Understanding antimicrobial use in pet dogs:

An anthropologically informed mixed-methods study

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I, Alice Tompson, confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.

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Abstract

Background: Antimicrobial use in companion animals could be an overlooked contributor to antimicrobial resistance relevant to human health. The aim of this study was to describe the material, biotic, and infrastructural interdependencies involved in antimicrobial use in the veterinary care of UK companion animals, particularly dogs.

Methods: Veterinary clinics, the main site of decision-making regarding companion animal antimicrobial use, are the focus of this mixed-methods thesis. Highest priority critically important antimicrobial (HPCIA) dispensing data were analysed using a mixed-effect, hierarchical modelling approach (dogs nested in clinics nested in veterinary groups). Ethnographic fieldwork in three veterinary clinics lasting nine months explored the animal–human–microbe interactions at play and situated these within wider political and economic contexts of the companion animal veterinary sector. Observations, interviews, and documentary analysis were undertaken and synthesised using a comparative approach.

Findings: Records of 468,665 antimicrobial dispensing events were analysed. Differences in the odd ratios of an event comprising of a HPCIA were apparent between veterinary groups (ranging from 1.00 to 7.31, 95% confidence interval 5.14–10.49). Fieldwork identified the infrastructural arrangements that support current patterns of antimicrobial use including the ‘business model of busyness’ and the role of the veterinary-industrial complex. Interspecies care involved the entanglement of mammalian and microbial bodies and was delivered within temporal and logistical constraints, at times in tension with infection control procedures. Antimicrobials formed part of the veterinary care for socially desirable—yet inherently unhealthy—breeds of dog.

Conclusions: Antimicrobial use is a bio-social practice that is produced by social, material, semiotic, and technical networks extending beyond the actors at the interface of their deployment. By rendering visible these networks—and decentring human behaviour as the focus for efforts to address antimicrobial use—this thesis proposes alternative approaches to reduce the pressures to prescribe antimicrobials in companion animals.

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Abbreviations

AM	Antimicrobials
AMVA	American Veterinary Medicine Association
BAME	Black Asian and Minority Ethnic (groups)
BMJ	British Medical Journal
BOAS	Brachycephalic Obstructive Airway Syndrome
BSAVA	British Small Animal Veterinary Association
BSE	Bovine Spongiform Encephalopathy
BVA	British Veterinary Association
CI	Confidence Interval
CIA	Critically Important Antimicrobial
COVID-19	Coronavirus Disease 2019
CPD	Continuing Professional Development
DANMAP	Danish Integrated Antimicrobial Resistance Monitoring and Research Programme
DEFRA	Department for Environment, Food and Rural Affairs
EDEP	European Dermatology Expert Panel
EEA	European Economic Area and Switzerland
EMA	European Medicines Agency
ENOVAT	European Network for Optimization of Veterinary Antimicrobial Treatment
EPR	Electronic Patient Record
ESBL	Extended-Spectrum β-Lactamase
ESVAC	European Surveillance of Veterinary Antimicrobial Consumption
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
FECAVA	Federation of European Companion Veterinary Associations
FVE	Federation of Veterinarians of Europe
GP	General Practitioner
HIA	Highly Important Antimicrobial
HPCIA	Highest Priority Critically Important Antimicrobial
ICCs	Intraclass Correlation Coefficients
IQR	Interquartile Range
ISCAID	International Society for Companion Animal Infectious Disease
IT	Information Technology
LSHTM	London School Hygiene and Tropical Medicine
KC	Kennel Club
MRSA	Methicillin-resistant *Staphylococcus aureus*
NHS	National Health Service
No.	Number of
OIE	World Organisation for Animal Health
OR	Odds Ratio
PMS	Practice Medical System
PPE	Personal Protective Equipment
RCVS	Royal College of Veterinary Surgeons
ROC	Receiver Operator Curve
RR	Risk Ratio
RUMA	Responsible Use of Medicines in Agriculture
RVC	Royal Veterinary College
SAVSNET	Small Animal Veterinary Surveillance Network
STS	Science and Technology in Society
UK	United Kingdom

US	United States
UTI	Urinary Tract Infection
VARSS	Veterinary Antibiotic Resistance and Sales Surveillance
VMD	Veterinary Medicines Directorate
VRE	Vancomycin-Resistant Enterococci
WHO	World Health Organization

Chapter 1 Introduction

> *'Antimicrobials are important tools for the therapy of infectious bacterial diseases in companion animals. Loss of efficacy of antimicrobial substances can seriously compromise animal health and welfare . . . A unique aspect related to antimicrobial resistance in companion animals is their close contact with humans providing opportunities for interspecies transmission of (multidrug) resistant bacteria. Use of antimicrobials that are critically important for human health in companion animals is an additional risk factor for emergence and transmission of antimicrobial resistance. Yet, the current knowledge relating to many aspects of this field is limited'.*
>
> European Medicines Agency (2015)

This thesis investigates antimicrobial use by United Kingdom (UK) companion animal veterinarians, focusing on their deployment in the care of pet dogs. The utilisation of antimicrobials—in both human and animal populations—is coming under increasing scrutiny due to concerns about antimicrobial resistance. Through the thesis I introduce the reader to the UK companion animal veterinary sector, explore daily life in veterinary clinics, and describe how care is enacted there. It reflects my journey through multiple new terrains, from large statistical databases to the consulting rooms and 'behind the scenes' spaces of veterinary clinics, and from the concerns of public health through to the multispecies entanglements of humans, animals, and microbes.

