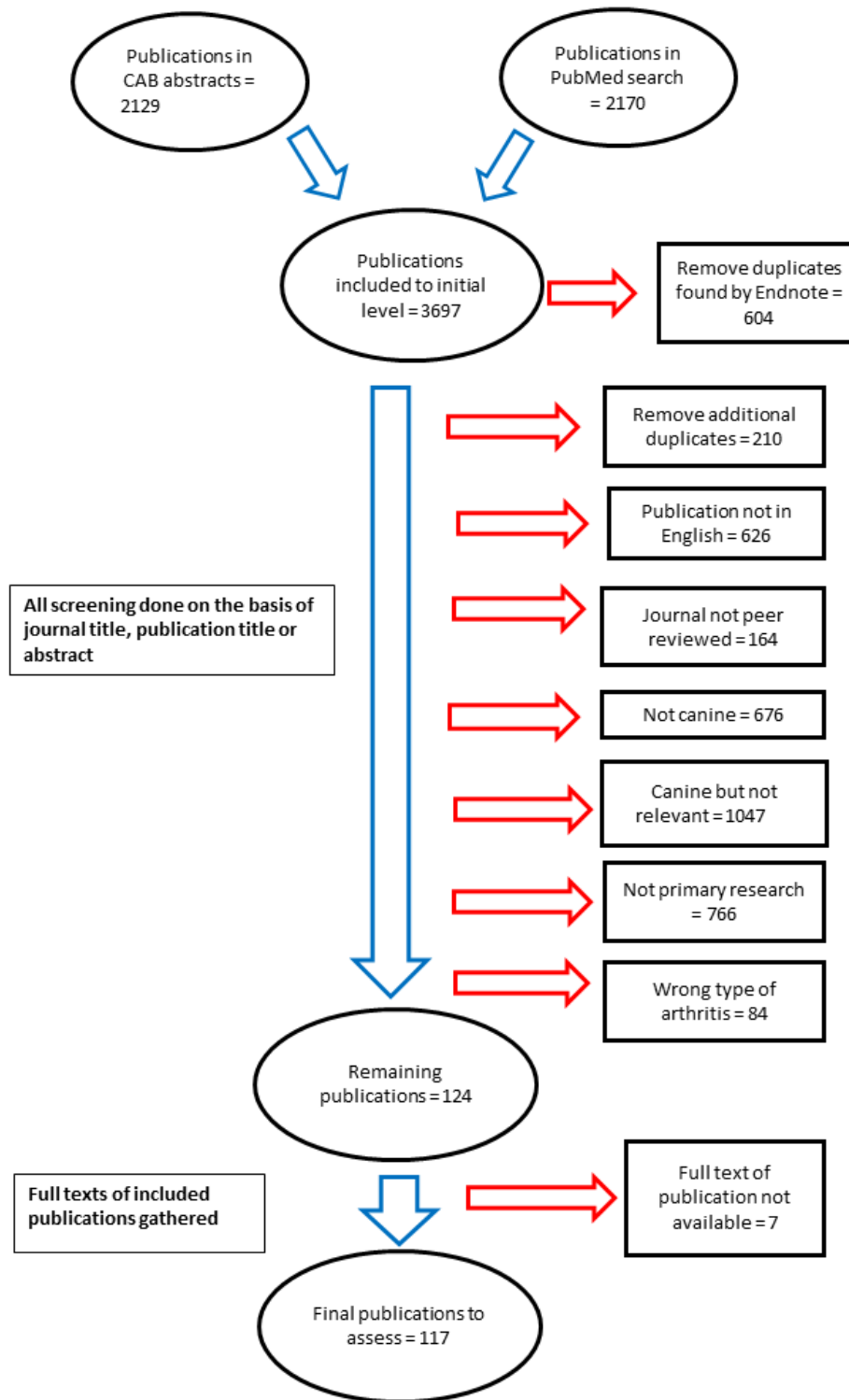


Figure 3. Summary of the quality of life outcome measure review process

Table 4. Assessment criteria for, and results of, quality appraisal of validated quality of life outcome measures using criteria adapted from Gill and Feinstein (1994), Guyatt *et al.* (1997) and Locker and Allen (2007).

	Are key terms (e.g. QoL) defined within the outcome measure?	Are the domains of QoL to be measured stated in the publication or outcome measure?	Do the investigators state why they used this outcome measure rather than any other?	During a pilot, were owners asked to suggest additional questions which could be included?	Were the questions informed by discussion or qualitative interviews with those who will complete the outcome measure?	If the authors aimed to measure QoL rather than HRQoL is the outcome measure doing so?	Is a single-question overall QoL rating included?	Are multiple items aggregated into a single score?	Are owners asked to indicate which items were personally important to them?	If so is this incorporated into a weighted score?
Brown <i>et al.</i> (2007)	N	Y	Y	Y	NS	Y	Y	N	N	NA
Budke <i>et al.</i> (2008)	N	NA	Y	NA	NA	Y	Y	NA	Y	Y
Favrot <i>et al.</i> , (2010)	D	N	N	N	NS	NA	N	N	N	NA
Freeman <i>et al.</i> (2005)	N	N	Y	N	N	NA	N	Y	N	NA
Iliopoulou <i>et al.</i> (2013)	D	N	Y	N	N	Y	Y	N	N	NA
Lynch <i>et al.</i> (2010)	Y	Y	Y	N	Y	Y	Y	N	N	NA
Mullan and Main (2007)	Y	Y	Y	N	N	Y	N	N	Y	N
Noli <i>et al.</i> (2011b)	Y	N	Y	Y	NS	N	N	Y	N	NA
Schneider <i>et al.</i> (2010)	D	Y	Y	N	N	Y	N	N	N	NA
Yazbek and Fantoni (2005)	D	Y	N	NS	NS	Y	N	Y	N	NA
Yeates <i>et al.</i> (2011)	D	Y	Y	Y	NS	Y	N	N	N	NA

Legend: QoL: Quality of life HRQoL: Health related quality of life N:No Y: Yes NA: Not applicable NS: Not stated D: definitions are discussed but a specific definition is not recommended.

Table 5. Summary of information extracted from the validated quality of life outcome measures

Publication [name of outcome measure if stated]	Function of outcome measure as stated by the authors	Brief description of outcome measure in the format available for review	Was the outcome measure validated in dogs with a specific disease type?	What was the recall period?	Was the outcome reproduced, described or referenced?	Publications that cite this publication found in Scopus search
Brown <i>et al.</i> (2007) [Canine Brief Pain Inventory]	Owners' perceptions of the severity and impact of chronic pain on their dogs with osteoarthritis	Two page, 11 question outcome measure. Four questions on pain, six on function (both numeric scales) and one scale for QoL (Likert-type).	Chronic pain	Previous seven days	No. Later publications refer to website for download	Brown <i>et al.</i> (2008), Brown <i>et al.</i> (2009), Brown <i>et al.</i> (2013a), Brown <i>et al.</i> (2013b), (Imhoff <i>et al.</i> , 2011), Gordon-Evans <i>et al.</i> (2013) Malek <i>et al.</i> (2012) Sullivan <i>et al.</i> (2013) Walton <i>et al.</i> (2013) Wernham <i>et al.</i> (2011)
Budke <i>et al.</i> , (2008)	Owner-perceived, weighted quality of life assessments for dogs with spinal cord injuries	Owners asked to choose five areas of life/life activity important to their dog, then to weight these using a laminated disk. Separate visual analogue scales for QoL and owner ability to cope with spinal cord injury.	Spinal cord disease	At the time of completion	Adequately described	Levine <i>et al.</i> (2008)
Favrot <i>et al.</i> , (2010)	Impact of atopic dermatitis on health-related quality of life of affected dogs and their owners	One page, 14 question outcome measure proposed for future use. Thirteen questions regarding QoL in the dog related to its skin disease and one about the QoL of the owners. Likert-type scale.	Skin disease	Since last visit to vet	Reproduced	Linek and Favrot (2010)

Publication [name of outcome measure if stated]	Function of outcome measure as stated by the authors	Brief description of outcome measure in the format available for review	Was the outcome measure validated in dogs with a specific disease type?	What was the recall period?	Was the outcome measure reproduced, described or referenced?	Publications that cite this publication found in Scopus search
Freeman <i>et al.</i> , (2005) [Functional Evaluation of Cardiac Health]	Health-related quality of life in dogs with cardiac disease	Two page, 18 question outcome measure. All questions relate to how the dog's heart disease has impacted on its comfort or sociability in the preceding seven days. Likert-type scale.	Cardiac disease	Previous seven days	Adequately described and available from author	Atkinson <i>et al.</i> (2009), Cunningham <i>et al.</i> (2013), Peddle <i>et al.</i> (2012), Marcondes-Santos <i>et al.</i> (2007), Rutherford <i>et al.</i> (2012)
Iliopoulou <i>et al.</i> , (2013)	Quality of life survey for use in a canine cancer chemotherapy setting	Four page, 30 question outcome measure. Three sections: 14 questions about how the dog was six months previously; 13 questions about the dog's QoL now; three questions about how the owners coped during the chemotherapy. Mixed scale types.	Cancer treated by chemotherapy	At the time of completion and six months previously	No. Available from the author	None
Lynch <i>et al.</i> , (2010)	Health-related quality of life in canine and feline cancer patients	One page, 24 question outcome measure. Eight sections, each with three questions. Sections on happiness, mental status, pain, appetite, hygiene, hydration, mobility and general health. Likert-type scales apart from the final global QoL question which is a visual analogue scale.	Cancer	At the time of completion	Reproduced	Chon <i>et al.</i> (2012)
Mullan <i>et al.</i> , (2007)	To raise awareness of welfare considerations of pet dogs visiting a veterinary practice	Four page, 39 question outcome measure. Seven sections: three questions on comfort; three on exercise; three on diet; three on mental stimulation; four on companionship; 16 across two sections on behaviour. Mix of Likert-type and visual analogue scales and one open question.	No	At the time of completion and 'at their best'	Adequately described and available from author	None

Publication [name of outcome measure if stated]	Function of outcome measure as stated by the authors	Brief description of outcome measure in the format available for review	Was the outcome measure validated in dogs with a specific disease type?	What was the recall period?	Was the outcome measure reproduced, described or referenced?	Publications that cite this publication found in Scopus search
Noli <i>et al.</i> , (2011b)	Quality of life of dogs with skin diseases and their owners	One page, 15 question outcome measure. No subdivision into sections, all disease related. Likert-type scale.	Skin disease	Previous seven days	Reproduced	Noli <i>et al.</i> (2011a)
Schneider <i>et al.</i> , (2010)	Multidimensional assessments regarding QoL and the human–animal bond of companion dogs	Four page, 88 question outcome measure. Four sections: physical (27 questions), psychological (30 questions), social (15 questions) and environment (16 questions). All Likert-type scale.	No	At the time of completion	No. Available from the author ^a	None
Yazbek <i>et al.</i> , (2005)	Health-related quality-of-life scale for dogs with pain secondary to cancer	One page, 12 question outcome measure. No subdivision into sections, Likert-type scale.	Cancer	At the time of completion	Reproduced	Flor <i>et al.</i> (2013)
Yeates <i>et al.</i> , (2011)	A participatory tool in order to encourage discussions and decisions about dogs' quality of life	One page, five question outcome measure. Questions asking owners how well they provide for five 'needs'. Visual analogue scale.	No	At the time of completion	Adequately described ^b	None

Legend: ^a The outcome measure provided by the author contains 88 questions; the publication describes a 91 question outcome measure. ^b The illustration of the outcome measure provided in the publication is different to its description; the author was contacted for clarification but did not respond.

Table 6. Results of reliability and validity assessment of quality of life outcome measures (see Table 3 for criteria)

Test	Reliability and consistency																				Validity															
	Intra-rater					Inter-rater				Test-re-test					Internal						Content			Construct		Criterion			Known grp							
Criterion	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
Publication																																				
Brown	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Budke	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Favrot	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Freeman ^a	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Iliopoulou ^b	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Lynch	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Mullan	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Noli ^c	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Schneider	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Yazbek	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>
Yeates ^d	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Legend: ■ Present in any of the publications assessed that contain this outcome measure □ Absent in any of the publications assessed that contain this outcome measure
 Not applicable to this outcome measure

^a Heart failure as assessed by the ISACH score was considered to be a construct, not a criterion measure, therefore criterion validity was not performed

^b Criterion 27 was likely to have been achieved, but the description of the methodology was inadequate to allow for replication

^c The criterion measures used did not fulfil the accepted definitions used in this review

^d The context in which this outcome measure was used means construct and criterion validity were not relevant, but they could in theory be assessed

2.4 Review 2: materials and methods

2.4.1 Search strategy

Searches of MEDLINE in process and non-indexed citations and OVID Medline (1946-2013) and CAB Abstracts (1910-2013) were performed in August 2013 using the OVID interface. The search included all papers available in the database at the time the search was performed. The abstract, original title, broad terms and key words were searched using terms relevant to dogs (dog, dogs, canine, canines or canis) and osteoarthritis (arthritis, osteoarthritis, DJD, degenerative joint, degenerative articular, OA). The searches were linked with Boolean terms as: [dog OR dogs OR canine OR canines OR canis] AND [arthritis OR osteoarthritis OR DJD OR degenerative joint OR degenerative articular OR OA].

2.4.2 Inclusion and exclusion criteria

The inclusion criteria were that the publication must: (1) be in the English language; (2) be in a peer-reviewed journal; (3) be accessible by the authors through institutional access, internet searching or contacting the authors; (4) contain one of the search terms in the title, key words or abstract; (5) be a primary research publication (i.e. original scientific research); (6) describe dogs with naturally occurring osteoarthritis and; (7) use at least one outcome measure for assessment of canine osteoarthritis. The exclusion criteria were any publications that did not meet the inclusion criteria plus: (a) that involved cases of infectious or immune-mediated arthritis; or (b) where the main focus was not osteoarthritis.

2.4.3 Application of inclusion and exclusion criteria

A single author (ZB) performed the initial search and applied inclusion and exclusion criteria to all publications. For consistency, a random sample of 20% of all publications that met the inclusion criteria were independently screened according to the exclusion criteria by a second author (RD).

2.4.4. Evaluation criteria

An outcome measure was defined a specific measurement used to provide data that assessed a specific outcome in clinical canine osteoarthritis. A single question in a multi-question outcome measure was defined as an item. The number of outcome measures used in each eligible publication was recorded as were details of the specific outcomes assessed and the methodologies used for these assessments.

Outcomes were split into 5 groups inductively developed to fit the data (see Table 7 for definitions). Within these groups, outcomes were categorized according to the assessment made (e.g. activity, crepitus, and lameness). All outcomes were placed into their categories by one author (ZB). Outcome measures for the assessment of each outcome were then collated. Where, for example, a lameness score was composed of the summed scores of 5 components, these components were counted as separate outcome measures as in some publications so the results of the individual components were discussed as separate results. Outcome measures in the “Named outcome measures” category were not split into their individual items so were each counted as a single outcome measure. The gaits used in outcome measures

categorized as “lame single gait/lateral motion” were recorded separately as several publications assessed and reported multiple individual gaits or directions of travel. Orthopaedic and neurological examinations were included only when specific measurements were described (e.g. range of motion of a joint, limb circumference).

The number of times each outcome measure was used across publications was also ascertained. When an outcome measure was used in only one publication, this was described as a “unique” outcome measure. Uniqueness was assessed by manually comparing all reported outcome measures for assessment of each separate outcome. An example of uniqueness would be an outcome measure assessing lameness using a numeric scale of 1-7 used in only one publication. This outcome measure would then be termed a “unique outcome measure”. Outcome measures for the assessment of most of the “outcomes from advanced veterinary diagnostic investigations” group were not assessed for uniqueness since the complex methodologies were reported to different levels of detail.

As a rudimentary assessment of whether any of the outcome measures had been validated, the PDFs of all included publications were searched for use of the term “valid*” (where the * is an abbreviation allowing any words starting with “valid” to be found). Where the term was present, its relevance to outcome measure validation was ascertained by reading the relevant text. Where the term was used in the description of the process of validation of an outcome measure, this was recorded; the quality of the validation process was not assessed due to time constraints. Additionally, where a reference to another publication was included with an outcome measure methodology, this was noted. Where available, through an online database or the University of Nottingham library service, the publication was read to determine whether it included any reference of the measure being validated.

2.5 Review 2: results

2.5.1 Outcomes identified

From 3697 publications retrieved by the initial search, 117 publications met the inclusion criteria (Figure 4). In these 117 publications, outcome measures were used 618 times (Table 7). The number of outcomes assessed per publication ranged from 1 to 32 with a mode of 1 and a median of 4 (interquartile range +/-4). Twenty-six of the 117 publications reported measurement of a single outcome in the clinical study described. The 117 publications dated from 1954 to 2013 and were found 25 different journals. Sixteen publications either described the clinical manifestations of osteoarthritis or assessed risk factors for its development; 67 publications reported the effect of treatment on dogs with osteoarthritis; 4 described diagnostic methods; 18 evaluated or compared outcome measures; 2 assessed monitoring methods; 8 assessed the impact of osteoarthritis on gait; and 2 assessed the impact of osteoarthritis on radiological measurements.

Outcome measures were divided into 5 groups and further divided in to 65 categories (excluding subsets of “lame single gait/lateral motion”; Table 7) according to the outcome assessed. The most frequently assessed outcomes were “lameness assessment with no stated gait or mixed gaits” (n=66), “radiography” (n=58), “lameness single gait/lateral motion” (n=55) and “pain” (n=54). The 618 outcome measures were used by veterinary surgeons (356), owners (243), veterinary physical

rehabilitation practitioners (14), veterinary surgeon and owner together (2) or researchers (2). The user was unclear for one assessment.

Of the 618 outcome measures reported, 491 were suitable for assessment of uniqueness. The remaining 127 outcome measures were too complex for evaluation as described in the evaluation criteria above. Of these 491 outcome measures, 348 (71%) were found to be unique to a single publication and a further 40 (8%) were not described in adequate detail to be assessed for uniqueness. Serial publications from the same clinical study frequently accounted for the same outcome measure being used in more than one publication (e.g. Beynen *et al.*, 2010, Beynen and Legerstee, 2010, Beynen *et al.*, 2011).

The majority of categories included multiple unique outcome measures. For example, “lameness assessment with no stated gait or mixed gaits” (n=66) was assessed using 49 unique outcome measures. This degree of heterogeneity was predominantly due to differences in how levels of severity were described and recorded in the response options. Response options used in these 49 outcome measures included visual analogue scales (VAS), numeric scales with descriptors, descriptors only and a combination of methods. Within the numeric scales with descriptors used for this outcome measure alone, 11 different numeric scoring systems were found (e.g. 0-3, 1-5, 1-7) and where descriptions were provided to illustrate each level of severity, several different descriptors were used in different publications, even when an otherwise identical scoring system was used. This phenomenon was similar across most categories. The emphasis of the outcome measure was also variable. As examples, “play” encompassed assessments of ability, willingness, improvement, change or hesitation. “Change over time” included binary, numeric, VAS and descriptor scales to determine owner and veterinarian satisfaction with improvement, relative improvement since the last assessment and whether the animal had been “cured”.

The outcome measures used to assess radiography and force plate gait analysis were not assessed for uniqueness due to their variable levels of methodological description. Force plate gait analysis methodology was not standardized, was variably reported and was poorly referenced. Whilst in some studies (e.g. Bockstahler *et al.*, 2009, Beraud *et al.*, 2010) force plate gait analysis was the only outcome assessed, many publications combined force plate gait analysis with other outcomes (e.g. Conzemius and Evans, 2012). Radiography was used either as an additional inclusion criterion after study enrolment or to subjectively or objectively check the progress of a particular type of pathology. Many radiological outcome measures were used with little reference to their validity (e.g. Runge *et al.*, 2008, Draffan *et al.*, 2009, Autefage *et al.*, 2011).

2.5.2 Validated outcome measures

Reference to the validation of an outcome measure was absent in almost all publications other than to state validated outcome measures did not exist for the desired outcome (e.g. Fritsch *et al.*, 2010). Fifty of the 117 publications included a reference associated with one or more outcome measures. Most of the references available had used the same outcome measure but did not provide any evidence of validation. Thirteen of these 50 publications stated the authors had modified the outcome measure to which they referred, invalidating any prior validation which may have been performed. Seven publications (Hudson *et al.*, 2004, Wiseman-Orr *et al.*,

2004, Hielm-Bjorkman *et al.*, 2009, Brown *et al.*, 2010, Brown *et al.*, 2013a, Hyytiainen *et al.*, 2013, Walton *et al.*, 2013) reported ten outcome measures as being validated (Table 8); five of these outcome measures are for owner assessments, the others are for use by a veterinary professional. These validated outcome measures were seldom used other than by their authors.

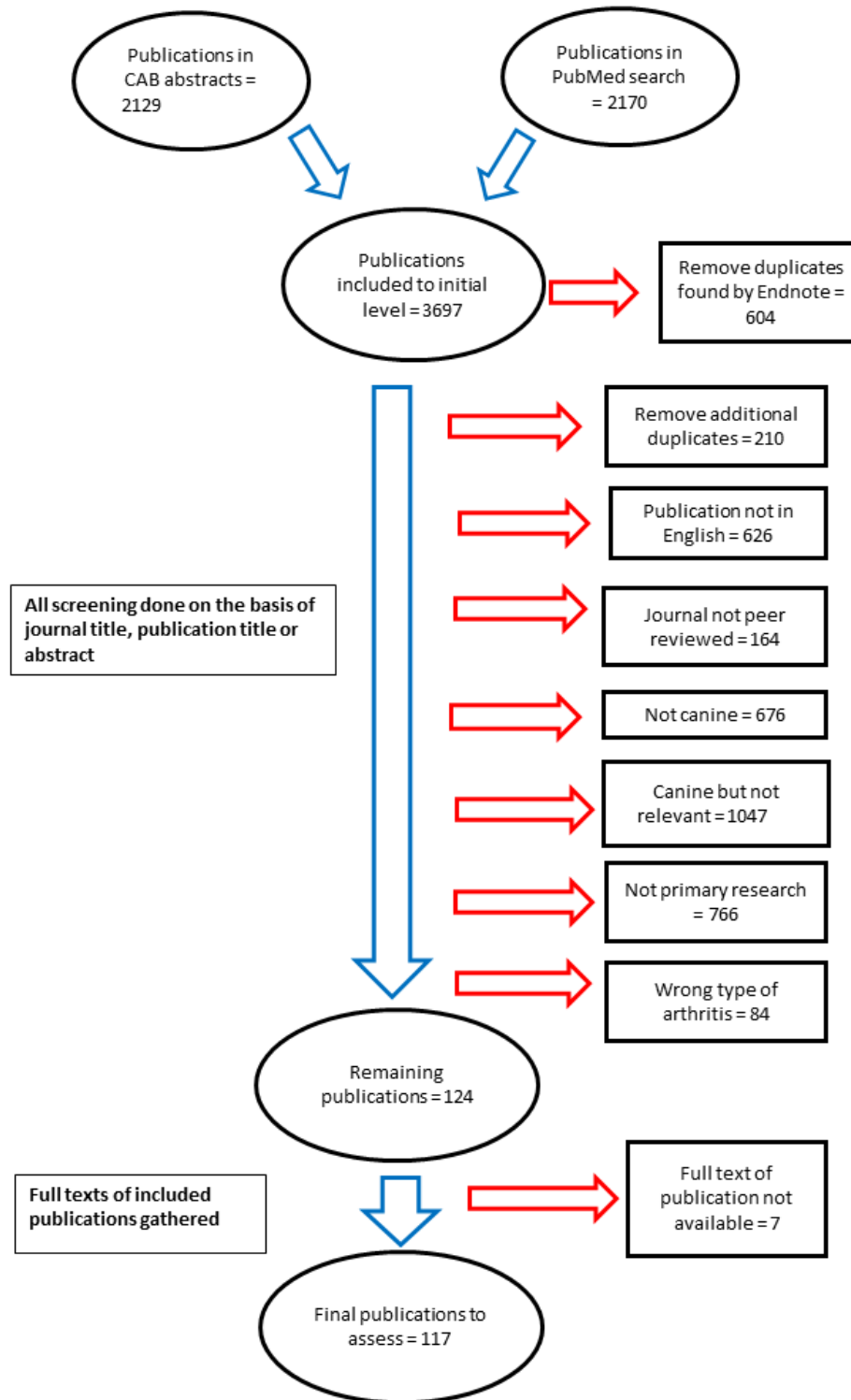


Figure 4. Summary of the osteoarthritis outcome measures review process

Table 7. Summary of the canine osteoarthritis outcome measures reviewed

Outcome groups	Outcome	Number of publications (n=117) in which this outcome is assessed	Number of unique outcome measures for this outcome	Number of incompletely described outcome measures
Named outcome measures - multi-item questionnaires with a specific name	Canine Brief Pain Inventory (CBPI)	10	1	0
	GUVQuest	3	1	0
	Helsinki Chronic Pain Index (HCPI)	6	1	0
	Liverpool Osteoarthritis in Dogs (LOAD) clinical metrology instrument	2	1	0
Behavioural assessments - specific behaviours that may reflect mental health	Activity	16	8	6
	Aggression	5	3	0
	Attitude	4	2	2
	Change over time	33	21	5
	Client specific outcome measure (CSOM)	5	2	0
	Comfort	2	2	0
	Contact with owners	1	1	0
	Following owners	1	1	0
	Happiness	1	1	0
	Novel owner questionnaire	4	1	3
	Pain	54	35	4
	Play	10	9	0
	Quality of life	7	5	1
	Severity of disease	1	1	0
	Submissiveness	1	1	0
	Tail wag	1	1	0
Vocalization	3	3	0	
Limb-only examination (physical health)	Contralateral limb lift	10	8	1
	Crepitus	6	6	0
	Goniometry	14	8	1
	Joint stability	3	2	1
	Forelimb circumference	1	1	0
	Hind limb circumference	3	2	1
	Muscle atrophy	1	1	0
	Patellar luxation	1	1	0
	Proprioception	1	1	0
	Range of motion	23	18	1
	Swelling	9	8	0
	Weakness	1	1	0
	Weight bearing	19	13	0
	Withdrawal	1	1	0
Visually observed mobility (physical health)	Car – get into/out of	3	3	0
	Climate (influence of on dog's mobility)	1	1	0
	Exercise tolerance	2	2	0
	Jump	14	11	3
	Lame (no stated gait/mixed gaits)	66	49	3
	Lame (single gait/lateral motion)	55	45	2
	(Lame diagonal walk) ^a	1	1	0
	(Lame gallop) ^a	3	3	0

Outcome groups	Outcome	Number of publications (n=117) in which this outcome is assessed	Number of unique outcome measures for this outcome	Number of incompletely described outcome measures
Visually observed mobility (physical health)	(Lame run) ^a	11	8	0
	(Lame trot) ^a	14	12	1
	(Lame turn) ^a	2	1	0
	(Lame walk) ^a	24	20	1
	Lie down	5	4	0
	Mobility impairment	6	6	0
	Pace on a walk	4	3	0
	Paralysis	3	1	2
	Rise from sit/lie	16	13	1
	Sit	1	1	0
	Stair/ramp ascend or descend	27	20	0
	Stand or lie	1	1	0
	Stiffness	22	15	2
	Outcomes from advanced veterinary diagnostic investigations (physical health)	Accelerometry	7	3
Arthroscopy		1	*	*
Arthrotomy		1	*	*
Computer tomography		3	*	*
Electrodermal testing		1	*	*
Electromyography		1	*	*
Force plate gait analysis		42	*	*
Hormonal tests		5	*	*
Kinematics		3	*	*
Neurological examination		1	*	*
Orthopaedic examination		1	*	*
Radiography		58	*	*
Scintigraphy		1	*	*
Surface electromyography		1	*	*
Synovial fluid assessment	3	*	*	
	Total	618	348/491 [127 not assessed]	40

Legend:

* Outcomes not assessed for uniqueness due to their methodological complexity

^a Outcomes that comprise the lame (single gait/lateral motion) category

Table 8. Outcome measures found during the review that were reported to be validated

Outcome group	Outcome	Outcome measure	Reference
Named measures	Canine Brief Pain Inventory (CBPI)	Canine Brief Pain Inventory (CBPI)	Brown <i>et al.</i> (2013a)
Named measures	Helsinki Chronic Pain Index (HCPI)	Helsinki Chronic Pain Index (HCPI)	Hielm-Bjorkman <i>et al.</i> (2009)
Named measures	Liverpool Osteoarthritis in Dogs (LOAD) clinical metrology instrument	Liverpool Osteoarthritis in Dogs (LOAD) clinical metrology instrument	Walton <i>et al.</i> (2013)
Named measures	Glasgow University Veterinary School Questionnaire (GUVQuest)	Glasgow University Veterinary School Questionnaire (GUVQuest)	Wiseman-Orr <i>et al.</i> (2004)
Behavioral assessment	Pain	Visual analogue scale questionnaire	Hudson <i>et al.</i> (2004)
Limb-only examination	Sit	Asymmetry in standing and lying position	Hyytiainen <i>et al.</i> (2013)
Limb-only examination	Muscle atrophy	Assessment of muscle atrophy	Hyytiainen <i>et al.</i> (2013)
Limb-only examination	Weight bearing	Manual and measured static weight bearing	Hyytiainen <i>et al.</i> (2013)
Limb-only examination	Range of motion	Measurement of stifle range of motion	Hyytiainen <i>et al.</i> (2013)
Outcomes from advanced veterinary diagnostic investigations	Accelerometry	Activity monitor	Brown <i>et al.</i> (2010)

2.6 Discussion

These are the first reviews of veterinary outcome measures using an evidence synthesis methodology. Whilst not as broad in their scope as narrative reviews, these reviews provide a comprehensive, repeatable, and accessible guide to the availability and quality outcome measures available for adoption by researchers and clinicians within a specific field. They are very useful for highlighting flaws with the current research and identifying new research priorities, as identified in a letter sent to *Veterinary Surgery* in response to Review 2 (Walton *et al.*, 2017). Review 1 included 52 publications containing instruments to assess canine quality of life or wellbeing. Quality of life was rarely defined, and most instruments were focused on physical health consequences of a specific disease rather than other aspects of welfare that were discussed in 1.4.1. Only 11 instruments had evidence of validation, and their quality was variable. Review 2 identified 117 publications relevant to canine osteoarthritis containing 618 outcome measures. Again there was little reference to validation in these publications and clear duplication of effort in developing multiple measures for the same outcome. There was little evidence of consensus on which outcomes should be assessed in canine osteoarthritis or how those assessments should be performed in either canine quality of life or osteoarthritis research. The lack of consensus on a definition of quality of life is a major barrier to progress in that field. A collaboration between animal welfare scientists, veterinary clinicians and dog owners may be the most likely to succeed in clearly defining what is meant by the term. The absence of a consensus on how osteoarthritis in dogs should be assessed means evidence syntheses to determine the best treatment fail to reach a conclusion because studies cannot be easily compared (Aragon *et al.*, 2007, Sanderson *et al.*, 2009, Vandeweerd *et al.*, 2012c). This presents a major problem to clinicians who need to decide how best to treat their patients based on this literature.

The challenges associated with defining and measuring quality of life in animals that have been identified by others were discussed in 1.4.3 and 1.5.2; many of those problems were identified in the instruments included in review 1. Instruments designed for the assessment of canine quality of life rarely included a definition, so it is not clear what their authors were setting out to measure or how synonymous quality of life might be with welfare. Health-related quality of life was also used interchangeably with quality of life by many authors. Almost all quality of life outcome measures identified were designed to be completed by owners acting as proxies for their dog through directly observation and interpretation of their behaviour; this has previously been described (McMillan, 2000, 2007). The problems with proxy assessment and interpretation of behaviour were discussed in 1.5.2. In many publications included in this review, physical health assessment was used as a measure of global quality of life. Such assessments are unlikely to adequately take into account the other impacts on how an animal feels that are likely to contribute to quality of life as discussed in 1.4.1. Whilst some of the quality of life outcome measures specified behaviours to assess, others left owners to decide what should be included. It is not known how owners either define or assess quality of life, so it is unclear whether the results of these questions would be comparable between owners. In the absence of any objective measurement for quality of life it remains challenging to determine how accurately these assessments truly reflect canine quality of life or welfare.

A focus on outcomes specific to the functionality of the musculoskeletal system was clearly evident in the assessments of canine osteoarthritis described in Review 2.

Very few publications measured aspects of welfare than other physical health, and even direct assessments of pain were not made in all studies. The outcome measures with evidence of validation had a heavy emphasis on mobility. This provides evidence that in clinical canine osteoarthritis research, aspects of welfare other than physical health as defined in chapter 1 are very rarely assessed. This is likely to make it very challenging for owners and veterinary surgeons interested in welfare to make decisions about which treatment to use based on the peer-reviewed literature. Due to the nature of the review, the content of the four named outcome measures (CBPI, HCPI, LOAD and GUVQuest) was not interrogated. All four focus on mobility and/or chronic pain and each identifies specific behaviours to be interpreted in this light. This assumes that the only cause that might deviate those behaviours from “normal” would be the dog’s osteoarthritis; as discussed in chapter 1 it is likely that this is not the case. Further discussion of the content and validity of these instruments will be provided in later chapters.

Many publications were excluded from both reviews because outcome measures were incompletely described. Poor reporting of veterinary and medical research is well documented (Moher *et al.*, 2010, Sargeant *et al.*, 2010, Giuffrida, 2014, Giuffrida and Kerrigan, 2014). Where reporting is incomplete, the work is not replicable, its reliability cannot be ascertained and the study cannot be included in evidence syntheses. This is one aspect of research waste; medical research which is poorly designed and/or incompletely reported (Chalmers and Glasziou, 2009, Yordanov *et al.*, 2015). A simple strategy to improve reporting would be to use reporting guidelines which clearly indicate the methodological details to be included in a publication. Several reporting guidelines are relevant for veterinary clinical research (EQUATOR network, 2016). However, Grindlay *et al.* (2014) found whilst 52% of editors of veterinary journals were aware of reporting guidelines, only 35.1% referred to them in instructions to authors.

The poor evidence of any assessment of the validity of outcome measures identified in both reviews has been reported in previous veterinary evidence syntheses (Tivers *et al.*, 2012, Bergh and Budsberg, 2014, Lamb and Nelson, 2015). Use of unvalidated outcome measures means the results of those studies may not be valid because it has not been ascertained that they reliably assess the outcome of interest (Heneghan *et al.*, 2017). This may result in biased data which risks hindering progress in that field (Giuffrida and Kerrigan, 2014). The poor attention to the validity may be multifactorial. Validation is a complex, iterative and time-consuming process and funding for such research is difficult to obtain (Royal College of Veterinary Surgeons Research subcommittee, 2013). Most small animal clinical veterinary research is performed in academic institutions where specialist training requirements (European Board of Veterinary Specialisation, 2016) require publication of original peer reviewed research in a limited time period. Research training for these clinicians is often inadequate (Mellanby *et al.*, 2015) and large scale and prospective multi-centre collaborative studies needed to answer many clinical questions are difficult to co-ordinate. Additionally, at the time the reviews were performed, little had been published in the veterinary literature about the importance of validated outcome measures (McMillan, 2000, Cook, 2007) or the methodology of validation (Taylor and Mills, 2006). It is hoped the publications resulting from these reviews (Belshaw *et al.*, 2015, Belshaw *et al.*, 2016a) and those of others (e.g. Giuffrida and Kerrigan, 2014, Dean, 2015) will assist future authors.

Like all evidence syntheses, these reviews have limitations. The focus of these reviews was very narrow so only specific information was extracted from the publications and a more usual narrative review of their content was not possible. The search strategies necessarily excluded all publications that did not contain these terms in their title, keywords or abstract. Some relevant canine publications may have been missed that did not include these terms and potentially useful material from other species was not identified. In addition, due to the methods used to index journal articles, it is not possible to update these reviews without repeating the full search. It is hoped that other research groups will take on this work. Searches for both reviews were performed in CAB abstracts and Medline as these databases were identified as being likely to contain the most clinically relevant veterinary references (Grindlay *et al.*, 2012). However, it is probable this led to the exclusion of other relevant outcome measures in publications not included in these databases. Time constraints meant only peer-reviewed material was included, potential sources of bias were not assessed, and rigorous attempts were not made to contact authors of incompletely described outcome measures. This may have introduced bias into the review by positively selecting for publications which allowed authors to include greater methodological details. Additional useful outcome measures may exist in the non-peer-reviewed grey literature or in publications that were excluded by the use of this type of review. When search terms were conceived in 2013, welfare seemed a term so alien to clinical veterinary medicine that it was considered very unlikely that welfare measures would be relevant to the quality of life rapid review. Addition of this as another search term may have further increased the size of the literature to be reviewed. However, it is possible that assessments relevant to this thesis were excluded by that search strategy. Since the reviews were performed in 2013, many more publications have been published about both canine quality of life and osteoarthritis, but the rapid review methodology means these cannot be added retrospectively; different journals may now be available in the databases meaning the entire search process would need to be repeated. Subsequent additional validation of some of the outcome measures may also have been published which was not identified here.

2.7 Conclusions

Canine outcome assessment warrants significantly more attention given its importance in generating evidence for decision makers. A huge number of outcome measures have been developed for use in canine osteoarthritis and quality of life research but the majority focus just on physical health and not broader aspects of welfare discussed in 1.4.1. Consensus is urgently needed on which outcomes should be measured in these fields of research and how those measurements should be made. Research identifying the outcomes important to owners and veterinary surgeons managing these canine populations should form part of that process.

Since so few of these outcome measures have been validated in any way, it is not known how useful the methodologies used might be as decision making aids for veterinary surgeons and owners of osteoarthritic dogs in clinical practice. The majority of outcome measures identified were for use by either veterinary surgeons or owners rather than for both working together; joint decision may better reflect what happens in clinical practice but this has not previously been investigated.

2.8 Relevance to the thesis

There appears to be a complete lack of consensus in the peer reviewed literature both about which outcomes should be measured in dogs with osteoarthritis or when assessing quality of life in dogs, and about how those outcomes should be measured. The majority of outcomes identified in both reviews focused only on physical health rather than any other aspects of welfare. As discussed in Chapter 1, little previous work has been done to identify which outcomes are important to veterinary surgeons in clinical practice or to owners of osteoarthritic dogs and it is not known how outcomes are assessed in that setting.

The next part of this thesis will focus on how veterinary surgeons and owners in general practice make decisions about dogs with osteoarthritis independently and together. This will determine how well the outcome measures identified in these reviews reflect the outcomes used by these decision makers and whether additional outcomes are used by either group that are not reflected in this published literature. This will help to identify whether any of the outcome measures identified in this review should be more widely promoted to assist decision making in clinical practice, or whether novel outcome measures are needed.

Chapter 3. Materials, methods and study population results of a qualitative study to investigate decision making in canine osteoarthritis

3.1 Introduction

Decisions that might be made about dogs with osteoarthritis were discussed in chapter 1. How those dogs are managed by owners and veterinary surgeons in general practice or on what those decisions are based has not been described. This is important since it has been suggested that most dogs with osteoarthritis are managed in that setting (Robinson, 2014). A range of methods have been used to capture data from general practices. Surveillance initiatives such as SAVSNET (Sanchez-Vizcaino *et al.*, 2015) and VetCompass (O'Neill, 2013, O'Neill *et al.*, 2014) have obtained data on disease prevalence from veterinary practice management software but they cannot capture the details of specific outcome assessments made by each veterinary surgeon or how decisions are based on these. Direct observation methods (Everitt, 2011, Robinson *et al.*, 2015a) have not included many cases of canine osteoarthritis. At the time the study described in this chapter was conceived, publications did not exist describing about how owners make decisions about dogs with any disease.

There is little description of the outcomes assessed in general clinical practice so it is not known whether any of the outcome measures identified in the previous chapter are used outside research settings or whether any additional outcomes are assessed that are not included in these outcome measures. Dogs in general practice frequently present with more than one problem (Robinson *et al.*, 2015a). This would limit the usefulness of many of the quality of life measures identified due to their focus on a single disease (e.g. Noli *et al.*, 2011b). Small animal consultations in general practice average 10 minutes in length (Everitt *et al.*, 2013, Robinson *et al.*, 2014), which may limit the use of some of the longer paper-based instruments. Differences in case management by veterinary referral clinicians and general practitioners were suggested by small surveys conducted in ophthalmology (Brennan *et al.*, 2015) and cardiology (Davies *et al.*, 2015). The same may be true in canine osteoarthritis. For example, the diagnostic tests performed on dogs with osteoarthritis are likely to significantly differ between the practice types due to time, caseload, knowledge and the availability of equipment (Robinson, 2014). Specialists may have different attitudes to, and experiences of, treatments compared to general practitioners.

SAVSNET, VetCompass and Robinson use predominantly quantitative methodologies to analyse their data. Quantitative methods use numbers to identify relationships between certain variables that can then be quantified and generalised to a wider context. This approach is useful to describe decisions made, but it cannot explore the underlying complexity behind those decisions (Christley and Perkins, 2010). In contrast, qualitative research uses data in the form of words gathered from individual participants to build an understanding of their actions and experiences, exploring both similarities and differences (Braun and Clarke, 2013b). Qualitative studies can provide an ideal foundation for later quantitative projects (Malterud, 2001) but can also be useful in their own right. Sample sizes are usually smaller than in quantitative research and the findings are less readily generalised but these data can be built into theories to explain complexity. Qualitative methods are particularly useful to collect data about attitudes

and beliefs and to understand the tacit knowledge used to make decisions (Christley and Perkins, 2010).

Qualitative research uses techniques including interviews and focus groups to collect data and data is interpreted using theoretical frameworks (Braun and Clarke, 2013c). Several of these frameworks align with specific epistemological and ontological standpoints about what constitutes knowledge and to what extent reality is a human construct (Braun and Clarke, 2013c). Many of these methodologies are very prescriptive. In contrast, thematic analysis is a more flexible method used increasingly in veterinary research to understand attitudes and actions of veterinary surgeons and their clients (e.g. Kaler and Green, 2013, Coyne *et al.*, 2014, Mateus *et al.*, 2014, Richens *et al.*, 2015). The aim of thematic analysis is to identify and provide an explanatory framework for patterns that emerge from a series of texts. It centres on the description of “themes” encapsulating something important from the data that directly relates to the aims of the research (Braun and Clarke, 2006). Thematic analysis does not have an identifiable heritage, unlike other analytic strategies used for qualitative data (Bryman, 2012b). Its “*foundational method*” (Braun and Clarke, 2006; p.4), independent of strictly laid down methodology, allows it to be used with more freedom than other methodologies, though this lack of clear theoretical underpinning is a criticism levelled at some medical qualitative research (Malterud, 2001). As a researcher new to qualitative research methods, the flexibility of thematic analysis offers many advantages and is appropriate to use when exploring decision making in canine osteoarthritis.

3.1.1 Aims and objectives

The aim was to characterise the nature and basis of decisions made about dogs with osteoarthritis by owners, veterinary surgeons and veterinary nurses in the UK. The objective was to explore how decisions were made about dogs with osteoarthritis through thematic analysis of qualitative interviews with dog owners and focus groups with veterinary professionals (veterinary surgeons and veterinary nurses). An overview of the study design is shown in Figure 5. Detailed methodology of the interviews and focus groups and the demographics of the study population are presented in this chapter followed by a discussion of the sample population and data collection methods. Results of thematic analysis and their discussion follow in chapter 4.

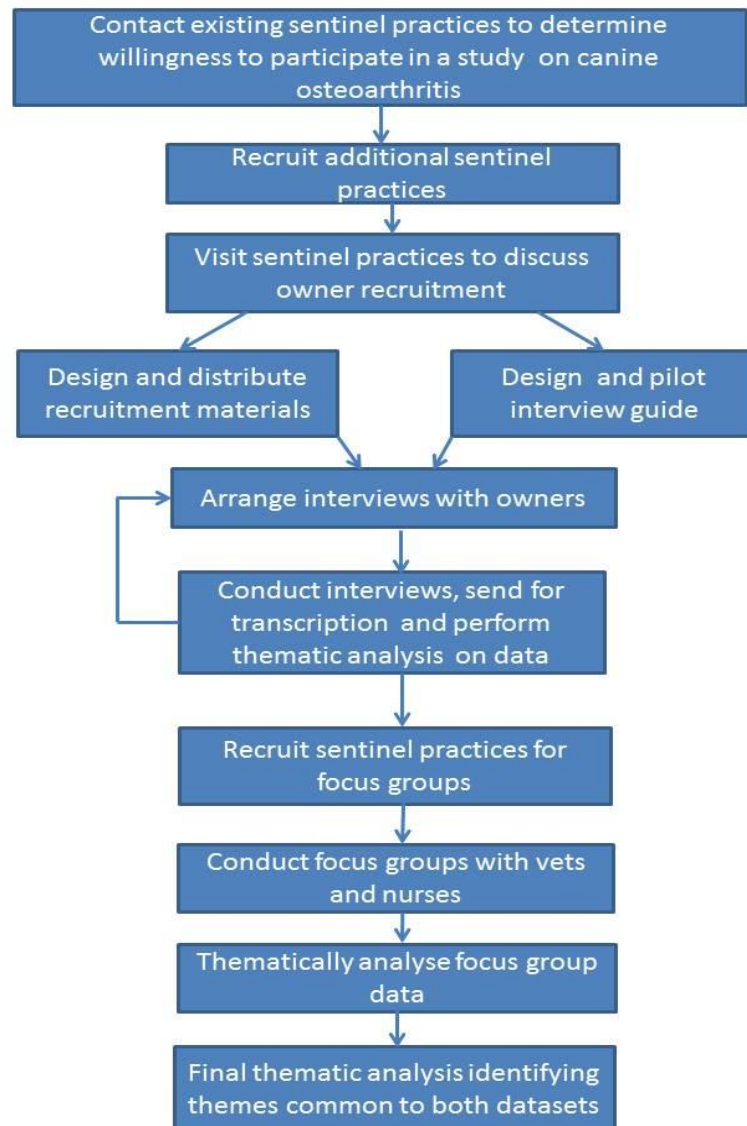


Figure 5. Overview of the qualitative study performed with owners of dogs with osteoarthritis, veterinary surgeons and veterinary nurses to explore their decision making process

3.2 Materials and methods

This section is described according to the consolidated criteria for reporting qualitative research (COREQ) guidelines (Tong *et al.*, 2007).

3.2.1 Ethical approval

Ethical approval had been granted before the PhD commenced, but additional approval for interviews and focus groups was granted by the ethics committee at the School of Veterinary Medicine and Science (SVMS), University of Nottingham (Ethics reference number:1106 140310).

3.2.2 Recruitment of sentinel practices

Interviewees were recruited from a convenience network of 6 established “sentinel practices” used for previous research by the CEVM (described in Robinson, 2014). These are veterinary practices who have voluntarily expressed an interest in collaborating with the CEVM in practice-based research. It is not known whether the use of this sentinel network confers any form of bias on data collected from their owners or veterinary surgeons. It is possible that the veterinary surgeons within these practices are more engaged in evidence-based veterinary medicine than those in non-sentinel practices but there are no data available to support this. Furthermore, it is not known whether engagement in practice-based research has any impact on clinical decision making. In addition, it is unknown how the willingness of a veterinary surgeon to be involved in research, or not, affects the type of owner attending that practice. The demographic of the “average” owner is unknown and therefore it is not known whether the current method of sampling is representative.

Five additional sentinel practices known to RD or ZB were added for the current study but one did not participate (see Figure 6 and Table 9). ZB visited 7 participating sentinel practices during October or November 2013; practices 1 and 9 had not agreed to participation at that point and practice 10 had not yet been recruited. The purpose of these visits was to explain the research idea and the proposed involvement of the practice. Veterinary surgeons and nurses were encouraged to attend, and any queries were answered. Practices 1 and 9 had been involved in several research projects previously so were subsequently happy to participate without a visit. Practice 10 declined a visit, so information about the study was emailed to the contact veterinary surgeon who kindly gained the approval of the practice to participate. All sentinel practices were given the incentive of free continuing professional development to be delivered by ZB or RD.

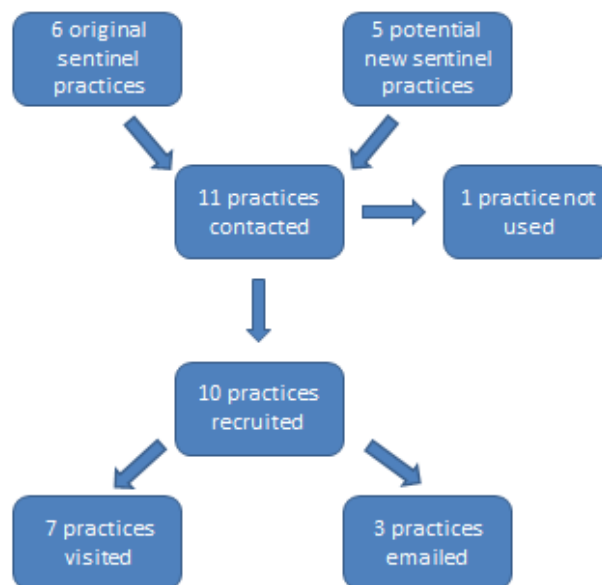


Figure 6. Flow diagram illustrating the process of recruiting veterinary practices to be involved in the qualitative study

Table 9. Characteristics of the veterinary practices involved in the study

Practice code number	Practice location	Practice description	Practice previously involved in CEVM research?	Approximate number of veterinary surgeons working in small animal practice at time of interviews	Nurse-led osteoarthritis clinics run at time of involvement?	Recruitment method(s) used
1	Central Scotland	Multi-branch, city, small animal private practice	Yes	15	No	Contacted eligible owners
2	South East England	Single branch, town, small animal private practice	No	5	No	Posters, newsletter, contacted eligible owners
3	Midlands	Multi-branch, city and town small animal private practice	Yes	20	Yes	Posters, newsletter, website
4	East Anglia	Multi-branch, village, mixed, private practice	No	5	No	Posters, newsletter
5	Midlands	Single branch, town, small animal private practice	Yes	5	No	Posters, newsletter
6	South England	Single branch, town, small animal private practice	Yes	5	No	Posters, newsletter
7	South East England	Single branch, town, small animal private practice	No	8	No	Posters
8	South East England	Single branch, town, small animal corporate practice	Yes	2	No	Posters
9	Midlands	Single branch, town, mixed private practice	Yes	8	No	Posters
10	South West England	Multi-branch, village, mixed, private practice	No	6	No	Posters

3.2.3. Owner interviews

3.2.3.1 Methodological justification

Interviews were chosen to gather information about owner decision making. A survey was considered, but since so little is published about both canine osteoarthritis and the dog owner experience, there was inadequate information on which to base questions and response options. Focus groups were considered too logistically challenging to organise given the wide geographic distribution of practices and the range of owners likely to be involved. It was possible owners who did not know each other would not be confident talking about their experiences in a focus group setting. Finally, it would have been much more difficult to capture chronological narratives using focus groups which we thought would be useful. Interviews were therefore considered to be the most useful and practical method of collecting data from dog owners. Gathering the views of owners from a wide range of backgrounds and locations was important to determine whether a common story was shared by all owners or whether there were influences created by local effects such as the environment or their veterinary practice. For this reason a purposive sampling frame was constructed to try to capture maximum variation; this is discussed in detail below. Interviews were conducted face-to-face in owners' homes. This provided a safe and private environment for owners in which it was hoped they could talk freely about potentially emotive subjects. Visiting owners' homes allowed observation of the dog's environment, triggering questions that would not have been possible had interviews been conducted by telephone (Bryman, 2012b) or in a neutral location. Face-to-face interviews also allowed establishment of a good rapport both with owner and dog which was likely to be important in later stages of the thesis.

3.2.3.2 Inclusion and exclusion criteria for owner interviews

The inclusion criteria for the study were: a) the owner(s) must currently own a dog they believe to have osteoarthritis due to any underlying aetiology; b) the dog with osteoarthritis should be at least five years of age at the time of the interview (potential exception for giant breed dogs if necessary); c) the osteoarthritis should be understood by the owner(s) to affect at least one limb; d) the owner(s) must be available to be interviewed at a time to suit the interviewer (ZB); e) the owner(s) and dog must live in the UK. Exclusion criteria were: a) the owner(s) do not currently own a dog with osteoarthritis; b) the dog with osteoarthritis is under five years of age at the time of the interview; c) the dog's osteoarthritis does not affect any limb; d) the owner(s) is/are not available to be interviewed at a suitable time; e) the owner(s) and dog(s) does/do not live in the UK. Where owners had more than one dog with osteoarthritis, it was left for them to decide which dog to discuss; where time permitted, all affected dogs were discussed.

Dogs with limb osteoarthritis were chosen as this is likely to be the most prevalent location for osteoarthritis; restriction to limb osteoarthritis made the group more homogenous. Due to a limit on the length of time available for this piece of work, dogs under the age of 5 were excluded to try to ensure a more comparable cohort; it was postulated owning a younger dog with osteoarthritis may lead to different challenges than owning an older one. It was hypothesised based on my own experience of veterinary practice and evidence from Robinson (2014) that many dogs were unlikely to have received a definitive diagnosis of their osteoarthritis; therefore

dogs believed by their owners to have osteoarthritis were included. It is possible that dogs that did not have osteoarthritis were included in the study but given the challenges discussed in chapter 1 of obtaining a definitive diagnosis for the disease, the inclusion criteria were considered adequate. It was unimportant whether the dogs were being treated for their osteoarthritis or whether they had comorbidities as the aim was to include dogs that reflected as closely as possible those managed in general practice; excluding untreated dogs may have limited this.

3.2.3.3 Sampling frame

A maximum variation method of purposive sampling was used (Bryman, 2012c). This methodology, used in previous veterinary qualitative research (e.g. Richens *et al.*, 2015), aims to capture diversity of experience. Using this strategy, less common experiences can be captured, but the dataset does not reflect the prevalence of those experiences in the population. To identify factors that may contribute to diversity, a sampling frame was constructed (Appendix 1) including a range of owner, dog and household characteristics that were considered likely to have a relevant impact on the experience of owning a dog with osteoarthritis. Unlike the sampling frame produced by Everitt (2011), it was difficult to know which factors were important, so this frame was based on relevant literature, conversations with colleagues, and my experience as a dog owner.

3.2.3.4 Recruitment of owners

Methods used to recruit owners from sentinel practices were any combination of: displaying posters (Appendix 2); a waiting room PowerPoint presentation; describing the project for the practice newsletter or website; or identifying then contacting eligible owners to ask whether they could be provided with further details of the study. The methods chosen by each practice are listed in Table 9. Practices were updated by email about recruitment progress, and were visited where practical when interviews were conducted in their area. Practices advertised the study from January 2014 until August 2014 when adequate interviewees had been recruited.

A standard information sheet (Appendix 3) was emailed or posted to owners who expressed an interest in the study. Owners willing to be interviewed after reading the information were asked to provide details of their dog's age, breed, osteoarthritis location, and treatment history. Owners with dogs under the age of five and/or who were unsure whether their dogs had osteoarthritis in a limb were advised they were not eligible for inclusion. Interviews were arranged through a series of emails or telephone calls, and it was made clear during each contact that there was no obligation to participate. Interviewees were advised interviews were likely to last approximately 1-2 hours. This time estimate was based on data from Health Experiences Research Group (Jenny Hislop, personal communication) and was substantiated by pilot interviews. In the 48 hours prior to the interview, owners were emailed or telephoned to answer any outstanding questions, and confirm directions and timings. Information relevant to owner aspects of the sampling frame was gathered during this period where possible; outstanding data were obtained during the interviews.

The sentinel practices provided geographical clusters of interviewees who it was postulated should be receiving similar information from their veterinary practices and should have access to the same facilities in the local area. It also meant several

interviews could be conducted within a small area minimising travel expenses and time. However, the recruitment method led to little control over those owners who were willing to be involved. As owners were recruited, their details were added to the sampling frame to determine how much of the variation had been covered. Where gaps emerged, these owners and dogs were actively sought; interviewees were asked whether they had friends who might fill the gaps and in some cases ZB contacted friends and colleagues to recruit dogs with specific characteristics.

The first owner who agreed to participate from practices 1, 2, 4, 7, 8, and 10 set an interview date, usually several months in advance to allow recruitment of other owners in the same area. Others in the same location were then asked whether they were free within a range of a few days of this date. Where possible all interested owners were included, but time and financial constraints meant some were excluded. Interviews with owners local to CEVM were arranged on an individual basis. The number of interviewees was governed by the time to reach data saturation, the point at which new information stops being added to the dataset by additional participants. An estimated time to reach data saturation of 25-40 interviews was based on other studies (Health Experiences Research Group Oxford pers comm, Christiansen *et al.*, 2013). The aim was therefore to recruit at least 30 interviewees, with any additional number being determined by how much of the sampling frame had been covered and whether data saturation had been achieved.

3.2.3.5 Interview guide and pilot interviews

An interview guide (Appendix 4) was based on relevant literature, the guide used by Christiansen *et al.* (2013), and ZB's personal experience both of owning an older osteoarthritic dog and as a veterinary surgeon with experience of working with this population of dogs. Questions concerning the owner's feelings about their dog's disease were particularly informed by the interview guide provided by Christiansen *et al.* (2013) as at that time very little had been published about owners' relationships with older pets. The first draft included eight broad subject areas, each starting with an open question followed by 4-10 prompts. The most straightforward questions and those most likely to be anticipated by the owners were placed at the beginning (Dillman *et al.*, 2008, Bryman, 2012b). An old-dog owning colleague with qualitative experience and other members of the CEVM team provided feedback on a draft version, following which, several questions were modified. A pilot was performed on a veterinary surgeon colleague who owned an osteoarthritic Labrador. A few minor changes were then made to the interview guide, to add clarity and additional prompts. Further minor changes were made after interviews 2, 3 and 5 but the interview guide used was sufficiently similar for data from all pilots to be included in the final dataset. The interview guide was not used as rigid script and terminology was adapted depending on the owner's knowledge and the language they used to describe their dog's disease; open questions were used to guide discussion with the prompts only used if owners had not already discussed that topic. Depending on the situation and what had already been discussed, not all questions were asked to each owner and the order in which questions was presented varied to fit with the flow of discussion.

3.2.3.6 Interview procedure and transcription

A bunch of flowers was given to each household on arrival as a thank you gesture. Before the interview commenced, interviewees were asked to re-read the information sheet (Appendix 3) and sign a consent form (Appendix 5). Owners were reminded that no veterinary advice would be given, that they did not have to answer questions they found difficult and that the interview could be terminated at any time. Interviews were recorded using an Olympus VN-731PC voice recorder. If non-participants entered the room, recording was stopped until they had left unless they were happy to participate. Brief field notes were taken during and immediately after the interviews. Owner ages were estimated by the interviewer or were taken from the interview or previous communications if disclosed. It is likely some owners' ages were categorised incorrectly using this method and in future studies it would be simpler to ask their age. The descriptions used for the interviewees' area came from the 2011 Rural-Urban classification of Local Authority districts (Bibby and Brindley, 2014), extrapolated to include Scotland. Other data for the sampling frame were gathered in informal discussions with the owners before or after the interview and were recorded in field notes. A letter of thanks was sent to each owner following the interview and email contact was maintained where possible.

Audio recordings were stored in a password protected computer drive to which only a transcriber (ProRata, Neath, UK) had access. Recordings were professionally transcribed verbatim. Transcripts were checked for accuracy against the original voice recording, with any mistakes corrected before analysis. Transcripts were not returned to participants for checking after the interviews as this was not required by the ethical approval. Additionally, one of the researchers at the HERG (Jenny Hislop, personal communication) advised this led to a high dropout rate after the interviews so should be avoided if possible.

3.2.3.7 Liverpool Osteoarthritis in Dogs (LOAD) instrument

To gather standardised data on the severity of the dogs' disease, owners were asked to complete the Liverpool Osteoarthritis in Dogs (LOAD) instrument (Walton *et al.*, 2013) at the end of each interview. The instrument was not in the public domain so was obtained by email from a Novartis Animal Health representative. LOAD was chosen from the validated osteoarthritis outcome measures described in chapter 2 because it captured a wide range of data on disease severity as reported by owners and was available for use when required. The range of total scores was 0-52 (from least to most affected). Visual analogue scales designed by LA to capture information about pain and quality of life were also piloted in with some owners in preparation for the next part of the study. The pilot was to determine the ease of use by the owners, and the data collected from these visual analogue scales are not presented.

3.2.3.8 Thematic analysis

Following transcription, interviews were analysed thematically following the six step plan identified by Braun and Clarke (2006) using the organisational support of nVivo (nVivo v10, QSR). Thematic analysis was chosen as it has been used for similar work both in veterinary (Coyne *et al.*, 2014, Horseman *et al.*, 2014, Mateus *et al.*, 2014) and medical contexts (Broom, 2005, Dow *et al.*, 2012). The methodology has

been used by others at SVMS (Kaler and Green, 2013, Richens, 2015), so support was available if needed during the analysis. This method was compatible with the aim of the study to use the interviews to discover and describe what interviewees thought and did. In-depth interpretation of the causes and meanings of owners' narratives could have been performed using methodologies such as interpretive phenomenological analysis.

Braun and Clarke's six steps are: 1) familiarisation with the data by reading through the entire dataset; 2) generation of initial codes of interest, where a code is defined as "*the most basic segment, or element, of the raw data which can be assessed in a meaningful way regarding the phenomenon*" (Braun and Clarke, 2006; p.18); 3) Searching for themes, where a theme is a descriptive term for a pattern within the data which captures something relevant to the research question; 4) reviewing candidate themes to ensure they form a coherent pattern and are valid, that all relevant codes can be described within these themes and that candidate thematic map truly accurately reflects the data; 5) defining, refining and naming themes by determining the "*essence*" of what the theme is about and considering how this fits within the overall dataset; 6) writing a report to ensure the reader understands the merit and validity of the analysis performed.

Codes that summarised the meaning of extracts of the transcribed text were inductively identified by iterative reading and re-reading of transcripts. All transcripts were completely coded, including extracts not relevant to the study question. Many extracts were coded multiple times as many sentences contained content relevant to multiple codes. Coding took place iteratively to look for instances of poor interview technique that could be addressed in subsequent interviews and for emerging themes to explore further. As new codes were developed, transcripts already coded were checked to determine whether extracts fitted the new codes. A random selection of 5 of the interviews was inductively coded by two colleagues with qualitative experience to determine whether additional useful codes would be created. Double coding has been identified as a method of reducing bias in qualitative research and for demonstrating its robustness and validity to those unused to qualitative data (Richens, 2015). However, the necessity of this has been challenged (Morse, 1997) and it was not considered to be necessary to double code a larger set of these data.

Codes were then inductively grouped according to their content to form subthemes. Only codes containing excerpts deemed relevant to osteoarthritis in dogs were included in this process as many owners discussed topics not directly relevant to the study question. Subthemes were iteratively reviewed and reorganised to ensure the content fitted the subtheme and to find the most comprehensive way of presenting the data. Content of codes was regularly re-checked to ensure the meaning of the extracts was compatible with the subtheme. These subthemes were then mapped onto a single large sheet of paper and manually organised into themes containing related subthemes. Themes were repeatedly reviewed and re-organised by ZB with the assistance of RD and LA as their content was progressively refined through writing of the analysis.

3.2.3.9 Epistemological and ontological stance

The inductive methodology used means the data led the analysis, rather than the researcher looking for codes to fit *a priori* themes. Data were handled using a

contextualist epistemology with an ontology based on critical realism (Braun and Clarke, 2013c) which bridges the divide between positivistic and interpretive positions (Malterud, 2016). This means while the aim is to determine a real understanding of the data, the reality is this will never be possible; we can never fully understand each other due to our different backgrounds and motivations. Context matters when analysing transcripts; everyone constructs their own understanding of the world which is true to them. It is likely what interviewees said was affected by the circumstances of the interview, and as a consequence they may have presented a slightly different version of events or views to that which they might believe to be the truth. This is inescapable and must be acknowledged. By interviewing multiple people and triangulating through focus groups with veterinary professionals, it is hoped the results of this piece of work comes as close as possible to reality as perceived by those involved.

3.2.4 Focus groups with veterinary professionals

3.2.4.1 Methodological justification

Focus groups were used to explore the attitude of the veterinary surgeons and veterinary nurses to osteoarthritis mainly because there was not time to organise, conduct and analyse more face-to-face interviews. Telephone interviews could have been used as demonstrated by Richens (2015). However, in contrast to those farm veterinary surgeons who might be able to participate when out on a call, small animal veterinary surgeons are usually based all day in a busy building where peaceful office space can be rare. Additionally, personal experience suggested it is often difficult for small animal veterinary surgeons to be free at pre-arranged times during the working day in comparison with a farm animal setting which might be more flexible. Focus groups were therefore chosen; acknowledging the possibility some participants might feel inhibited expressing their views in front of their colleagues.

Focus groups can provide a safe and permissive environment where ideas can frankly be exchanged (Bryman, 2012a). By allowing the participants to challenge each other, a wider variety of views may be elicited than in individual interviews (Bryman, 2012a, Braun and Clarke, 2013b). Organising focus groups including veterinary surgeons from multiple practices would have been logistically challenging, may have made participants feel uncomfortable and would have limited the ability to understand practice culture. It was also considered likely that senior staff would attend in preference to their juniors. Focus groups were therefore conducted within each practice building, including only staff who worked in that practice. This permitted exploration of whether there was any form of culture within the individual practices such as a lead decision-maker, or a particular attitude to the disease that may have been more difficult to ascertain by talking to individual practice members or conducting mixed focus groups.

Initially, only focus groups with veterinary surgeons were planned, but a couple of interviewees spoke about the nursing clinics they had attended and others mentioned it would be useful to have more access to veterinary nursing clinics. From personal experience, veterinary nurses are often the front line of owner queries about non-prescription medications and little is known about how they decide which products to recommend. Veterinary nurses were therefore also included in the eligibility criteria. Veterinary nurses and veterinary surgeons from the same practice were not combined within the same focus group due to concern the nurses might not be so open in the

presence of the veterinary surgeons and possibly vice-versa. A separate focus group for nurses was organised within the practice building.

3.2.4.2. Inclusion and exclusion criteria

To permit comparison between owner and veterinary professional attitudes and for ease of organising, only sentinel practices that had agreed to recruit owners were eligible for inclusion in focus groups. Inclusion criteria for the veterinary surgeon focus groups were: a) the veterinary surgeon had to be working as a general practitioner in one of the 10 sentinel practices at the time of the focus group; and b) they must perform consultations with dogs with osteoarthritis as part of their work. Veterinary surgeons who did not meet these inclusion criteria and those with a specialist qualification in orthopaedics were excluded. To be eligible for inclusion in a veterinary nurse focus group, the nurses needed to perform face-to-face consultations with owners where the primary purpose was to discuss canine osteoarthritis. All other nurses were excluded to ensure comparability between veterinary surgeon and veterinary nurse data.

3.2.4.3 Sampling frame

A purposive sampling frame consisting of the practice factors listed in Table 9 was used to determine which practices would be most suitable for the veterinary surgeon focus groups. Whilst factors such as time since graduation and time worked at that practice may have been useful, it was hoped the practice factors would act as surrogate markers for these. A sampling frame was not necessary for the veterinary nurse focus group due to the lack of choice available. The aim, as with the interviews, was to continue to collect data until data saturation was reached. Four practices which covered most of the sampling frame were chosen for the initial round of veterinary focus groups, partly on the basis of convenience. Only practice 3 had eligible nurses. Thematic analysis was then performed after these five focus groups to determine whether data saturation had been reached before additional groups were arranged.

3.2.4.4 Practice recruitment and organisation

Focus groups were arranged by email with the veterinary surgeon who had arranged the owner recruitment. The nurse focus group was arranged through the nurse in charge of nurse-led clinics. In all instances, focus groups were arranged at a time likely to be least disruptive to the working day when the greatest number of participants would be available. Food was provided as an incentive. The lead organiser of the focus groups at the practice was made aware of the inclusion criteria and asked to recruit colleagues accordingly. The participants were aware the purpose of the focus groups was to ask the veterinary professionals “a few questions about osteoarthritis”. Further details of the questions were not provided in advance so the attendees could not prepare their answers. Practices were advised the focus group would last about an hour.

3.2.4.5 Focus group question guide

The focus groups were conducted after completion and analysis of the owner interviews. A short question guide (Appendix 6), designed with the help of RD, explored two themes emerging from the owner interviews: diagnosis and treatment

of osteoarthritis. The number of questions was deliberately limited to allow the focus groups to follow their own course in the time available. Additional probe questions were used on an ad hoc basis to explore other topics as they arose; these were recorded in field notes. The same questions were used for both veterinary surgeons and nurses.

3.2.4.6 Focus group procedure and data recording

Focus groups were conducted in a practice meeting room chosen by the organiser. As participants arrived, each was given a consent form (Appendix 7). Participants were aware interviews had been conducted with owners from their practice, but no details were provided about their content. Focus groups were recorded using two Olympus VN-731PC voice recorders to ensure all voices were audible. Before the voice recorders were turned on, verbal guidance was given to the attendees that: a) the discussions should not be shared with anyone who could not attend to maintain confidentiality; b) participants should respect each other's views but were welcome to challenge them; and c) they should avoid talking at the same time as it would make transcription too difficult. Information about the background (e.g. age, time since qualification) of individual participants was not collected because it was not clear it was sufficiently relevant to be ethically justifiable. In hindsight, these data may have been useful.

Each focus group commenced when the organiser thought the majority of participants were present; late entrants were welcomed as they arrived. After the voice recorders were turned on, participants were asked to speak in turn so the transcriber could recognise their voice. The question guide was used to initiate and steer discussion but the participants were permitted to explore the broader theme of osteoarthritis in dogs as they wished. Initially the views of different participants were directly sought to ensure everyone had a say. The same technique was also used if there was a lull in discussion or if someone had not spoken during discussion of that topic. All focus groups were limited to an hour in length and the meetings were terminated at this point, irrespective of whether the questions had all been discussed. Field notes were made during the focus groups and immediately afterwards. I was aware the veterinary professionals might modify their responses to questions, especially when discussing sensitive topics arose, given my background. This was a particular risk in focus group 3 as this was a practice in which I used to work, though I had not worked closely with any participants.

3.2.4.7 Epistemology, ontology and thematic analysis

Due to time constraints, the focus groups were thematically analysed after the completion of the final group. Transcription and analysis were performed exactly as described for the interviews.

3.2.5 Combining the interview and focus group analyses

Several iterative versions of separate thematic analysis for the interviews and focus groups were performed as my techniques in identifying themes and writing thematic reports improved. At the end of this process, the focus group subthemes and themes overlapped greatly with the interview themes, albeit sometimes taking different perspectives. A similar phenomenon of convergent themes was identified by Coyne

et al. (2014) in a qualitative study involving pig veterinary surgeons and farmers. It was therefore considered interesting to contrast the attitudes and experiences of the owners and veterinary professionals in combined themes, presenting first the owner data on that subtheme, then the veterinary professional data. This technique of combining data derived using different techniques in a single thematic analysis has been previously used in other healthcare research (e.g. Entwistle *et al.*, 2011).

Transcripts were not re-coded. Most of the subthemes and themes identified in the individual analyses were shared by both sets of data so little re-analysis was required, since the relevant subthemes could simply be consecutively presented. However, both bodies of data contained unique subthemes. In these instances, the codes in the other body of data were checked for excerpts which might be relevant to this subtheme. If relevant extracts were identified, those were incorporated into the report. The final themes identified will be presented in the next chapter.

3.3 Demographic results of interview and focus group participants

3.3.1 Interview demographics

3.3.1.1 Interviews conducted

Thirty-two interviews were conducted between February and August 2014 capturing the views of 40 owners about 35 dogs. Owners were recruited from all 10 sentinel practices and from additional 7 veterinary practices by snowball sampling (**Figure 7**). Data saturation was thought to have been reached by interview 25 but due to the short time frame available and the logistics involved, the interviews in Scotland had already been arranged so were still conducted. Several additional codes emerged from these interviews, as did many aspects of existing codes not captured in previous interviews. The maximum number of dogs discussed in any interview was two. Interview length ranged from 52 minutes (interview 30) to 174 minutes (interview 18). Repeat interviews were not performed with any household. All the dogs discussed were present in the household, and often in the same room, during the interview.

3.3.1.2 Owner and household characteristics

Forty owners were included in 32 interviews; 8 interviews included two owners (Tables 10). The majority of interviewees were female (n=29). Twenty-four owners were estimated or disclosed by the owner to be aged 35-66; the next most frequent group were those estimated or disclosed by the owner to be 66 years or more of age (n=13). Whilst thirty owners had previous dog owning experience as an adult, for 25% of owners this was their first ever dog. Only 12 owners reported previous experience owning an osteoarthritis-affected dog.

Four owners were veterinary surgeons, all of whom expressed an interest in being interviewed from the perspective of an owner when they heard about the study. Three were personally known to ZB, one was a previous colleague of a friend and none worked in a sentinel practice. All had managed osteoarthritic dogs in clinical practice at some point in time but three were no longer working in general practice. Prior to this study, no research had been performed into the attitudes of veterinary surgeons towards their own pets. Therefore, the inclusion of veterinary surgeons as interviewees could be viewed as a limitation of this study as the experiences and knowledge of these owners had the potential to be significantly different to those of other owners. However, the pilot interview performed with a veterinary surgeon indicated that veterinary surgeon owners might share many of the same attitudes, questions and uncertainties as non-veterinary surgeons when considering the experience of owning an osteoarthritic dog. On this basis other veterinary surgeons were subsequently included on a convenience basis.

Twenty-seven houses contained a cohabiting couple. A mother and daughter in interview 31 lived separately but shared a dog between them; the dog spent the majority of its time with the mother therefore her household is described

in Table 11. All other owners interviewed within the same household lived there and had significant responsibility for the care of the dog(s). Eight households were home to children under the age of 18. Housing locations were fairly evenly distributed between rural (n=10), urban (n=12) and conurbation (n=10). In 21 houses, the dog with osteoarthritis was the only dog in the household; three households were home to at least two dogs with osteoarthritis.

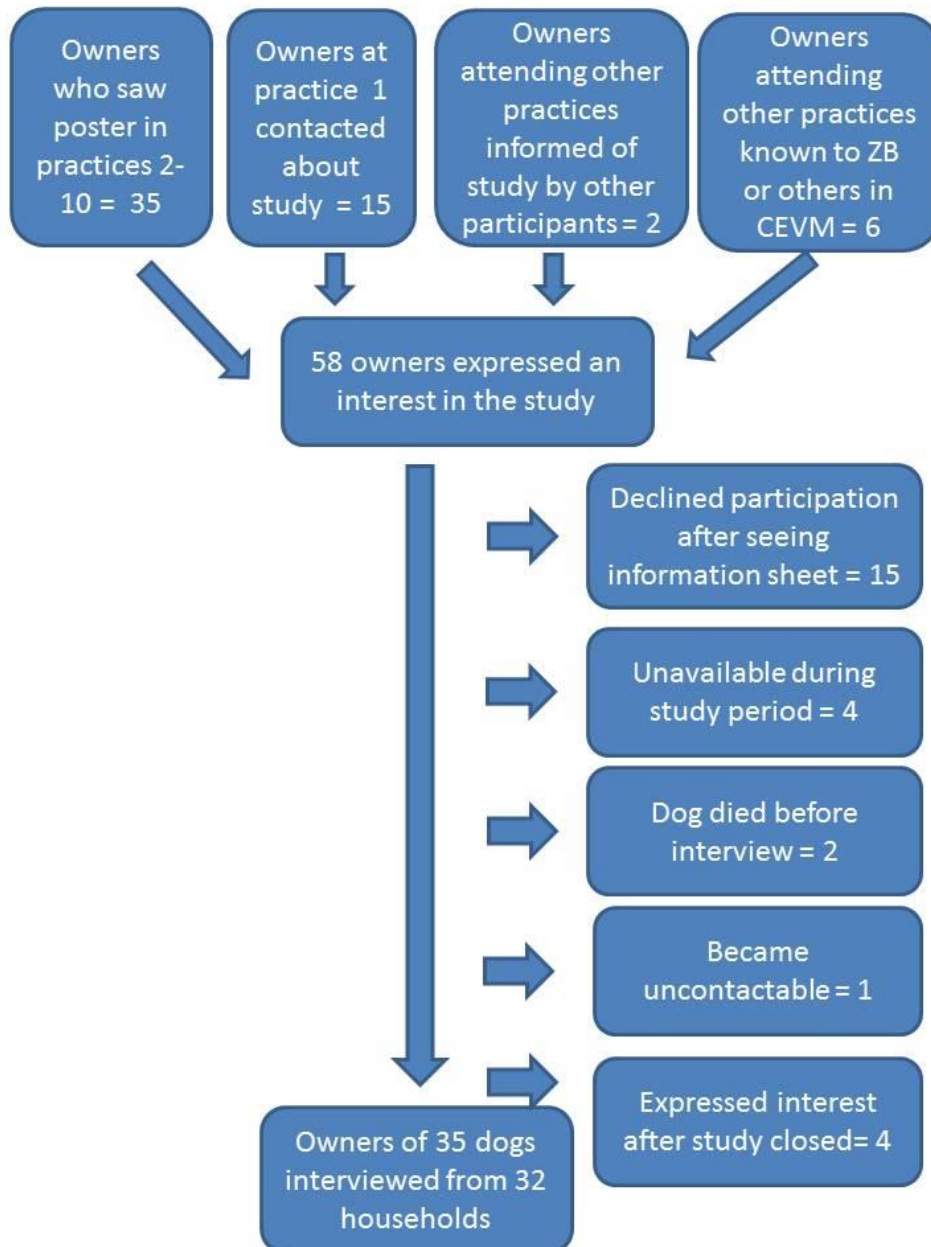


Figure 7. Flow diagram illustrating the recruitment of owners to the interview study

Table 10. Characteristics of the owners and households included in the interview study

Interview number	Interviewee sex(es)	Estimated interviewee age(es)	Interview location region	Sentinel practice number or alternative source	Owner's house location	Household status	Children living at home	Previous dog owning experience as an adult?	Previous dog osteoarthritis experience?	Relevant veterinary work history?	Currently own more than one dog?
1	F	36-65	Midlands	Known to ZB	Rural	Cohabit	N	N	N	Y, vet	Y
2	F	36-65	Midlands	Known to ZB	Urban	Single	Y	Y	Y	Y, recep	N
3	F	36-65	Midlands	3	Conurbation	Cohabit	N	Y	Y	N	Y
4	F	36-65	Midlands	9	Rural	Cohabit	N	Y	Y	N	Y
5	F	36-65	Warwick	5	Urban	Cohabit	N	Y	N	N	N
6	F	18-35	Midlands	Known to ZB	Rural	Cohabit	N	Y	N	Y, vet	N
7	F	36-65	Midlands	3	Conurbation	Cohabit	N	Y	N	N	N
8	F, M	66+, 66+	Midlands	9	Urban	Cohabit	N	Y, Y	N, N	N	Y
9	F	18-35	East Anglia	Known to ZB	Rural	Cohabit	N	Y	N	Y, vet	Y
10	F	36-65	South East	2	Urban	Cohabit	Y	N	N	N	N
11	M	36-65	South East	2	Urban	Cohabit	Y	Y	N	N	N
12	F, M	36-65, 66+	South East	2	Urban	Cohabit	N	Y, Y	Y, N	N, N	N
13	M	66+	South East	2	Urban	Single	N	Y	N	N	N
14	F	36-65	South East	8	Rural	Single	N	Y	N	N	N
15	F, M	36-65, 36-65	South East	2	Urban	Cohabit	Y	Y, Y	N, Y	N	N
16	F	36-65	South East	2	Urban	Single	N	Y	N	N	N
17	F, M	66+, 66+	South East	8	Conurbation	Cohabit	N	N, N	N, N	N	Y
18	F, M	66+, 66+	South East	7	Rural	Cohabit	N	Y, Y	N, N	N	Y
19	F	36-65	East Anglia	Known to ZB	Rural	Cohabit	N	N	N	Y, vet	Y
20	F	36-65	East Anglia	4	Rural	Cohabit	N	Y	Y	Y, hydro	Y
21	F	36-65	East Anglia	Snowball (Int 20)	Rural	Cohabit	N	Y	N	Y, behav	Y
22	F	36-65	East Anglia	Snowball (Int 8)	Rural	Cohabit	N	N	N	N	N
23	F	36-65	South	6	Urban	Cohabit	Y	N	N	N	N
24	F, M	66+, 66+	South West England	10	Urban	Cohabit	N	Y, Y	Y, Y	N	N
25	F, M	66+, 66+	South West England	10	Urban	Cohabit	N	Y, Y	Y, Y	N	Y
26	M	36-65	Central Scotland	1	Conurbation	Single	N	Y	Y	N	N
27	F	36-65	Central Scotland	1	Conurbation	Single	Y	Y	Y	N	N
28	F	66+	Central Scotland	1	Conurbation	Cohabit	N	Y	N	N	N
29	F	36-65	Central Scotland	1	Conurbation	Cohabit	Y	N	N	N	N
30	M	36-65	Central Scotland	1	Conurbation	Cohabit	Y	N	N	N	N
31	F, F	36-65, 66+	Central Scotland	1	Conurbation	Cohabit, single	N	Y, Y	N, N	N	N
32	F	36-65	Central Scotland	1	Conurbation	Cohabit	N	N	N	N	N

Legend: N = no, Y = yes, F = female, M = male, Recep = veterinary receptionist, hydro = canine hydrotherapist, behav = canine behaviourist, vet = veterinary surgeon

Table 11. Summary of the coverage of the sampling frame for owner and household factors in the interview study

	Category	Sub categories	Frequency	Interview number
Owner factors (n=40)	Sex	Male	11	8, 11, 12, 13, 15, 17, 18, 24, 25, 26, 30
		Female	29	All others
	Age (as judged by interviewer)	18-35 years	2	6, 9
		36-65 years	24	1, 2, 3, 4, 5, 7, 10, 11, 12, 14, 15, 15 16, 19, 20, 21, 22, 23, 26, 27, 29, 30, 31, 32
		66 years and over	13	8, 8, 12, 13, 17, 17, 18, 18, 24, 24, 25, 25, 28, 31
	Ethnic minority	Yes	1	30
		No	39	All others
	Previous dog owning experience as adult	Yes	30	2, 3, 4, 5, 6, 7, 8, 8, 9, 11, 12, 12, 13, 14, 15, 15, 16, 18, 18, 20, 21, 24, 24, 25, 25, 26, 27, 28, 31, 31
		No	10	All others
	Experience of owning a previous arthritic dog	Yes	12	2, 3, 4, 12, 15, 20, 24, 24, 25, 25, 26, 27
No		28	All others	
Household factors (n=32)	Housing status (may cover more than one category)	Single	5	2, 14, 26, 27, 31
		Cohabiting couple	27	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 28, 29, 30, 31, 32
		Elderly parent living in home	2	7, 30
		Children under 18 living in home	8	10, 11, 15, 23, 27, 29, 30, 32
	House access type	Difficult access e.g. flight of stairs to enter	1	27
		Other	31	All others
	House area	Rural	10	1, 4, 6, 9, 14, 18, 19, 20, 21, 22,
		Urban	12	2, 5, 8, 10, 11, 12, 13, 15, 16, 23, 24, 25
		Conurbation	10	3, 7, 17, 26, 27, 28, 29, 30, 31, 32
	More than one dog currently living in house	Yes	11	1, 3, 4, 8 ,9, 17, 18, 19, 20, 21, 15
No		21	All others	

3.3.1.3 Dog characteristics

The only aspect of the dog sampling frame (Table 13) not covered was inclusion of a toy dog. Recruitment of non-pet dogs and those with unusual causes of osteoarthritis was difficult. In future studies, different methods of recruitment may be needed to ensure the inclusion of these populations. Dogs ranged in age from six to 17 years; this included three rescue dogs whose ages were estimated by their owners. Two dogs had been used for agility prior to their development of osteoarthritis and one had been used for showing. One dog was a retired Guide Dog for the Blind; the rest were pets. The commonest breed was a Labrador (n=10), with crossbreeds as the next biggest category (n=6). The smallest dog included was a Shih Tzu, the largest a Rhodesian ridgeback. More dogs were thought to have osteoarthritis in either forelimbs or hind limbs (n=22) than in a mixture of the two (n=13), and most dogs had osteoarthritis in more than one joint (n=31). In some instances, the veterinary surgeon had given the owners a likely initiating factor behind the osteoarthritis in at least one joint; where this was recalled, the most frequent initiating cause was a cruciate ligament rupture repair (n=6). Twenty dogs had one or more comorbidity with some impact on their management. Comorbidities affecting exercise included deafness (n=10), laryngeal paralysis (n=5) and behaviour problems (n=4). Comorbidities affecting more general management included hypothyroidism (n=1), urinary or faecal incontinence (n=5) and renal disease (n=1). Nineteen dogs had known cutaneous mass lesions which their owners did not perceive significant.

3.3.1.4 Treatment details

Only dog 28 was receiving no treatment for her osteoarthritis at the time of the interview (Table 12). Four further dogs (8A, 8B, 24 and 32) were not receiving a treatment recognised to have analgesic properties. Twenty-three dogs were receiving an NSAID regularly or intermittently. Nineteen dogs were receiving an alternative analgesic in combination with or instead of an NSAID, with tramadol being the most frequently used (n=11). Several alternative treatments were used by smaller numbers of owners. Most owners reported their dog had received other treatments prior to those currently being given that had been withdrawn for a variety of reasons. Dog 21B was the only one to have received a hip replacement as part of her treatment.

3.3.1.5 Owner completed LOAD scores

All owners completed a LOAD assessment for their dog(s); the higher the score the more affected the dog (Table 12). Scores ranged from 5/52 (dog 8A) to 36/52 (dog 22) with a median of 20/52. Question nine which asked “*What overall effect does exercise have on your dog’s lameness?*” had descriptors ranging from “no effect” to “extreme effect”. Some owners thought exercise reduced their dog’s lameness whilst others thought exercise exacerbated the lameness. As the response options appeared to have a slightly negative valence, some owners whose dogs improved with exercise questioned how they should respond whilst others did thought it a badly worded question so responded anyway, despite their dog improving with exercise. This problem was not picked up until interview 5 so the valence responses of interviewees 1-4 were unclear. From this point onwards for clarity of interpretation, if a dog’s lameness improved with exercise it was given a score of zero, ensuring all responses had the same negative valence.