To provide the orientation for this mixed-methods investigation, in this introductory chapter I first introduce the problem of antimicrobial resistance and its development. I describe how it is regarded as a zoonotic risk requiring One Health solutions, that recognise the interconnectedness of human and animal health, and the environment. I then provide some context regarding the companion animal veterinary sector in the UK. From there, I set out my research aims and questions before describing the contribution made by this thesis. I conclude the introduction by providing an overview of the subsequent chapters.

1.1. What is antimicrobial resistance?

Antimicrobials are agents that kill or prevent the growth of microbes such as bacteria, fungi, viruses, and parasites (WHO, 2018). Within this umbrella term, antibiotics are a type of antimicrobial that targets bacteria, and they are the focus of this thesis. Antimicrobial resistance occurs when microbes inherently have or acquire genes that enable them to withstand the effects of antimicrobial agents. Acquisition can be vertical (from mother to daughter cells) or horizontal via the transfer of mobile genetic elements such as plasmids (Burmeister, 2015). Microbes that are resistant to multiple classes of antimicrobials are commonly known as ‘superbugs’ (NHS, 2019).

The ability to use antimicrobials to treat infections is held central to modern medicine, both in humans and animals, with procedures such as surgery and chemotherapy reliant upon their prophylactic use to prevent bacterial infections (Antibiotic-Action, 2015). Antimicrobial resistance has been identified as a key threat to health and economies globally due to the potential loss of therapeutic options for previously treatable conditions (Davies et al., 2013, O'Neill, 2016). The horizontal acquisition of antimicrobial resistance is a major public health concern due to the potential transfer of genetic elements between bacterial species sometimes coding for resistance against multiple antimicrobial classes, making tracking and tackling the spread of antimicrobial resistance more problematic (Burmeister, 2015).

The incidence of antimicrobial resistance is accelerated by the use of antimicrobials; the more they are used, the higher the selective pressure faced by microbial populations to adapt and evolve (Costelloe et al., 2010, Bennani et al., 2020). Consequently, there have been growing efforts to limit and target the use of antimicrobials to ‘appropriate’ cases through antimicrobial stewardship schemes (Charani and Holmes, 2019). Such schemes originated in human healthcare but are now applied in broader One Health contexts, and describe a range of approaches and interventions seeking to ‘optimise’ antimicrobial use (Dyar et al., 2017). In companion animal veterinary medicine, this has been interpreted as schemes to encourage the responsible use of antimicrobials by reducing prescription rates without increasing negative patient outcomes (Allerton, 2018). Stewardship efforts can include preventative measures to reduce the incidence of infections, for example, through vaccination and infection control procedures within healthcare facilities such as veterinary clinics (Prescott and Weese, 2009).

1.2. Antimicrobial resistance as a zoonosis

The rising concern regarding antimicrobial resistance has coincided with a renewed interest in the threat to human health posed by zoonoses—diseases spread from animals to humans (Rabinowitz and Conti, 2013). Antimicrobial genes and resistant bacteria can be transferred between animals and humans, either via direct contact with the animal itself and/or its excretions, or indirectly via the food chain and contamination of the environment with animal waste (Laxminarayan et al., 2013, Argudin et al., 2017). Consequently, adopting a One Health approach—considering animals, humans, and the environment—has been advocated for tackling antimicrobial resistance (Robinson et al., 2016, Wernli et al., 2017, Kamenshchikova et al., 2019).

Most initiatives targeting antimicrobial resistance in animals have focused on changing antimicrobial use in livestock, facilitated by international organisations like the World Health Organization (WHO), the World Organisation for Animal Health (OIE), and the Food and Agriculture Organization of the United Nations (FAO) (WHO, 2015). Meanwhile, companion animals have largely been overlooked in the public discourses surrounding antimicrobial resistance (Smith, 2018). As well as sharing lives and living spaces, humans and companion animals share diseases (Rijks et al., 2016), resistant bacteria (Guardabassi et al., 2004, Pomba et al., 2017), and medicines, with many antimicrobial classes being used in both human and companion animal populations (Table 1.1). Box 1.1 provides case studies of a 'superbug' and an antimicrobial group shared between humans and companion animals.

Table 1.1: Antimicrobial groups used in both humans and companion animals (adapted from Buckland et al. (2016) and Argudin et al. (2017))

Antimicrobial group	Examples	Categorisation	
		Human medicine	Veterinary medicine
Aminoglycosides	amikacin, gentamicin	CIA	CIA
Cephalosporins (first generation)	cefalexin	HIA	HIA
Cephalosporins (third generation)	ceftazidime	HPCIA	CIA
Fluoroquinolones	enrofloxacin, marbofloxacin	HPCIA	CIA
Lincosamides	lincomycin	HIA	HIA
Macrolides	erythromycin	HPCIA	CIA
Penicillin types	amoxicillin, ampicillin	CIA	CIA
Sulfonamides	sulfadiazine, sulfonamide	HIA	CIA
Tetracyclines	oxytetracycline, tetracycline	HIA	CIA

Notes:

CIA: Critically important antimicrobial; HIA: Highly important antimicrobial; HPCIA: Highest priority critically important antimicrobial.