Table 12. Comprehensive details of the dogs described in the interview study

Interview number (same as owner number)	Dog ID	Age (Years)	Breed	Sex	Comorbidity with impact on dog's management	Age at diagnosis	Limbs affected	Joint(s) (if known)	Diagnosed by radiography?	Known underlying cause of osteoarthritis in any site?	Current treatment for osteoarthritis	Total LOAD score (range 0-52)
1	1	14	Labrador	M	Dilated cardiomyopathy, glaucoma, deafness, food intolerance, laryngeal paralysis, early renal failure	9-10y	LH, RH	Hips	Yes	Hip dysplasia	Tramadol	22
2	2	10	German Shepherd cross	M	Behavioural problems	10.5y	LH, RH	Hips	No	No	Meloxicam, Yumove	13
3	3	10	Staffordshire Bull Terrier	F	No	11 months	LF, RF, RH	Stifle, elbows	Yes	Cruciate	Fish oil, green lipped mussel, serapeptase, hydrotherapy, physiotherapy, tramadol after hydrotherapy, laser therapy	34
4	4	7-10*	German Shepherd cross	M	No	6-9y	All limbs	Elbows confirmed	Yes, confirmed elbows and excluded hip dysplasia	Bilateral limb deformity	Meloxicam, gabapentin	18
5	5	7	Spinone	M	Colitis	4 y	LF, RF	Elbows	Yes	Elbow dysplasia	Onsior, cartrophen, magnetic collar	19
6	6	12	Collie	M	No	6y	LH, RH	Hips, stifles	No	No	Cartrophen, Onsior as needed	18
7	7	10	Labrador	F	Liver disease	6y	All limbs	Shoulder, elbow, hips	Yes for elbows and shoulders	No	Cimalgex, Cosequin, hydrotherapy, magnetic collar	21
8	8A	8	Miniature Poodle	M	No	8y	LF, RF	Carpi	No	Agility?	Cartrophen	5
8	8B	11	Miniature Poodle	F	No	11y	LH, RH	Hips	No	No	Cartrophen	7

Interview number (same as owner number)	Dog ID	Age (Years)	Breed	Sex	Comorbidity with impact on dog's management	Age at diagnosis	Limbs affected	Joint(s) (if known)	Diagnosed by radiography?	Known underlying cause of osteoarthritis in any site?	Current treatment for osteoarthritis	Total LOAD score (range 0-52)
9	9A	14	Basset	M	No	8-9y	LF, RF	Carpi	No	Conformation?	Hills j/d food, Previcox	31
9	9B	8	Springer Spaniel	F	Behavioural problems	4 months	RH, LH,	Elbow, hips	Yes both sites	Fracture	Hills j/d diet, Previcox, cartrophen	12
10	10	11	Labrador	F	Laryngeal problem	9y	RH, LH	Hips, stifles	No	No	Carprofen, Flexipaw	21
11	11	14	Labrador	F	Separation anxiety, deafness, intermittent faecal incontinence	2y	LF	Carpus, feet	No	Limb deformity following fracture	Previcox, intermittent tramadol, Glyco-Flex, cod liver oil	27
12	12	10	Australian terrier	M	No	7-8y	LH, RH	Stifles	No	Cruciate repair both stifles	Carprofen, Yumega oil	19
13	13	14	Giant Schnauzer	F	Urinary incontinence, deafness, hypothyroidism, laryngeal paralysis	11y	RH	Hip	No	No	Carprofen	26
14	14	9	Indian street dog	M	No	7y	RH, LH	Stifle	Yes	Cruciate repair both stifles	Onsior, tramadol	24
15	15	11	Labrador	F	Deafness, laryngeal paralysis	8y	All limbs	Shoulder worse than others	Yes	No	Previcox tramadol as needed, Zantac	31
16	16	10	Rhodesian Ridgeback	F	Amputated LF	8y	RF, back	Unknown	No	Likely from forelimb amputation when puppy	Carprofen	32
17	17	17	Shih Tzu	F	Deafness	15y	LF, RF	Unknown	No	No	Synoquin, Onsior, pushed in cart on long walks	30
18	18	13	Springer Spaniel	M	Deafness	7y	LH	Hip	Yes	Displaced hip	Carprofen as needed, Nutroquin,	20
19	19	>13*	Turkish street dog	M	No	8y	RF, LH, RH	Carpus, hips	No	No	Amantadine, gabapentin	25

Interview number (same as owner number)	Dog ID	Age (Years)	Breed	Sex	Comorbidity with impact on dog's management	Age at diagnosis	Limbs affected	Joint(s) (if known)	Diagnosed by radiography?	Known underlying cause of osteoarthritis in any site?	Current treatment for osteoarthritis	Total LOAD score (range 0-52)
20	20	10	Labrador	M	Multi-focal lumbosacral disc disease	3y	All limbs	Hips plus others	Yes (hips)	Hip dysplasia, elbow dysplasia	Gabapentin, Previcox	16
21	21A	9	Labrador	F	No	2y	All limbs	Hips plus others	Yes (hips)	Hip dysplasia	Tramadol, gabapentin, laser therapy [joint replacement]	22
21	21B	8	Basset	F	Chronic obstructive pulmonary disease, urinary incontinence	Unknown	All limbs	Right stifle and carpus most significant	Yes	Conformation?	Cosequin acupuncture, massage, tramadol as needed	26
22	22	>12*	German Shepherd cross	M	Urinary incontinence, deafness, poor eyesight, laryngeal problem	9y	All limbs	Unknown	No	No	Previcox, tramadol	36
23	23	6	Labrador	F	No	3y	LH, RH	Hips	Yes	Hip dysplasia	Seroquin, orthopaedic bed	11
24	24	10	Border Collie	M	No	8y	LF	Elbow	No	No	Devil's Claw, glucosamine	9
25	25	13	Labrador	M	Deafness	2y	LF, RH, LH	Shoulder hips	Yes	No	Meloxicam, Synoquin	30
26	26	9	Boxer	F	Urinary incontinence	3y	LH, RH	Stifle, hock	No	Cruciate, Achilles tendon rupture	Meloxicam, tramadol	14
27	27	13	German Shorthaired Pointer	F	Deafness, suspected nasal mass	11y	LH, RH, (one FL)	Hips	No		Meloxicam, tramadol, Arthri-aid	15
28	28	17	Border Collie	F	Hyperadrenocorticism cognitive dysfunction, deafness, poor eyesight	15y	LH, RH, LF	Hips,	No	No	None	29
29	29	11	Shih Tzu Staffordshire Bull Terrier cross	M	No	9y	LF, RF	Elbow	Yes	Angular limb deformity	Paracetamol	19

Interview number (same as owner number)	Dog ID	Age (Years)	Breed	Sex	Comorbidity with impact on dog's management	Age at diagnosis	Limbs affected	Joint(s) (if known)	Diagnosed by radiography?	Known underlying cause of osteoarthritis in any site?	Current treatment for osteoarthritis	Total LOAD score (range 0-52)
30	30	9	Soft Coated Wheaten	F	No	6y	RH	Stifle	Yes	Cruciate repair	Previcox, Seroquin, Zantac	14
31	31	9	Labrador	M	No	8y	LH RH	Stifle, hip	Yes	Cruciate repair	Previcox, Synoquin, tramadol	19
32	32	9	Greyhound	M	Deafness	8y	LF, RH	Hip, carpus	No	Probably from racing background	Synoquin EFA	5

Legend: * Rescue dog, age estimated; y= Years; LH = left hind; RH = right hind; LF = left fore; RF = right fore; FL = forelimb

Table 13. Summary of the dog factor sampling frame with details of the coverage of each subcategory by the dogs described in the interviews

	Sampling frame category	Sub categories	Frequency	Dog ID
Dog factors (n=35)	Dog role now/previously if change was due to diagnosis	Agility/showing	3	5, 8A, 8B
		Working	1	25
		Pet	31	All others
	Breed type (classified according to Crufts)	Gundog	14	1 5 7 9B 10 11 15 18 20 21B 23 25 27 31
		Hound	4	9A 16 21A 32
		Pastoral	3	6 24 28
		Terrier	3	3 12 30
		Toy	0	None
		Utility	3	8A 8B 17
		Working	2	13 26
		Crossbreeds	6	2 4 14 19 22 29
	Osteoarthritis location as understood by the owners	Forelimb(s) only	8	5 8A 9A 11 16 17 24 29
		Hind limb(s) only	14	1 2 6 8B 9B 10 12 13 14 18 23 26 30 31
		Fore and hind limbs	13	3 4 7 15 19 20 21A 21B 22 25 27 28 32
	Number of joints thought to be affected	One	4	13 18 24 30
		More than one	31	All others
	Initiating cause of osteoarthritis for at least one affected joint as understood by owner	Dysplastic joint	3	5, 20, 23
		Cruciate repair	6	3, 12, 14, 26, 30, 31
		Fracture	2	9B, 11
		Limb deformity	1	29
		Limb amputation	1	16
		Other	1 (racing injury)	32
		Unknown	21	All others
	Comorbidity with an impact on management	Yes	20	1 2 5 7 9B 10 11 13 15 16 17 20 21A 22 25 26 27 28 32
		No	15	All others
	Treatment which the dog received at least intermittently at the time of interview (includes all which apply)	NSAID	23	2 4 5 6 7 9A 9B 10 11 12 13 14 15 16 17 18 20 22 25 26 27 30 31
		Tramadol	11	1 3 11 14 15 21A 21B 22 26 27 31
		Other analgesia	8	4 19 20 21B 22 26 27 31
		Joint supplement (veterinary and non-veterinary)	16	2 3 7 10 11 12 17 18 21A 23 24 25 27 30 31 32
		Joint/mobility diet	2	9A 9B
		Hydrotherapy	2	3 7
		Physiotherapy	1	3
		Acupuncture	1	21A
		Herbal remedy	1	24
		Cartrophen	5	5 6 8A 8B 9B
Magnetic collar		2	5 7	
Joint replacement		1	21B	
No treatment		1	28	

3.3.2 Focus group demographics

Five focus groups were conducted in four practices between August and December 2014; four with a total of 26 veterinary surgeons and one with 5 veterinary nurses (see Table 14). Practices 1-4 covered all variation in the veterinary surgeon sampling frame other than the inclusion of a corporate practice. The addition of practice 8 to cover the corporate practice type was considered but it was likely only one veterinary surgeon from this practice would have been able to attend the focus group. Data saturation was considered to have been reached after the fourth veterinary surgeon focus group. It would have been fascinating to include additional nursing focus groups but unfortunately no other practices met the inclusion criteria. Focus groups 3 and 4 were conducted on different days.

Focus groups lasted 55 to 61 minutes. All the focus groups included the majority of eligible participants. Focus group 2 was the only one to include a regular locum; all other focus groups included only permanent members of staff. The number of participants in focus group 1 was particularly high because the partners had amended the practice rota to allow attendance by as many veterinary surgeons as possible as a continuing education talk was delivered by ZB immediately after the focus group. Continuing education talks were declined by the other practices. Participant demographics were not formally collected but information about the participants was recorded in field notes made at the time and was confirmed using details on the practice website where available. All focus groups appeared to reflect both the demographics of their individual practices and the veterinary profession in general (Buzzeo *et al.*, 2014).

Table 14. Comprehensive details of the veterinary practices in which the focus groups were conducted, listed in the order in which they were performed

Focus group number	Practice code (from Table 9)	Focus group type	Practice description	Approximate number of veterinary surgeons/veterinary nurses eligible for inclusion (data from practice websites)	Total number of participants (Number of males)	Number of practice partners eligible for inclusion (attending)	Length of standard consultation	Participant description from contemporaneous field notes and information on the practice website where available	Timing of focus group
FG1	1	Veterinary surgeon	Multi-branch, city, small animal private practice	15	11 (4)	3 (3)	15 minutes	Range of veterinary surgeons from a new graduate to senior partners. All permanent staff; most had worked at the practice for several years. Most worked in multiple branch practices.	Evening
FG2	2	Veterinary surgeon	Single branch, town, small animal private practice	5	4 (0)	2 (1)	10 minutes	Three permanent veterinary surgeons, one regular locum. All had been involved with practice at least 5 years. The permanent veterinary surgeons had all worked at this practice for many years.	Lunchtime
FG3	3	Veterinary surgeon	Multi-branch, city and town small animal private practice	20 (veterinary surgeons)	6 (2)	5 (1)	10 minutes	Five permanent vets within their first 10 years since graduation, only one of whom had been at the practice for several years plus one senior veterinary surgeon who had been at the practice many years. All worked in multiple branches.	Lunchtime
FG4	3	Veterinary nurse	Multi-branch, city and town small animal private practice	6 (veterinary nurses)	5 (0)	n/a	10-20 minutes	All permanent staff members, all under 30 years old. Three registered veterinary nurses, two trainees. One with main responsibility for organising nurse clinics, one with main responsibility for hydrotherapy pool but all ran mobility clinics.	Lunchtime
FG5	4	Veterinary surgeon	Multi-branch, village, mixed, private practice	5	5 (0)	2 (1)	10 minutes	Range of veterinary surgeons: one new graduate, two graduates of fewer than 10 years since graduation and two senior partners who had been at the practice many years. One veterinary surgeon also did equine work. All worked in branch practices.	Evening

3.4 Study design limitations

As with any qualitative research, generalisation of these results to a wider population must be done with caution. The interview and focus group sample sizes were small, limiting the range of experiences captured. A formula does not exist by which data saturation can be identified (Ziebland and McPherson, 2006) and there is always a possibility that an additional participant may have introduced a new theme. Due to the complexity of arranging visits to owners in Scotland, seven interviews were performed after interview data saturation was initially thought to have been reached. Only a few additional codes were created as a result which increased confidence that data saturation had occurred. No new codes were identified from the final veterinary surgeon focus group so it is likely that data saturation had occurred in the population available for inclusion. It is very likely that additional veterinary nursing focus groups would have identified different subthemes, and inclusion of nurses who did not perform consultations with owners would have added a fascinating alternative viewpoint; unfortunately, time precluded this. The attitudes of veterinary surgeons and nurses in the sentinel practices may not represent most UK veterinary professionals; to become a sentinel, practices needed to have an interest in evidence-based medicine and practice based research and it is not known how this might change their attitudes, practice or interactions with owners. Since most owners were recruited from sentinel practices, the maximum variation in experiences and attitudes of all owners, veterinary surgeons and nurses may not have been captured. However, inclusion by snowball sampling of owners who attended additional practices may have helped widen the breadth of owner experiences.

Owners were self-selecting; some may have had a particular motivation to be involved in the study. For example, owners who felt their dog's care was particularly good or bad, or those who were keen to raise the profile of a specific treatment about which they were passionate might have been more likely to volunteer. As owners were recruited through veterinary practices, the study did not include owners who had not attended a practice and may have biased selection towards owners visiting their veterinary practice more regularly; again snowball sampling may have helped this. The length of the interviews probably favoured owners who did not work, but by performing interviews in the evenings if requested, several owners working full time were included. In future studies, targeted recruitment strategies may be needed to ensure inclusion of more male dog owners, working or agility dogs and owners who do not regularly visit veterinary practices. There was a notable absence of people from an ethnic minority. The low involvement of non-Caucasians in qualitative research is well recognised (Braun and Clarke, 2013a) and data on the ownership of dogs by people of an ethnic minority are sparse. Using a UK birth cohort of over 14,500 children, Westgarth *et al.* (2010) found only 3% of all pets owned lived in households containing non-white respondents so the low inclusion in this study of non-Caucasian owners is less concerning.

The interview guide was lengthy and could perhaps have benefited from organisation into a-priori themes like Richens (2015). However, the more tangential questions produced interesting responses, and none of the questions appeared irrelevant. ZB's background as a veterinary surgeon and the owner of an osteoarthritic dog is likely to have influenced the content of the interview guide and there is a risk that this unconsciously biased some of the content to reflect personal experiences. Involving others in the design of the interview guide and drawing on questions used in other studies ensured this was mitigated as far as possible. This dual prior experience was

likely to have been beneficial in other respects; owners appeared to be comfortable talking about their experiences with someone who had also owned an affected dog, and there were no difficulties associated with understanding the sometimes complex veterinary terminology used. Additionally, previous professional experience of talking to pet owners about potentially emotive issues was beneficial in ensuring that interviews were sensitively conducted.

The accuracy of information provided by owners about veterinary aspects of their dogs' diseases is unknown and may have been subject to recall bias. These data were not verified with the owners' veterinary surgeons as this would have breached confidentiality. However, as owners were managing the dogs based on what they recalled, the information they provided was still valid. Given more time it would have been fascinating to re-interview owners as their dogs' condition deteriorated to determine whether it altered their decision making. The LOAD instrument captured only the owner's limited perception of their dog's mobility on that day so its inclusion as the only osteoarthritis severity assessment was not ideal. It was not thought appropriate to clinically examine dogs due to the ethical challenges that could be associated with identifying problems previously unknown to the owner. Furthermore, there is no evidence these assessments would have been any more valid or reliable than LOAD.

Sampling veterinary professionals at a practice level was logistically simple and effective in including a wide range of participants. In the focus groups, some individuals may have felt they could not be fully open in front of their colleagues, so the true range of attitudes may not have been captured. However, by performing focus groups in the practice setting it was possible to gain some idea of practice culture towards owners that would have been hard to capture in any other way. Alternative sampling strategies including use of a veterinary professional sampling frame to recruit individual veterinary surgeons from different demographics would have yielded different and potentially more interesting results, but would have been much more difficult to organise. It would have been fascinating to explore more questions in the focus groups, but time precluded this.

3.5 Discussion of the study population

Engaging owners of osteoarthritic dogs and veterinary professionals working in general practice in qualitative research was feasible and practical on a limited budget within a short timeframe. No incentives were provided for owner participation, and only one of the four practices involved took up the incentive of a continuing professional development session. This suggests their participation was sufficient reward, and highlights the interest of owners and veterinary professionals in improving the management of canine osteoarthritis in general practice.

Methods used to collect farmer attitudes have recently been reviewed (Richens, 2015) but such a review does not exist for collection of data from pet owners. In the current study, owners were recruited through geographically dispersed sentinel practices using a variety of methods. The CEVM sentinel practices have not previously been used to recruit owners; this study confirmed the feasibility of the approach. Previous qualitative research involving dog owners in the UK has required doorstep interviews in a limited geographic range (Westgarth *et al.*, 2008), face-to-face discussions within a veterinary practice (Yeates *et al.*, 2011), recruitment

through respondents to a survey (Kuhl, 2014) or identification of suitable owners by veterinary surgeons working in practices close to the lead researcher (Wisemann-Orr, 2005). Collecting the data from pet owners in a wider geographic region has previously relied on internet surveys (Buckland *et al.*, 2014), emails to registered dog breeders (Kuhl, 2014) post to attendees at dog training centres (Demetriou *et al.*, 2009) or telephone (Plessas *et al.*, 2012). The sentinel network provides a novel method of recruiting pet owners which will be of use in future research. Four of the owners were veterinary surgeons. Inclusion of these owners is another unique aspect of the study. Specific aspects of the owners' background were not included in the sampling frame as there was no evidence for which factors might make a difference but previous work in a veterinary setting may be a valuable category for future studies.

Labradors were the most frequently registered breed with The Kennel Club in 2013 and 2014 (The Kennel Club, 2015), and are predisposed to developing osteoarthritis particularly in their hips and elbows (Studdert *et al.*, 1991), so it is unsurprising that they were over-represented in this study. Twenty of the 35 dogs had a comorbidity owners perceived impacted their management. Robinson *et al.* (2015a) reported that consultations in an observational study of general practice included a median of 2 problems, and a study looking at the efficacy of gold bead implants for hip dysplasia found 9/15 dogs included to have had significant other pathology at the time of death (Lie *et al.*, 2011). This perhaps suggests comorbidities are indeed common in dogs with osteoarthritis. Only four of 35 dogs in the current study were thought to have osteoarthritis in a single joint. Peer-reviewed veterinary research into dogs with osteoarthritis often includes only dogs with only disease in a single joint, even when dogs with multi-joint disease are reportedly eligible for inclusion (e.g. Autefage *et al.*, 2011). This emphasises discordance between the peer-reviewed literature about canine osteoarthritis and some aspects of the cohort involved in the current study.

Veterinary surgeon focus groups have been used to understand prescription of antibiotics to pigs (Coyne *et al.*, 2014) and attitudes towards pedigree dog health (Kuhl, 2014). However, the inclusion of veterinary nurses in focus groups, or in any attitudinal research, appears uncommon. Page-Jones and Abbey (2015) involved veterinary nurses in a qualitative study exploring career identity, but other peer-reviewed studies seeking their opinions are difficult to find. This is perhaps associated with challenges of inter-professional working, particularly related to the perceived hierarchy of veterinarians versus nurses explored by Kinnison *et al.* (2014). Veterinary nurses form a vital part of small animal practice in the UK. The RCVS survey of the UK veterinary nursing profession 2014 (Williams and Robinson, 2014) revealed over 70% of nurses are involved in nursing clinics; such clinics are increasingly recognised as both good for business and client satisfaction (Ackerman, 2015). It is therefore important to involve veterinary nurses in veterinary research whenever relevant.

Chapter 4. Thematic analysis results and discussion

4.1 Subthemes and themes identified

The study aims, design and demographic data of respondents were presented in chapter 3; the methods used to thematically analyse the data were discussed in section 3.3.3. This chapter presents the results and discussion of the thematic analysis.

Ten subthemes and four themes were identified in the final thematic analysis (Figure 8); data will be presented in this order. Within each subtheme, owner interview data is presented first, followed by veterinary professional focus group data. Where veterinary surgeon owners described attitudes that contrasted with other owners, these differences are highlighted but otherwise their data is not differentiated from that of other owners. Veterinary surgeons and nurses are referred to as “veterinary professionals” if they shared a common attitude, otherwise they are individually identified. Veterinary surgeon is abbreviated to “vet” during the results as this was the term most commonly used by all participants. The term “problem” is used to describe any aspect of the dog’s health that an owner or veterinary professional thought either warranted discussion during a consultation and/or any form of intervention or investigation. This term was used by Robinson (2014) in her thesis and subsequent publications describing veterinary consultations so was used here to maintain the consistency of terminology.

Excerpts illustrate points of interest throughout. Where excerpts are shortened to remove text not relevant to the purpose of the excerpt in the report, deleted text is identified by [...]. Participants are identified through their interview (abbreviated to “Int”) or focus group (abbreviated to “FG”) number (see Table 9 and Table 12 for details). Where excerpts are included from two owners discussing the same dog, they are identified as “Mr” or “Mrs” after the interview number. As described in Chapter 3, four veterinary surgeons were included as interviewees. Information is provided at the beginning of each theme as to the inclusion of their responses within each subtheme.

Focus group participants were assigned an individual number during coding. That number is presented with each excerpt, and veterinary surgeons are additionally identified by their role in the practice as assistants or partners. The terms “owner” and “client” were used interchangeably by veterinary professionals; “owner” is used outside these excerpts. A short discussion is presented at the end of each theme, combining owner and veterinary professional responses. The themes are discussed together at the end of the chapter. Some data from theme 3 has been published (Belshaw *et al.*, 2016b); that publication is included as an addendum to this thesis.

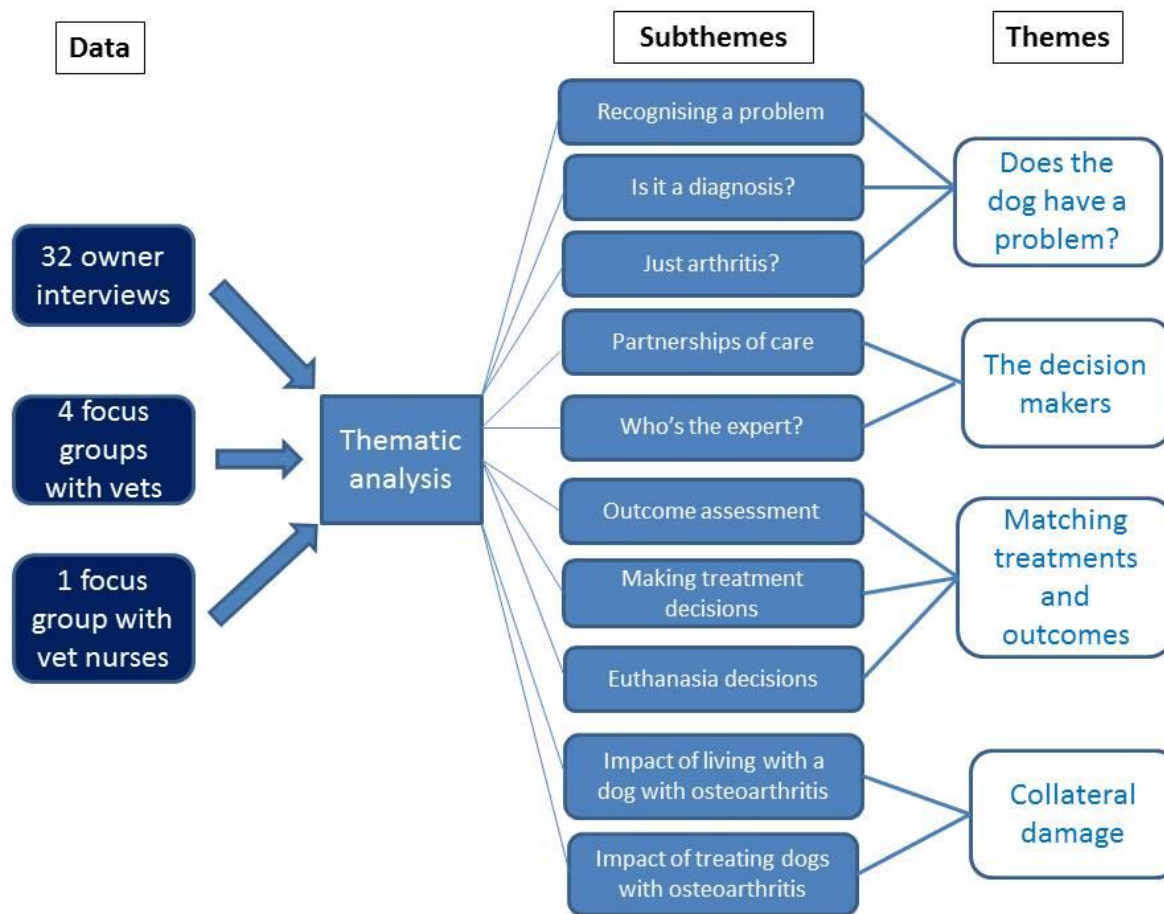


Figure 8. Overview of the thematic analysis process including the subthemes and themes identified

4.2 Theme 1: Does the dog have a problem?

Theme 1 explores the process of diagnosing osteoarthritis, starting with initial recognition of the behavioural changes identified by owners, moving on to diagnosis in the consulting room and finally to the perceptions of owners' attitudes to the diagnosis. Veterinary surgeon owners' perspectives are included at the end of each subtheme.

4.2.1 Recognising a problem

Owners

All owners recognised their dog had become stiffer or slower before this was discussed in a veterinary consultation. Few attributed this behavioural change to osteoarthritis; many initially related frequently subtle and inconsistent behavioural changes to environmental factors such as hot weather or rough ground. Many dogs were described as stoic, and on reflection owners were aware their dog's problem had been there for a while before they sought veterinary attention. The owner of a giant Schnauzer with hip osteoarthritis described the challenge in recognising the significance of these early signs in the face of otherwise normal behaviour.

On our normal long walk, as we got back, she would be slowing down, showing signs of, not a fatigue really, of not wanting to run about and jump around. And I can't say that, initially, I detected a limp, but it was more a slowing down [Int 13]

Very few owners had recent prior experience of owning a dog with osteoarthritis on which they could draw. Awareness of osteoarthritis in dogs appeared linked to the amount of time owners had spent around dogs and other dog owners. For example, owners involved in showing or agility were all aware of canine osteoarthritis. In contrast, the knowledge of first time dog owners was more limited, as exemplified by an owner whose children had persuaded her to buy them the family's first ever pet from a customer at her beauty salon.

ZB *Did you know dogs got arthritis?*
Int 29 *No. Because I really didn't know much about dogs*

Other owners reflected on their experience of osteoarthritis in previous older dogs. Dogs owned in childhood had usually not received any treatment for osteoarthritis leading some owners to think there was little point in seeking veterinary advice. Owners' experience of general practitioner consultations for their own osteoarthritis was also an important source of information.

I've got arthritis in this finger, and my doctor just said "Mm. It may hurt more now than it does eventually." [...] But they didn't seem to be offering anything else [...] I suppose I have just thought 'Well, there doesn't seem to be any magic cures for the humans, so it never occurred to me there'd be anything more to be discussed about it from a dog point of view. [Int 18, Mrs]

Sometimes owners or their relatives were concerned they were over-reacting in a way that would lead to them being negatively judged by others. This appeared to be

an important contextual factor for some owners when deciding whether to seek veterinary advice.

And he would be a bit slower, or he just seemed to be in discomfort. You know your pets, don't you? People say that, and you see people rolling their eyes, but you do, and I just thought 'Something's not quite right.' [Int 32]

Some owners were aware their dog was likely to develop osteoarthritis due to a previous radiological hip score or injury such as a cruciate ligament rupture. Having been forewarned what to look for by a veterinary surgeon, the signs were easy to recognise and early veterinary attention was sought. In contrast, a few owners reported that the first sign their dogs had shown was severe, acute onset lameness in a single limb. Vocalisation such as whining or repeated licking at a joint was a clinical sign reported only by owners of these dogs. This indicator of pain acted as a strong motivator to seek prompt veterinary attention. Owners of young dogs with acute pain signs thought their dog had picked up an injury. These owners had not considered osteoarthritis as being a possibility because of its association with older people, and therefore older dogs. A few owners with previous dog experience were aware of the possibility of joint dysplasia though none expected it to happen to their own young dog.

And then at two I took him to agility, and we did three weeks of agility, and he became really lame behind, really uncomfortable. So I took him to the vets, and had hip x-rays, which is when he was diagnosed with severe hip dysplasia and arthritis, to the point where he had cauliflower head already, and really not fitting into the cup at all. [Int 20]

The approach of veterinary surgeon owners was consistently different. Interestingly, these owners regularly switched between owner and veterinary perspectives, often contrasting what they knew they should do with their less rational “owner head”. Most veterinary surgeon owners were aware their dog might be predisposed to osteoarthritis, based on an unusual conformation or previous injury and many noticed very early signs. They described a thought process of immediately fearing the worst, for example the dog had a cruciate ligament rupture, followed by a rationalisation that this worst-case scenario was unlikely. Somehow, this led to an impasse where they chose not to investigate these abnormalities, even with a clinical examination, in the hope it would go away. They discussed their embarrassment at not noticing or treating the problem more quickly. Several recognised the need to use other people to help them make objective decisions about their own dogs.

And it is difficult, isn't it, because you always fear the worst as a medically-trained person. But actually, [partner's name] is very good at being quite objective about the animals, so that helps me, because I get far too emotionally-involved with them. I always think the worst is going to happen, and he's much more 'Come on, they're fine. Just get on with it.' So that helps. [Int 1]

Veterinary professionals

Veterinary professionals described two parts to making a diagnosis of osteoarthritis: recognising it themselves, and convincing owners to recognise the problem. This

second aspect will be described in 4.2.3. Fascinatingly, veterinary professionals described a process of almost unconsciously screening every dog for osteoarthritis, every consultation. They compared the dog's ability to rise from sitting in the waiting room and its ability to walk into the consulting room with a mental image of what they consistently described as "typical" osteoarthritis. A "typical" dog with osteoarthritis was older, possibly overweight, and stiff on rising with mild to moderate lameness in one or more limbs. They used this visual examination to make a presumptive diagnosis of osteoarthritis that they then sought to confirm. There was little variation in the description of a "typical" dog with osteoarthritis between participants. During the consultation, the owner's description of any behaviour change was used to strengthen the likelihood of the diagnosis of osteoarthritis. Probing questions included whether the dog was stiff in the morning, whether owners had noticed any lameness or a reduced willingness to exercise. Little variation in these probing questions existed either within or between focus groups. For many, this history was the most important diagnostic aid.

... if the owner's having a pretty clear history, and you're describing typical signs of the dog struggling to get up, and possibly more lame after exercise and things like that, then often I will say 'Okay, it sounds pretty indicative.' [FG3, Vet 1 (assistant)]

A clinical examination increased their confidence in the diagnosis. Participants in all focus groups discussed disease "severity", though exactly how this was determined and whether this was the same across all participants was not clear. This lack of definition was discussed at length in by some participants.

I think to grade things that you can physically grade is always very nice, but arthritis degree does seem to vary from patient, from exercise level, from age, from breed. It's such a hard thing to put a grade on... [FG3, Vet 3 (assistant)]

The description of events above was only possible where the clinical abnormality was discussed during the consultation. Many vets described a scenario of the dog with "typical" disease being presented for an entirely different problem; this was not a problem for the nurses who saw only dogs already identified to have a problem during their consultations. Vaccination consultations were recognised as one of the common occasions when osteoarthritis would be recognised by a vet but mentioned not the owner. The vet first had to deal with the reason the dog had been booked in to the consultation before moving on to the probable osteoarthritis. Many vets alluded to a clear conflict between discussing the problem and not running late.

I think any vaccination appointment which is time-limited to a clinical examination history, and administering vaccination, sorting worming, parasitic therapies, etcetera. I think if you discover any significant disease [...] it's a really difficult thing to keep to schedule. If you're consulting on your own, or with another person, and you don't want to drop them in it by you being very thorough and doing a twenty-five minute consultation. [FG3, Vet 5 (partner)]

Surprisingly, some vets chose not to mention the dog had a problem at all rather than try to squeeze it into the remaining time in the consultation, particularly if they felt the owner might not be receptive to the diagnosis. In this instance, osteoarthritis would have been recognised as a presumptive diagnosis by the vet but would not be

discussed with the owner. Sometimes, vets acknowledged that this required judgement of the owner's character.

Vet 2: *As I say, you have to look at the client first to decide whether it's worth mentioning it.*

ZB: *Is that what you do?*

Vet 2: *Can be.*

Vet 7: *Careful, it's being taped.* [FG1]

The final comment made by another participant demonstrates how uncomfortable some participants felt about making this admission. Other vets in both focus groups where these judgements were discussed appeared to agree, but were not comfortable talking about them so openly, typically nodding whilst avoiding eye contact with each other. This will be explored further in the next subtheme.

4.2.2 Is it a diagnosis?

Owners

Most owners recollected their dog was diagnosed with osteoarthritis by clinical examination only. Radiography appeared to have been performed only in younger dogs or those with acute onset signs which perhaps did not fit the "typical" picture. Several owners expressed surprise at how bad the joints appeared to be on the radiographs relative to the subtlety of signs their dog had shown.

[The vet] showed me the x-ray, he explained everything, which was really, really useful. And he showed me where the bone didn't quite fit in, he explained why he might be having some problems. [Int 31]

Most diagnoses were reached within a single consultation but a few owners described a more tortuous process. A Labrador was referred to a veterinary specialist centre for investigation of unwillingness to get out of bed in the mornings and slowing down on walks after a series of unproductive consultations at the local practice. Her owners described, with clear frustration, how they had to suggest the diagnosis to the vet in charge.

Mrs: *And she had a brain scan, and they prepared us for all this, and we made our decision that yeah, we didn't want to put her through anything awful. And they couldn't find anything at all. [...]* And then...

Mr: *Well, we said "Does she not have arthritis? It's a trait of Labradors".*

Mrs: *And we said, yeah [...]* "Could she have her legs looked at?" [....] *And yes, sure enough, it was then in her spine. And...*

Mr: *All her legs.* [Int 15]

Three veterinary owners avoided performing assessments on their own dogs; those dogs were clinically examined by colleagues outside normal working hours or by vet friends during a social visit; normal consultation slots for this purpose did not appear to be used. Often this occurred a considerable period of time after the clinical signs were first noticed. These owners expressed a desire to avoid being a burden to other colleagues who were already busy by asking them to look at their dog as a favour, and described how difficult it was to make these assessments for other vets.

And I do feel guilty about it to be honest, because then you finish at what time, I don't know, and sometimes you just want to go home. Especially you don't want to impose on other people, then asking 'Shall we do it now?' because it's late. [Int 19]

One vet wanted to avoid creating this burden of responsibility, so examined her dog herself.

Veterinary professionals

Most vets used only clinical examination when diagnosing “typical” osteoarthritis, demonstrating their confidence at recognising the signs. A few vets described offering radiography routinely, but others left it for the owners to suggest. Several thought radiographs did not provide additional useful diagnostic information in “typical” osteoarthritis and rarely changed what they did. Consequently, when owners asked about radiography some vets tried to dissuade them. The usefulness of the radiographs as a teaching tool for owners was not discussed.

I think I'm sometimes surprised if owners say 'Don't you want to x-ray it?' Because that would be the exception rather than the rule. I would say most people would be happy, I think, if you made a presumptive diagnosis. [FG5, Vet 1 (partner)]

However, in an atypical presentation, for example a young, acutely lame dog or a rapid increase pain or lameness in an older dog, vets would advise radiography to rule out other differential diagnoses rather than to rule in osteoarthritis. This appeared consistent between practices.

With the older dog it's probably we advise x-ray if it doesn't improve after maybe a month – or you x-ray first to diagnose osteoarthritis in the first place to make sure it's nothing sinister. A young dog is a mandatory x-ray after a week if it's not improved. [FG1, vet 1 (partner)]

For most vets, the final piece of evidence needed to confirm the diagnosis of “typical” osteoarthritis was trial treatment, typically NSAIDs for 5-7 days. At the end of this period, the owner history and a repeat clinical examination were used to confirm a response. “Typical” osteoarthritis would respond well to this initial treatment in almost all cases.

[The owners] come back and then they go 'Wow, they're a completely different dog.' [FG5, Vet 3 (assistant)]

Additional tests such as force plate gait analysis, arthroscopy and the use of paper-based owner questionnaires were briefly discussed. Most vets did not think them necessary or practical in a general practice setting, with time providing a big barrier, even in the practice running 15 minute consultation lengths.

We should be analytical and using some pain scoring system or getting the owner to fill in questionnaires; but that's just not what 15-minute consultations allow you to do. That is what would be the best if it was

recorded, but it doesn't fit. In general practice you've got to go with your hunches and go with what the owner says. [FG1, Vet 2 (partner)]

4.2.3 Just arthritis? Attitudes to the diagnosis

Owners

Owners' initial attitude to the diagnosis appeared dependent on how much they had anticipated it and how much they thought the disease might affect both them and their dog. Owners of older dogs with subtle signs were typically not particularly surprised about the diagnosis. Many described their preconceptions of osteoarthritis as a progressive, incurable disease in older people and thought the same would be true in dogs. Phrases such as “*I just thought*”, “*I just assumed*”, and “*Arthritis is just part of old age*” were commonly used by these owners. Use of the prefix of “just” made the disease seem insignificant and unimportant. Few anticipated the disease having a significant impact on them or their dog at diagnosis; most owners thought treatment would make the dog better, even if only in the short term. Unusually, one owner described a fatalistic, almost hopeless, attitude to the diagnosis.

I just thought of arthritis as a progressive process. At some point that will in effect cripple her. [Int 13]

In sharp contrast, acute onset clinical signs did not fit with owners' understanding of osteoarthritis. Owners of dogs diagnosed after these signs found it difficult to discount their prior knowledge to accept their dog had osteoarthritis; a few questioned the diagnosis repeatedly during the interview.

I think she must have pulled something, or something like that. Because, okay, she didn't suddenly develop arthritis of the hips, and suddenly 'Oh I've got arthritis of the hips, I'm going to stop moving.' So what I actually noticed, which was blatantly obvious, wasn't the arthritis. [Int 8, Mr]

Owners of young dogs diagnosed with osteoarthritis described shock, sadness and guilt. Consistently, they described considering their dog's osteoarthritis as their fault as they perceived it to be a disease of old age. Several, like this owner of a Labrador diagnosed with hip osteoarthritis at 3 years old, described racking their brains to work out what might have caused the problem.

When we got the diagnosis, and we're there thinking 'What have we done wrong? Is it something we've done?' and [husband's name] said “Well, do you think it's something to do with her being on a hard floor, from being a puppy... Has that destabilised her hips? Maybe it's something like that.” [Int 23]

The diagnosis was extremely traumatic for a couple of owners of young dogs who had not considered osteoarthritis as a potential cause of their dogs' problem. The owner of a young German shepherd with little prior experience of osteoarthritis in any species described how this assumption had contributed to her distress.

I was oblivious to the fact that she would have an issue, because she looked so good, because she moved so well, because she was the right shape for me

for a German shepherd. And when they said “Yeah, no, it is arthritis” I felt out of control, because I couldn't do anything about that because she had it. You can't chisel it away and start again, it is there. And, I kind of knew it's only going to get worse, because it does in any walk of life. And that was probably my limit of what I knew. And that scared me. She was, what, two-and-a-half, three, so she was young. [Int 20]

In contrast, owners who had previously managed a dog with osteoarthritis described the benefit of this experience. An owner of two dogs described the difference in attitude to the diagnosis of osteoarthritis in her second dog compared to her first, demonstrating her increased confidence and empowerment.

I wasn't as frightened about the condition as I was then. Because I thought it was the end of the world when [dog 21A] got diagnosed, whereas with [dog 21B], I was like 'Okay, she's a Bassett, I know how to deal with it.' [Int 21]

The veterinary surgeon owners had experience of managing canine osteoarthritis as a clinician. All had anticipated their own dog might develop osteoarthritis based on what they knew about their age, breed or conformation so the diagnosis was not a surprise. Unusually in comparison to other owners, they discussed worrying about having to make the decision to euthanase their dog from a very early stage after the diagnosis. Their awareness of what lay ahead appeared to make the diagnosis more painful for these owners than for many non-vet owners.

I think it's negative in the sense of knowledge is a bad thing, and I'm constantly in the back of my mind doing the final countdown, and I'm going to have to at some point make a decision that I'm really dreading making. [Int 6]

Veterinary professionals

The vets consistently identified two owner attitudes to the diagnosis. The first was denial. These owners were reported to respond to a question such as “*Is your dog ever stiff when he gets up?*” with replies such as “*He's fine, there's nothing wrong, he's just a bit stiff in the mornings*”. The second attitude was much more open, giving a response to the same question of “*Yes he is, why might that be?*” Owners' attitudes to these initial discussions seemed to predict how the rest of the consultation might progress. If an owner recognised the dog had a problem, from the veterinary professional's point of view the rest of the consultation was relatively easy – a matter of deciding on whether further diagnostics were necessary then formulating a treatment plan. However, not all owners were thought to be keen to treat their dogs, even if they did perceive a problem existed.

You sometimes get those people that clearly, they are telling you, from what they're telling you of the history and the answers to your questions, it's perfectly obvious that their dog has arthritis, and they will probably agree with you. And yet they don't want to do anything about it. [...] Which is quite frustrating. [FG 5, Vet 1 (partner)]

Where owners did not recognise a problem and the vet had both time and inclination to proceed with the issue, a potentially complex and arduous consultation lay ahead. In all focus groups, vets compared “*strategies*” and “*tactics*” used to “*persuade*” or “*convince*” these owners to treat their dog. Strategies included explaining changes on

the orthopaedic examination and running the dog up and down outside the practice to demonstrate lameness. Several suggested these strategies rarely helped.

I've tried to teach them to watch the rhythm of the movement so they know whether it's lame or not, because so many people haven't the faintest idea; not a clue. ((Laughter)) [FG1, vet 3 (assistant)]

The laughter with which this comment was met suggests it was a situation familiar to others in the room and use of the term “tried” suggests a lack of success. Most vets agreed many owners left the consulting room unconvinced. This was a source of major frustration, and vets considered these owners as a barrier to the dog receiving treatment. Some vets felt the majority of owners of osteoarthritic dogs fell into this category.

... my main struggle is getting people to appreciate that there's a condition there at all in the majority of arthritic patients. [FG3, vet 2 (assistant)]

Most vets expected owners to know dogs developed osteoarthritis and discussed feeling surprise and some incredulity when they did not. A few examples were provided of owners of young pedigree dogs diagnosed with hip or elbow dysplasia who apparently perceived a pedigree certificate was a guarantee of good joint health. These examples suggested the vets were not always sympathetic to owners who they perceived were ill-informed.

You do get the odd one who takes it really badly, and cries. And you say 'Well no, no, at most the dog's a bit sore, and you just have to manage it.' And then they take some management, and some of them are the dogs that aren't actually that bad. So where they've been hiding I don't know where they live that they've not heard of arthritic dogs before. [FG5, vet 1 (partner)]

Some vets acknowledged potential barriers to owners recognising the clinical signs of osteoarthritis. Some perceived owners thought behaviour changes such as stiffness on rising were a normal part of old age, which reflected the owners' understanding of osteoarthritis in people. Several identified the importance of the rate of change, with owners much less likely to see or act upon an insidious change than an acute one. None described having verified these ideas with an owner and a few did not acknowledge any barriers to owners recognising the clinical signs of osteoarthritis. Several thought owners believed their dog would vocalise when in pain and reported using human medical analogies to help overcome this misconception.

I always say it's like the difference between having an achy back and stubbing your toe: if you stub your toe then you're going to go, "Ow!" But if you've got an achy back you're not going to stand there and constantly go, "Ow! Ow! Ow!" [FG1, vet 4 (assistant)]

A less common hypothesis was that owners were worried the vet might tell them to euthanase their pet, or they were in denial their pet was getting older. The tone of voice used by the vets often demonstrated a lack of empathy towards owners holding these views.

They don't want to accept that the dog is becoming older, and they don't want to accept that the dog is becoming limited. [FG 2, vet 1 (locum)]

Veterinary nurses chose different ways to explain osteoarthritis to owners. Several recognised the need to teach owners about the disease using non-medical language, instead using changes in the dog's body the owners could recognise. When interactions were described, they appeared to involve the owner much more than those described by the vets.

You say 'Ooh, did you notice that this one's a bit thinner than the other leg?', and they go 'Ooh, no. I didn't notice that. Why's that?' And then they talk to you about that. [FG4, nurse 1]

Several vets and most nurses recognised the importance of the owner's relationship with their dog, the speed of onset and the severity of the clinical signs in the owners' likelihood of believing their diagnosis. However, there was little discussion in any vet focus group of the negative impact the diagnosis might have on the owner. In contrast, some veterinary nurses recognised for many owners, the dog was an important part of their family and this might affect how they felt. They reflected on their own experiences to empathise with the impact on others.

It depends on the client's perception of the pet as well, you can't judge them, because some, like me, mine is my child rather than my pet. So, as well, attached to that client is an extended part of their family as well. [FG4, nurse 2]

4.2.4 Does the dog have a problem? Discussion

This theme explored the decision making process used by owners and veterinary professionals around the diagnosis of canine osteoarthritis. Some owners in this study and those interviewed by Stoewen *et al.* (2014) about dogs with terminal cancer described guilt at not having presented their dogs to a veterinary surgeon earlier. Common barriers to seeking veterinary attention identified by owners included the slow and inconsistent rate of change in their dog's behaviour, their prior knowledge about the disease and their uncertainty about the significance of the behavioural changes on their dog. Prior knowledge and fluctuating health levels as factors in seeking veterinary attention were identified by Scantlebury *et al.* (2014) in a mixed-methods study involving owners of horses with colic and by Christiansen *et al.* (2013) and Christiansen *et al.* (2016) in interviews with Danish owners of seriously ill dogs. Using an online survey of 445 UK dog owners, Buckland *et al.* (2014) determined owners' ability to associate canine behaviours with positive emotions was significantly influenced by their prior experience with dogs. It is therefore unsurprising these are also factors in canine osteoarthritis and highlights the importance of educating owners about how behavioural changes relate to disease and welfare. In the current study, owners also described using their human healthcare knowledge to make decisions about their dogs' osteoarthritis. This was not described in the previous studies, perhaps due to the difference in diseases included. Many veterinary surgeons over-estimated the ability of owners to recognise subtle behavioural changes and under-estimated the importance of these factors in owner decision making; this has also not previously been reported and suggests dissemination of these results may be very valuable.

In cases of “typical” osteoarthritis, veterinary surgeons in this study did not think radiography would change what they did, providing an additional motivation to rely on their experience. This contradicts the advice of experts in canine orthopaedics (e.g. Innes, 2012) but was consistent with the low rate of diagnostic testing in general practice described by Robinson *et al.* (2015b). Interestingly, owners both in this study and those interviewed by Stoewen *et al.* (2014) found radiographs useful in understanding their dogs’ disease, so perhaps this could be an additional justification to perform the procedure. Owners described a range of attitudes to the diagnosis of osteoarthritis ranging from devastation to fatalism. The importance of these attitudes on the decisions subsequently made about the dog’s treatment did not appear to have been recognised by the veterinary professionals in the current study. This will be explored further in section 4.5.3.

Osteoarthritis was frequently diagnosed during consultations for a different problem, particularly vaccination consultations, when veterinary surgeons described time was particularly limited. Everitt *et al.* (2013), and Robinson *et al.* (2014) found a significant number of consultations about dogs conducted in general practice exceeded their allotted length. Vaccine consultations have been identified as being particularly complex with a large number of different problems discussed (Robinson *et al.*, 2014, Robinson *et al.*, 2016). It is unsurprising that veterinary surgeons found discussing a diagnosis of osteoarthritis in these consultations stressful.

Few veterinary surgeons performed radiography when diagnosing dogs with osteoarthritis they recognised as “typical”, instead relying on history taking and clinical examination to make an intuitive diagnosis. May (2013) emphasises the need for a good bank of clinical experience before intuition can be trusted in veterinary diagnostics. However, McKenzie (2014) rationalises such approaches are necessary in general practice due to the constraints of time and money. This use of intuitive knowledge is similar to the “mindlines” discussed in chapter 1, and fits with System 1 of the dual process theory of decision making described by Kahneman (2011) which describes fast, intuitive decision making. When the dog’s signs were not typical, a more thorough assessment of alternative differential diagnoses and use of diagnostic imaging were more likely. This behaviour fits with System 2 of Kahneman’s dual process theory – a deliberate, explicit process of collecting and processing relevant information. This is compatible with the two types of decision making process described by Belgian veterinary surgeons interviewed by Vandeweerd *et al.* (2012a).

Veterinary surgeons described a range of strategies to convince owners to treat their dog’s osteoarthritis, but perceived these were often unsuccessful; this has not previously been described and may relate to discrepancies in the language used by owners and veterinary surgeons to describe the clinical signs of osteoarthritic dogs. For example, many owners used the term “stiff” when talking about their dog’s gait whereas veterinary surgeons consistently used the term “lame”. A similar discrepancy in terminology was identified by Horseman *et al.* (2014) when talking about lame dairy cows to farmers. Interestingly, the veterinary nurses in the current study appeared much more confident in their ability to persuade owners to treat their dogs, perhaps because their language and explanations were more owner-friendly. Owners of dogs with cancer interviewed by Stoewen *et al.* (2014) and those in the current study identified many aspects of veterinary communication they perceived to be important, including clear explanations, management of feelings and not using judgemental language. However, the veterinary surgeons included in this study did

not appear to be aware of the importance of these and this may be an additional explanation for their lack of success. Fascinatingly, there appear to be incredibly strong parallels with general practice consultations about human osteoarthritis. Paskins *et al.* (2015) identified that osteoarthritis was often discussed in complex consultations by general practitioners when it was not a condition that was high on the patient's agenda. Paskins reports that many doctors also made incorrect assumptions about the understanding that patients might have about their disease and the impact that the condition might be having on their lives.

Consultations like these may contribute to the high level of mental health problems in the UK veterinary profession identified by Cardwell *et al.* (2013). The sense of personal failure alluded to by some veterinary surgeons who did not succeed in convincing owners may be identifiable as the moral stress described by Rollin (2011) or emotional labour, described by Wharton (2009). Both characterise types of stress that occur when people are not able to do what they feel they should be doing due to the constraints of their workplace. The impact of the relationship between owner and veterinary professional on treatment decision making will be explored further in section 4.3.3.

The attitudes of the veterinary surgeon owners to their own dogs' disease highlighted challenges associated with being in a dual position of responsibility as owner and veterinary surgeon. In particular the difficulty in accessing independent veterinary advice is evident. This will be explored further in the discussion of themes 2 and 3.

4.3 Theme 2: The decision makers

Theme 2 discusses the importance of the relationship between owner and veterinary professionals in making decisions about an osteoarthritic dog. Veterinary surgeon owners described a different perspective both to getting external help managing their dogs' disease, and with looking for information. Their responses are included at the end of each subtheme.

4.3.1 Partnerships of care

Dog owners

Few owners described a strong relationship with a veterinary practice before their dog's diagnosis with osteoarthritis. Following diagnosis, a relationship with a practice, and often a single vet, was built by many owners through repeated consultations. Continuity of care was an important attribute of a good relationship with a veterinary practice but the conduct of the support staff, the ease of getting an appointment and even the type of building were important to some owners.

It freaked me out in a house, in a little dark... Doesn't feel right. It feels antiquated, if that's the right word. It doesn't feel like it's moved on, and that's what I'm interested in, and that's what gets me, is the forward thinking. [Int 14]

Owners who had developed a good relationship with a single vet talked about “my vet” and often used their vet's first name in discussions. This was the vet they saw by choice for most of their dogs' care, though interestingly many were happy to see an alternative vet for what they perceived to be a less important consultation such as a vaccination. Some owners described travelling long distances to a branch practice to maintain continuity of care with their vet if needed. Several owners drew parallels with what they would expect from a doctor, exemplifying that many owners view their pets as family members.

And any time we actually go to the practice I'll always just say 'Can I get an appointment for [vet's name]?' Not that I don't trust any of the other vets, but I prefer to have a vet that knows my dog. When you go to your doctor, you don't want to see another doctor that doesn't know you, so I want my dog to see someone who knows my dog. [Int 26]

A strong, trusted relationship with an individual vet was built around a variety of positive attributes. Owners expected their concerns to be validated without being made to feel stupid, the vet to empathise with them over difficult decisions and the dog to be treated with care and respect. Honesty about the potential costs of treatment and not feeling rushed during the consultation were also important to some owners. Clinical skills and knowledge were rarely discussed when owners described the positive attributes “my vet”, emphasising the importance of consultation skills. A highly motivated owner of two affected dogs described the attributes of her ideal vet, again drawing parallels with doctors.

I expect a fantastic relationship, in the sense that I can have a two-way conversation with them, I can express my concern without feeling stupid, and

they might say [Owner name], you're being over reactive about that.' And I'll take that on the chin [...] And I want to get to a stage with them where I completely trust them. Because I want that with my own doctor. So why would it be any different? Because these are my family, I don't dress them up in kids' clothes, I'm not weird like that, but they're my family. [Int 21]

Mutual trust and respect was identified by several owners as key to these relationships. Interestingly, where owners from the same veterinary practice were interviewed, certain vets' names appeared to repeatedly be associated with these good relationships, suggesting these individuals had good interpersonal skills. Where a relationship was very good, owners described implicitly trusting the vet to give them the best possible advice. Owners in good relationships felt confident to bring information to their vet for discussion, were able to ask questions and disagree with suggestions they did not feel right for their dog and were comfortable to ring their vet at any time with a query without being negatively judged. Several commented their vet prefixed advice with *"If it was my dog, I would....."* which made these owners feel very confident the recommendations had really been considered. Each positive interaction seemed to further strengthen the bond and increase their confidence they were in a good partnership of care. These owners also realised trust was a two-way thing, requiring them to keep up their end of the bargain through compliance to maintain the relationship.

So that again is part of the building the trust, that if [vet's name] said that he actually needed something, then we'd make sure he got it. [Int 12, Mr]

Unfortunately, most owners identified that their relationship with their vet was not this good, though some of these owners still used the term *"my vet"*. The vets involved in these relationships were rarely criticised by the owners who often described trusting them as *"a good vet"*. However, these vets were often described as being somewhat judgemental of the owners, particularly if they made treatment suggestions or asked about things they had read. Rarely these vets were described as brusque, rushed or uncaring. An owner described her experience of telling an orthopaedic surgeon a homeopathic treatment had been helping her Labrador.

... and he poo-pooed it [...] And it was helping her. And he just said "There's no evidence for that at all". And I thought ' but she's got a bit better on it!' [Int 7]

As a result, these owners typically did not feel confident to question the advice given to them by their vet even if they were not sure it was correct. The owner of a Spinone whose current treatment for elbow osteoarthritis was not working explained her concern about her vet's advice, but suggested that she would not challenge it.

I'm very worried that when he's next due at the vets in two weeks' time, because all this isn't working, that the vet's going to suggest steroids. And I've picked up from the health forum, this, er, this steroid is not the greatest thing in the world for a dog. So I'm feeling a little bit despondent at the moment. [Int 4]

Interestingly, once a relationship with a vet had been established through a few consultations it appeared rare for an owner to visit an alternative vet, even if their experience was not ideal. Some owners said they would feel guilty switching but the

motivation of others was not explored. A few owners who had had serial negative interactions felt no vets could be trusted, frequently questioning their financial motivations. These owners were more likely to stop prescribed treatments and less likely to attend regular re-examinations than those owners who talked about “my vet”. These owners instead sought advice from non-veterinary sources. The owner of a border collie with elbow lameness described how she and her husband learnt about a treatment from their butcher’s daughter.

And she sees me walking around town. And one day she said “Your boy's limping.” And I said “Yeah, he's got arthritis.” She said “Devil's claw.” And I said “Well what in heavens is that?” And she told us, she said “It's quite expensive...”, and it is quite expensive. It's twelve ninety-nine for fifty tablets. [...] Still cheaper than Metacam. But we said “Oh, we'll give it a try, it can't do no harm.” So, that's how we got on it, never heard tell of it before. [Int 24, Mrs]

Several owners had experience of veterinary nurse clinics and thought these would be a useful addition or alternative to seeing a vet. Nurses were thought to explain things in less complex terms; were in less of a rush, allowing owners to mention more minor concerns; and were less likely to make an owner feel stupid. For some owners, building a relationship with a specific practice nurse would be preferable to seeing a vet.

Because, and if you had that person that you're going to see the same person all the time, that would build up a rapport well, you would build up, and they're not vets, so they're not as judging. [Int 29]

Only one of the veterinary surgeon owners had specifically taken her dog to a different veterinary surgeon to discuss osteoarthritis management, and then only when there was a possibility that joint replacement might be needed. The other vets described using their friends and colleagues for advice on an opportunistic basis. All described feeling a conflict between what they would do in a clinical setting with a different dog and how they felt about treating their own dog. Several described a sense of guilt that they weren’t doing more.

I think I'm more likely to ignore things that maybe if I was very objective, and stood back with my vet's head on, I would pay more attention to. And every now and again I think 'Well, what if you were the vet, and this was a client? What would you do then?' But I think that's a really hard thing to do, to detach yourself from the whole owner-animal relationship. [Int 1]

Despite this, all the vet owners wanted to retain control over decisions made about their dog’s osteoarthritis treatment. Several described instances where they had declined investigations or treatments mentioned by a colleague if they thought they were not in the best interests of the dog. Typically, their motivation to be the final decision maker was based a feeling of responsibility, though one vet owner questioned her ability to be objective.

I understand my own decision-making processes and not necessarily [those of my family members]. But then I don't trust my decision-making processes. So I don't know! I don't know. Maybe [I make the decisions] so I can blame myself if it all goes wrong. [Int 9]

Veterinary professionals

Many vets alluded to having good relationships with some owners and very poor relationships with others. Older vets and nurses tended to speak more favourably of owners in general than did younger vets. Vets and nurses used the terms “owner” and “client” interchangeably when talking about dog owners, perhaps emphasising the conflict some felt in their role in these relationships. Somewhat surprisingly, the main attribute of a trusted relationship for vets appeared to be owner’s compliance with their recommendations. Veterinary nurses, through their experience on the reception desk, highlighted how little some owners understood about veterinary practice.

The other day I had a client she wasn't very happy with her vet. [...] I don't think they had the connection, they wanted that friendship sort of connection. Didn't like the vet, didn't want to see them again. And I said 'Oh, I'm really sorry about that, but why don't you ask to see such-and-such a vet?' 'Well, am I allowed to do that?' 'Yeah.' 'Is that going to be a different fee?' 'No, it's exactly the same. You have the right, like going to the doctor and asking for the same people.' And people aren't aware that they can do that. [FG4, nurse 1]

Vets thought continuity of care allowed a relationship of mutual trust to be established which led to better compliance. Fascinatingly, both compliance and continuity of care appeared to be viewed by the vets as a personal success. Compliant owners were perceived as more committed to their dogs’ care by both vets and nurses. In all focus groups vets also discussed a population of owners who they thought actively disregarded their recommendations for a variety of reasons including money and arrogance; these owners appeared to be a great source of frustration.

A lot of the time clients will do what they want anyway. If you say to them, “Oh, he’s still stiff in that joint” but if they think he’s a lot better they’ll just stop the medication, and they won’t continue because they see the cost and well, he’s better. Then they’ll come back like three weeks later and say, “Actually he’s gone stiff and lame again”. Bring him back to the vets and you have to start all over again. ((Laughter)). [FG1, vet 1 (partner)]

Different consultation styles were described, potentially leading to different relationships with owners. Many of the younger vets reported adopting an owner-led approach. Some offered a range of treatment options from which the owner could choose; several described the need to align owners’ expectations with their own, suggesting they rarely challenged owners, even when they felt they were making poor choices.

Because you see dogs coming in that can barely walk and the owners are still happy, and you're sitting here thinking 'This dog needs to be put to sleep. It's not responding to any of the treatments.' And then you get one that, maybe it just can't go for as long of a run as it used to, and the owners are still unhappy with that as well. So it's difficult, I think, matching up expectations,

and what the owners are thinking with what you're thinking sometimes. [FG3, vet 1 (assistant)]

A few vets talked about the need to “judge” owners when deciding which recommendations to make in a limited period of time, particularly in relation to what they might be able to afford. This topic appeared to make some vets uncomfortable and discussions were often short, followed by rare periods of silence. One of the veterinary nurses agreed, whilst not ideal, judging owners did happen.

I think, like you say, although people would like to think that you don't judge people when you see them, I think people do make a knee-jerk reaction on someone, their ability and their time, in what they can commit to the pet. So that makes a big difference to what you would suggest. [FG4, nurse 2]

Motivations for adopting this approach were varied. Some vets appeared to use an owner-led approach to avoid having to discuss treatment costs. Others thought owners should always be allowed to choose what they wanted. Surprisingly, in some cases it appeared these vets actively withheld their views on what they felt was the best treatment because they did not think they could challenge the owner’s decision until the animal’s welfare was clearly compromised.

I think a lot of it is really down to the client as a whole, and it's very difficult to go against what a client wants unless there's a welfare issue, in which case Royal College rules kick in, and you say 'No, you have to have some painkiller.' [FG3, vet 3 (assistant)]

That was the only reference to the term welfare by any participant in any focus group, which may indicate the lack of perceived relevance of the term to veterinary professionals. The vets in practice 2 consistently had a different view on their role in giving advice to owners to those in other focus groups. They advocated a paternalistic approach where they clearly stated a treatment plan they felt was best for dog without taking into account any financial considerations or owner wishes. Where owners did not agree with this recommendation, they described a process of bargaining where the vets upheld their responsibility for ensuring the dog’s needs were still met.

You just do what's best for the animal, don't you, and then they can then decide whether or not they can afford that, if they can't you find a cheap alternative. But you have to go best first, don't you? [FG2, vet 4 (partner)]

They discussed the owner-led approach they had seen some recent graduates use, emphasising the negative aspects they perceived it to have on both owners and consequently animal welfare:

I think they don't actually appreciate the practical difficulties their approach will create. It sometimes totally paralyses owners, and they don't know which way to turn, and we've had instances where owners couldn't make any decision whatsoever, and left the animal without treatment because they just thought 'What am I going to do? The vet doesn't know what to give him, or her, and I don't know either.' [FG2, vet 3 (assistant)]

4.3.2 Who's the expert?

Owners

Most owners expected their vet to be the best source of information about canine osteoarthritis, though few recalled having been told much about the disease at the initial diagnosis. Most recalled a paternalistic initial consultation where their dog was prescribed an NSAID with little discussion of the alternatives. Few owners recalled asking questions during this consultation, even though several did not understand what their vet had explained to them. This owner summed up the experience of many:

I think we were just given the tablets, and that was, not quite as bad as that, but that sort of thing. I don't recall any explanation about what it was or anything like that, just getting arthritic and these are the things you need to take... [Mr, Int 18]

A consistent experience for many owners, with the exception of those with a very good relationship with their vet, was after the initial consultation, their vet rarely offered additional treatment suggestions or management advice. Instead, the same treatments were dispensed even if their dog was deteriorating and it was up to owners to make suggestions about alternatives. Some felt it was their job to lead these discussions:

Well, I suppose because I know that symptoms have got a bit worse, so I think I'd be looking to say [at the next re-check] 'Should I be changing her medication?' 'Should I be looking at changing the way we do things?' [Int 10]

For some owners of large breed dogs, the effort of getting the dog to the practice for a re-check did not match the benefit. As a result, several owners preferred to use the annual vaccination consult as a check-up rather than attend osteoarthritis re-checks. A few owners expressed frustration their dog did not even receive a clinical examination during re-check consultations. Several owners had ideas about how these consultations could be improved including vets telling them what might happen to their dog's condition in the future rather than what had occurred since the last examination and better use of nurses, seen by some to have more practical knowledge. Despite this, none of the owners described discussing these ideas with their vets.

Last time I went, must have been about a year ago, but I think I just tell them how much he's deteriorated. There's not a lot else to say. [Int 22]

When their dogs deteriorated and their vets did not make any practical suggestions about what to do next, many owners sought other sources of information. Very few obtained information leaflets about osteoarthritis from their vet or picked them up from the practice waiting room. Instead, most used Google to search for generic advice on dog arthritis with little idea what they were looking for. Whilst some owners talked positively about their experiences of performing their own research on the internet, others found the experience frustrating. Many expressed concern they did not know which websites contained trustworthy information, and several suggested it would be useful if a vet could direct them to trustworthy sites. None recalled this had happened. A few owners had talked to friends with osteoarthritis,

other dog walkers and breeders. More rarely, owners had used Facebook, veterinary publications, textbooks and owner webinars to supplement their knowledge. Interestingly, most owners had received recommendations for non-prescription treatments from friends, family members or even complete strangers they met on a walk; surprisingly often they had then tried that product. Many owners described instances where they had then advised other owners about using these treatments.

And as I said, I've met other people walking their dogs. So yes, there's a general owner swapping of information. Yes, it's made me try Yumove. [Int 4]

Some owners directly extrapolated from their knowledge of human or equine treatments without doing additional research. For a few owners, including some of the vets, their prior knowledge about osteoarthritis acted as a barrier to seeking additional information as they assumed nothing else could be done. Interestingly, very few owners who trusted their vet as an expert performed any additional research. Sadly, these owners were typically the least well informed about the treatments available.

I didn't do a lot in biology, and I don't understand how the body works, I don't understand how a dog's various organs work, and therefore reading something where you're not able to make judgements on which you've got no scientific knowledge to base... it is much more credible for me to go and ask the expert. [Int 12, Mr]

By the time of the interviews, most owners who had done any form of research had concluded their vet was not the expert in osteoarthritis management they had expected them to be. Several talked about finding out about treatment alternatives too late and expressed sadness and frustration that a vet had not alerted them to the possibilities sooner. In some cases, this led to the owners feeling guilty at trusting their vet as the expert.

I said to the vet that we'd been going to just recently, I said "Can she have a physio assessment?" and she said "That's a really good idea, yes, that would..." And I thought 'Why didn't you say before?' instead of just giving us the painkiller? [Int 7]

Veterinary surgeons were thought by most owners to be particularly unhelpful when asked about additional treatments such as nutraceuticals, physiotherapy and hydrotherapy. Many owners were frustrated at just being advised they could try these treatments and see how they got on. Owners who had spent money on ineffective nutraceuticals expressed annoyance they had not received advice from their vet about the likely efficacy of these products. Conversely, owners of dogs that had benefited from these treatments described frustration they had not been recommended. None of these owners described discussing with their vet why these recommendations had not been made at an earlier stage, giving further insight into the relationship many owners had with their vet. Many owners concluded they were disappointed in the information available from their veterinary practice, and they wished they had been given clearer advice about which treatments were likely to be best.

I fear he is past being able to really get any benefit from [hydrotherapy]. But I'm certainly willing to try. But I wish I'd known, or had the thought even put

in my head. And yes, I do feel as if yes, I should have gone [onto the internet] and had a look at dog arthritis. [Int 18, Mrs]

In contrast, few of the vet owners described having performed any additional research specifically about their own dog's disease. Instead they described relying on what they had learnt about the disease at veterinary school or on continuing education courses in the past, even if the last update was several years previously. Several described a fatalistic attitude that they didn't think there would be any additional useful treatment information since they last looked.

No. No, I don't think [I've read about anything]. I think I just, from practice ... also, from how I know my gran managed it and things like that. I've just built on that, haven't really researched or looked into it any further. Why haven't I researched it? I don't know. I guess because I assume there's nothing I can do, so.... [Int 6]

Veterinary professionals

Veterinary surgeons described providing owners with information ranging from explaining the diagnosis to teaching them how to administer medications. Most vets expected owners to have a surprisingly high level of both medical knowledge and practical veterinary skills. Only a few vets reported explaining the pathophysiology of osteoarthritis to owners. This was attributable to a mixture of assumed knowledge and lack of time.

I think it's certainly a word that, as long as you don't put 'osteo' in front of it, that most people are going to have a concept of what it is, that it makes you sore and lame and stiff, and old people get it. So I wouldn't go into any massive detail. [FG5, vet 2 (partner)]

Rarely, vets described printed resources they gave out in a consultation to explain the disease and treatment options. Others, even in the same practice, were unaware of these resources. Simple barriers such as not knowing where to find leaflets, being unaware of what was available and not having the time to leave the consulting room to fetch them were described in several focus groups. A few vets expressed scepticism that owners would bother to read printed materials, emphasising their negative assumptions about some owners. In contrast, the veterinary nurses were aware of, and sympathetic to, owners' lack of knowledge. They described frequent use of leaflets or follow-up telephone calls to supplement their verbal information. Interestingly, nurses felt themselves to be under-used when it came to educating owners about the management of osteoarthritis. Perceived barriers included vets' lack of time, lack of awareness about what veterinary nurses could do, and a difficulty in persuading owners to return to the surgery for a nurse-led appointment once they had seen the vet.

Because they have to have a three-monthly check-up anyway, for their non-steroidals, if they're coming back in three months they'll think 'Well, I can wait for three months.' I don't really want to come in three months and then half-way through see the nurse and then come back to see the vet. [FG4, nurse 3]

Views of owner use of the internet varied between participants. For some vets, the internet just led to owners challenging their clinical decisions with spurious information. These vets appeared to view all canine veterinary health information available on the internet as dangerous and some alluded to questions from owners being disrespectful to their professional knowledge levels. Several gave examples of owners finding websites warning about adverse effects of prescribed drugs which led to subsequent confrontation in the consulting room. Interestingly, some vets were aware they were not trusted as a reliable information source by all owners but none acknowledged owners were looking for information they did not provide. This vet described advising owners to visit websites which would verify the information she had provided.

Sometimes when owners are really keen to Google I will try and find sites that I think are good and know are good. I'm like, "There is a lot of information out there but not all of it is good. I'm going to write this web address down for you; why don't you go and look at this?" And then they feel that they're at least getting someone else saying the same thing when they've found it on the internet so they're happy that that is reliable information.
[FG1, vet 5 (assistant)]

A few examples were provided where vets did not feel they had any information to provide because the evidence base was so poor. For example, all vets were aware the evidence base for nutraceuticals for canine osteoarthritis is inadequate though very few cited sources of this information. As a consequence, few vets felt confident to provide owners with advice on these treatments. Many described advising owners to try nutraceuticals and see how their dog got on, recognising these treatments seemed efficacious in some dogs but not others. This vet was the only one who cited any evidence for the lack of efficacy of nutraceuticals, but despite this his advice to owners was clearly contradictory.

I don't like [nutraceuticals]. Again, Cochrane studies, there's no decent evidence at all on their usage or no benefit proven to them at all. I always say to the owners, "There's no proven benefit. In fact I think there are of no benefit. At the same time I do have osteoarthritis in both my knees due to sport and when my knee is sore I take glucosamine." ((Laughter)) [FG1, vet 1 (partner)]

Newer treatments such as hydrotherapy and acupuncture appeared to be used either by many vets within a practice, or none. Barriers to vets adopting new treatments included a lack of time to learn about them or to discuss the pros and cons as a practice, and scepticism the new treatment would be preferable to an existing one. Conversely, nurses were confident to adopt and recommend alternative treatments, even ones they had only read about on a Facebook group or heard about at trade fairs. Interestingly, nurses did not appear to discuss these treatments with the vets in the practice, but clearly exchanged knowledge regularly with each other; one commented that it was important they gave the same advice. That practice had a hydrotherapy pool but the nurses did not think it was being adequately used for canine osteoarthritis; indeed none of the vets in the focus group described referring owners to the pool. Time was seen as a barrier to teaching others in the practice about hydrotherapy.

Yeah, we need to have a little CPD though, we keep talking about, don't we? It's just getting the time to do it so that people are more confident. Because even in-house, people aren't that confident in actually what and why and when. [FG4, nurse 2]

4.3.3 The decision makers discussion

This theme described different relationships between owners and veterinary professionals and the potential impact these might have on treatment decisions. Owners expressed a preference to form one strong relationship with a single veterinary surgeon that would last the lifetime of their dog. Similar attitudes were expressed by some cattle farmers in the study by Richens (2015), American owners of dogs with life-limiting cancer (Stoewen *et al.*, 2014) and Danish dog owners interviewed by Christiansen *et al.* (2016). Whilst veterinary surgeons agreed continuity of care was preferable, it appeared much easier to achieve in small practices than in large multi-branch ones where the veterinary surgeons might work in several locations. Relationships between owner and veterinary professional appeared to differ in the levels of mutual respect and trust, leading to relationships that might be described on a spectrum from good to bad. Both owners and veterinary surgeons appeared to be able to tell whether their relationship was a good one, often through non-verbal communication, and both veterinary surgeons and owners adjusted their behaviour in the consulting room, perhaps in an effort to build a good relationship. Trust in, and respect from, their veterinary surgeon were identified as being very important by owners of dogs with cancer interviewed by Stoewen *et al.* (2014) and in this study. McKenzie (2014) identified trust built through shared goals to be important to veterinary surgeons when making decisions; that was less evident in these focus groups.

A questionnaire by Mellanby *et al.* (2011) identified UK owners and small animal veterinary surgeons did not completely agree on the attributes associated with “a good veterinarian”. Richens *et al.* (2015) reported the communication style and perceived roles of farm veterinary surgeons were sometimes at odds with what farmers expected. Both problems were also identified in the current study. Veterinary surgeons and owners described withholding their opinions, and some veterinary surgeons described actively withholding treatment options they thought the owner might find unfavourable. The withholding of information by veterinary surgeons was described by Hankin (2009), who considered it might violate the legal obligations of informed consent, and by Batchelor *et al.* (2015) who used this to question the moral reasoning used in clinical decision making. Furthermore, owners interviewed by Christiansen *et al.* (2016), and those in the current study identified that veterinary surgeons delegated many decisions. Veterinary surgeons acknowledged that this was done, even if it risked the owner making a decision that they did not think to be in the dog’s best interests. Perhaps as a consequence, many decisions were described which one partner in that decision did not think was necessarily in the best interest of the dog. However, those decisions did not appear to be challenged in the consulting room in most cases. Some owners described being unlikely to follow recommendations they did not agree with but it seemed most respected and followed the advice of their vet, even if they did not completely agree with that advice. This could have serious negative consequences for the welfare of the dogs involved.

An ethnographic study in a New England veterinary hospital identified that over-involvement with a pet, being excessively demanding and ignorant were attributes of clients seen by veterinary surgeons as problematic (Sanders, 1994). Owners perceived to be poorly educated were identified as a problem by veterinary surgeons in this study. An overestimate of owner knowledge and time pressures were apparently factors in this; both are problems related to the veterinary surgeons rather than owners. Owners in this study and those interviewed by Christiansen *et al.* (2016) explained they needed to be demanding to ensure their dog received the best treatment. This emphasises the importance of veterinary surgeons understanding the perspectives and knowledge levels of owners. Some owners in the current study described taking the lead in re-check consultations. This appeared to be influenced by the owner-veterinary surgeon relationship, the dog's clinical progress and owner awareness of treatment alternatives. Many owners resented paying for re-check consultations they thought were of little benefit, so perhaps their willingness in these circumstances to challenge the veterinary surgeons felt more justified if they perceived they were receiving poor value for money.

Veterinary surgeons did not agree on their role in advocating for the dog, particularly when asked by an owner "*What would you do if it was your dog?*" Discussing euthanasia, Rollin (2011) described this question as an appeal to "*Aesculapian authority*" (p.656) and argued "*to deploy such authority on behalf of an animal to end suffering is...not only permissible, but also obligatory*" (p.656). In the same essay, Rollin acknowledges medical paternalism has been replaced in veterinary education with shared decision making. Some veterinary surgeons in the current study thought the model of shared decision making they were taught advised owners must be allowed to make all decisions unless welfare was clearly threatened; their understanding of where this intervention point lay was regrettably not directly addressed. Others felt the evidence base was not adequate to guide owners, though few referred to any use of evidence in their decision making; factors underlying this were discussed in chapter 1.

In contrast, veterinary surgeons in one practice felt it was their duty to advocate for the dog, even if the owners might not agree with their advice. This suggested a practice culture may exist around consultation styles. An alternative perspective is presented in the beautiful essay by Guglani (2016). He describes how doctors may need to emotionally isolate themselves from their patients in order to cope with their job. The same may be true for veterinary surgeons, particularly considering their role in euthanasia. Perhaps considering that dogs have the capacity to feel emotions just makes the job too difficult; this may be a reason for veterinary surgeons to avoid thinking about "*what if it was your dog?*" Owners who trusted their veterinary surgeon described responses to this question led to valuable, trustworthy advice. It was evident many owners in this study and that by Christiansen *et al.* (2016) wanted their veterinary surgeon to advocate for the best possible treatment for their dog, but the current study suggests that barriers to this may exist that should be explored further.

Most owners described performing their own research to supplement the information provided by their veterinary surgeon, but had limited success in finding relevant, reliable information. Good quality online information is available for owners about feline health conditions through sources such as International Cat Care (2015) but similar centralised resources do not exist for canine diseases. Studies assessing the information available for dog owners on the internet (Jehn *et al.*, 2003, Hofmeister *et*

al., 2008, Taggart *et al.*, 2010, Kuhl, 2014) have all found it to be of highly variable quality. Given the time pressures and risks of poor exchange of information in veterinary consultations described in this study, a reliable, centralised and evidence-based internet-based information source for owners about canine health and welfare would appear to be much needed.

Veterinary nurses were positive about both owners and their own ability to influence owner behaviour. Similarly, owners who had interacted with veterinary nurses generally felt these interactions had been positive. Several owners commented they felt veterinary nurses could be given a greater role in canine osteoarthritis and some nurses felt they were undervalued in the practice. A qualitative study conducted in Canada by Moore *et al.* (2015) found registered veterinary technicians (the equivalent of veterinary nurses), also felt undervalued by some veterinary surgeons and Kinnison *et al.* (2014) suggested the lack of inter-professional education could be a cause. The relationships between owners and veterinary nurses and the role of the nurse in canine osteoarthritis warrant further research.

Veterinary surgeon owners described finding it hard to be objective when considering the health of their own dogs. However, they did not describe routine use of other veterinary professionals for advice or consistently ensuring that they were up-to-date when deciding on treatments for their own dog. This might pose a threat to the welfare of those dogs. . The challenges for doctors associated with the treatment of their own family members have been described (Chen *et al.*, 2001, Fromme *et al.*, 2008) and specific guidance on this has been issued by the General Medical Council (2013) which advises doctors to “*avoid providing medical care to anyone with whom they have a close relationship*”. Whilst the current study included only 4 veterinary surgeons, a case of a veterinary surgeon who neglected her own dogs was recently heard by the Royal College of Veterinary Surgeons disciplinary committee (Royal College of Veterinary Surgeons, 2016) so this does appear to be a risk. Practical guidance may be required for veterinary surgeons around the treatment of their own pets.

4.4 Theme 3: Matching treatments and outcomes

Almost all owners accepted their dog had a progressive, painful and incurable disease. However, fundamentally, very few had any idea, even at the time of the interview, what their dog's trajectory of decline might look like, which behaviours they should be monitoring to determine treatment success or which treatments might be effective. This lack of knowledge appeared to have a profound effect on the decision making process throughout the course of the dog's disease. The decisions related to treatment were complicated, multi-factorial and frequently highly individual to a single dog-owner-veterinary surgeon triad. The description below attempts to simplify this complexity into three subthemes but in reality, decisions were rarely this linear. The perspectives of veterinary surgeon owners are integrated with those of other owners in this theme as their responses were very similar; they assessed outcomes and considered euthanasia in their own dogs in the same way as other owners.

4.4.1 Outcome assessments

Owners

Section 4.2.3 identified that few owners recalled having been advised what osteoarthritis might mean for their dog. Similarly, few recalled being given any strategy for monitoring their dog's response to treatment. Instead, almost all owners, including the vets, had chosen a set of behaviours to monitor that they hoped were relevant; very few had ever discussed these with a vet. The behaviours monitored were common to almost all owners. Willingness to get out of bed, excitement when the lead was produced, stiffness when walking, interest in food, demeanour, walk speed and body language were commonly listed, often being collectively monitored by all members of a household each day. Mobility first thing in the morning was perceived to be particularly useful by many owners to determine how their dog was feeling. As an example of the detail of this monitoring, this owner of a giant Schnauzer watched her whenever she went to her bed.

Sometimes when she's getting down she'll circle several times as though she's trying to pluck up the courage to drop down. And sometimes she does it like that, she gets fed up, and then just goes straight down. [Int 13]

Owners used these behaviours to determine whether a treatment strategy was helping, and used them to answer the question "*How is he/she doing?*" posed by vets in re-check examinations. However, very few appeared confident in exactly what these behaviours told them. Most owners reported, independent of treatment, their dogs' had a mix of "good" and "bad" days with changes daily, weekly or seasonally, and not always in a negative direction; good days could follow really bad ones. Whilst some owners were keen for their dog to maintain a normal routine on a bad day, others described letting the dog take the lead. On a bad day, dogs were less keen to exercise, would go less far on a walk or walk with more reluctance, and rarely were more aggressive to other dogs. Some owners were able to recognise potential influences on this pattern, with cold weather leading to bad days for many, and warmer weather being positive for some but not all dogs. Bad days seemed easy for

an individual owner to recognise in their own dog but hard to describe, suggesting very subtle behavioural cues were used, often focused on demeanour.

I don't think a dog gets fed up as such, but the human word I would use is fed up ((sighs)). You know, that kind of general dour attitude. 'It's just not a good day.' [Int 11]

In parallel, most owners had, at some point since their dog's diagnosis, identified broad outcomes they thought were important. These included happiness or quality of life, being pain-free and remaining mobile. Whilst some owners used the terms independently, others described being happy and pain free as aspects of quality of life. Interestingly, owners with direct human experience of osteoarthritis were often less worried the impact of pain. Others sought insights from friends and family with osteoarthritis.

Well, I've got a lot of friends who've got it. I've not got it, and me mum's not got it, so I can't really understand what it feels like, but they say all about the good days and the bad days, and things. I'm trying to ask them. 'How are you?' 'Is it painful, or is it just a nuisance?' To try and see what's happening with her. [Int 7]

None of the participants recalled discussing with a veterinary professional what quality of life or happiness might mean to their dog, how it could be recognised or achieved. Each owner, including the vets, had created a definition of what they thought quality of life or happiness might mean. Definitions varied widely; some were very broad, others specific to a couple of behaviours. None were consistent with the medical concept of quality of life being an individual's satisfaction with their life in relation to alternatives; many focused just on physical health.

I think all the while she can potter around and get herself to the toilet independently, then that's her quality of life. If at some point she can't get herself to the toilet, I would be thinking, particularly if we then couldn't manage what the support she needed to do it within the framework of work etcetera, then I would say her quality of life had gone down if she ends up wetting her bed, or messing her bed or anything like that. [Int 10]

Unfortunately, most owners' confidence in their ability to assess their dog's happiness or quality of life was poor. In contrast, interviewees 20 and 21 were close friends who had both spent a long time educating themselves about dog behaviour and Tellington Touch methods of dog training following their dogs' diagnoses. They discussed at length the need to recognise and facilitate breed-specific motivated behaviours and were fairly confident they could tell whether their dogs were happy. Both were critical of vets' focus on physical health outcomes, contrasting this with their approach.

I'm trying to balance the welfare and the psychological needs with the physical. And that's a very fine line to tread sometimes. Because vets can be very much physical. It's just about physical rehab or physical needs. And a lot of vets don't talk about their psychological needs. And for them that's just as important as it is physically... A lot of vets in the past have never talked about her emotional state. [Int 21]

Ageing was problematic to owners of older dogs. Behaviour changes, ranging from reduced walk speed to being quieter than normal, were discussed as being related to either pain or old age, depending on the owner; many were just not sure.

I noticed at Christmas time, just overnight one day, the next day I woke up and I thought 'Oh, you're looking tired today pal.' And she was. She's slowed down ever since then ... And I'd noticed it overnight sort of thing. But she's picked up again with the Tramadol and stuff, she's picking up again. I don't know if it's just her getting a bit older. [Int 26]

Almost all owners, including all the vets, found it incredibly challenging to determine whether their dog was in pain. For example, where two owners of the same dog were interviewed, there was often debate about whether stiffness was related to pain; most owners hoped it wasn't pain because their dogs were frequently stiff. Owners did not describe being taught by their vet how to recognise pain, or using any resources to learn how to identify chronic pain behaviours. Many thought their dog experienced pain on a daily basis, but some dogs were described as very stoical. One of the vets described the difficulty in recognising pain in her stoical dog.