The WHO categorises the importance of each antimicrobial group to human health based on two criteria: 'the antimicrobial class is the sole, or one of limited available therapies, to treat serious bacterial infections in people' and 'the antimicrobial class is used to treat infections in people caused by either: (i) bacteria that may be transmitted to humans from non-human sources, or (ii) bacteria that may acquire resistance genes from non-human sources' (WHO, 2019). Antimicrobials that meet both criteria are considered 'critically important' in human medicine, and antimicrobials that meet one criterion are 'highly important'. The WHO further prioritises antimicrobials within the critically important category in order to target stewardship resources to where there is evidence of the transmission of resistant bacteria or resistance genes from animal sources to humans. The three criteria used relate to the volume of use in humans (x2) and to the risk of transmission (x1). Antimicrobials meeting all three criteria are classified as 'highest priority critically important antimicrobials' (HPCIAs) (WHO, 2019).

Box 1.1: Case studies of infections and antimicrobials shared by humans and companion animals.

Methicillin-Resistant *Staphylococcus Aureus*

Strains of *Staphylococcus aureus* that have developed resistance to the beta-lactam class antibiotics—broad-spectrum agents including some penicillin derivatives and cephalosporins—are known as MRSA (Methicillin-resistant *Staphylococcus aureus*) (Pomba et al., 2017). MRSA is one of the most widely known 'superbugs' and a major problem in human healthcare (NHS, 2019). Originally associated with human intensive care, these bacteria are increasingly found in community settings. The first identified outbreak in companion animals was of human strains amongst companion animals living in a human geriatric ward, who had contracted it from their human wardmates (Scott et al., 1988). In the following 20 years, MRSA infection and colonisation in companion animals have been reported with increasing frequency (Pomba et al., 2017): It has been isolated from skin and soft tissue infections, surgical wounds, urinary tract infections (UTIs), and pneumonia, with outbreaks occurring in veterinary hospitals and other animal facilities.

The dynamics and risk factors of MRSA colonization are not fully understood. Companion animals appear to become reservoirs of MRSA through contact with infected humans. Most MRSA strains isolated from companion animals are identical to human hospital-acquired strains (Pomba et al., 2017). When screened, veterinary staff in two UK companion animal referral hospitals showed MRSA carriage rates of 18% and 27%, respectively (Loeffler et al., 2005). Carriage was 9%—and mainly of human hospital-acquired MRSA strains—in UK first opinion clinic staff (n = 388), similar to rates seen in human healthcare, although the route of transmission was unclear (Loeffler et al., 2010).

Third-generation cephalosporins

Third-generation cephalosporins are deemed HPCIAs in human medicine for use as a last resort in the treatment of life-threatening conditions caused by multidrug resistant pathogens (WHO, 2019). They are one of the few treatments available for serious *Salmonella* spp. and *Escherichia coli* infections in humans. The former UK Chief Medical Officer, Sir Liam Donaldson, recommended that they were 'too valuable' for use in livestock as this has been associated with the emergence of extended-spectrum beta-lactamases (Bonner, 2011). These bacteria—mostly *E. coli* and *Klebsiella* spp.—produce enzymes that make them resistant to many different beta-lactam antibiotics, and often to other antibiotic types, too (PHE, 2014).

A 2017 study found that cefovecin, a third-generation cephalosporin, was the most frequently prescribed antimicrobial in British cats despite its HPCIA status (Singleton et al., 2017). Review of clinical records found there was typically no microbiological evaluation or reason given for prescribing this agent over clinically suitable alternatives (Burke et al., 2017). Its broad spectrum and long-lasting activity delivered via injection means that it is popular with veterinarians and owners who can ensure the full course of treatment is received by their feline patients who are difficult to medicate orally (Mateus et al., 2014).

Given that utilisation of antimicrobials is a key driver of antimicrobial resistance, their use in companion animals could be an important and, to date, mostly overlooked source of community-acquired antimicrobial resistance relevant to human health (EMA, 2015, Pomba et al., 2017). Loss of antimicrobial therapeutic efficacy will also have important consequences for companion animal health and welfare, especially given that any new antimicrobials developed are likely to be reserved for human healthcare use.

1.3. Antimicrobial use in animals in the UK

In the UK, prior to the twentieth century—and the mainstream acceptance of germ theory—there was a general tendency to slaughter animals in response to infectious disease outbreaks, rather than to treat them with pharmaceuticals (Corley and Godley, 2011). Although culling remains a sometimes-deployed component of infectious disease management, the advent of vaccines for livestock and then, in 1935, the introduction of antibacterial sulphonamides led to a 'drugs revolution' in UK veterinary medicine (Jones, 2010). Having witnessed the recovery of some calves from a mysterious—and previously incurable—disease following the administration of a sulphonamide, the famous veterinarian-author James Herriot wrote that he had observed 'the tremendous therapeutic breakthrough which was to sweep the old remedies into oblivion' (Herriot, 1974, p. 152) quoted in (Corley and Godley, 2011). The subsequent introduction of different antibiotics over the next twenty years enabled infectious diseases to be treated more successfully, coinciding with the rapid development and expansion of the UK veterinary pharmaceutical industry (Corley and Godley, 2011).