I swear you could stick a knife in him, he probably wouldn't move. So it is difficult. I find him very difficult to judge if he is in pain or not. The only thing that sometimes gives me a clue is if he's a bit slow at getting out of his bed in the morning, and that kind of thing. You think 'Oh, I wonder if that's the painfulness. [Int 1]

Vocalisation was apparently very rare, even in dogs thought by their owners to be in severe pain. Whilst almost all owners were aware dogs with osteoarthritis did not make a sound every time they were in pain, one owner was confident her dog did not require any analgesia because she did not vocalise.

And she's not in any pain, well, not that we know of. She does that [dog falls sideways into lateral recumbency on the carpet next to her owner, apparently unable to bend her legs] but then to me that's because she's older. There's no noise coming from her. She doesn't come over like she's in pain. [Int 28]

The negative welfare impacts of this incorrect knowledge are evident. Very few owners knew either how treatments prescribed for their dog related to their identified outcomes of interest or whether they were helping. Most described progressive desperation as serial treatments appeared to make little difference to the behaviours they could monitor. Many thought the assessment of treatment efficacy was the responsibility of the vet, but it did not seem to be happening in re-check consultations. At the time of the interviews, very few owners thought their dogs were pain free or had good mobility; most had accepted that this was to be expected because their vet had not told them any different. Others weren't sure anyone could really tell which treatments were working:

I think the only way to tell whether medication's working is to see the dog moving around over a period of time. And that's something that only we can do. So there are times when I'm not sure whether he's better or worse, or whether something is helping. But I'm not sure that the vets would have been able to help any more with that. I think that's an owner thing. [Int 4]

Veterinary professionals

Specific treatment outcomes were not articulated by any participants. Instead, it appeared having a dog on any treatment was a success and poor treatment efficacy after the initial period was accepted. Perhaps as a consequence of fatalism, only broad, long term treatment goals were discussed in focus groups. Many vets described a successful treatment as one that led to an improvement in the dog's physical activity ability at home that could be recognised by the owner. They acknowledged that they struggled to determine the success of a treatment when owner-reported improvement was unclear. Only a few vets thought it was hard for owners to recognise chronic pain; others thought that owners could recognise pain but perhaps chose not to see it. Several discussed challenges of subjective and potentially inaccurate owner assessments, describing instances where they did not trust an owner's account. However, vets' own assessments of treatment success were often limited. Some described performing a full clinical examination including assessment of the range of motion of joints or walking the dog outside to assess its gait but many said they didn't have the time for this. Most conceded there was little point in performing these tests because their interpretation of the results would not necessarily concur with the owner's report, and that had to take precedent.

Several vets made reference to a population of dogs whose osteoarthritis was not painful; the impact of stoicism on pain assessment was mentioned by only a few vets. Very few vets appeared to consider owner reports of demeanour improvements significant unless mobility had also improved.

I find it very difficult because quite often they'll be doing better, the client will say, "Oh yeah, they're doing better." But if you do examine them they'll still yelp. ((Laughter)) Quite often I will not examine them. [FG1, vet 1 (partner)]

There was no consistency either within or between practices about which measurements were assessed by vets or how these were recorded. The lameness evaluation system used appeared dependent on what each individual had been taught in veterinary school or on a course. In addition, several vets described modifying their favoured scale over time.

I find that if I'm doing a lameness scale, it's more for my benefit than anyone else's. Obviously one is hardly lame and nine or ten is severely lame. But the ones in the middle I'd say were more for my benefit, to know that what I thought it was on previous exam, and then you can then refer back to it, because obviously you don't necessarily remember each individual animal. [FG3, vet 6 (assistant)]

As a result, vets seeing a dog for the first time were often unable to interpret their colleagues' notes, so were completely reliant on the owner's opinion of treatment success. Many agreed continuity of care was important for this reason. Two practices had trialled a paper-based owner questionnaire provided by a pharmaceutical company to monitor treatment success. All had concluded the administration was challenging and they did not have time to discuss the findings. None were using a questionnaire and none planned to do so at the time of the focus groups. One practice

owner felt they did not even have time to discuss the implementation of questionnaires within their practice, let alone use them.

You have these talks and you try to implement things, and you never actually... Just, life takes over, and practice takes over. You have these good ideas and they don't actually happen. [FG2, vet 2 (partner)]

Interestingly, the veterinary nurses were not aware of these questionnaires but they expressed great interest in using them in the future. In their mobility clinics, they combined a clinical examination with questions about specific activities the owner had reported the dog to struggle with during the previous consultation. Some nurses described using a tape measure to record changes in limb muscle mass, an approach not mentioned by any of the vets. Several felt using things the owner could clearly recognise was helpful but they were aware assessing change was difficult for some owners.

We see differences that owners won't see. Because they see them every day, and especially the weight clinics, they walk in and sometimes you can't believe what they look like. And I suppose in arthritis we might see the same thing, like walking into the consulting room differently. And because they see them every day, they might not actually have seen that difference in them. [FG4, nurse 2]

Vets and nurses recognised quality of life to be an important outcome both to the dog and their owner. A few vets reported routinely discussing quality of life with owners at the time of diagnosis though it was unclear whether any definition of the concept was explored. None of the vets or nurses defined what they meant by quality of life or described using any form of tool or instrument to assess it but it appeared that quality of life in osteoarthritis was thought mainly to relate to mobility. When discussing specific case examples, some participants thought the constituents of a good quality of life in general might be breed-specific but it was not clear how they related this to dogs with osteoarthritis. It was apparent some vets thought a few owners had defined quality of life related their own lifestyle rather their dog's.

- Vet 2 *And I find some of them, even though this animal is...*
Vet 1 *Can't walk.*
Vet 2 *Can barely walk, they seem somewhat reluctant to try anything else as well.*
Vet 1 *Whether in their head they're appeasing their guilt, or whatever... Because 'It's on treatment, it's fine.'* [FG 5]

4.4.2 Making treatment decisions

Owners

Following diagnosis of osteoarthritis, NSAID treatment was typically instigated by the vet. Most owners noticed a clear improvement in their dog's demeanour and mobility within a short time after initiating NSAIDs. Some related these changes to their dog being in less pain, others hoped it was a long-term cure. The owner of a border collie described an initial response to treatment common to many dogs.

Actually, when she got the Loxicom, she was like a pup again... Jumping about and trying to run outside. [Int 28]

Sadly, almost all owners described their dog's response to this initial treatment gradually diminished and the same level of improvement had never been achieved again. A few dogs had shown an acute deterioration after a long period of having no apparent clinical signs on the first NSAID prescribed. However, the long course of the disease made it difficult for many owners to be sure whether the dog was doing as well as previously. Very few owners kept any record of their dog's condition, though several commented it would probably have been very useful. Most struggled to recall how much their dog had deteriorated.

You see, her [magnetic] collar made a big difference to her at first, and she wears it most of the time. And I think 'Well, is it still giving her the same benefit as it did at first?' [Int 7]

Many owners described either asking their vet for new treatments when they felt existing ones were no longer working or taking decisions into their own hands. Several described a perpetual search for a treatment that would return their dog "back to normal".

I was always looking for her to come back to the point where it had started. Could never get into my head that actually it was never going to be like that. [Int 15, Mrs]

A few owners accepted deterioration as an inevitable part of either the disease process or old age and did not do anything to try to halt the decline. Others gave up hope after a period of time using treatments that did not have much perceptible impact. This owner of a German shepherd with advanced osteoarthritis described her attitude to exploring additional treatments.

I don't think there's a lot of point to be honest....If it had been a while ago, and I felt there was something that could be done, but I now feel that it's just waiting for God. [Int 22]

Many owners performed their own research about treatment alternatives but few described a clear understanding of treatments' mechanisms of action. Owners described NSAIDs and other prescription analgesics as "pain relief"; very few talked about their role in improving mobility and rarely, some thought they were just masking the problem and should be avoided. Nutraceuticals were associated with joint repair or analgesia; several owners described this understanding to have come from human healthcare.

When [glucosamine] first burst onto the scene from the Daily Mail story, this wonderful long-distance runner who's miracle cure... So I started taking them because on long walks and runs and things, I used to do a bit of cross country running and things like that, I just got sore joints afterwards. So I started taking that. So I was again aware that how the joints work and this sort of thing. So I just adopted that for the dog as being 'It's not going to do any harm and potentially might do some good'. [Int 11]

The risks of treatments versus the benefits appeared to be an important consideration when owners were making treatment decisions. The ideal treatment or management strategy was one combining maximum efficacy with zero risk of harm through adverse events. Some owners traded the benefits against the risks of treatment; safe treatments were always worth trying whereas treatments associated with risk were only used by some owners.

[I'll] try anything as long as it's not going to injure the dog or hurt the dog's tummy or anything digestive. Why not try it? [Int 2]

Owners attributed different amounts of potential harm to the same treatment depending on their awareness and perceptions of risk. Risk awareness came from personal experience, vets, nurses, pharmacists, friends, family and the internet. Some owners were aware of risks associated with specific treatments before their prescription. Nutraceuticals, massage, heat pads, acupuncture, magnetic collars and homeopathy were typically associated with no risk so owners were generally happy to try them without obtaining veterinary advice. Some owners associated hydrotherapy with no risk, whilst others thought there was a possibility it could make their dog stiffer. Conversely, several believed NSAIDs given at full dose would shorten their dog's life through hepatic, renal or gastrointestinal damage. Some questioned their vet's judgement in prescribing such harmful treatments; for a few, the risk associated with NSAIDs was so great they elected to treat their dog only with supplements or hydrotherapy. However, most owners recognised NSAIDs were effective so adopted strategies they hoped would minimise the risks whilst maintain some efficacy. These were typically reduced dose or reduced frequency of dosing combined with regular blood tests. Rarely, owners acknowledged they would rather their dog be in pain than risk them having an adverse event. Conversely, a few considered quality of life more important than quantity, again emphasising the belief that NSAIDs would shorten lifespan.

So as far as I'm concerned, if he's comfortable I'd rather him be comfortable, and die of liver failure at the age of ten than be in pain but live 'til twelve. [Int 20]

The only treatments reported to have caused adverse events were NSAIDs, tramadol and nutraceuticals. No specific NSAID appeared to be associated with more or less adverse events; some dogs were reported to have had adverse events on several NSAIDs though this was unusual. Typically, owners reported short-term haemorrhagic gastroenteritis that abated when the drug was withdrawn. The decision about what to do after an adverse event appeared was usually made by the vet though a few owners had been insistent their dog did not receive further NSAIDs. Some dogs had gone back onto the same NSAID at a reduced dose with or without a gastroprotectant; some had been switched to a different NSAID or an alternative analgesic such as tramadol; and a few had had analgesia withdrawn altogether.

So we started him on Metacam. And, that seemed to be quite good, and he was fine with that up until last year. And then he was sick with blood through it. And he was just really, really ill. [...] So what they said was that he's probably got a bleeding ulcer. [...] So he's not on any medication for his pain now because the Metacam caused that. [Int 29]

For many of the owners whose dog had been prescribed tramadol, the negative effect of the sedation caused by the drug exceeded any analgesic benefit. Most had therefore stopped using the treatment, or were using it only occasionally. Most had not discussed this with their vet. Whilst treatments associated with adverse events might be withdrawn even if efficacious, those thought by an owner to be safe were sometimes continued in the absence of any apparent efficacy just in case they were doing something. Nutraceuticals were commonly mentioned in this context despite their high cost; some owners thought they had helped their dog but most were unsure.

[Vet's name] said it's pretty much the same as when doctors prescribe glucosamine and things, some people swear by it and say 'Yes, it's been the answer to all...' and other people say no difference. But we kept her on them, and again, I don't know whether it's made any difference. [Int 23]

Some owners thought exercise could lead to harm through increased pain. In contrast, others thought walks improved mobility and a few thought this might mean the dog was less painful. Some owners did not allow off lead exercise at all in case the dog hurt themselves, others allowed their dog to chase squirrels and many permitted limited free running. Many owners, including the vets, found making a decision about how to exercise their dog very difficult; often their decision reflected their perception of quality of life and their understanding of their dog's capacity to understand the future.

What's the worst quality of life for him? A bit of uncomfortableness on the way home on his walk, or not going on the walk? And I feel for him. You know, they live for the moment, don't they, so actually, what he wants is to go on the walk. But, yeah, it's difficult. [Int 1]

Veterinary professionals

Veterinary professionals described experience with a wide range of treatment and management options for osteoarthritis; vets talked only about strategies targeting physical health with none discussing the impacts of the disease or its management on dogs' mental health or breed-specific needs. Very few discussed any environmental modifications. Treatment choices were very rarely related to outcomes. Instead, each individual seemed to have preferred treatment combinations based on their own experiences of efficacy, safety, the experience of colleagues, which treatments were available in the practice, and information from continuing education courses and drug representatives. Younger vets and nurses appeared keener to try new treatments whilst some of the older vets preferred to stick with what they knew.

A lot of products coming up and they've been touted as the best thing since sliced bread. And when it comes down to it they don't actually quite live up to expectations, and they're suddenly then found after six months or twelve months that yes, there have been more side effects than was originally anticipated. And we have the tendency to fall back on the tried and tested when we know what sort of side effects to expect. [FG 2, vet 2 (partner)]

These preferences were then adapted to fit the requirements of the owner and the dog on an individual basis; the commonest response to any question about treatment

choice was “*It depends*”. Different consultation styles appeared to have a big impact on how much the vet fitted their ideal treatment to the owner’s wishes.

I think that, obviously, if the dog's obviously lame, and it looks sore with it, or it really struggles and takes a few seconds to get up that then we're going to push the NSAIDs more. But if it seems more of a less severe issue, that then we will try the supplements, weight management, things like that to start with. But, again, some owners think supplements are a waste of time, why would you bother trying those? And then also I think it's influenced by the owners' feelings. [FG3, vet 6 (assistant)]

NSAIDs were the only treatment all participants agreed to be initially effective in most cases. Specific NSAIDs were not identified as having greater efficacy than others. The perceived efficacy of other treatments varied widely between individuals. Interestingly, it seemed to be accepted by many vets that dogs would continue to feel pain even with NSAIDs; none described having a treatment objective of eliminating all pain.

I sometimes find that pain response is sometimes quite useful, because although they perceive they're doing better to say to people, “They're still sore so you do need to still keep them on this pain relief, the pain relief still needs to continue because he's still obviously sore. But his quality of life has improved significantly” [FG1, vet 6 (assistant)]

The use of adjunctive analgesics such as tramadol or amantadine appeared very inconsistent and several vets suggested it was owner-led. All vets and nurses expressed concern about the safety of NSAIDs, particularly hepatic and renal adverse events. However, haemorrhagic gastroenteritis was the only NSAID-related adverse event any participant recalled. Some vets believed using NSAIDs long term would shorten a dog’s life. The mechanism by which this would occur was not specified and others were unsure if this was true; there were no vocal advocates that this was not correct in any focus group where it was discussed. Interestingly, vets associated most adverse events with poor owner compliance, citing examples of incorrect dosing, administration without food or continued administration to an ill dog. Frequency estimates for haemorrhagic gastroenteritis associated with NSAIDs varied widely between practices. Vets in focus group 1 thought the frequency was about 1 per 40 prescriptions; participants from other practices gave much lower estimates. Many vets were aware of challenges recognising a true adverse event.

I think sometimes we're attributing [gastrointestinal] signs to the non-steroidals and they're probably not purely caused by non-steroidals. The number of animals that we see with [gastrointestinal] upsets, which look like non-steroidal side effects, where they haven't taken any, is probably bigger than the ones we see that do. So, but obviously you have to err on the side of caution, you have to assume it is the medication that could cause the side effects... [FG 2, vet 3 (assistant)]

Concern about NSAID safety impacted their use. Based on their experiences of adverse events in dogs receiving NSAIDs during routine surgery, some nurses described never advocating their use in osteoarthritis. Several vets described some NSAIDs as being “safer” than others; cimicoxib, firocoxib and robenacoxib were typically mentioned in this context. Strategies to reduce risk were used by almost all

vets. These included frequent monitoring of hepatic and renal parameters with blood tests, dose reduction, frequency reduction, use of a “safer” NSAID and use of alternative analgesics such as tramadol. Members of the same practice described different levels of caution with the same drug. Decisions about when to use which drug frequently appeared subjective, particularly regarding what to do when adverse events occurred.

... if [gastroenteritis] came on almost instantaneously, within days of starting carprofen, and the animal was really ill, then I would be really 'Maybe we can't really use non-steroidals with this.' But if on the other hand it came on after a few weeks, and it wasn't particularly bad, then yeah, take it off the carprofen for a while, give it a wash-out period, get his tummy back to being normal and then try on Previcox or Cimalgex. [FG2, vet 2 (partner)]

A few vets discussed the challenges of determining the benefit of their adverse event monitoring strategies. In the following extract, a vet talks about the evidence base for using blood monitoring of hepatic and renal parameters in dogs treated with NSAIDs. This was a part of a heated debate on the topic in this focus group which highlighted the diversity of behaviour within a single practice.

Personally I think it's the right thing to do the bloods, and I do do the bloods, but whether or not we do it for the right reasons or whether or not there's much evidence that it's actually necessary – I think this is where there is a lack of knowledge around it. I totally recommend people do do them and I do them longer term; but often it's not going to change what I do. [FG1, vet 2 (partner)]

Many vets described pressure from owners to modify the dose of NSAIDs, to use therapeutic monitoring and to prescribe alternative treatments. It appeared most vets agreed with their owners' wishes but interestingly, they expressed concern and frustration about owners taking these decisions into their own hands. This was in sharp contrast to their attitude to other treatments such as nutraceuticals where vets were typically happy for owners to modify doses. The veterinary nurses discussed why owners might want to take this course of action:

... a lot of people don't recognise pain in animals, and that's why they think 'Well, he's not that painful, because yesterday he went for a walk and he was fine.' But, a lot of people have heard of their pets being put to sleep because they went into kidney failure. [FG4, nurse 2]

The nurses discussed the choice owners had to make between quality and quantity of life when using NSAIDs, particularly where a dog had an existing comorbidity. Most said they did not feel comfortable discussing these decisions with owners. In contrast, weight loss, exercise reduction and nutraceuticals did not appear to be associated with any risk by vets or nurses. Several vets described advocating weight loss as one of the mainstays of treatment for osteoarthritis because of their belief in its efficacy. However, many found it challenging to get owners to take action.

It can be a case of isn't there much point going on about this because there's no hope in hell that they're actually going to get the weight off the dog. But you can judge if a client is actually switched on: they realise that if the dog is carrying just a few extra kilograms if they get that weight off a young dog

then their symptoms can just suddenly disappear. And it does work; it's proven to work. [FG1, vet 2 (partner)]

Attitudes to allowing dogs to exercise and play varied. Some participants felt dogs should be allowed to do whatever they wanted and analgesia should be tailored to allow this for an optimal quality of life. Others thought exercise was fine in only moderation in case it led to too much pain. It was unclear how much advice most vets gave owners regarding exercise. Several veterinary nurses recommended the dog receive consistent exercise each day, though it was clear they were not sure whether this was correct.

I, whether right or wrong, I just always say try and pick a length of walk that you can do in the week, not just a nice walk at the weekend, and try and have it that its regular exercise every day rather than massive hikes and then twenty minutes on a lead. [FG4, nurse 3]

4.4.3 Euthanasia discussions

Owner

By the time of the interviews, some owners had tried a huge range of treatments with varying success whilst others had just used a single treatment recommended by their vet. Most owners had realised with great sadness their dog might need to be euthanased as a consequence of their osteoarthritis. Some described thinking about having to make this decision on a very regular basis. Many discussed the decision in terms of quality of life or a level of mobility or pain that might be “*unacceptable*”, and a few described not wanting their dog to suffer. What was acceptable frequently appeared to relate to what other people including family, friends, other dog walkers or their vet might think about their decision rather than exclusively to the dog’s welfare. Most owners, including the vets, expressed concern they might not know how to identify the right time. Many described trying to work out which behaviours they might need to use to identify the point at which to euthanase their dog. Most had no previous experience of managing a dog with osteoarthritis so few were confident they could be sure what their dog’s final deterioration might look like.

And I think that if she had some other medical condition that you knew, well, she's in too much pain, or she can't deal with this, 'Right, this is the end.' It's much easier than something like arthritis that's slippery slope. And, well, how do we know? We don't know. [Int 15, Mrs]

Owners thought their dog might not be able to squat to pass faeces or urine, would stop eating, would no longer be able to walk or would show clear signs of unbearable pain. Rarely, owners thought major organ failure due to NSAID treatment might be the cause of death. A couple expressed hope that one morning they would get up and find their dog dead so they did not have to make a decision. Several owners described previous episodes when they thought their dog had been approaching their final days, only for them to suddenly get much better. The unanticipated problems that might create are described by this vet.

And I know it's not good for him, but I thought he was going to die, so I really wanted to spoil him, and give him some nice treats and bits of bacon rind and

things. And I've had to stop doing it again because he put on a kilo-and-a-half of weight. And he's not dead yet, so... Poor boy! So he's back on a diet at the moment much to his disgust. [Int 1]

Few owners described any discussions with their vet about how they might make the decision to euthanase their dog. Several said they would wait until their vet mentioned euthanasia to be sure it was an acceptable option. Many felt it was the responsibility of a vet to advise owners when they thought a dog should be euthanased, particularly if they recognised any evidence of suffering. Owners with a good relationship with their vet said they would trust them to advise when the right time had come if they were unsure themselves. Rarely, owners with a poor relationship with their vet expressed concern at discussing their dog's deterioration in case they were advised the dog should be euthanased when they were not ready. Many owners, including the vets, were aware they might not be very objective when it came to making euthanasia decisions.

You can be blind because of loving them so much, so I think you need a bit of help when things get really hard. [Int 16]

Most owners were hopeful these decisions were a long way in the future. Many expressed ongoing confidence that when their dog deteriorated further, another treatment would improve their condition, though this optimism was not shared by all owners. Interestingly, many had an idea in mind about the age to which their dog might live, though few were sure where this had come from. This number was used to determine when owners had started thinking of their dog as "old", to guess how much longer their dog might live for and to determine whether the disease or its treatment had reduced their dog's lifespan.

It's terrible, and I know you shouldn't compare, but you do. The Greyhound Awareness League, they always post pictures of dogs that have died, and they'll have the dates and stuff, and I always go 'How old are they?' [Int 32]

For owners whose dogs' clinical condition was deteriorating at the time of the interview, discussions about euthanasia were often upsetting as they imagined a future without their dog. Interestingly, this appeared to be particularly acute for the veterinary surgeon owners who described a very strong emotional bond with their dog; their veterinary knowledge led them to dread having to make the decision. Other owners could not face making a decision at all. The owner of a very severely affected border collie had inherited her dog from her mother and felt it was her duty to keep the dog alive as long as possible. She described she would feel guilty euthanizing the dog too soon, instead hoping her dog would die in her sleep so she would not have to be responsible for the decision:

The only thing I hope is that when I wake up one morning, or she passes when asleep. I don't want to make a decision. That's the only thing. I don't want to do that, but if I have to do it I have to do it. It's a family thing, but obviously I'm the main one that's got to make a decision. [Int 28]

Veterinary professionals

Many examples were given of owners who had not accepted treatment for their dog's osteoarthritis. This was perceived by some vets to lead to premature euthanasia

through severely diminished mobility or, more rarely, aggression. Anecdotes discussed included dogs presented for euthanasia because they could no longer stand and were passing faeces in their bed. A couple of examples were given of owners who had already paid for euthanasia before the consultation leaving the vet with no option but to comply, even if they didn't agree. Most agreed that when an owner had booked their dog in for euthanasia, there was little point in trying to persuade them to try treatment. Discussions often inferred the owner had noticed a problem but ignored it until it had a negative impact on their own life, at which point euthanasia was sought:

Vet 3: *And I think that is what a lot of people find really difficult, is coming down and having to clear up dog poo every morning. And I think that's the point where a lot of people decide...*

Vet 1: *And they care more about that than the dog's pain.*

Vet 2: *Yes.* [FG5]

Several participants suggested money was an important component in the owners' decision to avoid treatment. The veterinary nurses and a couple of vets identified that fear the vet would recommend euthanasia was a major barrier to older dogs being presented at an earlier stage. A nurse drew on her personal experience to illustrate the point.

When my dad's dog got ill, she went off her back legs, and he did not take her to the vets. I wasn't a nurse at the time, but he left her for so long until basically he was carrying around to go to the toilet, and then had to euthanase her. Because he was so scared that the vet would, you know, just say 'It's just a sign of old age.' That's what most people think that there's nothing you can do. [FG4, nurse 2]

Vets appeared to advise euthanasia of dogs with osteoarthritis receiving treatment at the point they became unable to stand. Several agreed at this stage, the dogs were usually of a sufficient age that the owner would be "accepting of it"; these owners appeared to be seen in a better light than those who had not treated their dogs. Some vets were unsure whether owners would have considered osteoarthritis to be disease which would limit their dog's lifespan.

Yeah, so it is a bit difficult, because you can't put your granny down if she can't get up. But yes, it's... Whereas if we've told them that the dog had cancer, I think that would probably make them think more about life-limiting... [FG5, vet 2 (partner)]

Some vets appeared uncomfortable at the prospect of talking to owners about euthanasia if the owner had not raised the subject. A few vets discussed the importance of introducing euthanasia as a concept to owners when the dog started to deteriorate but this was not widely discussed. The importance of emphasising the disease could not be cured was clear.

If the dog's already struggling, and it's only going to start struggling more towards a point where then it can't get up, and it's urinating and defecating all over itself, you're saying 'Right, we can stop it before it gets

to this stage.', again, I just think then they're more accepting of when the time does come. If they know that there's no way out of this, there's not a cure. [FG 3, vet 3 (assistant)]

In contrast, the veterinary nurses reported they did not feel confident talking about disease progression with owners and would advise them to see a vet if they asked about prognosis. None of the participants in any focus group directly addressed the difficulty owners might have in assessing when the time was right to euthanase their dog, or their own role in actively helping owners to make the decision. No vet or nurse in any focus group mentioned the Animal Welfare Act (2006) or any definition of welfare or suffering.

4.4.4 Matching treatments and outcomes discussion

The impact of the relationship between owner and veterinary professional on decision making was discussed in 4.3.3. This theme identified additional challenges associated with making treatment decisions and assessing outcomes. Outcomes of interest and treatment aims did not appear to be discussed during many consultations. Outcomes of interest to owners were pain, happiness, quality of life and length of life; conflicts between the latter two were evident. All aspects of outcome assessment and decision making described by owners in this study bear striking resemblance to the results of interviews reported by Brown (2014a), Christiansen *et al.* (2013) and Christiansen *et al.* (2016). In all four studies, owners found it difficult to assess these important outcomes but monitored a range of behaviours in the hope that these reflected the outcome of interest. Many owners in this study recognised that their dog's condition waxed and waned over time giving rise to what were often identified as "good" and "bad" days over a short period of time. This added an additional challenge to owners attempting to decide whether a specific treatment was effective and made it difficult to summarise in a re-check consultation how their dog was doing. Owners in this study and those interviewed by Stoewen *et al.* (2014) and Christiansen *et al.* (2016) identified a clear role for veterinary surgeons in helping owners to assess important outcomes. However, many veterinary surgeons in the current study identified challenges with assessing osteoarthritic dogs, and many heavily relied on owner report as they felt their own examinations were not helpful. Confounding impacts of the practice environment on dogs' behaviour identified by Dawson *et al.* (2016) may justify this but this means alternative strategies are needed to assist owners with their decision making.

Yeates and Main (2011b) reported 19% of veterinary surgeons responding to a survey thought they saw dogs in chronic pain most days with 30% identifying cases most weeks. The veterinary surgeons in the current study also identified this was a frequent problem. Veterinary surgeons receive little training in canine behaviour or applied welfare unless they pursue further study in these subjects (Roshier and McBride, 2012, Ballantyne and Buller, 2015); this may have an impact on clinical assessments reliant on behaviour to assess welfare outcomes. Despite acknowledging their own difficulty in recognising these outcomes, veterinary surgeons involved in this study did not appear aware of the challenges some owners also faced in making these assessments.

None of the owners or veterinary professionals said they were using any validated outcome measures for canine osteoarthritis assessment identified in Chapter 2; several veterinary surgeons identified practical barriers to their adoption: These potential barriers include lack of time to both learn about and implement such outcome measures during short consultations; lack of the awareness of the benefits of standardised outcome assessment; difficulties of integrating paper-based documents into practice computer systems; and the challenges associated with using such outcome measures in dogs with multiple comorbidities all warrant exploration. It is not known whether use of some form of instrument would help in monitoring or making decisions about osteoarthritic dogs' welfare. A small survey of UK veterinary surgeons by Bell *et al.* (2014) identified they found it difficult to recognise behaviours associated with canine chronic pain. Furthermore, validated behaviour-based outcome measures for canine osteoarthritis variably associate the same behaviours with either chronic pain (Wiseman *et al.*, 2001, Wiseman-Orr *et al.*, 2006) or mobility changes in general (Brown, 2014a, Brown, 2014c). It is difficult even for behaviour experts to accurately define canine behaviours associated with normal ageing versus disease (e.g. Salvin *et al.*, 2011, Salvin *et al.*, 2012, Overall, 2015b, a) so expecting owners to be able to do this may be overoptimistic.

None of the veterinary professionals expressed concern that dogs with osteoarthritis under their care were in pain. Reasons for their lack of advocacy for maximum analgesia were not directly explored, but may have been related to an inability to consistently assess pain and a fear of treatment adverse events. The poor evidence relevant to treating osteoarthritis in the population of dogs involved in the current study was evident to veterinary surgeons and some owners. Even for NSAIDs where there is substantial evidence for efficacy (Innes *et al.*, 2010), the study population (Hazewinkel *et al.*, 2008, Monteiro-Steagall *et al.*, 2013), trial length (Autefage and Gossellin, 2007, Ryan *et al.*, 2010) and outcomes assessed (Pelletier *et al.*, 2000, Moreau *et al.*, 2003) in clinical trials are not relevant to many of these dogs. Poor awareness of evidence relating to the incidence of adverse events associated with NSAIDs appeared to be a factor in the many risk aversion strategies adopted by veterinary professionals and owners. Two recent reviews of the safety of NSAIDs in dogs (Monteiro-Steagall *et al.*, 2013, Hunt *et al.*, 2015) observed the overall incidence of adverse events is difficult to calculate. Data in published studies typically includes only healthy dogs, and reports by veterinary surgeons in practice to the Veterinary Medicines Directorate are often incomplete. However, both studies concluded the number of severe adverse events associated with NSAIDs is likely to be low. The participants in this study did not appear to be aware of this information and many viewed these drugs as likely to cause harm. Strategies adopted by owners and veterinary surgeons to reduce the risk they associated with NSAIDs, such as dose reduction, are not well evidence-based (Wernham *et al.*, 2011) and there is little information about the frequency at which therapeutic monitoring should be performed. The frequency at which risk-reduction strategies were described in the current study suggests veterinary surgeons and owners do not feel confident in the safety of NSAIDs when used long-term in older dogs with osteoarthritis.

Interestingly, veterinary nurses appeared to be more aware of, and happier to attempt to assess, outcomes relevant to owners than veterinary surgeons. However, they also appeared to be more risk averse than many veterinary surgeons and perhaps less aware of how to appraise evidence. Little is published in peer reviewed literature about the training of veterinary nurses in the UK. Yeates (2014) called for nurses to

consider themselves “*welfare ambassadors*” to both owners and veterinary surgeons (p.250). Whilst the nurses in the current study did appear to be championing animal welfare outcomes more pro-actively than the veterinary surgeons, their reluctance to recommend treatments associated with potential harm may present a risk to welfare. The inclusion of teaching about evidence-based treatment decision making in veterinary nursing courses may be warranted.

4.5 Theme 4: Collateral damage

Themes 1-3 explored the decisions made by owners and veterinary professionals and how these may have on the welfare of dogs with osteoarthritis. This theme will describe the impact of owning a dog with osteoarthritis and the positive and negative aspects of looking after dogs with osteoarthritis in veterinary practice since this could also affect decisions made. The perspectives of veterinary surgeon owners are integrated with those of others when talking about their own dogs in the first subtheme. A short section at the end of that subtheme contains the veterinary surgeon owners' reflections on how their attitudes to the managing the disease has changed.

4.5.1 Impact of living with a dog with osteoarthritis

Owners

Most owners described their dog as “*just a pet*”, but also identified a wide range of additional roles from companionship and exercise buddy to social engineer. Most described a relationship of mutual love, support and fun. The personality of the dogs typically appeared to have remained unchanged. Many owners talked about their love for their dog, the things they did which still made them laugh and the ongoing companionship they provided.

I think she's definitely a family member. But I think she is definitely a dog. She's not classed as one of the children although I do sometimes say 'Oh, she's like a third child. She's like the third child I didn't have,' as it were.

[Int 10]

Especially out in the country, she's great company, I'm talking away, she knows what I'm saying. I nod my head, and she follows. So she's like having a person with you, it's great that way.

[Int 26]

Sadly, almost all owners felt their dog's osteoarthritis had led to a huge change many aspects of their relationship. As osteoarthritis progressed, dogs became increasingly reliant on their owners, leading several to compare their new role with being a carer for an elderly relative.

She also had a role in looking after me. She would have protected me, and she would have put herself before me any time [...] So definitely that's changed. And were we mates? Yeah, we were mates. And you get this empathy, don't you, between you and your dog. And so, yeah, the role has changed, very significantly.

[Int 13]

One owner described interpreting the instructions from their vet on diagnosis as “*don't do anything that's fun*” [Int 8, Mr], and for many this seemed to sum up the new reality. Many owners described worry about their dog's condition and a feeling of sometimes overwhelming responsibility when making proxy decisions.

You have to look after them, you have to make sure that they don't hurt themselves, for instance that they don't do silly things. You have to actively look for signs as well which tell you how they feel, whether they've got a good day or a bad day, whether they're more painful or less painful. And that does

become part of your daily routine, and was never really part of your daily routine when they were young because they were healthy, playful, up for anything. And you didn't really have to worry. And now you're much more worried about them [Int 19].

A few dogs had taken part in showing or agility before their diagnosis. Much of their owners' free time had been spent enjoying these activities with their dog, often travelling widely and being part of a community who shared the same interest. These owners described their sadness following the diagnosis of osteoarthritis in their dog which effectively removed them from this community:

Mrs: But it was a big blow to you, wasn't it, to lose your agility. Because that's really the only hobby [he] has outside the house. Whereas I've got other hobbies and other interests. So I get out for other things. But it's when your social interaction and things like that, you lose that. And that's a bit of a shame and a bit of a shock, isn't it.

Mr: That's right, it is, yeah. [Int 8]

A major impact on the lives of almost all owners was their dogs' reduced capacity for exercise. Several dogs walked only a few hundred metres each day with a couple not even leaving their garden; others were estimated to be covering several miles on a good day but none could go on the long walks many owners had loved. Almost all owners described their dog's walk pace as frustratingly slow, with a big increase in time spent sniffing. Many found it less annoying to let their dog walk at their own slow pace off the lead whilst they walked ahead. Many found guidance from their vet about walk length impractical.

My vet was very clear about it. You walk him for ten minutes, ten minutes maximum. Ten minutes with him, he stops at every gatepost, at every twig. Ten minutes is about fifty yards! [Int 12, Mrs]

Several owners described their guilt at going for a walk without their dog, leading them to significantly reduce their own exercise rather than leave their dog behind; all explained how this led to great sadness, particularly on good weather days. Others described personal health impacts of carrying or supporting big dogs up and down stairs. A few owners described purchasing a different car to allow their dog to get in or out more easily; many owners had tried using ramps for this purpose with very limited success. A couple of owners described less conventional ways of taking their dog for a walk.

I've taken [my Rhodesian ridgeback] in the wheelbarrow for a long walk, but it was downhill and it was bumpy, and it's hard work. But going back up the hill with thirty-two kilos of dog that got up to look and move was hard work. [Int 16]

Owners of more than one dog described challenges of meeting their different exercise requirements. Strategies involved walking the dogs separately, taking the healthy dog on additional walks or allowing the osteoarthritic dog to walk a shorter circuit. Owners who had previously walked their dog to be cared for by a friend or relative whilst they were at work were now having to deliver the dog by car or public transport because their dog could no longer walk the distance. Holidays were a

challenge because many owners did not feel comfortable putting their dog in kennels or leaving them with a friend. Some were worried about their dog's needs not being met whilst others felt it was unfair to burden someone else with their dog. Several owners had not had a holiday for several years because of their dog's condition.

She's too old to go in a camper van, because that was our holiday, there was a camper van into France and Spain and Austria, places like that. And that was very good. And now, I can't take her, I won't put her into kennels, I can't take her in the car, so it's a severe restraint on me. I just can't take a holiday. Well, I won't take a holiday for as long as I've got her. I'm stacking them up now, all the holidays, cruises here, and Peru and things like that. And I've started a big file upstairs on different holiday destinations. [Int 13]

A surprising impact was described by male owners of dogs severely affected by osteoarthritis who had previously enjoyed walking in the countryside or in parks. Several realised without having a dog to legitimise their presence in the rural location or near a playground, they were viewed as a threat by some women. This was confirmed by several female interviewees who described experiencing fear when approached by a man walking in an isolated area without a dog. For this reason, these male owners no longer walked in these areas.

You can see people going 'What are you doing here?' It's a little bit odd. If you're out in the woods, out in the fields, a guy on his own is a bit strange. You've got a dog with you, and it's 'Morning! How are you?' [Int 11]

Other impacts included the stress of veterinary visits, worry they had let their dog down by failing to find effective treatments, challenges in getting the dog to take medications and keeping the dog at a reasonable weight with reduced exercise levels. As described in the first theme, several owners of younger dogs described persistent guilt they had in some way been responsible for their dog's osteoarthritis. However, for almost all owners, the bond with their dog remained very strong albeit they felt their role in the relationship was very different.

Again, because you've built that relationship, you've had that fun together. If it was the other way... If you like, if I was blind I'd probably have a dog guiding me. So, if she's getting to the point of having a few difficulties I'm going to care for her, yeah. [Int 11]

Most described how they had changed their lives to accommodate the needs of their dog with a couple of owners changing jobs as a direct result of their dog's osteoarthritis. Most felt it was their responsibility to look after their dog, given all the dog had done for them. Frequently, owners made analogies with between the dog and an elderly person.

We just all love her, and she's just like your old granny or something, she's just an old lady. We just look after her and make allowances for what she can do and what she can't do. [Int 27]

Owners gave many examples illustrating the impact of the views of other people on their decisions. Many gave examples of support and advice they received from other dog owners they met on a walk. Others talked about their dog having lots of friends in the community who asked about their progress and worried about them when they

were having a bad day. Owners were also conscious that people who saw their dog might be judging them. This was a particular concern for owners more severely affected dogs that were having a bad day.

When you walk round your local patch, and people see you through the window, and I think 'Ooh, they're thinking 'Ooh, that dog's not doing so well.' And I'm thinking 'I hope they don't think I'm being cruel to her by dragging her out.' [Int 6]

Several of the veterinary surgeon owners reflected that they had not been aware of the challenges faced by owners of osteoarthritic dogs prior to having personal experience of managing the condition. They agreed that they were now had a much better understanding of the owner experience and the role of the veterinary surgeon.

And I can think back now to a few situations when I was in practice where I don't think I helped owners. And I can understand more now why owners come in and say 'Well what would you do?' Because they want that paternalistic guide don't they? They want somebody to tell them what to do, because it is really hard to make these decisions. And of course we as vets like to think that it's a joint decision-making process. But sometimes we're not that good at equipping owners with that information to contribute to that. So, yeah, it's challenging. Definitely challenging. [Int 1]

Veterinary professionals

Many vets described a population of owners who they felt did not care for dogs with osteoarthritis and euthanased them as soon as there was any impact on their own quality of life. Several examples were also provided of owners who were thought to have exacerbated their dogs' condition by exercising them too much to fulfil their own needs, not considering the impact on the dog. The consensus amongst vets who discussed the impact of owning an osteoarthritic dog during the focus group was that the majority of owners were minimally affected.

Vet 1: Not a huge amount [of impact], no, because if they're on, say, once daily medication, and you just put it in their breakfast or their dinner or whatever. That's not too bad, I wouldn't say.

Vet 2: And so the only change in their lifestyle potentially is meds going on their food once a day, and in their pocketbook. Which sometimes is a problem. [FG4]

Furthermore, vets were not always sympathetic when recalling owner descriptions of challenges of managing affected dogs, sometimes implying that these were excuses to make them feel better about euthanizing a dog that had become an inconvenience. This vet recalled a conversation with an owner struggling to balance the needs of a young healthy dog and an older dog with osteoarthritis.

[The client] was saying 'Actually, that one is out twenty minutes three times a day. I can't keep going with this anymore, I can't do that.' I'm thinking 'Well...' [FG2, vet 4 (assistant)]

Interestingly, discussions revolved around the impact of the initial diagnosis rather than the longer term consequences of living with a dog with osteoarthritis. It was often suggested that by treating a dog's osteoarthritis, any impact of the disease on their owner was largely mitigated. Several vets thought the impact of owning a young dog with osteoarthritis would be greater than that of an older dog, though not because it would limit what the owner could do themselves.

I think if you've got an animal that's young, that has a big impact on them, because they're going to then have to manage that animal for the next ten years, twelve years, however long. And if it's a young animal and it's wanting to do things, they're potentially going to be more upset themselves seeing this animal not able to do the things they were hoping that it would be able to do. [FG 2, vet 2 (partner)]

The most commonly articulated view was that the impact of owning an older dog with osteoarthritis was restricted to the financial implications of treatments and the inconvenience of remembering to administer medication. Typically, owners were considered to be happy with their older dog's reduced exercise ability. Many comments demonstrated the vets had little idea of how the owners' lives were changed by their dogs' disease.

We see all the people with their various designs of ramps, it makes me laugh a little bit, people fashion their own ramps. And I think that's maybe one of the things that affects people the most, is trying to get their dogs into their car. [FG5, vet 4 (assistant)]

In contrast, the veterinary nurses appeared to have more empathy with the owners in general. Many reflected on their own experiences of dog ownership or conversations that they had had with owners following veterinary consultations. They described giving owners advice about how to modify their houses to make life easier for them and their dog, and empathised with the challenges they described. Some described tailoring some of their recommendations to make them more feasible for owners, even if this was not in the best interest of the dog.

I would like to see patients twice a week [for hydrotherapy]. But realistically rarely do I recommend that because I know that that's such a huge commitment, and it can put people off coming once a week if they think they're not doing enough coming twice a week. [FG4, nurse 2]

4.5.2 Impact of treating a dog with osteoarthritis

Owners

Non-veterinary owners did not comment on the impact of their dogs' osteoarthritis on the vets treating their dogs other than when passing comment about the financial implications of the disease. Several owners, even those who described a very good relationship with their vet, felt both re-check appointments and certain treatments for osteoarthritis were aimed mainly at providing a good source of revenue for the vets.

But yeah, they've got to make money, they're a business, they're not a charity ... And it was funny, because one of the receptionists one day, she said "Oh my God, you're prescribing the Synoquin EFA like it's going out of fashion.", and I thought 'Well, of course she is.' There'll be a reason for that. [Int 32]

Veterinary surgeon owners did not typically provide perspectives on their own experiences of treating osteoarthritis in practice. However, a couple reflected on the challenges associated with persuading owners of severely affected dogs to euthanase them.

Sometimes people don't see it as well, how much their pet's suffering. And again because it's such a gradual process. Or they're scared to take the decision. I find it really hard to take the decision. And I think they should have a little bit of help, or guidance. But on the other hand, it should still come from them and they should not be talked into it. And I think that is really difficult to find a balance, to do the right thing. [Int 19]

Veterinary professionals

There appeared to be a mixed impact on the wellbeing of vets managing canine osteoarthritis. Many found owners who declined treatment deeply frustrating. There was broad agreement amongst the vets that treatment could prolong osteoarthritic dogs' lifespan by up to six months whilst some veterinary nurses estimated euthanasia might be delayed by two years if early treatment was instigated. A few vets alluded to a sense of personal failure and sadness when they did not manage to persuade an owner to take treatment, particularly if that dog was then presented for euthanasia in a poor state. Successful strategies to manage these owners did not appear to have been developed and the impact of these negative interactions on some vets was clearly long lasting as they recalled the cases in great detail. Other causes of frustration included poor treatment compliance, lack of time to discuss osteoarthritis where it was not the reason for presentation and difficulty maintaining continuity of care. Another challenge was the poor evidence base for many of the treatments available which left some vets unsure whether to use certain medications.

Cartrophen, I went through a stage of using that quite a lot. And then we had [Vet's name] here. He didn't like it, didn't think it did anything, so then I went off it. And now I'm starting to see cases that are on it again that do quite well. And so, I don't know, it's difficult. There's often different trends, aren't there, of what to use and what not to use. [FG3, vet 2 (assistant)]

In contrast, vets and nurses also described the pleasure derived from rewarding relationships with committed owners who worked with them to find the best treatment for their dog. The common, marked improvement in a dog's condition after the initial dose of NSAIDs appeared to be particularly rewarding for many vets.

Sharing the joy. Very often they'll say, "Like a puppy again". ((Laughter)) [FG1, vet 7 (partner)]

4.5.3 Collateral damage discussion

This theme identified a wide range of positive and negative impacts of owning a dog with osteoarthritis. Much research into the human-companion animal bond emphasises the positive aspects of relationships to human health (e.g. Ormerod *et al.*, 2005, Friedmann and Son, 2009, Proudfoot *et al.*, 2015). These benefits were evident; owners described their dogs as a comfort and social support, and many identified them as a key family member. However, this study provides further evidence that pet ownership is not always beneficial. Social isolation, guilt, worry and responsibility were described by many owners in this study and that by Christiansen *et al.* (2013). Similar negative impacts were associated with owning dogs with other diseases including diabetes mellitus (Niessen *et al.*, 2010), epilepsy (Wessmann, 2011), Chiari-like malformation (Rutherford *et al.*, 2012) and cancer (Stoewen *et al.*, 2014). Little support appeared to be available for these owners, some of whom felt that they were living the life of a carer. The need to support carers of ill people is well recognised (Duggleby *et al.*, 2016) and this study provides evidence that more support may be needed for owners of ill pets. Veterinary surgeons in this study did not appear aware of the need to provide this support and may not be best placed to do so.

Similar to Christiansen *et al.*, (2013), many owners described negative impacts of no longer being able to take their dog on long walks. Benefits to owners' physical and emotional health of dog walking are described (Westgarth *et al.*, 2009, Christian *et al.*, 2013, Degeling and Rock, 2013, Westgarth *et al.*, 2014) and dog walking has been identified as a strategy to help reduce problems of human obesity (Byers *et al.*, 2014, Martin *et al.*, 2015). Owners in the current study were no longer able to enjoy those benefits, and this may have implications for own health. The perception of male owners that dogs legitimised their place in the countryside was particularly interesting and warrants further investigation since walking exercise is being recommended as a public health intervention (Westgarth *et al.*, 2014). Surprisingly, several owners recalled their veterinary surgeons had advised walk lengths to be limited to ten minutes; this was not verified with the veterinary surgeons and it is not clear where that advice might have originated from but it may have negative, unanticipated consequences on the owner.

Caring for an ill pet has been associated by owners, including some in the present study, with a strengthened bond with their pet (Freeman *et al.*, 2013). However, strong attachments between an owner and their pet have been associated with delayed euthanasia decisions leading to welfare compromise (Wensley, 2008) and there was evidence in this study that the same might occur. Owners in this study and others (Oyama *et al.*, 2008, Christiansen *et al.*, 2013, Christiansen *et al.*, 2016) described struggling to recognise chronic pain, assess quality of life and identify the right time to euthanase their dog. Many felt unsupported by veterinary surgeons in making these decisions, exacerbating the negative impacts on both the owner and potentially on the dogs' welfare. Whilst support exists for owners after a pet has been euthanased (Blue Cross, 2014), little is available whilst those pets are still alive, with the main source of both information and support likely to be the veterinary practice (Morgan, 2007, Christiansen *et al.*, 2016). Veterinary surgeons did not describe providing much support or advice. This may have a negative impact on the welfare of the dogs, and may add further to the negative impacts of the condition on the owners.

Negative impacts on the veterinary surgeons were also identified, particularly the stress associated with poor owner communications, the inadequate evidence on which to base treatment decisions and challenges associated with balancing owner expectations and their preferred treatment choices. It is possible that these may contribute to the high level of mental health problems have been identified in the profession (Platt *et al.*, 2012, Cardwell *et al.*, 2013). There is a clear need to improve the communication between owners and veterinary surgeons regarding how to make decisions about the welfare of dogs with osteoarthritis, and this study suggest this may also have beneficial impacts on the veterinary surgeons and the owners.

4.6 Discussion

4.6.1 Methodological discussion and limitations

Using a qualitative method to collect and gather data permitted collection of fascinating data in this under-researched area. The sampling frames and geographical dispersion of participants appeared to facilitate collection of a range of attitudes though, as discussed in 3.5, these should not be widely generalised. Inclusion of household and dog factors in the interview sampling frame was particularly helpful in maximising diversity. Inclusion of veterinary surgeons as a subset of owners may be warranted in future studies given their unique perspectives. Much of the data collected may be subject to recall bias, particularly the interviews where owners were recalling historical events. There was also a risk of social desirability bias in both interviews and focus groups. This was a particular risk in focus groups where individuals may have felt uncomfortable expressing attitudes in conflict with their colleagues, particularly in practice 3 where the veterinary nurses were aware that veterinary surgeons in that practice had already participated. The more senior staff were frequently the first to respond to a question, often seeking to explain what they perceived to be a practice-wide policy or attitude. The frequency at which these views were disputed by other participants hopefully reflected their feeling the focus group settings were safe and confidential. Inclusion in both interview and focus groups of questions ascertaining participants' knowledge of and perceived relevance of the Animal Welfare Act (2006) was a regrettable omission.

The development of "a story" from the coded data was initially difficult as anticipated for an inexperienced researcher (Ziebland and McPherson, 2006), but multiple iterations of report writing helped to identify strong themes that are relevant to the thesis. The apposition of interview and focus group data in each subthemes is unusual in veterinary qualitative research, but helped to highlight similarities and differences in attitudes that were helpful when drawing conclusions. The different methods of data collection, the use of different question guides in interview and focus groups and the brevity of the focus groups relative to the length of the interviews may limit the validity of this comparison. Furthermore, during the interviews, owners described relationships with one or two dogs and a few veterinary surgeons in great detail, whilst veterinary professionals summarised relationships with many hundreds of owners. The veterinary professionals may have been describing a population of owners not included in the interviews, though from their responses this appears unlikely. The inclusion of veterinary surgeons as owners could be criticised as some of their experiences and perspectives were different to those of other owners. However, their insights into how their attitudes to the disease had changed as a result of owning an osteoarthritic dog and their description of the challenges they faced in being their own dog's veterinary surgeon provide fascinating pilot data for future work.

Alternative methods of analysis and different ontological and epistemological stances would have led to different results. Despite these limitations, this study has provided many interesting insights into the decisions made by owners and veterinary professionals in relation to canine osteoarthritis and should provide a solid foundation for future research.

4.6.2 Outcomes assessed

Almost all owners were making efforts to act both as good proxies and advocates for their dogs' welfare by assessing a range of outcomes related to both their physical health and welfare. The "owner" and "dog" factors illustrated in Figure 9 appeared to have an influence on this, and these are likely to be useful areas of future research. All owners appeared aware their dogs had the capacity to feel both positive and negative emotions; many had identified impacts on these emotions including their own behaviour, the dog's environment and the experiences that their dog was permitted to have. None of the owners discussed using any of the outcome measures identified in Chapter 2 to aid their decision making. Instead, many owners closely monitored their dogs, interpreting any behaviour change relative to the magnitude, consistency and duration of change, contextualised by their age, personality, health state and environment. This suggests that owners may use a system of inputs and indicators similar to that discussed in 1.5.2. However, most owners identified huge challenges in interpreting those behaviours, and in particular the change in the dog's condition between what were identified as "good" or "bad" days presented an additional problem.

There appeared to have been very little advice from veterinary surgeons about which outcomes owners should be monitoring or how that should be done. Therefore, in common with owners interviewed by Christiansen *et al.* (2013), and Christiansen *et al.* (2016), owners had little idea how to interpret what they were seeing, limiting their ability to advocate for their dog's best interests. Negative impacts on both dogs' and owners' welfare were evident in these studies. Echoing the findings of Christiansen *et al.* (2016), most owners felt their veterinary surgeons should play a much bigger role in helping them to make decisions about the welfare of their dogs, particularly in relation to euthanasia.

In contrast, veterinary surgeons focused almost entirely on the physical health of osteoarthritic dogs, and described many challenges to making accurate physical health assessments. Physical health outcomes assessed were typically limited to limb-only physical examinations and visual assessment of mobility other than in cases where the veterinary surgeons were less confident about their diagnosis. There was little consensus within or between practices about which outcomes should be assessed or how assessment of those outcomes should be performed, reflecting the results of the reviews in Chapter 2. Problems associated with the validity of these measures were recognised by a few participants but potential solutions were not identified. It was not clear whether the veterinary surgeons had a good grasp of how osteoarthritis might affect welfare, how welfare might be assessed beyond physical health, how well owners could assess relevant outcomes or their own responsibilities towards advocating for the dog's welfare. This reflects the results of the survey of veterinary surgeons performed by Yeates and Main (2011b) which found veterinary surgeons to place a much higher priority on physical health problems than potential welfare risks due to environmental or mental health challenges. Animal welfare was not included in all UK veterinary curricula until after 2007 (Anon, 2007). It is therefore possible many of the veterinary surgeons included in the focus groups had little idea of aspects of welfare other than physical health and relied on owners to assess and make decisions about other aspects of welfare; this was discussed in 1.3. This study suggests limited knowledge of veterinary surgeons about welfare and their responsibilities towards it may have a direct negative impact on their patients and suggests that owners are therefore the main decision-makers about the welfare of dogs with osteoarthritis.

4.6.3 Decisions made

Owners described making a series of decisions before veterinary attention was sought. Many of the influences they described when making these decisions were previously reported by Scantlebury *et al.* (2014) in relation to owners of horses with colic. Those authors developed a theoretical model of the process of decision making. Using data from these interviews, that model has been adapted to form a theoretical model (Figure 9) to describe the decisions made by owners of dogs who undergo a behavioural change. Such a model is useful since it clearly identifies the motivators and barriers to seeking treatment from different sources. Whilst Scantlebury's model was relevant only for the initial diagnosis of colic, this model is likely to be relevant to decisions made by owners throughout the course of a dog's disease. Veterinary professionals in the focus groups did not appear to be aware of many of these factors, so this model is likely to be useful as an educational tool and may help veterinary professionals to better understand how they might persuade owners to instigate treatment for dogs affected by osteoarthritis. Scantlebury *et al.* (2014) and Jansen *et al.* (2010) identified horse owners and farmers could be organised into "typologies" depending on their attitudes towards a diagnosis. Owner and dog factors identified in Figure 9 could be used to build typologies of dog owners if this was considered to be of benefit.

Many parallels were evident between owner and human healthcare decisions, and many owners repeatedly drew on their own medical knowledge and experience when making decisions. The impacts of prior knowledge and assumptions about what others might think appeared important barriers to these dog owners; this has been described in people with osteoarthritis seeking medical attention (Gignac *et al.*, 2006, Bedson *et al.*, 2007, Ryan *et al.*, 2013) and parents making decisions on behalf of children (Kai, 1996). People with osteoarthritis, dog owners in this study and horse owners interviewed by Scantlebury *et al.* (2014) all identified the importance of their relationship with their healthcare professional on their decision making. People with symptoms of osteoarthritis are less likely to seek medical attention if they perceive their doctor will think the disease is a normal part of ageing (Coxon *et al.*, 2015); dog owners identified this as a factor in the current study. Risk aversion was evident in proxy decisions made both by dog owners in relation to NSAIDs and in parents of children concerned about vaccination reactions (Wroe *et al.*, 2005). In both instances this led to omission bias, where a potentially beneficial treatment was withheld on the basis of risk aversion. These links between human and veterinary healthcare in relation to decision making warrant further investigation.

Figure 10 illustrates the range of decisions related to canine osteoarthritis described by owners and veterinary surgeons. Remarkably few required agreement between owners and veterinary surgeons. This highlights the need for owners to have both a good relationship with a veterinary professional and access to reliable information sources outside the consulting room to enable them to make the best decisions for their dog. Many owners described using the internet to seek additional information about their dog's disease; veterinary surgeons did not appear keen for them to do this, perhaps due to a perceived threat to their autonomy. Patients with prostate cancer who used the internet were reported by Broom (2005) to have been alienated by doctors in a strategy to reinforce their authority; the same may happen in some veterinary practices. However, patients interviewed by Broom (2005) found well-designed patient-centred support resources very helpful. Similar resources may be beneficial for owners of dogs with osteoarthritis.

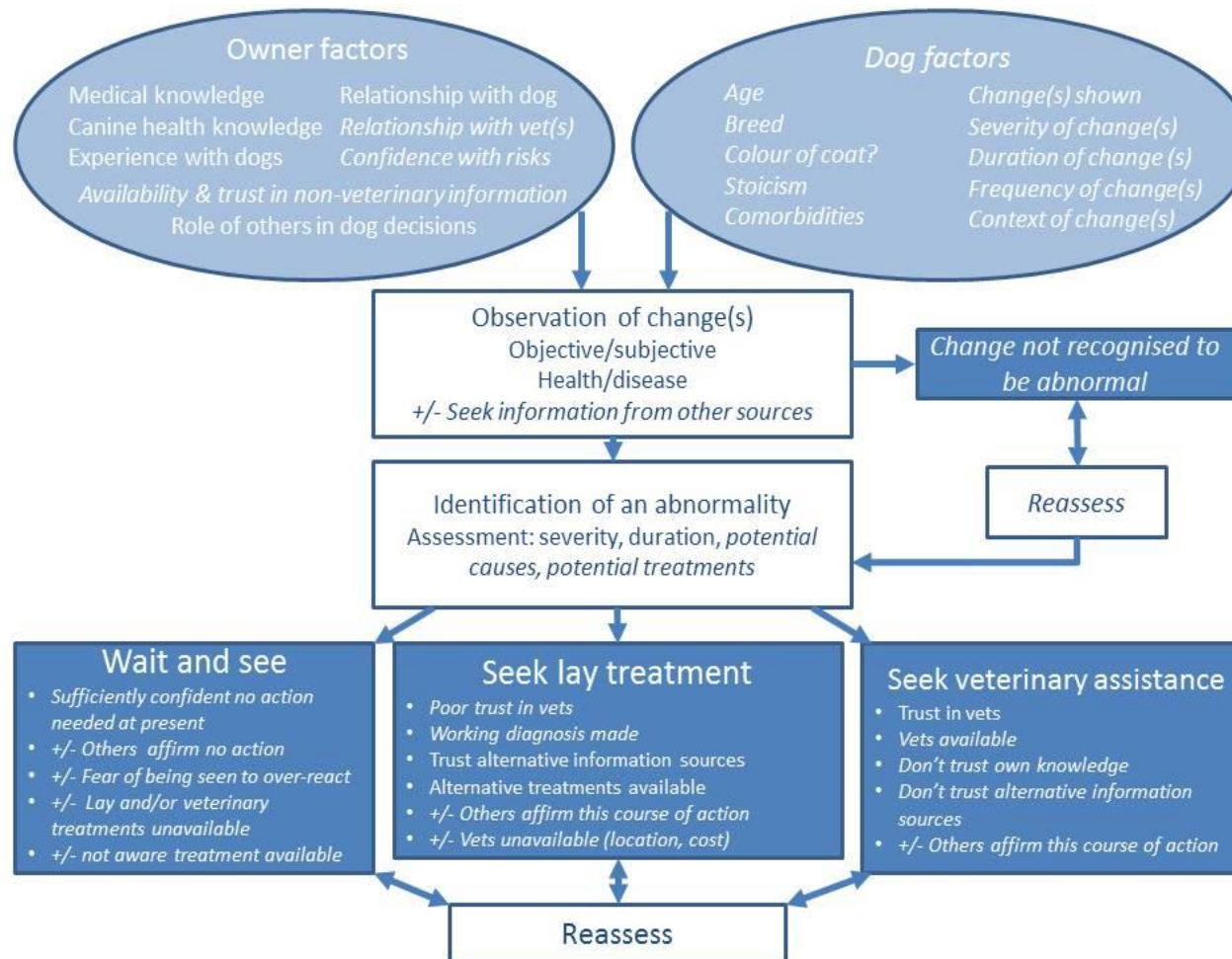


Figure 9. A theoretical model of dog owners' approaches to recognising a change in their dogs' behaviour. Adapted from the model described by Scantlebury *et al* (2014). Items not included in Scantlebury's model are included here in italics.

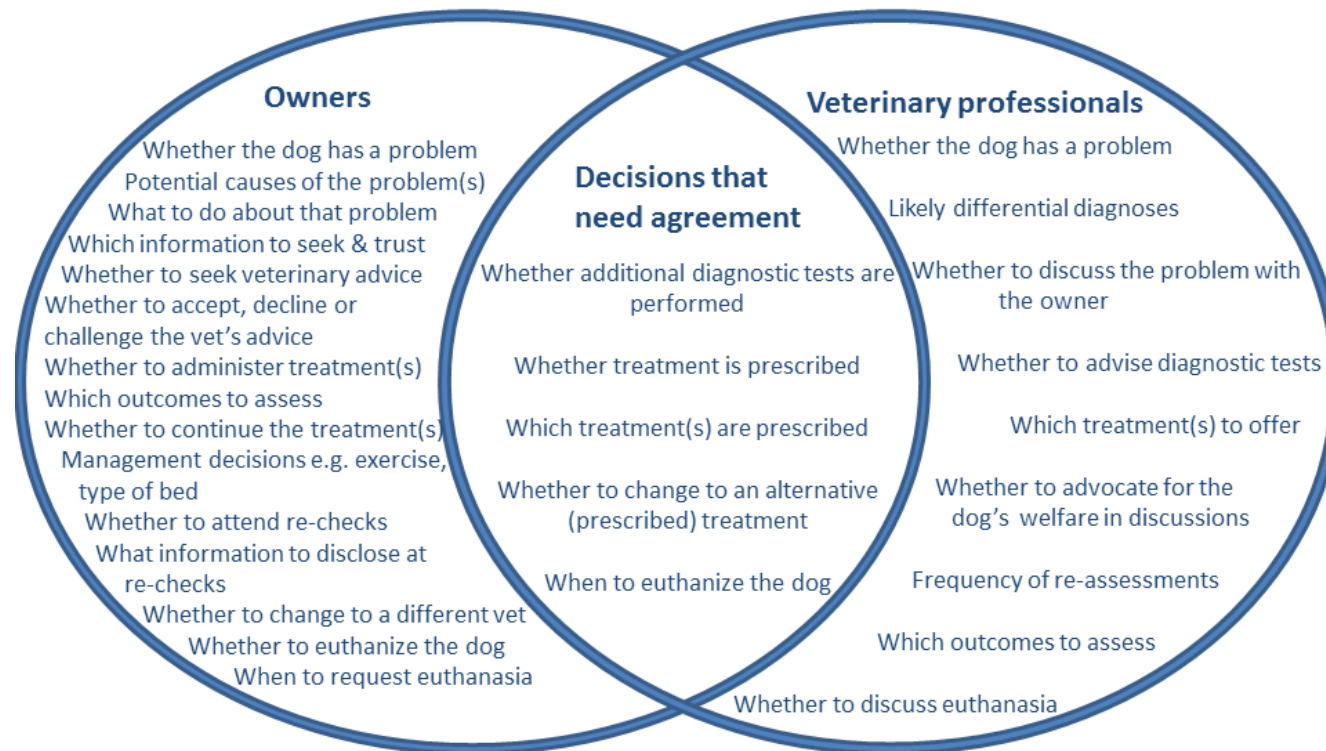


Figure 10. Decisions described in the interviews and focus groups which were made separately by owners and veterinary professionals, and those that require agreement in the consulting room.

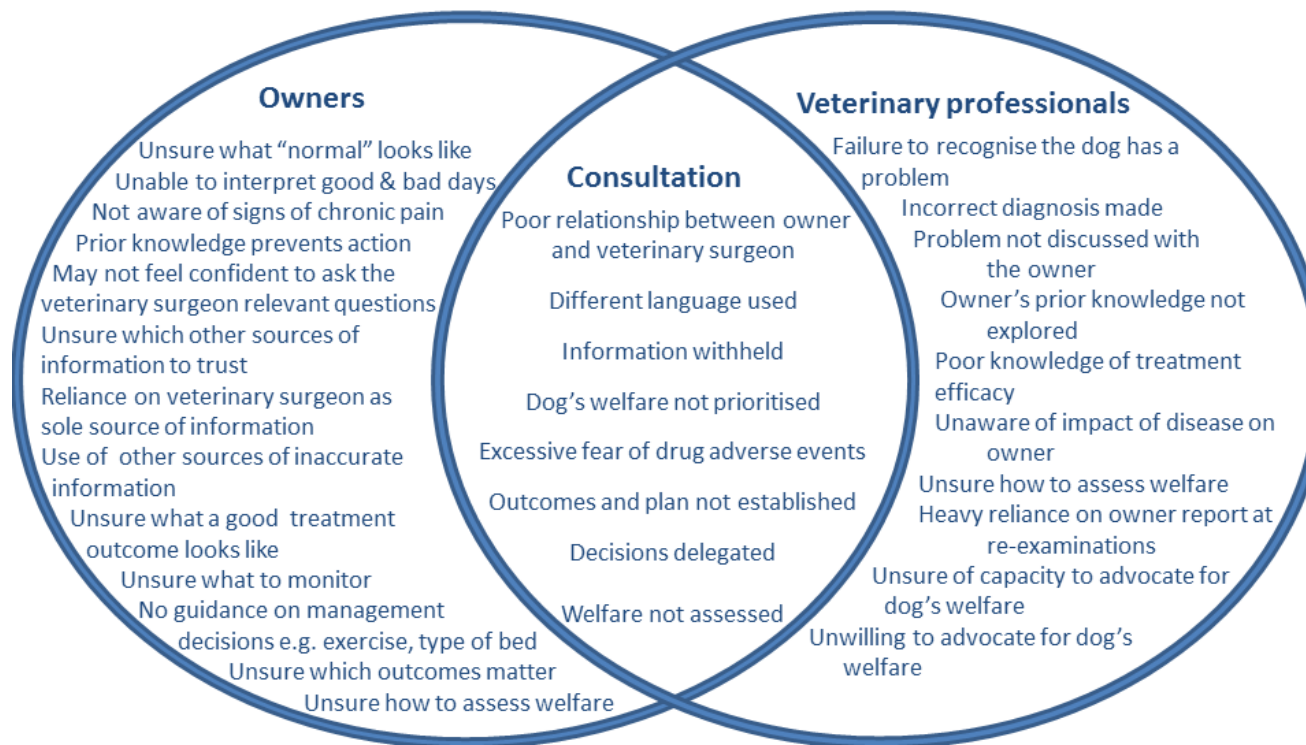


Figure 11. Barriers to good proxy and advocacy for welfare of dogs with osteoarthritis described during interviews and focus groups

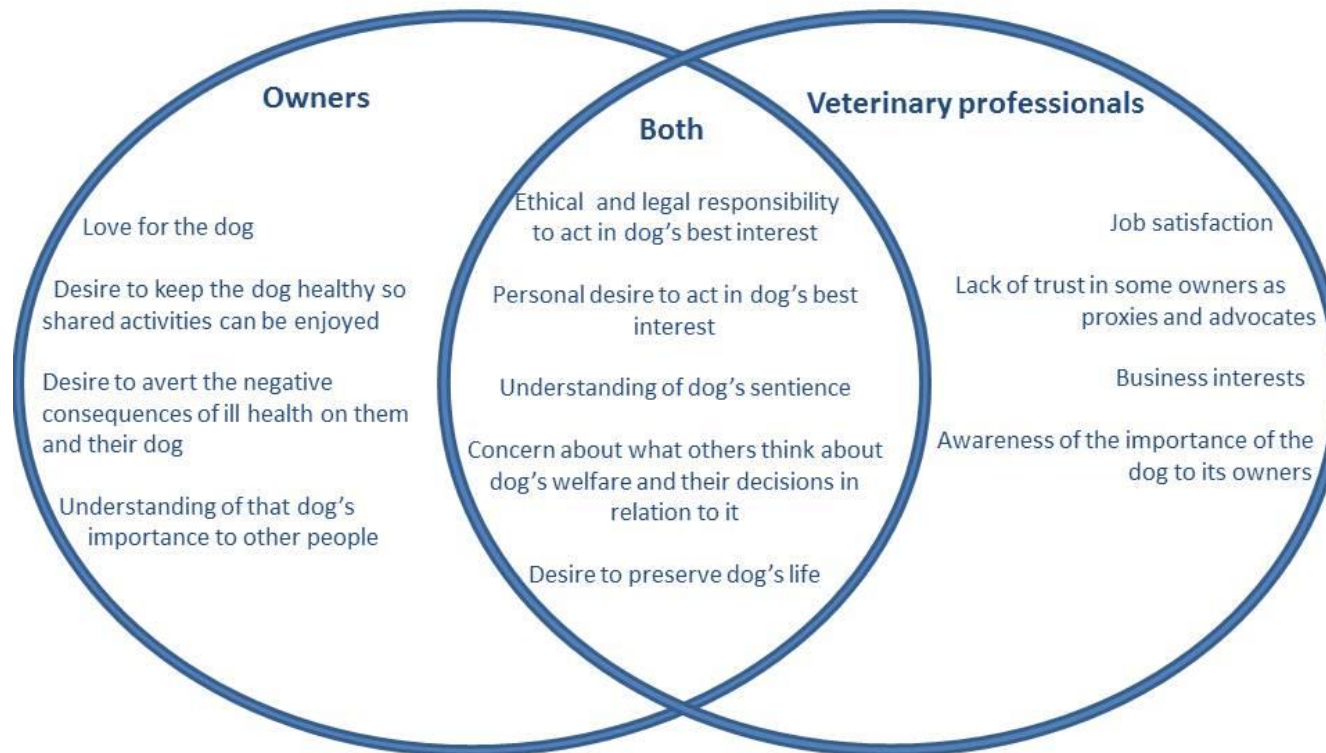


Figure 12. Motivators for good proxy and advocacy for welfare of dogs with osteoarthritis identified in interviews and focus group

4.6.4 Motivators and barriers to welfare advocacy for dogs with osteoarthritis

Osteoarthritis appeared to have a direct negative impact on the physical health of many dogs included in the study through pain, reduced mobility and rarely through adverse events from treatments. Mental health may have been compromised as walks were withdrawn but other sources of stimulation were not instigated. Relationships with owners may have changed as dogs' health deteriorated, and a few owners identified that their dogs appeared to be less confident in interactions with others. In addition, poor decisions made at all stages of the management of a dog's disease have the capacity to compromise welfare. Owners and veterinary surgeons described a wide range of potential motivators and barriers to proxy decision making or advocacy (Figure 11 and Figure 12).

A fascinating novel finding in this study was the difference in descriptive terms used by owners and veterinary surgeons to describe the clinical signs of dogs with osteoarthritis. This meant that the significance of very similar outcome assessments could potentially be misinterpreted during consultations due to a difference in language used. This is likely to have contributed to the problematic relationships between many veterinary surgeons and owners that were evident in each theme and may distract from roles of both parties as welfare advocates. Since veterinary surgeons act as gatekeepers to prescription analgesics and euthanasia, it is vital they do not present unnecessary barriers to these treatments through withholding information, making inaccurate judgements about, and providing insufficient support for, owners. Short consultation times, a lack of understanding of owner priorities and knowledge levels, the poor availability of good evidence on which to base treatment recommendations, and perhaps a lack of understanding of welfare other than physical health may contribute to the lack of advocacy suggested.

The Calgary Cambridge Guide on which teaching of veterinary communication skills is based (Kurtz, 2006) is subject to remarkably little critique in the veterinary literature; only Silverman (2007) acknowledges it risks being taught as a checklist rather than a guide. This study suggests it may not adequately equip veterinary surgeons to deal with the negotiations needed to advocate for a dog's welfare. Furthermore, the Calgary Cambridge model places the needs of the owner rather than the dog centre stage. This may not adequately reflect the best interests of the dog. Interestingly, veterinary nurses appeared both to have better relationships with owners and to have a better understanding of the broader impacts of osteoarthritis on dogs than the veterinary surgeons. Their number was too small to draw any firm conclusions but these data suggest there may be a greater role for veterinary nurses in helping owners to manage dogs with osteoarthritis.

Finally, owners and veterinary professionals highlighted many negative aspects of managing dogs with osteoarthritis. The impact of parents caring for ill children has been described in a detailed ethnography by Anspach (1993), and the changing impact of the burden of care placed on the family of ill adults is well recognised (Poston *et al.*, 2003, Sales, 2003). Similar burdens were described in the current study and that by Christiansen *et al.* (2013), yet the role of carers for chronically ill animals receives nothing like the level of societal attention and support. The potential negative impacts of this carer role on the decisions made about the dogs' welfare

were discussed in section 4.5.3 and these pose another clear risk to welfare through advocacy for length over quality of life.

4.7 Conclusions

This is the first description of the process of decision making by owners and veterinary professionals in relation to canine osteoarthritis. They described a wide range of decisions that need to be made about osteoarthritic dogs, both alone and in partnership. Those data will be useful to disseminate to veterinary surgeons working in general practice and to key opinion leaders. Owners described a strong motivation to act as good proxies and advocates for their dogs but identified many barriers in their ability to do this, predominantly related to lack of knowledge about osteoarthritis in dogs, lack of ability to interpret the behaviour of their dogs and in some, risk aversion related to a desire to preserve the length of their dogs' life. Many relied on veterinary surgeons to help make decisions but veterinary consultations were not always helpful. Veterinary nurses appeared to have a better understanding than many veterinary surgeons of the knowledge levels and motivations of owners and to use language that was more readily understood by owners. The evidence used by owners and veterinary professionals to make many decisions was weak; this may lead to risk-averse treatment decisions. The impact of owning a dog with osteoarthritis was considerable for many owners and negative impacts were also evident in veterinary surgeons with a poor ability to advocate for their preferred treatment option. Validated instruments identified in Chapter 2 were not used for decision making by any participants.

Veterinary surgeons mainly focused on physical health outcomes rather than other aspects of welfare in their assessment and treatments, reflecting the outcomes identified in 2.5; veterinary nurses appeared to recognise the importance of additional outcomes relevant to welfare. Owners described making assessments of, and decisions in relation to, most of the aspects of welfare described in Figure 2 and many veterinary professionals were reliant on owners to make these assessments and decisions. Many owners felt that they were making important decisions related to their dog's welfare with little support from their veterinary surgeon but that good alternative information sources were lacking. Owners' ability to make good assessments, and subsequent decisions based upon those assessments, was questioned by veterinary surgeons and many owners; their desire to make dog-focused decisions was very clear.

Many barriers were described in veterinary professionals' ability to act as proxies and advocates for the dog, though not all appeared to view these as important. Some veterinary surgeons expressed frustration at their inability to act as effective advocates; others were unsure of their ability to advocate for the dog. Additionally, conflicts were identified between maintaining good relationships with clients and fulfilling advocacy roles. The relationship between owners and veterinary professionals was identified as important in the ability for both parties to make dog-focused decisions; poor relationships appeared to be a major confounding factor to dog-focused discussion. Consequently, decisions described to have been made in veterinary consulting rooms did not appear always to have the best interests of the dog at their centre. Common elements have been identified with motivators and barriers to decisions made by other owners, parents, veterinary professionals and

doctors. This suggests there may be shared factors underlying medical decisions made across multiple fields. That is a potentially exciting area for future research.

4.8 Relevance to the aim of the thesis

The study described in Chapters 3 and 4 provides the extensive analysis based on qualitative data of the nature of, and rationale for, decisions made by owners and veterinary professionals about dogs with osteoarthritis managed in general practice. The four themes identified important aspects of the decision-making process; each warrants much more attention than was possible in this thesis. Many decisions are based on outcomes that rely on interpretation of canine behaviour, and the methods owners and veterinary professionals described to assess outcomes were often inconsistent, unvalidated and may be inaccurate. Many challenges were identified by both vets and owners to interpreting these outcomes. Owners were identified to be the main assessors of, and decision makers, about the welfare of their osteoarthritic dogs. However, they received little advice in how to carry out this important role from veterinary professionals and did not use any of the outcome measures identified in Chapter 2 for this purpose. This will be explored further in the next chapter.

Chapter 5. Development of a novel home-monitoring checklist and daily diary for owners of osteoarthritic dogs to aid welfare assessment and decision making

Additional studies were performed as part of this work assessing the face validity of instruments identified in Chapter 2 and piloting a novel accelerometer to determine activity levels. Information about those studies is not presented here but is available from the author (and see appendix 8 and 9).

5.1 Introduction

The previous chapter identified that owners appear to be the key decision makers about the welfare of osteoarthritic dogs. During the interviews, owners described independently identifying a range of outcomes to assess in the form of behaviours they monitored. Often these behaviours were remarkably similar between owners and included assessments of both physical ability and demeanour. Owners reported observing these behaviours on a daily basis to determine whether their dog's day was good or bad. Owners also identified these behaviours as important in relation to many decisions they made including whether a treatment was working and when to consider euthanasia. Veterinary professionals reported being heavily reliant on these observations to guide their own decisions. However, many owners described challenges interpreting the behaviours they monitored in relation to the severity of their dogs' osteoarthritis, the efficacy of any treatment and the impact the disease on their dogs' welfare. Furthermore, both veterinary surgeons and owners were aware these assessments had the potential to be subjective and inaccurate. This potential for bias and subjectivity in owner observations has previously been reported (e.g. Conzemius and Evans, 2012, Sharkey, 2013). Providing more guidance for owners about which outcomes should be assessed and what these might mean may therefore improve the quality of decisions made by owners and veterinary professionals about these dogs.

The reviews conducted in Chapter 2 identified four outcome measures that had some evidence of validation which could be used for this purpose (Table 8): the Canine Brief Pain Inventory (CBPI; Brown *et al.*, 2013a), the Liverpool Osteoarthritis in Dogs Clinical Metrology Index (LOAD; Walton *et al.* 2013), the Helsinki Chronic Pain Index (HCPI; Hielm-Bjorkman *et al.*, 2009) and GUVQuest (Wiseman-Orr *et al.*, 2004). Of these, only the CBPI, LOAD and HCPI remain available for use. Since the reviews presented in Chapter 2 were conducted, two additional outcome measures for use by owners of dogs with osteoarthritis that have some evidence of validation have become available: the Canine Orthopedic Index (COI; Brown 2014 a, b, c) and the Sleep and Nighttime Restlessness Score (SNoRE; Knazovicky *et al.*, 2015). These outcome measures are described in more detail in Table 15. Despite some previous validation, these outcome measures have several potential design flaws when viewed in relation to the data collected in the previous chapter.

Table 15 Summary of outcome measures identified in the peer-reviewed literature with some evidence of validation that are available for completion by owners of osteoarthritic dogs

Instrument name	Description of instrument	Description of content	Time period owners are asked to summate	Were owners involved in question development?	Country of origin	Source
Canine Brief Pain Inventory (CBPI)	Three factor, 11 item numeric scale about pain	Four questions rating pain, five relating to the impact of pain on the dog's mobility, one about the impact of pain on life enjoyment and one about quality of life	7 days	Yes	America	http://www.vet.upenn.edu/research/clinical-trials/vcic/pennchart/cbpi-tool [Accessed 29 April 2016]
Liverpool Osteoarthritis in Dogs Clinical Metrology Instrument (LOAD)	Three factor, 13 item descriptor and numeric scale about functional impairment	Thirteen questions about mobility	7 days	No	United Kingdom	Through direct contact with Novartis representatives in 2014 (website address in original publication no longer functioning).
Helsinki Chronic Pain Index (HCPI)	One factor, 11 item descriptor scale	One question about mood, one about play, one about pain, eight about mobility.	7 days	Not stated	Finland	http://www.vetmed.helsinki.fi/english/animalpain/hcpi/about.html [Accessed 17 March 2017]
Canine Orthopedic Index (COI)	Four factor, 16 item descriptor scale about functional impairment	Four questions about stiffness, four about limb function, five about gait and three about quality of life.	7 days	Yes	America	http://www.vet.upenn.edu/research/clinical-trials/vcic/pennchart/canine-orthopedic-index [Accessed 29 April 2016]
Sleep and Nighttime Restlessness Evaluation Score (SNoRE)	Six item numeric scale about sleep and restlessness	Six questions relating to sleep disturbance	7 days	Not stated	America	From author by email

Firstly, all require owners to reflect on their dog's behaviour in the previous week and summate that into a single observation. This is likely to be challenging given that the owners interviewed in the previous study identified their dogs might have good and bad days within a single week. Secondly, four of these outcome measures were developed outside the United Kingdom and have not been validated with British owners. This step of cross-cultural validation is standard practice in the development of medical outcome measures to identify words or whole questions that are less likely to be relevant or understood in a different setting (e.g. Alrubiay *et al.*, 2014). For example, the COI and CBPI include reference to the term "curbs"; what this means may not be immediately apparent to dog owners in the United Kingdom. Thirdly, owners are only described to have been involved in the development of the COI and CBPI outcome measures. The crucial importance of including the end-users of outcome measures in their design is discussed in detail by Henehghan *et al.*, (2017). It is therefore not possible to be sure whether items included the HCPI, LOAD or SNoRE are relevant to owners of osteoarthritic dogs based in the United Kingdom, or whether the descriptive terms used are correctly phrased. Finally, the interviewees identified the importance of how their dog felt, for example whether they might be bored, and what experiences they were able to enjoy, when making assessments about their welfare. This is not well reflected in any of these outcome measures which place a heavy focus on pain and diminishing physical ability.

This suggests that a novel outcome measure may be needed which includes behaviours and terminology appropriate to owners of osteoarthritic dogs in the United Kingdom and allows proposed day-to-day variation in a dog's condition to be captured. The interview data presented in the previous chapter forms a good basis from which the content of a novel outcome measure can be developed.

5.1.1 Study aims

The primary aim of this study was to create and trial a behavioural checklist and daily diary based on owner descriptors derived from data collected in Chapter 4. The secondary aim was to collect additional data on how owners made decisions about whether their dogs' day was good or bad.

5.2 Methods

5.2.1 Ethical consideration and approval

Clinical examinations of dogs were not performed to avoid distress to the dogs and their owners, and to ensure that no veterinary advice could be provided. The study design was piloted to ensure study materials were easy to use whilst capturing relevant data. Information sheets (Appendix 8) were provided to owners and their veterinary surgeons in advance of the study and an ethically approved consent form was used (Appendix 9). All participants were aware they could withdraw their consent at any time. All owner data were anonymised before analysis. The study design received ethical approval from the School of Veterinary Medicine and Science Clinical Ethical Review Panel (reference number: 1498 150619).

5.2.2 Designing the behavioural diary

A seven-day daily diary was designed because many owners interviewed for Chapters 3 and 4 had reported their dogs' signs to vary on a daily basis. As discussed above, the validated instruments that were identified in chapter 2 typically asked owners to provide a single score for the previous seven days.

5.2.2.1 Behavioural Checklist

Behaviours described by owners in relation to good and bad days were collated from the interview data collected for chapter 4. The list of behaviours was iteratively refined to combine descriptions of the same behaviour. For example, "not keen to get up in the morning", "doesn't want to get out of bed" and "stays in bed longer than normal" were combined as "reluctant to get out of bed". All behaviours sufficiently described were included; those considered too vague were excluded. Dog-owning and non-dog-owning colleagues provided advice on descriptors difficult to succinctly summarise. A final list of 34 behaviours was named the behavioural checklist (Figure 13). With the help of colleagues at the CEVM, the behavioural checklist was converted into the instrument in which asked owners whether each of the 34 behaviours had been observed more, less or the same amount than during the previous day. The directionality of each question (whether a response of "more" correlated with a good or bad day) was determined from the interview data, and was tested in the protocol feasibility study (see section 5.2.4). The behavioural checklist was included in the diary on each of days 1-7 in the same format. A baseline version of the behaviour checklist (Figure 14) was designed for owners to complete at the beginning of each study period. This used the same list of 34 behaviours with the question "Do these describe your dog's behaviour yesterday?" with response options amended to "yes", "no", "not sure" or "never". This captured baseline data against which the first day's data could be compared for each dog.

5.2.2.2 Daily summary page

To collect information about other relevant behaviours not included in the checklist, a daily summary page was designed to capture free-text information about the dog's day (Figure 15). This asked owners to score each day of the study as good, bad or unsure and to provide free text information about why they chose that option. In other sections, owners were asked to record the length in minutes of each walk their dog had been on that day. Owners were also invited to collect video clips of their dog when they thought they were having both good and bad days and record the details of these clips in the daily diary; these data are not presented in this thesis due to word count limitations.

Think back over the time you have spent with your dog today and complete the following phrases by ticking the correct answer.
Compared to yesterday, my dog was....

	More	Less	Same	Not sure
Stiff getting out of bed				
Reluctant to get out of bed				
In bed during the day				
Digging bedding before lying down				
Circling before lying down				
Changing position when lying down				
Reluctant to go for a walk				
Limping or lame				
Holding up a paw or leg				
Stiff when walking				
Panting on a walk				
Willing to walk when outside				
Slow when out on a walk				
Able to stand when going to the toilet				
Making sounds you associate with pain				
Interacting with other dogs on a walk				
Able to jump up or down steps/stairs/into car				
Hesitant before jumping up or down steps/stairs/into car				
Withdrawn or quiet				
Clingy or attention seeking				
Grumpy				
Growling, snapping, lip curling at other dogs				
Growling, snapping or lip curling at people				
Playing with <u>dogs</u>				
Playing with <u>people</u>				
Making a sound e.g. yelping, whining when being touched				
Making a sound e.g. yelping, whining when <u>not</u> being touched				
Flinching or jumping when touched				
Moving away to avoid being touched				
Looking sad				
Looking like they are in pain (from face or body language)				
Dull in the eyes				
Licking joints or other areas				
Eating their normal food				

Figure 13. Behavioural checklist included days 1-7 in the diary

Do these describe your dog's behaviour yesterday?