In the 1950s, the introduction of intensive farming methods enabled the provision of cheap dietary protein to feed Britain's post-war population (Guardabassi, 2013, Kirchhelle, 2018). Rearing animals under these novel conditions altered the epidemiology of livestock disease, necessitating the administration of a 'cocktail of highly sophisticated medicines' (Corley and Godley, 2011). These regimens included: the use of antibiotics to treat infections; the prophylactic use of antibiotics to prevent the spread of disease between herd/flock members; and the administration of regular, sub-therapeutic doses of antibiotics that acted as growth promoters and to enhance productivity (Guardabassi, 2013, Kirchhelle, 2018). Agricultural antibiotic use was soon accused of propping up reduced animal welfare standards, threatening food safety through the effects of residues in livestock products, and promoting the development of antimicrobial resistance (Kirchhelle, 2018). As a result, the UK government convened the Swann Committee, whose 1969 report identified that 42% of the total UK antibiotic output was being used in livestock and warned that their use as growth promoters and prophylactically would lead to the loss of therapeutic efficacy (Corley and Godley, 2011, Guardabassi, 2013). The precautionary recommendations of the report were largely ignored; however, they form the foundations of much of the European policy in this field seen today (Kirchhelle, 2018). The utilisation of antimicrobial growth promoters in livestock was not completely banned in the UK (and other European Union (EU) countries) until 2006 (RUMA., 2020).

The 1970s and 1980s saw the demand for veterinary medicines continue to grow, fuelled in part by the need for advanced foodstuffs for intensively farmed livestock (Corley and Godley, 2011). Livestock consumption of antimicrobials—both as therapeutic and growth-promoting agents—increased exponentially (Guardabassi, 2013). The 1990s, however, witnessed moderation in the demand for pharmaceuticals as the use of veterinary medicines in livestock was increasingly regulated (Corley and Godley, 2011). Public health concern regarding antimicrobial utilisation in agriculture was renewed by the discovery that using avoparcin, a vancomycin analogue, as a growth promoter was associated with selection of vancomycin-resistant *enterococci* (VRE) in chickens and pigs, and the possible transmission of these multidrug-resistant bacteria to humans through the food chain (Guardabassi, 2013). This set-in motion the chain of antimicrobial use initiatives that we see continuing today.

The increasing regulation of livestock production prompted the veterinary pharmaceutical industry to pay greater attention towards the smaller—but less price sensitive—companion animal market (Corley and Godley, 2011). Prior to the 1990s, the absence of companion animals in the historical accounts of UK veterinary medicines use described here is striking. In Section 1.4, I outline the development of the companion animal veterinary sector that, like veterinary antimicrobial use, 'took off' in the 1950s.

1.4. The companion animal veterinary sector in the UK

In the UK, antimicrobials are prescription-only medicines—including their use in companion animals—and are not available 'over the counter'. In order for veterinary antimicrobials to be supplied (dispensed), a prescription is required from a veterinarian registered as a practising member with the Royal College of Veterinary Surgeons (RCVS) (RCVS, 2020b). In the UK, prescribing decisions by veterinarians are dictated by the 'Cascade principle', which declares that they are legally required to use a veterinary medicinal product authorised for use in that species, for that condition, and that route of administration (VMD, 2019). However, if one is not available—and an animal is at risk of unacceptable suffering—an unlicensed medicine can be used, for example, one authorised for use in that condition but in another species, such as humans (Horspool, 2013).

As a consequence of the legal supply of antimicrobials for use in companion animals being via veterinarians, this research becomes entangled with the actors involved in the companion animal veterinary sector. There are approximately 30,000 veterinarians on the UK professional register, with around 23,000 currently practising (RCVS., 2018); just over half (53%) work caring for companion animals (Robinson et al., 2020), a relatively recent role for veterinarians.

Historically, the veterinary profession in the UK was orientated around treating economically valuable equine and livestock species (Swabe, 1999). However, societal changes in the twentieth century resulted in the practising of medicine on companion animal species becoming an accepted, legitimate form of veterinary work (Swabe, 1999). Following the industrial revolution, the urbanised 'middle classes'—with their more sentimental attitudes towards animals and companion animal keeping—grew in size (Franklin, 1999). Meanwhile, the rise of the motor vehicle resulted in fewer horses being required for transport and requiring veterinary care (Degeling, 2009). Together, these changes, necessitated by a need to earn a living, prompted veterinarians to extend their focus beyond large animals. Pioneer veterinarians provided canine care in elite Edwardian London, although this was an early example of specialisation, rather than a mainstream shift in the profession (Skipper, 2019).

During the economic depression between the First and Second World Wars, urban companion animal veterinary clinics were set up by animal welfare charities in the face of hostility from the veterinary profession (Hamilton, 2014). These clinics paved the way for private clinics dedicated to the care of companion animals that sprang up in the post-war years as prosperity returned. The British Small Animal Veterinary Association (BSAVA) was founded in 1957 as a professional body to serve veterinarians treating companion animals, and helped to consolidate dogs and cats as legitimate veterinary patients (Hipperson, 2018). By the end of the twentieth century, the term ‘dog doctor’ was no longer a derisory term within the veterinary profession (Hamilton, 2014).

Unlike human healthcare in the UK, the vast majority of veterinary care is delivered via private providers. Traditionally, these were in the form of independent veterinary practices: senior veterinarians owned the business as partners and would be supported by a team of salaried staff, including junior veterinarians. Between them, they would provide care from a main clinic and—perhaps a few branch clinics—covering in-hours and out-of-hours (emergency care) shifts. The challenging work–life balance was rewarded by profits for the practice partners and, for the junior veterinarians, the opportunity to become partners in the business when a partner retired (Treanor and Marlow, 2019).

In 1999, the Veterinary Surgeons Act (1966) was altered to allow non-veterinarians to own veterinary practices, paving the way for the development of large corporate veterinary groups acquiring strings of clinics (Anonymous, 2018a). A range of business models have emerged, with varying portions of business functions centralised to the group’s head office. In some groups, clinics are overseen by a local partner whilst others operate via joint venture partnerships. By 2018, the largest six corporate veterinary groups in the UK ran 35% of veterinary clinics (1,781 out of 5,068) and employed over 12,000 veterinarians and veterinary nurses (Anonymous, 2018a).

Corporate groups are able to capitalise on economies of scale, reducing their costs and placing pressure on competing independent clinics. In addition to clinics, groups have also acquired veterinary laboratories, product suppliers, and specialist referral centres. Some have accused them of prioritising profit over clinical outcomes (Nicol, 2012), whilst others have criticised this view as naïve: all veterinary clinics need to be financially sustainable regardless of whether or not they belong to a corporate veterinary group (Leonard, 2019). This thesis adopts a neutral position towards the corporatisation of the UK companion animal veterinary sector: it does not set out to judge how these changes have been beneficial and/or harmful. Rather, it uses the corporate group as a lens through which to move the consideration of antimicrobial use in the companion animal sector beyond individual veterinarian behaviour. Acknowledging how veterinarians work in clinics nested in corporate groups enables investigation of the context within which an increasing number of UK companion animal veterinarians are situated.

It is estimated that 12 million (41%) UK households include one or more companion animal. Pet dogs are the most common—and the focus of this thesis—with an estimated UK population of nine million, up from five million in 1970 (PFMA, 2019). Despite the vast majority of veterinary care in the UK being privately provided, only a minority of dogs—approximately one-third—are insured for veterinary costs (ABI, 2018). The cost of veterinary care and insurance claims are increasing rapidly, partly due to the availability of treatments, e.g. chemotherapy, and sophisticated diagnostic technology (Anonymous, 2017c). In Britain, $93 are spent on companion-animal care per person per year, second in the world only to the US (Anonymous, 2020d).

1.5. Research aim and questions

This mixed-methods thesis aims to describe the material, biotic and infrastructural interdependencies involved in antimicrobial use in the veterinary care of companion animals, in particular pet dogs in the UK. To achieve this aim, the thesis asks and attempts to answer the following research questions:

- What is the quantitative variation in HPCIA use in dogs attending first opinion veterinary clinics in large corporate veterinary groups?
- What are the infrastructural arrangements—including the evidence landscape—in the companion animal veterinary sector that support current ways of caring with antimicrobials?
- How are the multiple foci of care—including the recent imperative to care for antimicrobials—enacted within the ordering and arrangements of the social and material worlds of the companion animal veterinary clinic?
- How do the intersectional engagements between human actors in the veterinary clinic shape personal experiences of providing companion animal care, including antimicrobial use?
- How do bio-socially produced canine bodily forms—bred to meet societal demands for particular dog breeds—impact animal health, veterinary care work and antimicrobial use?

- How do these findings shed fresh light on existing antimicrobial stewardship efforts in the UK companion animal veterinary sector?

1.6. Contribution of thesis

This thesis makes a number of novel and important contributions. The central argument—or the thread running through this work— is that antimicrobial use is a bio-social practice. It is shaped by structural factors beyond the individual actors—the veterinarians, the owners, the dogs—involved at the interface of their deployment.

In terms of its approach, it is the first study to combine epidemiological and anthropological methods investigate antimicrobial use by UK companion animal veterinarians. In doing so, a nuanced and contextualised account of antimicrobial use is provided in a, to date, largely overlooked group of society—companion animals. Whilst this research focuses on antibiotic use in dogs—the most common companion animal species in the UK—the insights gained will help inform the design of sustainable antimicrobial stewardship interventions for the broader companion animal veterinary sector.

This study is the first to study antimicrobial use by companion animal veterinarians ethnographically. In doing so, it enables the study of enacted practices—rather than self-reported behaviours—and renders visible what has been previously taken for granted or overlooked. It thus demonstrates the much-needed input of rich ethnographic insight as part of social science informed endeavours to tackle antimicrobial resistance. This research also adds to anthropological and ethnographic efforts to explore human and more-than-human relations. In terms of antimicrobial use, by describing the animal–human–microbe entanglements at play in the context of wider ecologies and infrastructures, the study expands the 'options on the table' when seeking to intervene.