	Yes	No	Not sure	Never
Stiff getting out of bed				
Reluctant to get out of bed				
In bed during the day				
Dug bedding before lying down				
Circled before lying down				
Changed position when lying down				
Reluctant to go for a walk				
Limped or lame				
Held up a paw or leg				
Stiff when walking				
Panted on a walk				
Willing to walk when outside				
Slow when out on a walk				
Able to stand when going to the toilet				
Made sounds you associate with pain				
Interacted with other dogs on a walk				
Able to jump up or down steps/stairs/into car				
Hesitant before jumping up or down steps/stairs/into car				
Withdrawn or quiet				
Clingy or attention seeking				
Grumpy				
Growled, snapped, lip curled at other dogs				
Growled, snapped or lip curled at people				
Played with dogs				
Played with people				
Made a sound e.g. yelping, whining when being touched				
Made a sound e.g. yelping, whining when <u>not</u> being touched				
Flinched or jumped when touched				
Moved away to avoid being touched				
Looked sad				
Looked like they are in pain (from face or body language)				
Dull in the eyes				
Licked joints or other areas				
Ate their normal food				

Figure 14. Baseline behavioural checklist used at the start of the study

What time was the diary completed today?..... Who by?

1. Would you say that today has been good day today or a bad day for your dog? Please tick the appropriate box.

Good day Bad day Not sure

2. What did your dog do today which made you think it was a good day or a bad day?

3. If today was different to yesterday, can you think of any reason?

4. For each walk you went on with your dog today, how long were you walking for (in minutes per walk)? This includes time waiting whilst the dog sniffs etc. If you're not sure, give your best estimate.

Walk 1 Walk 2 Walk 3.....

5. If you captured any video clips today, please provide details about what you recorded and why.

6. Please add anything else you think is important to note about today, e.g. any changes of medication, concerns about the collar monitors, anything which might have impacted your assessments today or might affect your dog tomorrow.

Figure 15. Daily summary page included days 1-7 in the diary

5.2.3 Protocol feasibility study

A protocol feasibility study (Figure 16. Data collection protocol for the feasibility study.

16) was performed with a convenience sample of five volunteer dog-owning members of academic and non-academic staff from SVMS during August 2015. Dogs included in the feasibility study had not been diagnosed with osteoarthritis (this number of osteoarthritic dogs were not available) and were of a range of ages and breeds. The owners were recruited simultaneously, but the pilot was performed iteratively to ensure serial modifications to the diary could be made if needed. As this was a feasibility study, data from these dogs were not analysed but any feedback from their owners was used. Owners were asked to complete the baseline behaviour checklist then complete the behavioural diary on the next seven evenings. On day 7, owners returned the diary for analysis.

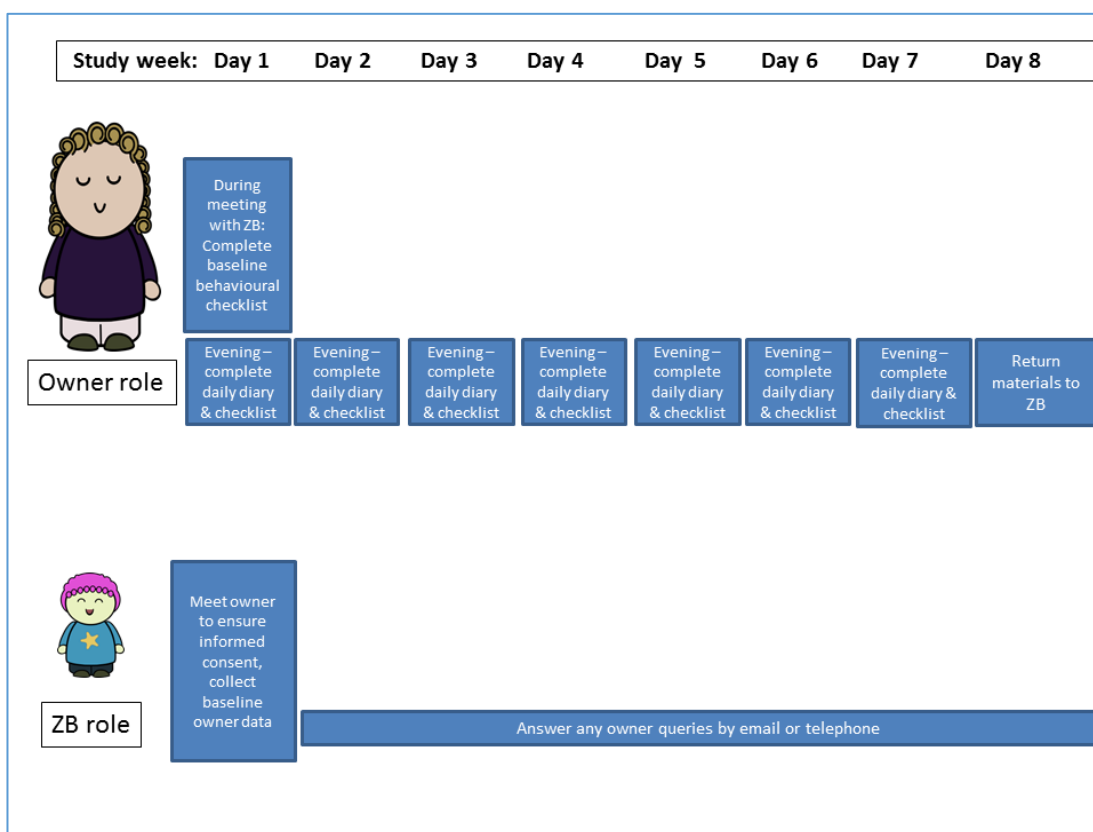


Figure 16. Data collection protocol for the feasibility study.

During this feasibility study, ZB met each owner and their dog at a time of their choice; this day would become day one of the seven day study week. After ensuring they had read the participant information sheet (Appendix 8) and confirming consent (Appendix 9), owners were asked to complete the baseline behavioural checklist. All owners were asked whether they would associate a response of “more” to each question with a good or bad day; these responses were recorded by ZB. Whilst completing the baseline checklist, behaviours owners reported their dog never performed were manually crossed out by ZB from each day’s behavioural checklist to minimise the risk of response fatigue.

Five owners completed the feasibility study. The feedback was largely positive regarding the diary but in response to helpful suggestions, further minor adjustments were made. All owners agreed on the positive or negative directionality of each checklist item.

5.2.4 Owner and dog recruitment

A sample size calculation was not performed due to the hypothesis generating nature of this study, the heterogeneity of measurements being made, the difficulty in predicting the differences expected and the lack of clarity on which parameters would be important in these. Instead, a convenience sample of fifteen dogs was chosen because this was estimated to be the number of dogs still alive from the first part of the study and this was considered a feasible number.

All owners included in the interview study whose dogs were not known to have died were sent the information sheet (Appendix 8) by email or letter to ask whether they would be interested in participating. It was made clear that there was no compulsion to be involved and that declining to be involved did not invalidate their involvement in the first part of the study. If a reply was not received within 3 weeks, a further email or letter was sent; those who did not reply were excluded. These owners were used again due to time limitations on recruiting new owners and because there was no evidence that involvement in the first part of the study should affect their responses in the second part. Additional dogs were recruited in a snowball method from colleagues at SVMS and owners who had expressed an interest in the study after the interview data were collected. Inclusion criteria were the same as for the interview part of the study (see section 3.2.3.2). There was no limit on the number of eligible dogs per household.

Owners who expressed an interest in participating were asked to pick a week for the study which was likely to represent to their dog's normal routine. Owners were advised the study could commence at any time of day on any weekday to suit them and would run for the following seven days. They were aware they could withdraw their involvement at any point in time. Incentives were not provided but as with the interview study, each owner received a bunch of flowers at the visit as a gesture of thanks.

5.2.5 Final study protocol

The final study protocol was the same as that used in the pilot (see 5.2.3). ZB visited each owner's home on day one of the study to talk through the information sheet, study aims and protocol, to obtain signed consent and to ensure the completion of the baseline behavioural checklist. Data (not presented) were also collected (see appendix 8 and 9) using instruments identified in Chapter 2 to determine the owner-reported severity of the dogs' osteoarthritis to ensure that dogs with a range of owner reported severities were included. Owners were provided with a stamped addressed envelope to return the diary to ZB after day 7.

5.2.6 Data coding

Before data analysis, each question was numbered 1-34 from top to bottom of the checklist and the raw data entered into a spreadsheet. The association of each question in the baseline checklist with a good (positive) or bad (negative) directionality (valence) had been confirmed during the feasibility study; this is summarised in

Table 16. Coding applied to the behavioural checklist for analysis. For the purpose of data handling, when a dog was reported as performing a behaviour associated with a positive valence (response of yes) or was not reported as performing a behaviour with a negative valence (response of no or never), this was coded as “positive” and coded as “1”. Conversely, when a dog was reported as performing a behaviour associated with a negative valence or was not reported as performing a behaviour with a positive valence, this was coded as “negative” and coded as “-1”. Responses of “not sure” were not ascribed a valence and were coded as 0.

In the checklist for days 1-7, the response options were “more”, “less”, “same” or “not sure” for change since the previous day. Using the valence of each question, the responses given for each behaviour in each dog each day were as follows for analysis. A code of “better” was given if the dog had performed more of a behaviour with a positive valence or less of a behaviour with a negative valence. A code of “worse” was given if the dog had performed less of a behaviour with a positive valence or more of a behaviour with a negative valence. Responses of “same” were not coded as “better” or “worse” due to the complexity of determining the previous response which had a valence. It was useful to determine how many behaviours remained unchanged as this provided a guide to the behaviours which were not useful to characterising good and bad days. In order to perform statistical analysis on the data, these code terms were converted into a numeric code; a response of 1 corresponded to “better”, -1 corresponded to “worse” and 0 corresponded to “same” (see Table 16).

Table 16. Coding applied to the behavioural checklist for analysis

Behavioural checklist descriptor (question numbers)	Interpretation of the response “yes” from baseline checklist (code)	Interpretation of the response “more” on days 1-7	Coding for responses on day 1-7		
			More	Same	Less
Willing to walk when outside (12); Able to stand when going to the toilet (14); Able to jump up or down stairs/steps/into car (17); Played with dogs (24); Played with people (25); Ate their normal food (34)	Positive (1)	Better	1	0	-1
All other questions	Negative (-1)	Worse	-1	0	1

5.2.7. Data analysis

5.2.7.1 Statistical analysis overview

Statistical analysis was completed by ZB with the assistance of LA using R version 3.2.3 (R Core Team, 2015). Additional R packages used to implement specific tests are listed where relevant. Histograms were used to visually assess whether residuals appeared normally distributed. Where a parametric distribution was suggested, the Shapiro Wilks test was used to determine normality. In basic data results, mean and standard deviation are reported for parametric data whilst median and interquartile ranges are reported for non-parametric data.

5.2.7.2 Basic data

For each dog, the number of good, unsure and bad days and the number and length of walks was counted; their mean, range and standard deviation were calculated for the whole population. Free text data describing the dogs' days were collated from all dogs and categorised according to descriptors inductively derived from the data. Where a response contained several different descriptors (e.g. happiness, lameness, appetite), these individual descriptors were categorised using broad terms without an associated valence inductively derived from the responses given. For example, descriptor term "demeanour" included any description of whether a dog was happy, sad, withdrawn, quiet, interactive or interested. The frequency of use of each of these descriptor terms was then counted across all dog days. The number of good and bad day responses to each of the 34 questions in the baseline checklist and each daily checklists was summed for all dogs. The number of changes in behaviour was counted per dog, where a change is defined as the descriptor not being the same as the previous day.

Qualitative owner feedback on study feasibility was collected through the blank sheet at the end of the diary and any correspondence with owners during or after the study and through field notes collected during owner visits. These qualitative are reported narratively with no additional analysis.

5.2.7.3 Statistical analysis

A generalized linear mixed effects model was used to determine whether there were any relationships between the number of changes each day in the checklist and whether that day was good or bad. In that model the outcome variable was the number of behaviours scored as positive or negative and the comparator was behaviour scored as "same". The fixed effect was the day descriptor and the random effect was dog identity. This was implemented with R package lme4. To improve readability, only results considered to be of statistical interest are included. As this is a small study where the risk of type II error is high through inadequate data points, all statistical results with a p value of <0.1 are reported. To determine the significance of these data, the improved Bonferroni correction (Haccou and Meelis, 1992) was applied to all p-values <0.1 . In this method, p values are ranked from largest to smallest. The number of results generated from each test is counted, then a

new p-value for significance is calculated for each result by dividing 0.05 by the rank order of that correlation where the largest p value is 1, the next largest is 2 etc. Where the calculated p-value for each correlation is smaller than the new p-value, it is considered to be significant. In all calculations performed, a p-value of <0.05 or lower as dictated by the improved Bonferroni method means it is very unlikely any associations could have occurred by chance. All data are rounded to three decimal places.

For completeness, in addition to the p-value, additional statistical data which provide information about the significance of the result are reported as appropriate for the test performed. The degrees of freedom (df) are the number of data points included minus two; this number is reported where appropriate by convention. In the generalized linear model, the estimate describes the mean change in the outcome variable predicted by a change of one unit in the comparator variable whilst holding all other predictors in the model constant. The standard error (SE) is the standard deviation of the estimate. The z-statistic is the estimate divided by its standard error. This provides a measure of the precision with which the estimate has been calculated and can be used to interpret the significance of a result in the absence of a p-value.

5.3 Results

5.3.1 Study population

Seventeen dogs belonging to 16 owners completed the study between September and December 2015; the process of their recruitment is shown in Figure 17. Twelve dogs had been included in the interview study. Dogs ranged in age from 8-14 years and were from 9 breeds plus two cross breeds (Table 17.). Two dogs were believed to have osteoarthritis in a single joint; the remaining 15 were believed to have osteoarthritis in multiple joints. Only one dog was not receiving any treatment at the time of the study.

5.3.2 Baseline checklist data

All owners completed the baseline behavioural checklist with no missing data. Four owners asked for clarification of the meaning of the word “bed” question 3 (in bed during the day) since their dog had multiple beds; they were advised they should interpret it as any bed to which their dog had access. Five owners asked for assistance with questions 17 and 18. Some dogs were able to negotiate some sets of steps but not others; owners were advised to think of a set of steps or stairs their dog used regularly then use their ability on those steps to answer the question throughout the study week. When completing the checklist, several owners commented many changes in behaviour were unrelated to osteoarthritis.

The number of “negative” responses recorded per dog ranged 4 (dog 10) to 17 (dog 13) with a median of 10 per dog and an interquartile range of 8-12. Sixteen dogs spent time in bed, 11 were slow on a walk, 10 were limping or lame, 10 hesitated before jumping and 9 were stiff when walking (Table 18). Only two dogs had made a sound associated by the owner with pain, two had been unable to stand when going to the toilet and one dog had made a sound when touched. Questions 23 (aggression directed towards a person) and 29 (moved away to avoid touch) were answered “no” or “never” by all the owners.

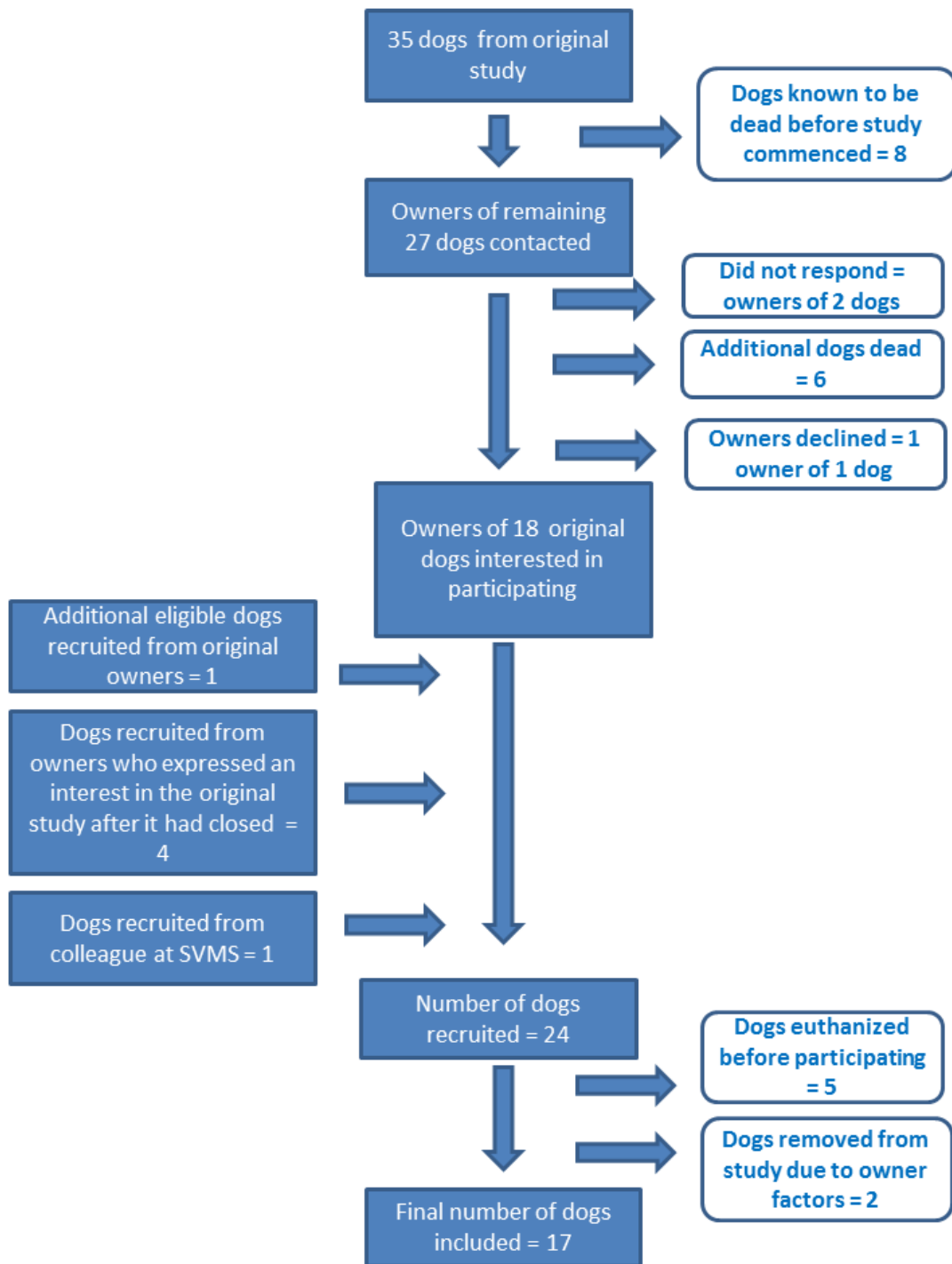


Figure 17. Recruitment of dogs into the prospective study

Table 17. Details of dogs included in the prospective study

Dog ID this study	Previous dog ID	Breed	Age (years)	Joints affected	Comorbidities	Current treatment for osteoarthritis	Restrictions to exercise?
D1FLOR	7	Labrador	11	Multiple	None	Cimalgex, hydrotherapy	None
D2TIGG	8A	Toy Poodle	9	Carpi	None	Cartrophen	None
D3PIP	8B	Toy Poodle	12	Hips	None	Cartrophen	None
D4BRAM	n/a	Labrador	11	Multiple	Urinary incontinence	Metacam, tramadol, Yumove	Short walks
D5HUGO	5	Spinone	8	Elbows	None	Prednoleukotropin	None
D6HARV	n/a	German Shepherd	8	Hips	Epilepsy	Hydrotherapy only	Short walks
D7FOLL	9	Springer Spaniel	9	Right elbow, hips	Behavioural problems	Hills' j/d, Previcox, cartrophen	None
D8TEDB	n/a	Collie cross	13	Stifles	Deaf	Hills' j/d, Previcox	None
D9MOLL	21B	Basset	9	Hips	Hypothyroid, chronic lung disease	None	None
D10MAIS	21A	Labrador	11	Left stifle	None	Gabapentin, Cosequin	None
D11ELKA	n/a	Labrador	14	Front paws, right shoulder, back	Deaf, seizures	Metacam, glucosamine, osteopathy	None
D12DODG	18	Springer Spaniel	14	Hips	Severe hind limb paresis	Tramadol Rimadyl, Cosequin	Garden only
D13LIVI	n/a	Rottweiler	10	Front paws	None	Glucosamine, turmeric	None
D14TEDR	6	Collie cross	9	Left stifle, right hip	Deaf	Yumove, Onsior	Lead only
D15FROD	24	Collie	11	Right elbow	None	Devil's claw	None
D16MILL	26	Boxer	11	Right hock, left stifle	Renal disease, cruciate rupture	Tramadol on bad days	No jumping
D17BOSS	32	Greyhound	10	Left carpus, right hip	Blind since mid-2015	Synoquin	Lead only, no stairs

Legend: n/a = not applicable

Table 18. Summary of the responses provided for all dogs to the baseline behavioural checklist

Response given by owners to baseline questions	Yes	No	Not sure	Never	Total negative valence responses	Total positive valence responses
Behavioural checklist question (number)						
Stiff getting out of bed (Q1)	7	9	1	0	7	9
Reluctant to get out of bed (Q2)	5	11	1	0	5	11
In bed during the day (Q3)	16	0	0	1	16	1
Dug bedding before lying down (Q4)	5	8	0	4	5	12
Circled before lying down (Q5)	8	7	0	2	8	9
Changed position when lying down (Q6)	8	5	4	0	8	5
Reluctant to go for a walk (Q7)	2	11	1	3	2	14
Limped or lame (Q8)	10	7	0	0	10	7
Held up a paw of leg (Q9)	2	13	0	2	2	15
Stiff when walking (Q10)	9	8	0	0	9	8
Panted when on a walk (Q11)	8	8	1	0	8	8
Willing to walk when outside (Q12)	13	4	0	0	4	13
Slow when out on a walk (Q13)	11	5	0	1	11	6
Able to stand when going to the toilet (Q14)	15	1	0	1	2	15
Made sounds owner associated with pain (Q15)	2	12	0	3	2	15
Interacted with other dogs on a walk (Q16)	11	4	0	2	6	11
Able to jump up or down stairs/steps/into car (Q17)	13	2	1	1	3	13
Hesitated before jumping up or down (Q18)	10	4	2	1	10	5
Withdrawn or quiet (Q19)	3	11	1	2	3	13
Clingy or attention seeking (Q20)	6	10	0	1	6	11
Grumpy (Q21)	4	12	0	1	4	13
Growled, snapped or lip-curved at another dog (Q22)	2	13	0	2	2	15
Growled, snapped or lip-curved at a person (Q23)	0	13	0	4	0	17
Played with dogs (Q24)	8	7	0	2	9	8
Played with people (Q25)	10	5	0	2	7	10
Made a sound when touch (Q26)	1	12	0	4	1	16
Made a sound when not touched (Q27)	1	12	0	4	1	16
Flinched or jumped when touched (Q28)	3	12	0	2	3	14
Moved away to avoid touch (Q29)	0	16	0	1	0	17
Looked sad (Q30)	3	12	1	1	3	13
Looked like they were pain (Q31)	3	11	1	2	3	13
Dull in the eyes (Q32)	1	12	1	3	1	15
Licked joints or other areas (Q33)	10	7	0	0	10	7
Ate their normal food (Q34)	16	1	0	0	1	16

5.3.3 Behavioural checklist data from days 1-7

Checklists were analysed as described in 5.2.7. All owners completed the behavioural checklist each day (Table 19. 19). A maximum of 238 behaviours (34 behaviours on 7 days) were scored per dog per week with up to 119 scores provided per behaviour across all dog days (17 dogs on 7 days). Some owners crossed out or wrote “*not applicable*” next to behaviours on some days. Where this was consistent across the study week it caused no problems, but otherwise it made it impossible to know whether the next score for that behaviour related to the previous day or the last day on which that behaviour was scored. For the purpose of analysis, crossed out questions were counted as “not applicable” and all scores provided were assumed to be in comparison to the previous day. The format of the diary asking owners to compare their dogs’ day with the previous day made it difficult to track changes in good and bad day behaviours for each individual dog throughout the week.

All dogs had a reported change from baseline in at least one checklist item on at least one day. The total number of changes in any direction in all behaviours across the study week ranged 1/238 (dog 3) to 77/238 (dog 4) with a mean of 34/238 (SD=21.54) changes per dog during the study week. For all questions, the response “same” was most frequently recorded. Questions 12 (willing to walk when outside) and 13 (slow when out on a walk) were the most sensitive to change with 40 changes to “more” or “less” recorded for each across all dog days. Questions 22 (aggression directed towards another dog) and 23 (aggression directed towards a person) were most frequently deemed not applicable. Questions 6 (changed positions when lying down) and 7 (reluctant to go for a walk) were the questions about which the owners were most often unsure. On some days, several owners wrote notes that changes were not related to the dog’s osteoarthritis. The inability of a dog to have performed a behaviour on that day due to its management (e.g. the owner did not have time to walk or play with the dog; hot or wet weather led to a change in the walk chosen) was the most commonly described. For the purpose of analysis, the changes were still included.

5.3.4 Free text daily diary responses

Each dog’s day was scored as good, bad or unsure by their owner with no missing data (Appendix 10). The range of good days for each dog across the study week was 2-7 (mean = 5, SD = 1.52), bad days ranged 0-3 (mean = 1, SD = 1.20) and unsure days ranged 0-2 (mean = 1, SD = 0.78). Owners used between one and four descriptors per dog per day (**Error! Not a valid bookmark self-reference.20**); many used the same descriptors daily. Typically, each day’s description included assessments of a dog’s demeanour, often contextualised with experiences or stimuli, and their physical ability. The dog’s demeanour and willingness to walk were the most common descriptors used; only dog 12 was not described in terms of demeanour any day. The descriptors used for dogs 9 and 10 were different despite being assessed by the same owner.

Some descriptors were written in terms of change from the previous day (e.g. “*Happier than yesterday*”), whilst others were just a statement the descriptor had occurred (e.g. “*Stiff*”). On good and bad days, the directionality of descriptions of demeanour was the same as the directionality of descriptors related to physical ability, e.g. happier and less stiff on a good day. Unsure days consistently appeared to be associated with discordance between the directionality of demeanour and

physical ability descriptors. For example, the dog was less happy in demeanour but normal or better in terms of mobility or vice versa.

Table 19. Scores for each behaviour for all dogs across the study week (n=119 per question)

Behavioural checklist descriptor (question number)	Better	Same	Worse	Not sure	Not applicable
Stiff getting out of bed (Q1)	16	97	5	1	0
Reluctant to get out of bed (Q2)	17	82	7	1	12
In bed during the day (Q3)	15	79	15	3	7
Dug bedding before lying down (Q4)	9	60	5	7	38
Circled before lying down (Q5)	13	83	2	1	20
Changed position when lying down (Q6)	11	95	5	6	2
Reluctant to go for a walk (Q7)	22	58	11	1	27
Limped or lame (Q8)	13	88	17	0	1
Held up a paw of leg (Q9)	9	80	4	1	25
Stiff when walking (Q10)	16	85	16	1	1
Panted when on a walk (Q11)	12	88	6	3	10
Willing to walk when outside (Q12)	23	77	17	1	1
Slow when out on a walk (Q13)	23	69	17	0	10
Able to stand when going to the toilet (Q14)	5	94	5	1	14
Made sounds owner associated with pain (Q15)	2	63	0	1	53
Interacted with other dogs on a walk (Q16)	17	68	8	0	26
Able to jump up or down stairs/steps/into car (Q17)	8	85	6	3	17
Hesitated before jumping up or down (Q18)	5	85	11	3	15
Withdrawn or quiet (Q19)	10	63	8	2	36
Clingy or attention seeking (Q20)	7	61	8	1	42
Grumpy (Q21)	5	61	5	0	48
Growled, snapped or lip-curved at another dog (Q22)	9	45	9	0	56
Growled, snapped or lip-curved at a person (Q23)	3	50	2	1	63
Played with dogs (Q24)	12	72	9	1	25
Played with people (Q25)	17	74	5	1	22
Made a sound when touch (Q26)	1	62	1	0	55
Made a sound when not touched (Q27)	0	66	1	1	51
Flinched or jumped when touched (Q28)	2	71	4	0	42
Moved away to avoid touch (Q29)	4	77	1	1	36
Looked sad (Q30)	8	67	14	1	29
Looked like they were pain (Q31)	5	67	7	2	38
Dull in the eyes (Q32)	7	69	1	1	41
Licked joints or other areas (Q33)	14	88	5	2	10
Ate their normal food (Q34)	8	105	5	1	0

Table 20. Descriptions of dogs' days provided by owners in the free space in the diary

Dog day descriptor	Definition of this descriptor	Frequency of use (any dog, any day) (n=119)	Number of dogs described using this term on any day (n=17)
Demeanour	Any description relating to a dog's demeanour e.g. happiness, sadness, their willingness to interact with people, dogs or objects either in the house or on walks	59	16
Willingness to walk	Keeness/willingness either to go on or continue with a walk.	56	17
Play	Play with people, dogs or objects	21	8
Walk speed	Any comment on the dog's speed during a walk	14	7
Lameness	Any description of lameness including presence/absence and severity	14	7
Owner's ability to give the dog attention	Any reference to a dog's day being impacted by owner behaviour	13	7
Walk length	The length of a walk in time or distance	9	5
Stiffness	Any description of stiffness	8	5
Restlessness	Presence or absence of restlessness	7	2
Appetite	The dog's appetite or interest in food	6	4
Bladder/gastrointestinal problems	Bladder or gastrointestinal problems	6	3
Sleep quality	Length of or ability to sleep	4	3
Ability to walk	Any description of mobility not included in the previous descriptors	3	2
Ease of handling	The owner's ability to handle the dog	1	1
Pain	Pain or comfort	1	1
Effect of treatment change	Any comments about medications or physical therapies which might have affected the dog's day	1	1

5.3.5 Relationship between changes in the behavioural checklist each day and the description of that day as good, bad or unsure

Generalized linear mixed effect models suggested when an owner described their dog's day as "good", greater number of behavioural descriptors were scored positively (by an estimated 1.53 descriptors per dog per day, SE=0.23, $z=6.63$, $p<0.001$) and fewer were scored negatively than on a "bad" day (by an estimated -1.76 descriptors per dog per day, SE=0.1703, $z=-10.355$, $p<0.001$; Figure 18). Conversely, when an owner described their dog's day as "bad", a greater number of behavioural descriptors were scored negatively and fewer were described positively than on a "good" day. When an owner described their dog's day as "unsure", fewer behavioural descriptors were scored negatively than on a "bad" day (by an estimated -0.5123 descriptors per dog per day, SE=0.1869, $z=-2.741$, $p=0.006$). There was not a corresponding increase in the number of descriptors scored positively on an unsure day (estimated 0.1443 descriptors per dog per day, SE=0.3275, $z=0.441$, $p=0.660$). Behaviours with a valence of positive and negative correspond to owners' interpretations of their dogs' days as good and bad respectively. The relationship between the descriptors and unsure days is less clear.

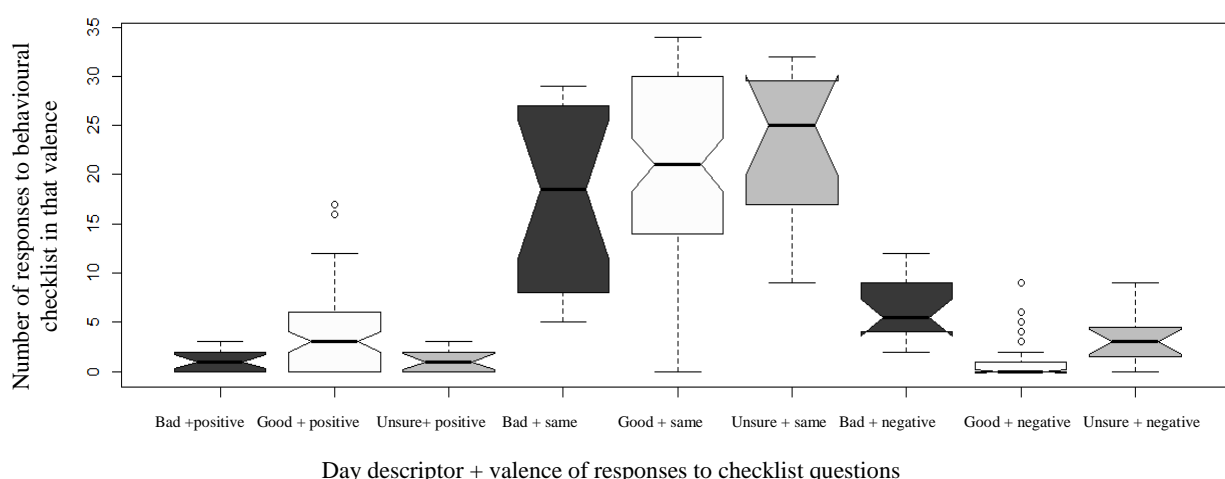


Figure 18. Boxplot comparing the type of day with the number of behaviours scored as positive, negative or the same number on the behavioural checklist. The waist demonstrates the median value, with the upper and lower boundaries of the box corresponding to upper and lower quartiles respectively. Maximum and minimum values are represented by the whiskers with outliers represented as o.

5.3.6 Owner feedback on their involvement in the study

Thirteen owners of 13 dogs provided feedback on their experience of participating in the study. Most reported the experience of being involved in the study to have been easy and the clear framework of behaviours to assess each day useful. Several commented completing the diary each day had helped them to understand how their dog's behaviour was affected by their osteoarthritis. Two said the process had helped provided them with a useful framework to decide when to euthanase their dog. A couple of owners of minimally affected dogs commented they found the diary boring because their dog's behaviour had not changed during the study week. Several felt it would have been helpful to be able to record when changes in behaviours in the

checklist were not related to their dogs' osteoarthritis and a few said it would be useful to be able to insert their own descriptors.

5.4 Discussion

This study is the first of which the author is aware that asked owners to record observations about osteoarthritic dogs on a daily basis for seven consecutive days. These data should be of use to veterinary professionals both in clinical practice and in clinical research to improve their understanding of the outcomes owners of osteoarthritic dogs feel to be important, are able to monitor, and the language that they use to describe those outcomes.

The behavioural checklist appeared acceptable to most owners and was very useful as a research tool to document daily behavioural changes that have not previously been described. Several key findings emerged. It was identified that most osteoarthritic dogs are recognised by their owners to have both good and bad days during a single week and that there may be days that owners find difficult to classify in this binary manner. Good and bad days have been described in relation to canine osteoarthritis (Brown, 2014a), but the existence of unsure days had not previously been identified. These fluctuations within a single week may undermine owners' ability to accurately determine their dogs' disease severity and to make decisions about treatment efficacy. This could have significant consequences for the welfare of those dogs.

The free text diaries provided a fascinating insight into how owners make decisions about whether dogs' days are good and bad, highlighting that 16/17 dogs had an assessment of demeanour included in this decision. These data suggest that when owners are discussing good and bad days, they may be referring to a composite measure of their dogs' physical health and demeanour. The data collected on "unsure" days suggests that some dogs on some days have a divergence between physical ability and demeanour; this relationship is clearly complex and merits further attention.

Behaviours in the checklist appeared to have captured a significant proportion of the outcomes used by owners to describe their dogs' day when compared to the daily diary. Associations between specific behaviours identified during the interviews and owners' perceptions of good or bad days were tested using that checklist and those associations appeared to be valid. However, several descriptors in the checklist did not appear to perform well. Most significantly, descriptor "looked sad" which had been included to encompass the descriptions of demeanour provided by interviewees, was recognised by only a few owners. Owners interviewed by Brown (2014a) during the development of the COI reported associating similar changes in their dogs' demeanour with good and bad days. Brown collated these descriptors into a single term but this was excluded from the COI instrument as it was not identified by enough owners as relevant. Given the similar finding in this study, this suggests that the use of a single overarching descriptor for demeanour in a fixed item instrument is not sufficiently sensitive for all dog-owner combinations. However, the free text data captured during this study strongly suggests an assessment of demeanour should be included in any outcome measure designed for this purpose as it is used by many owners when assessing their dog's day. Further work is needed to identify whether a

more universally applicable term exists for this important outcome in future outcome measures and if not, alternative approaches should be sought to capture these data.

The free text box data demonstrated that owners appear to be appraising both inputs and indicators of behaviour in a very similar way to that theorised by Yeates (2013). Inputs included the owners' ability to spend time with their dog, the environment, treatment efficacy and any comorbidities that might affect their dogs' health. Indicators included willingness to play, walk, appetite, and sleep quality. The impact of factors other than physical health on osteoarthritic dogs' behaviour should be integrated into future outcome measures for canine osteoarthritis. Only one owner used the term "pain" in the free text box. The CBPI (Brown *et al.* 2009) is reliant on owners being able to recognise the impact of pain on their dogs' activity levels. These data suggest that as discussed in the previous chapter, descriptors such as stiffness and willingness to walk should be investigated as appropriate, more owner-friendly synonyms.

This study suggests that owners are aware of the importance of assessing multiple aspects of their dogs' welfare in a way not reflected in the physical health-dominated outcome measures described in Table 15. Furthermore, those outcome measures may be challenging for owners to complete for a range of reasons: they do not permit daily changes in dogs' conditions to be recorded; they do not allow owners to reflect the impact of different inputs that might affect their dogs' behaviour; the outcomes included may not be those that owners consider relevant to their dogs; and outcomes that are included may be challenging for owners to interpret. This demonstrates the value of using a qualitative approach involving owners when constructing an outcome measure for their use and of performing work to ascertain the validity of any new outcome measure before using it in clinical research. However, no matter how well designed any outcome measure for canine osteoarthritis might be, their value as evidence-based decision making tools is currently severely limited by the paucity of evidence to link any individual treatment for the disease to an outcome recognised to be relevant to owners in this research.

5.4.1. Study limitations

Since this pilot study includes only a small sample of dogs it is not possible to extrapolate the findings to a wider population, but the results provide useful insights to inform future work. The study design had several limitations which may have impacted results.

At present, there is no gold standard method to collect data about a dog's welfare so the link between these owner observations and how the dog was actually feeling remains unknown. This remains a significant limitation of any work which relies on interpretation of canine behaviour and much more work should be directed to this area. Use of video data or standardised walks similar to those described in Bruno *et al.* (2015) could be novel methods to address this. The 16 self-selecting owners may not represent the feasibility of using this study design in a wider population. It would have been ideal to recruit a new set of owners for this study to test the checklist terms with a naïve population but time pressures precluded this. Consequently, many of the owners included had already participated in the first part of the study. It is possible that involvement in the earlier study changed what these owners noticed in their dogs or affected their responses to the questions posed. However, a systematic review of publications investigating the risks associated with research participants in non-

laboratory settings being aware of the interests of the researchers found no conclusive evidence that this had a detrimental impact on data collected (McCambridge *et al.* 2012). In support of this, there were no obvious differences in the original owners' responses when compared to those of newly recruited owners and without concurrent video footage of each dog it is impossible to determine how accurately any owners completed the checklist or diary. Even if owners were sensitised to particular aspects of their dogs' disease through prior involvement, this should only have improved their accuracy at noticing relevant behavioural changes. In addition, over a year had elapsed between the interviews and recruitment for this second part of the study during which there had been no contact with these owners. It is therefore unlikely that this method of owner recruitment altered the findings of this research. Owners should not have felt pressurised to participate in this second part of the study since the letter of invitation sent to them clearly stated that there was no obligation to be involved and those owners who did choose to take part expressed a strong desire to do so.

Useful data were gathered using the checklist that could not have been obtained without some form of daily diary but its design would require significant refinement before being used again. The number of descriptors should be refined; presence or absence of behaviour in a day provides only very crude data; and many behaviours were likely to be affected by factors other than the dogs' disease. Factor analysis could reduce the number of items to minimise risk of response fatigue. The analytical challenges associated with including comparison with the previous day in the main checklist should have been anticipated, particularly relating to the "same" behaviours. The design could be refined by removing these comparisons to leave just presence or absence of each behaviour each day, though it is unlikely that many behaviours are so binary. The free text diary entries provided arguably the most interesting data but this too was challenging to analyse due to the diversity of owner responses. Other analytical techniques such as thematic analysis may have been more appropriate for these data.

5.5 Conclusions

This study collected daily owner observations about osteoarthritic dogs over a 7-day period. Although only a small study, it identified several important deficiencies in the existing outcome measures available for use by owners of osteoarthritic dogs, highlighting the importance of working with owners to better understand this disease. These data suggest that the outcome measures currently available for use by owners of osteoarthritic dogs may not contain descriptors that owners perceive to be relevant to their dogs' disease and that collecting data on a daily rather than weekly basis is likely to be important for many dogs. Owners appear to assess multiple aspects of their dogs' welfare in addition to their physical health but they are often unsure about how to interpret what they see. These results suggest that interpreting canine behaviour in relation to osteoarthritis is very challenging and that a dog's demeanour may not always reflect their physical ability. Much more work is needed to understand how best to monitor and make decisions about osteoarthritic dogs' welfare in a home environment; this study provides pilot useful data that can be used in the design of any future outcome measures for this purpose.

5.6 Relevance to the aim of the thesis

Chapter 4 identified that owners have a key role in making decisions about the welfare of osteoarthritic dogs. Veterinary surgeons therefore need to be aware of how owners make these decisions. This study captured details of how 16 owners interpreted the behaviour of 17 osteoarthritic dogs. Almost all owners appeared to use a complex mix of their dogs' physical health, demeanour and the experiences that they had that day to make a judgement about whether each day of the study week was good or bad. On some days, owners were not able to make a clear binary judgement. Impacts identified by owners of personality, management, the environment and comorbidities on dogs' behaviour suggest identification of behaviours affected only by osteoarthritis may be extremely challenging. This confirms the relevance of the aspects of welfare identified in Figure 2. The validity of outcome measures that assess only physical health in canine osteoarthritis or that make a direct link between specific behaviours and osteoarthritis severity warrants further investigation.

Chapter 6. Discussion

This thesis used a range of methods to investigate how owners and veterinary surgeons in the United Kingdom make decisions about osteoarthritic dogs. It includes the first two published reviews to systematically describe veterinary outcome measurements; the first comprehensive qualitative research into the perspectives of owners and veterinary professionals about canine osteoarthritis; and the first use of a daily checklist and diary to monitor osteoarthritic dogs' behaviour in a home environment.