This thesis addresses a clear but as yet rarely met need for social science engagement with the companion animal veterinary sector. The theoretical and empirical insight offered by the social sciences can help unpick what are often understood to be complex problems—such as antimicrobial use—whilst the veterinary sciences can offer a fresh perspective with which to consider circulating ideas. For example, the study of daily life in veterinary clinics reveals the tensions between the inherently tactile aspects of interspecies care and the imperative to control infection through the management of microbes.

This research also adds to the One Health literature seeking to inform the development of sustainable antimicrobial stewardship interventions. Throughout this thesis, insights drawn from human healthcare and the companion animal veterinary sector are held in productive conversation. This positioning—for example, comparing companion animal veterinarians with their livestock counterparts—makes sense given that the role of companion animals as family members is increasingly accepted. It also enables novel suggestions for stewardship initiatives in human healthcare to be made based on veterinary care of our more-than-human family members.

Empirically this thesis draws on the epidemiological analysis of a large UK dataset arising from first opinion companion animal clinics and ethnographic fieldwork conducted in three such clinics. The fieldwork was conducted over nine months, and consisted of observations with nested interviews. I also undertook documentary analysis of relevant media articles, policies, and guidelines.

1.7. Thesis structure

The following chapter—**Chapter 2**—is a literature review. In it, I summarise existing research into antimicrobial use by companion animal veterinarians, describing not only *what* these studies found, but *how* they went about investigating it and how this influences the proposed 'solutions'.

Chapter 3 begins with my theoretical orientation, describing how—by drawing upon social theory—I adopt a novel vantage point compared to previous studies in the field. From this footing, I then present my epidemiological and ethnographic methods.

In **Chapter 4**—**'Setting the scene'**—I sketch a picture of clinic operations in the companion animal veterinary sector to acquaint the reader with the systems, processes, and imperatives that frame the findings of this thesis. I augment the details provided in Section 1.4 to describe the context in which UK companion animal veterinarians work.

Chapter 5 reports the findings of my epidemiological study. I utilise a hierarchical model to analyse the variation in the percentage of antimicrobial events comprising of HPCIAs in dogs attending UK clinics belonging to large veterinary groups. Due to the time constraints of this PhD project, this analysis is limited to pet dogs. A manuscript based on this chapter with abridged ethnographic insights has been published in the peer-reviewed journal *Preventative Veterinary Medicine*.

The next four chapters draw upon my ethnographic fieldwork and documentary analysis. The aim of **Chapter 6—'Looking beyond the individual: the veterinary industrial complex'**—is to render visible aspects of the infrastructure that support current ways of working with medicines— particularly antimicrobials—and other veterinary products. This infrastructure includes the sector's fees structure, income from medicines sales, and veterinarian renumeration packages. It reflects upon the role of the powerful veterinary-industrial complex in shaping the evidence landscape in which veterinarians and owners make decisions. The chapter concludes with a case study that investigates how forms of 'appropriate' antimicrobial use in companion animals are moulded to align with the broader goals of the veterinary pharmaceutical sector.

Chapter 7—'Providing care in the intersectional space of the veterinary clinic'—explores how care is enacted in companion animal clinics, and the implications this has for antimicrobial use and stewardship interventions. Through an ethnographic approach, I am able to provide fresh insight into the ordering, arrangements, and implications of the social and material worlds of veterinary practice and the intersectional engagements between the human actors there. As a relative newcomer, the imperative to care for antimicrobials is yet to find an established location, be that within time, in the space of the clinic, or the broader veterinary profession. By drawing attention to the humdrum and unremarked upon, I am able to offer additional—and previously overlooked—avenues for consideration when seeking to intervene regarding antimicrobial use.

Chapters 8 and **9** are shorter and slightly different in tone. Whilst still interested in the comings and goings of daily clinic life and the actors involved, these chapters adopt more of a case study approach to focus on two relatively recent arrivals—brachycephalic dog breeds and antimicrobial stewardship schemes—to consider how they interact with veterinary care.

I turn my gaze to focus on companion animals in **Chapter 8—'Caring for the companion animal: A bio-social case study'**. I consider the interspecies challenges of caring for 'the canine multiple'. By reflecting on bio-social entanglements, I propose that anthropocentrism has resulted in the phenotypic and genotypic forms of dogs for whom poor health and veterinary intervention is the norm. Within this context, I consider how 'appropriate' veterinary care, including antimicrobial use, is produced.

In **Chapter 9**—'**Antimicrobial 'misuse': A consequence of owners failing to 'Trust your Vet'?'**, I reflect upon existing UK companion animal veterinary antimicrobial stewardship efforts, in particular the 'Trust your Vet' campaign. Using comparative discourse analysis methods—and informed by a recent analysis of UK public health campaigns targeting human antimicrobial consumption (Will, 2020)—I consider the structures of power that are produced and reproduced. When viewed as a 'boundary object' (Star and Griesemer, 1989), the work 'Trust your Vet' does to 'shore up' a profession whose expertise and social standing is threatened is rendered visible. I also consider how this initiative might operate within different spaces of the clinic.

This thesis concludes, in **Chapter 10**, with a discussion of my research findings and their implications for antimicrobial stewardship. I reflect upon the strengths and weaknesses of this thesis, and present recommendations for veterinary practice and for future research.