The range and nature of decisions made about dogs with osteoarthritis appears to be highly complex, with a large proportion of all decisions being made by owners. Owners and veterinary professionals may use different terminology when discussing the disease and do not always understand each other's perspectives. Few decision-makers involved in this research appeared confident that they were making the best decision for the dog involved. This was due to a wide variety of factors including: poor awareness in owners of the clinical signs of osteoarthritis; poor exchange of information during veterinary consultations; little relevant evidence on which to determine treatment strategies; poorly defined outcomes of interest to monitor any treatment instigated; challenges interpreting canine behaviour in relation to osteoarthritis; and the strong emotional attachment of many owners to their dogs. Current outcome measures designed to aid decision making about osteoarthritic dogs may not be fit for purpose as they do not take into account the complexity of canine behaviour or the influence of inputs to a dog's welfare other than physical health.

Many of the key findings in this thesis were due to the use of qualitative research methods that directly engaged with owners and veterinary professionals. By using interviews and focus groups, a relatively small number of participants were able to generate rich data that identified aspects of osteoarthritis management not previously included in the more quantitative research studies previously performed in this field. These data identified incorrect assumptions that had been made by other researchers about the language that owners might use to describe their dogs' disease, outcomes that they would find important and challenges associated with practically applying outputs of previous research. Collecting these data was relatively inexpensive and incredibly rewarding. It is highly recommended that other researchers working in veterinary medicine adopt qualitative methodologies to ensure incorrect assumptions made by researchers do not proliferate in other fields.

The process of decision making identified in 1.5 will be used to frame this discussion, highlighting new insights gained from this work.

6.1 Thesis limitations

This limitations sections refers to the thesis as a whole. Limitations of each of the individual studies making up the thesis were discussed in sections 2.6, 3.4, 4.6.1 and 5.4.1.

Much of the data presented in this thesis, particularly in Chapter 5, is of a preliminary nature so its generalisability is likely to be limited. My inexperience in all the fields of the research included in this thesis is likely to have had an impact on the design, data collection, analysis and interpretation in all studies presented. It

would have been fascinating to more directly address the relevance of the Animal Welfare Act (2006) with owners and veterinary professionals. My understanding of welfare as a term applicable not just to cruelty cases evolved during the course of this thesis, and that is reflected in the content of the sequential chapters. This change is a due in no small part to the book by Yeates (2013); had that book been available when the studies contained in this thesis were devised, their content would have been significantly different and that is regrettable. Literature in the field of experimental animal research has not been included and this may contain many relevant frameworks for canine welfare assessment.

6.2 Recognising problems

If owners do not recognise behavioural changes or clinical signs relating to osteoarthritis, treatment will not be instigated. The challenges faced by owners to distinguish normal and abnormal canine behaviours were evident in data presented in Chapters 4 and 5. Many factors were identified that precluded owners from realising their dog had osteoarthritis or that it was worth seeking veterinary attention (summarised in Figure 9). Many veterinary surgeons described challenges associated with trying to convince owners that their dog had osteoarthritis; both owners and those veterinary surgeons suggested that this was a common problem. The language used by owners to describe their dogs' disease appeared to be different to that used by veterinary surgeons and this may present a very significant barrier in these discussions. Veterinary surgeons may require different communication skills to explore and challenge owners' incorrect prior knowledge during consultations where osteoarthritis is not a presenting problem; explanations used by veterinary nurses may be useful. Further exploration of the use of the free text descriptors collected in Chapter 5 with a larger population of owners may help to identify a different lexicon that veterinary professionals could use when discussing canine osteoarthritis.

Information for owners should be produced and widely distributed focused on barriers identified during this thesis to recognising and treating canine osteoarthritis. Given the estimated prevalence of the disease, dog owners should be educated about the signs described by owners in this study when their dogs are at a young age. Longer consultation times to permit thorough discussions of barriers to treatment are likely to be needed in many veterinary practices.

6.3 Assessing health and welfare

The Animal Welfare Act (2006) and the RCVS Code of Professional Conduct (2012) describe clear responsibilities for maximising animal health and welfare. However, significant problems relating to the assessment of health and welfare in osteoarthritic dogs under veterinary care were identified during this research. Owners assessed their dogs' health, welfare and treatment response through their behaviour. Directly observed, or owner-reported, behavioural change was also the method of choice for veterinary professionals to diagnose osteoarthritis and monitor treatment success. However, behavioural assessments described were subjective and are at risk of many sources of bias. Age-related changes, comorbidities, treatment adverse events, personality traits such as stoicism, owner management practices and environmental factors such as the weather confounded owners' ability to use behaviour to determine the severity of their dogs' osteoarthritis or the impact of any treatment. The strong

bonds identified between many owners and their dogs is likely to be a cause of additional subjectivity in owners' behavioural interpretations.

Veterinary surgeons' focus on physical health assessment was evident throughout this thesis. Those involved in focus groups suggested their assessments of anything other than physical health were limited, and some owners felt that even those assessments were inadequate. It appeared that discussions of welfare beyond physical health were typically limited to conversations near the time of euthanasia. Potential threats to welfare from management regimes such as limited exercise did not appear to be recognised by veterinary surgeons, and little advice appeared available to owners about how to improve their dogs' comfort or happiness in a home environment other than through pharmaceutical means. In contrast, the few veterinary nurses involved in this research described frequently discussing these aspects of osteoarthritic dogs' care.

Owners appeared largely reliant on veterinary surgeons to assess their dogs' health but they attempted to understand their dogs' welfare through identifying good and bad days. These behavioural assessments frequently incorporated both physical health and demeanour parameters, as well as comparisons of the dogs' behaviour in specific situations to previous days. Interpreting these assessments is demonstrably challenging. For example, the mobility of many dogs involved in this research was thought to be impaired, but it remains unclear how mobility relates to pain, and pain to welfare; some owners noticed changes in their dogs' demeanour independent of their mobility. It is not clear how reliable these assessments are or how they can be interpreted but they appear highly significant in owner decision making so warrant further investigation.

Clarity on definitions of welfare and its synonyms in relation to clinical veterinary medicine is urgently needed. Discussion of animal welfare should be incorporated throughout the veterinary undergraduate curriculum, particularly in clinical disciplines, taught by veterinary surgeons. Education of general practitioners to consider welfare other than physical health in every single consultation should be prioritised, led by veterinary surgeons with credibility in clinical veterinary medicine and surgery. It is hoped that the VetFutures panel's focus on this area will achieve this aim (Anon, 2016b). Owners involved in this thesis would suggest this would be welcomed by the pet-owning public.

6.4 Evidence-based decisions

Evidence-based medicine encourages evidence-led decisions. The peer-reviewed evidence for the treatment and management of canine osteoarthritis was critically appraised in 1.6. This evidence is often weak and answers to key questions identified by owners and veterinary professionals involved in this research such as the most effective treatment combination, how much exercise dogs with osteoarthritis should receive, how often to perform blood tests for dogs on NSAID treatment and how to manage dogs with significant comorbidities have not been addressed. Chapter 2 identified that many of the outcomes used in studies on which treatment guidance is based were unvalidated so it is unclear how reliable this evidence is, and the range of outcomes measured is prohibitive to good evidence synthesis. Many dogs involved in Chapters 3-5 had multi-joint disease and comorbidities that affected their management; similar dogs are rarely included in clinical trials or in the validation of

outcome measures. This further contributes to the challenges associated with applying any published evidence to this population.

The negative impact of incorrect or outdated prior knowledge on decisions made by owners and veterinary professionals was evident throughout Chapter 4. Owners interviewed had very poor access to any published evidence either through their veterinary surgery or the internet, so were unable to make evidence-led decisions. Some felt unable to discuss things they had heard about outside the practice with their veterinary surgeon for fear of being negatively judged. Many felt that their veterinary surgeon was not well informed about the range of treatment options available. Furthermore, owners' knowledge about canine behaviour in relation to assessing outcomes in which they were interested was highly variable and often very limited. Veterinary surgeons appeared unaware of some of the published evidence, used outcome assessments that might be unreliable, described using tacit knowledge in preference to making regular reference to published information sources and sometimes made judgements about which evidence to present to owners. Some understood owner wishes needed to take precedence over the evidence. Many thought that the risk of adverse events was too great to allow them to use the treatments most likely to be effective in some patients. It was not clear that the veterinary nurse participants were aware of the need to appraise the quality of any evidence before applying it to patients.

The evidence base, and awareness of that evidence base, for the treatment and management of osteoarthritic dogs, particularly those with comorbidities and multi-joint disease, appears very poor. Considering the likely prevalence of this disease, this is a serious problem. Many improvements could be made. Inclusion of dogs more relevant to the population identified in this thesis in clinical trials; inclusion of outcomes relevant to owners, veterinary professionals and dogs in those clinical trials; assessment of those outcomes with validated outcome measures; research focused on questions prioritised by owners and veterinary surgeons; and dissemination of the results of those studies to owners and veterinary professionals, particularly through online sources, will be important strategies to improve the quality of evidence for making decisions about dogs with osteoarthritis.

6.5 Identifying and assessing outcomes

Chapter 4 identified that treatment goals, and outcome measures for assessing these goals, were rarely established during veterinary consultations. Many owners considered their dogs' comfort, happiness and quality of life important outcomes and were aware of the complexity of those concepts. In contrast, veterinary surgeons participating in the focus groups appeared to consider outcomes related to pain and mobility to be the most important. Outcome measures for the assessment of canine osteoarthritis in the peer reviewed literature identified in Chapter 2 also focused predominantly on physical health. Many of the quality of life outcome measures identified had a disease-specific physical health focus; few were relevant to canine osteoarthritis. There is a clear need for consensus on the most important outcomes for owners, veterinary professionals and dogs, and the production of validated, practical outcome measures with which they can be assessed; data collected in Chapter 5 will help with this.

Quality of life appears to be an important outcome for owners of osteoarthritic dogs and the term was used by veterinary surgeons in relation to euthanasia decision-

making. However, definitions of quality of life proposed by owners involved in this research bore little resemblance to the broadly accepted concept of an individual's satisfaction with their own life. Proposed definitions of quality of life were discussed in 1.4.3 yet there remains no consensus on a definition and the term is rarely defined in instruments for its assessment. To base life or death decisions on quality of life assessments if this complex concept is not defined is irresponsible. Taylor and Mills (2007) suggested the term quality of life should be used instead of welfare because at that time, welfare definitions did not acknowledge the need for positive experiences, only the avoidance of negatives. It could be argued that now definitions of welfare have changed to encompass positive experience, the term quality of life has become progressively redundant. Replacing "quality of life" with "happiness", whilst less scientific, may be much more helpful to all decision-makers to ensure assessments have the right focus.

Effort should be put into developing good frameworks to allow owners and veterinary professionals to understand and discuss welfare inputs to continually ensure that dogs with osteoarthritis have the best possible welfare. Combining assessments of inputs to welfare with assessments of dogs' behaviour indicators as postulated by Yeates (2013) perhaps provides the clearest framework currently available to assessing welfare. The reliability of any behavioural assessments might be maximised when a dog has a choice of what to do in a relaxed home environment to reduce the number of other factors that may be influencing that behaviour. Standardised tests, such as those described by Bruno *et al.* (2015) or used in behavioural science (Roth and Jensen, 2015), warrant further investigation. Mobile telephones could be used to video dogs' behavioural responses to situations identified by owners as being likely to induce positive emotions, for example when a lead is produced or when food is offered, to see what the dog looks like at its best. Identification of specific behaviours (including facial, tail and whole body movements) consistently associated with positive and negative welfare states in dogs of a wide range of ages, breeds and health conditions would move practical welfare outcome assessment forward a huge step. This is likely to involve collaboration between animal welfare scientists, veterinary surgeons, canine behavioural experts and dog owners; this may be possible due to the new Animal Welfare Research Network (Mendl *et al.*, 2016). In the interim, encouraging discussions of all aspects welfare between owners and veterinary surgeons may benefit canine welfare more than the development of additional instruments to assess quality of life.

6.6 Ensuring decisions made and outcomes assessed are in the best interests of the dog

Figure 11 and Figure 12 summarised motivators and barriers to owners and veterinary professionals acting as proxies and advocates for osteoarthritic dogs. Many barriers related to problems identified above but poor relationships between owners and veterinary surgeons appeared to be an exacerbating factor. Short consultation times; poor understanding of owner terminology, knowledge levels and perspectives; lack of awareness of the impact of osteoarthritis on dogs and their owners; poor continuity of care; risk aversion; the perceived need to compromise advocacy in favour of maintaining client relationships; and a lack of clarity regarding their ability to advocate for welfare outcomes were all factors that contributed to a lack of advocacy by veterinary surgeons. Many interviewees felt their veterinary

surgeon had not adequately advocated for their dog's welfare, and for some this led to an erosion of trust and/or respect of one or many veterinary surgeons. Rare examples were given where owners felt that their veterinary surgeon had acted as a barrier to their own advocacy. Some interviewees suggested a greater role for veterinary nurses due to their perceived non-judgemental attitude towards owners and those involved in the focus group appeared keen to increase their involvement with these dogs and owners. Veterinary nursing clinics may help to overcome some of the time pressures and poor continuity of care associated with some veterinary consultations described. A framework for what should be discussed in canine osteoarthritis consultations may be beneficial to improve their focus on all aspects of welfare.

Preferred relationship styles ranging from autonomy to paternalism were identified by both interviewees in the current study and those interviewed by Christiansen *et al.* (2016). Veterinary consultations are highly complex interactions (Everitt *et al.*, 2013, Robinson, 2014) and there may be no best single model for consultation. However, interviewees in this thesis suggested the best decisions are made in collaborative relationships that encourage both owner and veterinary professional to contribute information a decision centred on the dog. The current model of veterinary communication skills, based on a human medical framework that champions patient autonomy (McCartney *et al.*, 2016), may not be fit for purpose when discussing dogs with osteoarthritis. The information gathered in this thesis should be useful in the development of alternative consultation approaches that focus more on the needs of the dog.

6.7 Decisions made by owners after the consultation

Owners interviewed described making a huge number of decisions without any veterinary advice after their dog was diagnosed with osteoarthritis. Most felt their ability to make good decisions was limited by their lack of knowledge. The owner-led focus of some veterinary consultations meant that decisions made outside the consulting room could subsequently affect decisions made by veterinary surgeons. Whilst a few owners were reliant on their veterinary surgeon for all information, many used alternative information sources ranging from Facebook to strangers. Most owners were aware that this information may be less evidence-based than that provided by their veterinary surgeon but many still used this advice. In some cases, this led to owners stopping prescribed medications. This has clear potential for negative welfare implications for those dogs. Details collected during this research of the information owners reported seeking will be useful for veterinary surgeons to improve the content of their consultations.

These results suggest provision of good quality information for owners on the internet about the treatment and management options available for canine osteoarthritis is likely to benefit the welfare of osteoarthritic dogs, though the problems with that evidence base have previously been discussed. A particular problem was identified around the use of NSAIDs. Owners described varying degrees of risk-aversion towards giving analgesic medications to osteoarthritic dogs. When high level risk-aversion was combined with a poor ability to recognise signs of pain, the chance of those medications being withdrawn or their dosing modified appeared to increase. This further emphasises the need for owners to be aware of the behaviours linked to outcomes of interest. Development of websites including videos

of owners talking about how they recognised and managed pain in their dog may be a particularly powerful method of tackling this problem.

Negative impacts of owning a dog with osteoarthritis discussed in 4.5.3 were also identified by owners of chronically ill dogs interviewed by Christiansen *et al.* (2013). Veterinary surgeons in the focus groups appeared aware of some of these impacts but did not appear to perceive them to be particularly significant to some owners. Dissemination of the results of this research to veterinary surgeons may help to improve their empathy towards owners. Many owners interviewed by Christiansen *et al.* (2016) and in this study described a desire for veterinary surgeons to provide them with more advice about when to euthanase their dog. However, re-check appointments were frequently described as unhelpful and veterinary surgeons were not sure this was their responsibility. However, unsupported owners may delay making decisions or choose risk-averse options that are not in the dogs' best interests. Hopefully this thesis will go some way to improving the quality of those interactions.

6.8 Overarching conclusions

At the inception of this thesis, very little research had been conducted to understand how and why veterinary professionals or owners make decisions; some of those gaps have now been filled. Outcome measures developed for the assessment of canine osteoarthritis and quality of life are limited in their scope, quality, validity and relevance. Those outcome measures were not used routinely by any owners or veterinary professionals involved in this study. Consequently, many decisions about dogs with osteoarthritis managed in general practice are likely to be based on subjective, unvalidated behavioural assessments that may not accurately reflect the dogs' welfare. Decisions made, particularly inside the veterinary consulting room, are not always focused on the best interests of the dogs and may place excessive emphasis on physical health. Risk aversion may play a significant role in treatment decisions made by owners and veterinary professionals. Owners are able to gather data that may be useful to aid decision making, but the absence of a link between these data and evidence-based treatment or management guidance means these data are relatively meaningless. In combination, this has significant negative consequences for the welfare of osteoarthritic dogs, their owners and even the veterinary professionals involved in their care.

6.9 Future work

This thesis has identified several avenues for further work; these are tabulated overleaf (Table 21). The responsibilities of the veterinary profession towards the prevention of animal welfare problems need to be considered in undergraduate education, clinical practice and by the Royal College of Veterinary Surgeons. There is an urgent need for consensus on which outcomes are relevant, meaningful and measurable in canine osteoarthritis. Suitable outcome measures then need to be developed working in conjunction with veterinary professionals and owners who will be using them, ensuring inclusion of dogs that reflect those seen in general practice. More work is needed to determine how best to educate and support owners of dogs with osteoarthritis and how to ensure that veterinary surgeons and owners fully understand each other's language and perspectives during consultations. Barriers to this work being performed are likely to include: companion animal welfare being

low on major funders' priority lists; fragmentation of expertise across animal welfare science, behavioural medicine and veterinary medicine; poor understanding by some in these fields of the value of qualitative research; and the challenges associated with encouraging key opinion leaders to collaborate and accept that there are problems with existing solutions.

Table 21. Summary of key findings and recommendations for future work

Chapter	Key findings to be addressed	Recommendations
1	<p>Definitions used by animal welfare scientists may not be relevant to practicing veterinary surgeons. Quality of life may not be a helpful term. Clarity is needed on how to practically apply the Animal Welfare Act (2006) and the RCVS Code of Practice for Veterinary Surgeons in relation to welfare of animals with spontaneously occurring disease.</p> <p>Lack of evidence about all aspects of treatment and management of canine osteoarthritis.</p>	<p>Reintegrate animal welfare into the clinical veterinary curriculum, develop definitions relevant to practicing veterinary surgeons and educate practicing veterinary surgeons about the importance of aspects of welfare other than physical health. More clarity from the RCVS on the roles and responsibilities of veterinary surgeons in relation to welfare.</p> <p>Perform research that addresses common clinical questions using relevant outcomes.</p>
2	<p>Few validated outcome measures exist for the assessment of canine osteoarthritis or quality of life that would be of use to owners or veterinary surgeons in general practice. Lack of consensus on core outcomes to be assessed in canine osteoarthritis or on definition of quality of life leads to poor quality evidence for decision-makers.</p>	<p>Promote the need for better outcome measure design. Collaboration between veterinary professionals, owners, behaviour specialists and animal welfare scientists to reach consensus on core outcomes to assess and develop valid, relevant and useable outcome measures for canine osteoarthritis and welfare assessment that can be used in research and practice.</p>
3	<p>Many dogs involved in this study have comorbidities and multi-limb disease.</p>	<p>Ensure inclusion of dogs like these in osteoarthritis research to ensure results are relevant.</p>
4	<p>Barriers identified to both veterinary surgeons and owners recognising welfare problems in dogs with osteoarthritis. Veterinary consultations may be dysfunctional. Many decisions are made on the basis of poor evidence and subjective behavioural assessments that are likely to be subject to bias. Decisions may be influenced by risk aversion. Negative impacts identified on dogs, owners and veterinary surgeons of the lack of good evidence on which to base decisions.</p>	<p>Address the barriers identified to dogs with osteoarthritis receiving the best available treatment. Improve the quality of consultations for canine osteoarthritis to ensure collaborative, dog-focused decisions are made. Provide owners and veterinary professionals with good quality, accessible evidence on which to base decisions. Develop reliable, relevant outcome measures to assess important outcomes. Ensure veterinary surgeons are aware of the challenges associated with owning an osteoarthritic dog.</p>
5	<p>Assessing canine osteoarthritis through behaviour is very challenging for owners and current outcome measures designed for owners may include outcomes that are not relevant and do not accurately reflect the welfare of those dogs. The current lack of evidence on which to base decisions about osteoarthritic dogs minimises the values of such outcome measures.</p>	<p>Improve the quality of outcome measures for owner completion with further qualitative research. Further research into how to reduce the subjectivity of behavioural assessments and development of more objective assessments. Improve the link between outcomes measured and treatment and management of canine osteoarthritis.</p>

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Appendices

Appendix 1. Purposive sampling frame for interviews

DOGS

Dog role

Pet
Working
Agility/flyball/showing etc

OA site

Arthritis in multiple joints in all legs
Arthritis in forelimb only
Arthritis in hind limb only
Dog with 3 legs?

Breed type

Gundog
Hound
Pastoral
Terrier
Toy
Utility
Working
Crossbreed

Osteoarthritis location (limb)

Osteoarthritis cause

Number of joints affected

Concurrent treated health problems

Yes
No

Treatment(s) given

OWNERS

Sex

Ethnic minority?

Age

Previous dog ownership?

HOUSEHOLD STATUS

Household type

Single

Cohabiting couple
Others living in household

Home area

Rural
Urban
Conurbation

House access

Easy for dog to access
Difficulty, e.g. Flat/apartment upstairs

Number of dogs living in house

Appendix 2. Poster displayed in sentinel practices to advertise the study




CENTRE FOR EVIDENCE-BASED
VETERINARY MEDICINE
Putting research into practice

 | The University of
Nottingham
UNITED KINGDOM · CHINA · MALAYSIA

Do you own a dog with arthritis?

If so, we would love to talk to you!

*** Vets are working with Nottingham Vet School to learn more about how arthritis affects owners and their dogs.

We hope this study will help us to maximise the quality of life of dogs with arthritis.

To find out more, please ask complete a form at reception, or email Zoe at zoe.belshaw@nottingham.ac.uk

The Nottingham Dog Arthritis Project is fully approved by the University of Nottingham ethics committee. You can withdraw your participation at any time. Full details will be provided before enrolment. Your dog's care will not be affected or changed in any way.



Appendix 3. Study information sent to owners

Information sheet on the Nottingham Dog Arthritis Project

My name is Zoe Belshaw. I am a veterinary surgeon completing a PhD at the School of Veterinary Medicine and Science, the University of Nottingham. I owned a terrier, Barney, who developed arthritis in his old age. I realised then that as vets we know very little about how to advise owners to best care for arthritic dogs to ensure that they have the best possible quality of life. This led to me starting my research in this area.

What is the aim of this study?

Vets know how to treat dogs with arthritis but we know very little about how arthritic dogs are cared for at home, what impact, if any, having an arthritic dog has on the rest of the household, and how owners assess whether their dogs are having a good or a bad day. I am very interested in talking to owners of dogs with arthritis to help fill in some of these gaps in our knowledge. I hope that these interviews, along with some other projects being run at the same time, will help us to come up with information and resources for vets and owners which will benefit other arthritic dogs.

What would I like from you?

I would like you to take part in a face-to-face interview, where you can tell me about your experiences. The interview will be carried out at a date, time and location that are convenient to you, and will last approximately two hours. The interview will consist of very broad questions relating to your dog's arthritis, how you look after your dog and how you feel about having a dog with arthritis. I may also ask you to take part in a follow up interview at a later date, and we may recruit you and your dog to be involved in another part of the project in which we hope to find new ways to tell whether a dog is comfortable and happy. You can decline to be involved or ask to be removed from the study at any stage.

Confidentiality

I will record the interview using a Dictaphone, and if you are comfortable, a video recorder. Any data that I gather throughout the study will be securely stored at the University or in my possession and will only be accessible to me and my supervisors. Information from the interview may be published scientifically and shared with your vets to help improve their services and support. However, I will anonymise all data so that neither you nor your dog will be identified in any of the written records or outcomes. The only time that anonymity may be breached is if there are serious concerns about your or someone else's safety. In this first instance I will discuss these concerns with you and identify any further support that may be required.

If you wish to take part...

Great, thank you! Please email me at zoe.belshaw@nottingham.ac.uk and include details of the best way to contact you. I will discuss the study in more detail with you, and you can decide whether or not you still wish to participate. Again if at any stage you wish to withdraw from the study you are free to do so.

Thank you for taking the time to find out about this study. If you have any questions or require any further information you can contact me at zoe.belshaw@nottingham.ac.uk, ☎ 0115 9516436, or my supervisor Lucy Asher at svzla@nottingham.ac.uk, ☎ 0115 9516436. Alternatively, if you have any queries or concerns about the design of the study you can contact David Haig, the head of the School of Veterinary Medicine and Science Ethics Committee at david.haig@nottingham.ac.uk. My PhD is being jointly funded by the Centre for Evidence-based Veterinary Medicine and an external organisation investing in biological research (the Biotechnology and Biological Sciences Research Council or BBSRC).

Appendix 4. Interview guide

1. Tell me about [your dog] first of all in terms of a general background, how long you have had them for, any health problems he/she has other than OA etc?
 - a. How old was he/she when acquired and where did they come from?
 - b. Concurrent diseases
 - c. Previous dog owning history? Other dogs now? Any with OA?
 - d. Use of dog – working, pet etc – relationship with/purpose of that dog/ special bond with this one?
 - e. Dog role in the house
 - f. Any human experience with arthritis? Any with other pets?
 - g. Any kind of dog training philosophy – importance of that?

2. We're going to talk about the diagnosis now and your information sources. What signs did you first notice which made you think [your dog] might have arthritis, and what happened from there?
 - a. When was it that the dog got OA? Was it easy to define a moment or really insidious?
 - b. What clinical signs were there which made you think it was likely?
 - c. Why did you decide to go to the vet?
 - d. How did they diagnose OA?
 - e. How did you feel about the diagnosis? Surprise? Did you expect it – if so, since when? Did that help?
 - f. What about the prospect of starting on treatment – how did you think about that?
 - g. What information did they give you about the disease? Was it useful?
 - h. What did you know about OA before that? Where from?
 - i. Did you receive any information about how to manage your dog at home from the vet? Was it useful?
 - j. Which information sources have you used since – friends, internet, books etc if any – importance of breed specificity in that?

3. Now we'll move on to talking about treatments and monitoring. So [dog name] is on some treatment for the arthritis. Tell me about the treatments [your dog] is on – how you decided on them, how well they work, any problems or worries about them etc. Treatments include any supplements, physiotherapy, magnetic collars, swimming, acupuncture etc as well as drugs.
 - a. How did you come to a decision about how to treat [your dog] with the regime you started with?
 - b. What treatments have you used, has it changed over time, why did you chose it (diet, nutra, drugs, supplements, physio etc) TIME FRAME?
 - c. What were your hopes for that treatment in terms of how it would change things?

- d. How do you feel about your dog being on that treatment? Peace of mind that in less pain?
 - e. Did or do you have any concerns about side effects? Positives and negatives about treatment? What have you done about those concerns – advice sources etc? Information on s/es adequate?
 - f. Do you use the medication as advised or do you sometimes change the schedule? Do you do anything else other than what your vet has advised which you think helps? Do you find it easy to follow what was advised or do you sometimes forget doses etc – others say they do! Have you had any problems with administering any treatment?
 - g. Have you added any supplements or other therapies which your vet didn't tell you about e.g. magnetic collar, massage, joint supplements?
 - h. Do you monitor your dog's arthritis at home – if so, how? Any advice from vets/others on monitoring at home?
 - i. How do you tell whether or not a medication is working?
 - j. How to tell a good day from bad one – best tests? How easy is it to tell that the dog is having a good versus bad day - stoic personalities or easy to tell – how?
 - k. Do you need to go for re-check s to your vets? Do you see a vet or a nurse? What do they do? Do you find them useful? Why? How could the visit be made more useful?
 - l. Support with the disease – from others, vets, dog forums, importance of non-emotional view e.g. talking to strangers?
 - m. How do you make decisions about whether to change medications or add in other treatments – what influences those decisions? Who decides?
4. Now for a bit about day to day life. Tell me about a typical day with your dog(s) – your routine, walks, medications etc.
- a. Was that routine based on advice from your vet, your own experience, changed with time?
 - b. Does the arthritis cause problems with getting in and out of the house, car, and stairs.
 - c. Have you had to adapt the house to help [your dog] or help you cope?
 - d. Is that changing with time – how do you know you need to make a different change?
 - e. Other dogs and how manage OA vs. non-OA dog (if applicable), especially with exercise, limiting play etc?
 - f. Do you do things differently on good days versus bad days? What are the things which the dog finds easy/difficult now? How do you manage those?
 - g. Are there things which your dog used to enjoy doing which he/she now can't do?

- h. How has your dog coped with not being able to do the things they were doing before? Have you added anything to replace those activities?
 - i. Things which affect [the dog] positively or negatively – exercise, damp?
 - j. Changes in [the dog] other than physical health – attitude, mentation, play etc? Have interactions with other dogs changed at all?
 - k. [If appropriate, you have another younger dog – did you worry about getting a second dog when this one had arthritis? What difference has that made to your workload?]
5. Now on to your relationship with your dog and how you are coping with them having OA. Do you think your relationship with (dog's name) has changed since he/she developed arthritis?
- a. A study looking at dogs with other chronic diseases said people worry much more about their pets when they get ill and feel more like a carer – do you agree?
 - b. What aspects worry you the most?
 - c. To what extent does having a dog with OA interfere with your normal day to day life? Problems with lifting etc?
 - d. Has the fact your dog has arthritis had effects on any other members of your family? Children, holidays, visitors coming round, days out?
 - e. Is it harder to put the dog in kennels or get help with a dog sitter if needed because of the arthritis?
 - f. Has it affected your social contact e.g. contact with other dog walkers?
 - g. Finance if appropriate? Insured? Does it pay?
6. Now on to something a bit different. Do think the term quality of life is relevant to dogs? What do you think it means – is it something you think about?
- a. Have you discussed quality of life with your vet?
 - b. How do you think they judge it? How do you judge it?
 - c. Do you think you judge your dog's quality of life in a different way to your vet?
 - d. To have a good quality of life, what do you think your dog needs?
 - e. Has this changed with age?
7. Can we talk more now about decision making in the past and the future- others have said this is one of the hardest things to know how to assess their dog as it gets older – do you agree?
- a. Others have said they really worry about others worrying about decision making as their dog gets older – do you agree?

- b. Dog as a semi-public figure – thoughts about what other dog walkers might think of walking an older stiff dog?
 - c. Involvement of family and friends – are any decisions you make your own or do you have to involve what others would think too e.g. friends and family?
 - d. Decision making about new treatments, end of life thoughts – how to decide when enough is enough?
 - e. Difference if first dog/dog which has been through a lot with them?
 - f. Feelings about this?
 - g. Where will get advice from – vet, family etc – importance of an objective view?
 - h. Whether having OA changes thoughts on other diseases – would it make more or less likely to see vet advice about e.g. lumps, dental disease? “Ignore stuff because you don’t want to know?”
8. Finally would you have any messages for other dog owners of vets – top tips, areas for future research etc?
- a. Owners
 - b. Vets
 - c. Questions for any HCPs – areas of research?
 - d. Resources which they would find useful? Diagnostic, monitoring, general information? Dog forums, arthritis nurse clinic, more advice on what to monitor
9. Is there anything else you would like to talk about which we haven’t covered?

Appendix 5. Consent form for interviews

Project title: *Nottingham Dog Arthritis Project: interviews of owners of dogs with arthritis*

Researcher's name: *Zoe Belshaw*

Supervisor's name: *Lucy Asher, Rachel Dean*

- I have read the Participant Information Sheet and the nature and purpose of the research project has been explained to me. I understand and agree to take part.
- I understand the purpose of the research project and my involvement in it.
- I understand that I may withdraw from the research project at any stage and that this will not affect my status now or in the future.
- I understand that while information gained during the study may be published, I will not be identified
- I understand that interviews will be recorded during the research.
- I understand that data will be stored at the University or in the possession of the researcher and will only be accessible to the researcher and supervisors.
- I understand that I may contact the researcher or supervisor if I require further information about the research, and that I may contact the School of Veterinary Medicine and Science Ethics Committee, University of Nottingham, if I wish to make a complaint relating to my involvement in the research.

Signed
(Research participant)

Print name

Date

University of Nottingham telephone: 0115 9516436
(Supervisors: *Rachel Dean. Lucy Asher*)

Appendix 6. Focus group question guide

1. How do you diagnose osteoarthritis in dogs?
 - a. Ask about use of specific tests and validated measures if appropriate
2. What do you do at re-check appointments?
 - a. Role of the owner?
 - b. Use of any validated tests?
3. How do you treat osteoarthritis in dogs?
 - a. Think about prompts for different treatment types if needed

Appendix 7. Focus group consent form

Project title: *Nottingham Dog Arthritis Project: focus groups*

Researcher's name: *Zoe Belshaw*

Supervisor's name: *Lucy Asher, Rachel Dean*

- The nature and purpose of the research project has been explained to me. I understand and agree to take part.
- I understand the purpose of the research project and my involvement in it.
- I understand that I may withdraw from the research project at any stage and that this will not affect my status now or in the future.
- I understand that while information gained during the study may be published, I will not be identified
- I understand that focus groups will be recorded during the research.
- I understand that data will be stored at the University or in the possession of the researcher and will only be accessible to the researcher and supervisors.
- I understand that I may contact the researcher or supervisor if I require further information about the research, and that I may contact the School of Veterinary Medicine and Science Ethics Committee, University of Nottingham, if I wish to make a complaint relating to my involvement in the research.

Signed (Research participant)

Print name

Date

University of Nottingham telephone: 0115 9516436
(Supervisors: *Rachel Dean. Lucy Asher*)

Appendix 8. Participant information sheet used in the prospective study

Nottingham Dog Arthritis Project Part 2

My name is Zoe Belshaw. I am a veterinary surgeon completing a PhD at the School of Veterinary Medicine and Science, University of Nottingham. I owned a terrier, Barney, who developed osteoarthritis in his old age. I realised then that as vets we know very little about how to advise owners to ensure that arthritic dogs have the best possible quality of life. This led me to start research in this area.

What is the aim of the Nottingham Dog Arthritis project?

Vets treat dogs with arthritis but we know very little about how arthritic dogs are cared for at home; what impact, if any, having an arthritic dog has on the rest of the household; how owners assess whether their dogs are having a good or a bad day; and whether the current way of treating dogs for arthritis works from the point of view of an owner. This project is using a combination of interviews with owners and monitoring of the dogs themselves to help us to come up with information and resources for vets and owners which will benefit other arthritic dogs.

What happened during Part 1 of the Nottingham Dog Arthritis project?

For Part 1 of the Nottingham Dog Arthritis Project, I travelled to 10 locations in England and Scotland to interview people in 32 households who between them owned 36 dogs with arthritis. Interviews lasted 2 hours on average. Information was gathered on all aspects of living with, caring for and making decisions about dogs with arthritis. In addition, five focus groups were conducted with veterinary surgeons and veterinary nurses to understand how these groups make decisions about dogs with osteoarthritis which present to their surgeries.

The 70 hours of interview data has been typed up then analysed line by line with each sentence being classified according to what was discussed. The results will take the form of a description of the common “themes” which owners, vets and nurses discussed. Analysis is still ongoing so the final results aren’t available yet.

What is the plan for Part 2 of the Nottingham Dog Arthritis project?

Before the start of this project, little was known about how dogs with arthritis spend their time compared to dogs that don’t have arthritis. I now have some of this information from the interviews, but I would like to gather more data by monitoring the dogs themselves. It is not clear how easy it is for owners to estimate the length of time their dogs spend on different activities, whether there are behaviours associated with bad days which are shared between all dogs with arthritis, or whether it might be beneficial to try to alter the activity levels of dogs with arthritis to improve either their pain management or their quality of life.

The plan for Part 2 of the Nottingham Dog Arthritis Project is to use collar-mounted monitors to record both the location and activity of arthritic dogs over a 7 day period. For more information on the collars, see page 2. Owners will be asked to complete a brief daily diary about their dog’s day, and where possible, to record short video clips of their dogs at home. I will visit each of the owners to show them how the collars and diaries work; collars and diaries can then be returned by post at the end of the week. I will also take some short video clips of each dog when I visit. The aim is to collect information about what happens to the dogs in an average week, so the management and medications of the dogs will not need to change at all during the study week. Any data that I gather throughout the project will be securely stored at the University or in my possession and will only be accessible to me and my supervisors. The project has been ethically approved by the School of Veterinary Medicine and Science, University of Nottingham.

What do you need to do if you would like to take part?

If you have a dog with arthritis and are interested in taking part, please contact me at zoe.belshaw@nottingham.ac.uk to confirm that you would like to be involved and to check the suitability of your dog for the project. I will discuss the project in more detail with you, and you can decide whether or not you still wish to participate. If at any stage you wish to withdraw from

the project you are free to do so. If you do wish to proceed, we can then identify the best week to monitor your dog.

Thank you for taking the time to find out about this project. If you have any questions or require any further information you can contact me at zoe.belshaw@nottingham.ac.uk, ☎ 0115 9516436, or my supervisor Rachel Dean at rachel.dean@nottingham.ac.uk, ☎ 0115 9516436. Alternatively, if you have any queries or concerns about the design of the project you can contact David Haig, the head of the School of Veterinary Medicine and Science Ethics Committee at david.haig@nottingham.ac.uk. My PhD is being jointly funded by the Centre for Evidence-based Veterinary Medicine and an external organisation investing in biological research (the Biotechnology and Biological Sciences Research Council or BBSRC).

What will the collar monitors look like?

We will provide a separate loose collar for the monitors to attach to. As shown in the photo below, the monitors are tiny and it is very unlikely that your dog will even know they are there.



What do the two different monitors record?

Each dog will wear two monitors. The first monitor is a GPS (global positioning system) monitor which records the location of the dog. This allows us to see how active the dogs are and where they go. The second monitor is an accelerometer, which is similar to a pedometer. This allows us to find out what kind of activity the dog is doing – the monitors can tell the difference between time spent walking, sleeping, eating and many other behaviours. By combining this with the GPS monitor, we can get a really accurate picture of how dogs with arthritis spend their time.

Will I need to do anything with the monitors?

We will ask you charge up the GPS monitor between walks. You can charge it using a normal wall socket – I will show you how to do that. The accelerometer monitor works for 7 days so you won't need to touch that one. The monitors are fine in the rain, and will survive even a brief swim. It doesn't matter if they get muddy or scratched. The only important thing is that they hang below the dog's neck all the time on the separate collar I will provide, and that the lead isn't attached to this separate collar as this will interfere with the recording.

What will the diary involve?

Each day we will ask you to fill in the answers to a few short questions about how you think your dog has been that day, and to tick off a list of behaviours which you may or may not have seen your dog doing. This helps us to confirm the collar recording data is accurate, and gives us information on whether the dog was having a good or bad day each day. At the beginning and end of the week we will ask you to fill in a couple of questionnaires to summarise how your dog has been, again to compare this to the diary and the collar data.

Why do you need the video clips?

We are really interested in getting video clips to document times when you think your dog is having both a good day and a bad day. What you film will depend on the dog – it might be how they get out of bed in the morning or how happy they are to be going for a walk. You can record as many or as few video clips as you like – there is no need to video your dog every day. We are particularly interested in getting footage of your dog's face when you think he/she is having a good or a bad day as many of the interviewees told us that this was an important part of how they assessed the dogs' pain levels.

I don't have a video camera – is that a problem?

No, don't worry. You can use the video option on your mobile phone if you have one, and if not we can provide you with a tiny video camera which you can send back at the end of the study. We aren't expecting professional level video footage and will use any clips you can get.

What happens if I forget to do something?

Don't worry, just skip that recording and carry on. If it would help, we can send you a daily reminder text or email each day of the study week, and I will give you my phone number so you can get in touch with any questions.

What happens if my dog's treatment needs to change during the study week?

That's fine, it won't affect the results of the study at all, just note down any changes in the diary.

Do I need to do anything different with my dog in the study week?

No, please do exactly what you would do on a normal week, that's exactly what we want to capture.

Appendix 9. Consent form used in the prospective study

PARTICIPANT CONSENT FORM

Project title: *Nottingham Dog Arthritis Project Part 2: monitoring of dogs with arthritis*

Researcher's name: *Zoe Belshaw*

Supervisor's name: *Lucy Asher, Rachel Dean*

- I have read the Participant Information Sheet and the nature and purpose of the research project has been explained to me. I understand and agree to take part.
- I understand the purpose of the research project and my involvement in it.
- I understand that I may withdraw from the research project at any stage and that this will not affect my status now or in the future.
- I understand that while information gained during the study may be published, I will not be identified
- I understand that my dog's activity and location will be recorded during the research.
- I understand that data will be stored at the University or in the possession of the researcher and will only be accessible to the researcher and supervisors.
- I understand that I may contact the researcher or supervisor if I require further information about the research, and that I may contact the School of Veterinary Medicine and Science Ethics Committee, University of Nottingham, if I wish to make a complaint relating to my involvement in the research.

Signed
(Research participant)

Print name

Date

University of Nottingham telephone: 0115 9516436
(Supervisors: *Rachel Dean. Lucy Asher*)

Appendix 10. Summary of the number of good, bad and unsure days per dog per week

Dog ID	Number of good days in week	Number of bad days in week	Number of unsure days in week
D1FLOR	4	2	1
D2TIGG	5	0	2
D3PIP	7	0	0
D4BRAM	3	3	1
D5HUGO	6	0	1
D6HARV	5	1	1
D7FOLL	3	3	1
D8TEDB	4	1	2
D9MOLL	7	0	0
D10MAIS	7	0	0
D11ELKA	5	2	0
D12DODG	2	3	2
D13LIVI	6	0	1
D14TEDR	5	0	2
D15FROD	5	1	1
D16MILL	7	0	0
D17BOSS	5	2	0

Appendix 11. Publications arising from work contained in this thesis

BELSHAW Z, ASHER L, HARVEY N, DEAN R (2015) Quality of life assessment in domestic dogs: An evidence-based rapid review *The Veterinary Journal*, 206, 203-212 <http://www.sciencedirect.com/science/article/pii/S109002331500307X>

BELSHAW Z, DEAN R (2015) Calling time on survival times? *Journal of Small Animal Practice* 56, 635-636 <http://onlinelibrary.wiley.com/doi/10.1111/jsap.12413/full>

BELSHAW Z, ASHER L, DEAN R (2016) A systematic review of outcomes used in canine osteoarthritis research *Veterinary Surgery* 45, 480-487 <http://onlinelibrary.wiley.com/doi/10.1111/vsu.12479/full>

BELSHAW Z, ASHER, L, DEAN R (2016) The attitudes of owners and veterinary professionals in the United Kingdom to the risk of adverse events associated with using NSAIDs to treat dogs with osteoarthritis. *Preventive Veterinary Medicine* 131, 121-126 <http://www.sciencedirect.com/science/article/pii/S0167587716302227>

BELSHAW Z (2017) Validated outcome measures in canine osteoarthritis *Veterinary Surgery* 46, 341-342. <http://onlinelibrary.wiley.com/doi/10.1111/vsu.12636/full>