Chapter 2 Literature review

2.0. Introduction

This chapter reviews the existing literature regarding antimicrobial use in companion animal care, particularly pet dogs. My interest here is not only *what* these studies found, but *how* they framed this ‘problem’ and went about investigating it, and how this influenced the proposed ‘solutions’.

2.1. Methods

Studies were identified via searches of the PubMed database, CAB Abstracts, Google scholar, publication reference lists, and the International Standard Randomised Controlled Trials Number clinical trial registry, as well as through discussion with experts in the field (Dr Ana Mateus and Professor Dave Brodbelt). I also contacted investigators of trials in progress to request further details. Table 2.1 describes the criteria for studies to be considered for inclusion. Commentaries or reviews with no primary data were excluded, as were papers describing resistant bacteria found in companion animals; the latter were beyond the scope of this thesis.

This review sought to be a narrative review conducted in a systematic manner, rather than a systematic review. Data regarding the study authors, population, methods, and findings were extracted into a standardised template in excel and synthesised. Due to the heterogeneity of the study populations and outcome measures, formal statistical synthesis (meta-analysis) was not possible. Data extraction was not cross-checked by a second reviewer, nor was formal quality assessment undertaken.

2.2. Results

Figure 2.1 visually summarises the literature identified. There has been an upturn in the number of papers in this field published annually, particularly since 2017. Research has been primarily conducted in Europe, Australia, and North America. A single study took place in Africa, with none identified in South America or Asia. Figure 2.1 illustrates the recent move towards qualitative studies and those considering the perspectives and experiences of social actors other than veterinarians.

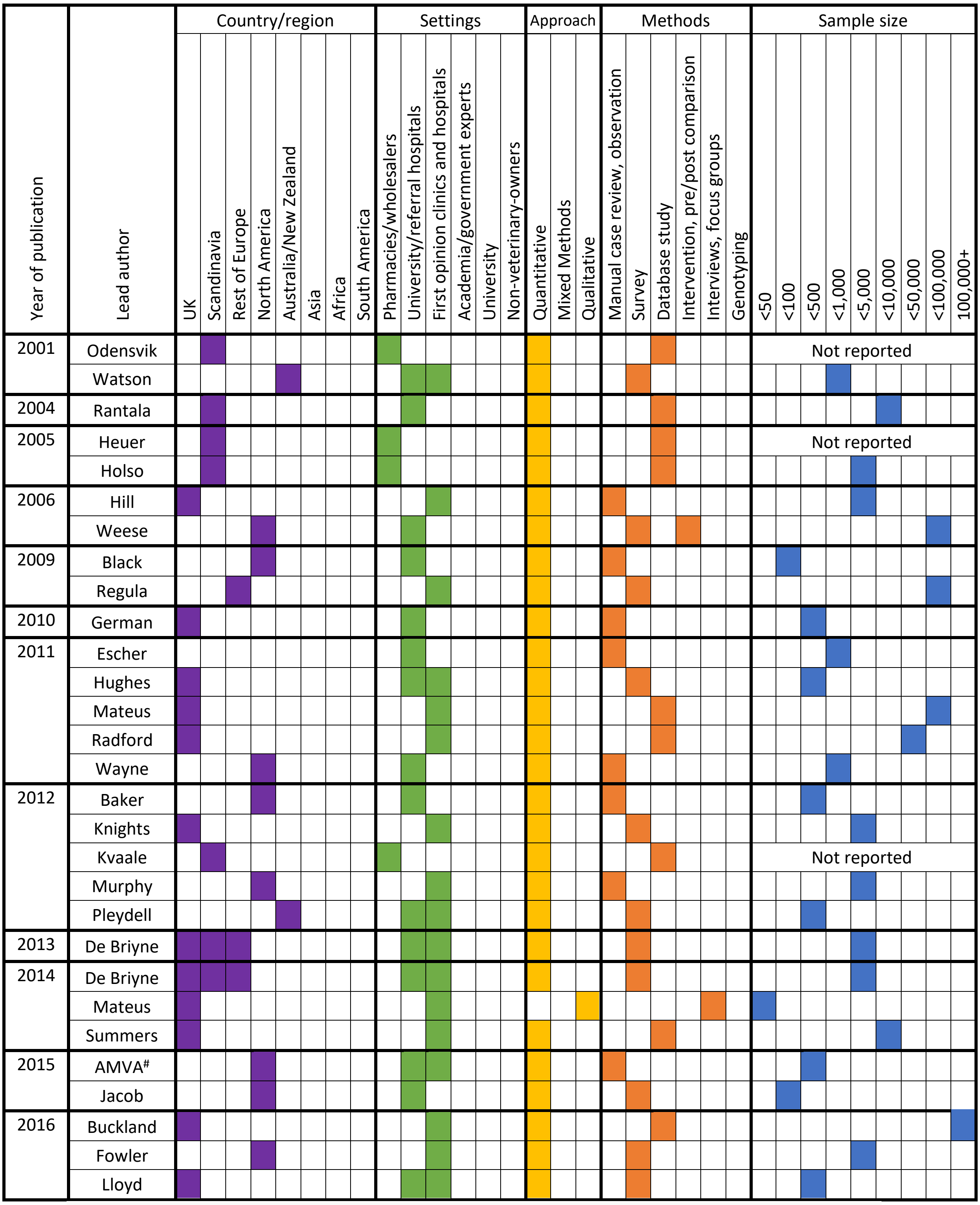
The results are organised by the methods used followed by additional sections describing the use of diagnostic testing and the term antimicrobial stewardship. I begin with some of the earliest studies.

Table 2.1: Remit of the biomedical veterinary literature review

Population	Must include dogs *Both inpatient and outpatient populations were considered.* *Studies considering companion animal species without dogs were excluded* *Studies considering only large animals, such as horses or livestock, were excluded*
Intervention	Antimicrobial use *This term is used rather than 'antibiotic' to provide a more comprehensive orientation to the existing literature in the field*
Study designs	Observational studies (Randomised controlled) trials Before and after comparisons (e.g. field intervention studies) Qualitative studies Mixed methods studies Delphi consensus techniques
Outcome measures	Quantitative: *Antimicrobial utilisation* *'Appropriate' antimicrobial utilisation* *Use of diagnostics to guide antimicrobial utilisation* *Use of guidelines to guide antimicrobial utilisation* *Knowledge of antimicrobial resistance/appropriate antimicrobial use/antimicrobial guidelines.* *Use of the term antimicrobial stewardship* Qualitative: *Themes regarding antimicrobial utilisation* *Themes regarding 'appropriate' utilisation* *Themes regarding antimicrobial stewardship*

Figure 2.1: Overview of published biomedical veterinary research in antimicrobial use in companion animals including dogs.

Annual monitoring reports–such as UK-VARSS and DANMAP (Section 2.2.1.)—are not included.



#AMVA: American Veterinary Medicine Association Task Force for Antimicrobial Stewardship in Companion Animal Practice

Figure 2.1: Overview of published biomedical veterinary research in antimicrobial use in companion animals including dogs (continued).

Annual monitoring reports–such as UK-VARSS and DANMAP (Section 2.2.1.)—are not included.

		Country/region								Settings						Approach			Methods						Sample size								
Year of publication	Lead author	UK	Scandinavia	Rest of Europe	North America	Australia/New Zealand	Asia	Africa	South America	Pharmacies/wholesalers	University/referral hospitals	First opinion clinic and hospitals	Academia/government experts	University	Non-veterinary-owners	Quantitative	Mixed Methods	Qualitative	Manual case review, observation	Survey	Database study	Intervention, pre/post comparison	Interviews, focus groups	Genotyping	<50	<100	<500	<1,000	<5,000	<10,000	<50,000	<100,000	100,000+
2017	Barbarossa			■							■	■				■				■							■						
	Barzelai					■					■	■				■				■							■						
	Chipangura							■			■	■				■				■				■				■					
	Hardefeldt[a]					■					■	■				■				■								■					
	Hardefeldt[b]					■					■	■				■				■								■					
	Jessen		■								■	■				■				■							■						
	Sarrazin			■								■				■						■							■				
	Singleton	■										■				■					■												■
2018	Cartelet	■										■						■					■		■								
	Currie	■											■					■					■		■								
	Dyar	■												■		■				■							■						
	Gomez			■								■				■			■								■						
	Hardefeldt[a]					■								■		■				■							■						
	Hardefeldt[b]					■					■	■					■			■			■				■						
	Hardefeldt[c]					■					■	■				■					■												■
	Hopman			■							■	■						■					■		■								
	King	■									■	■						■					■		■								
	Smith	■										■			■			■					■		■								
	Sorensen		■									■				■			■								■						
	Van Cleven			■								■				■						■					■						
	Zhou					■					■	■				■				■								■					
2019	Dickson	■													■			■					■		■								
	Hopman[a]			■							■	■				■				■							■						
	Hopman[b]			■								■				■					■				Not reported								
	Hopman[c]			■								■				■						■			■								
	Hopman[d]			■								■				■					■				Not reported								
	Norris					■					■	■				■				■							■						
	Redding[a]				■										■			■					■		■								
	Redding[b]				■							■			■		■			■			■				■						
	Singleton[a]	■										■				■					■												■
	Singleton[b]	■										■				■					■												■
	Singleton[c]	■										■				■					■								■				
	Singleton[d]	■										■				■					■												■
2020	Hur					■					■	■				■					■												■
	Joosten			■								■				■								■			■						
	Singleton			■								■				■					■												■

2.2.1. Sales data

Prior to companion animal studies, some of the first efforts to quantify antimicrobial use in animals were in livestock in Scandinavia. In the 1990s, scientists working in Denmark identified a link between routine antimicrobial use in farm animals and the high incidence of bacteria resistant to important antimicrobials used in human healthcare (DANMAP, 2012). Therefore, antimicrobial use in agriculture became of public health interest and the remit of the Danish Integrated Antimicrobial Resistance Monitoring and Research Programme (DANMAP) was extended from humans to include data collated by the Danish VetStat system (DANMAP, 2012). Initiated in 2000, VetStat collects veterinary prescribing information from pharmacies, veterinarians, and feed mills and enables the quantification of medicines use in livestock (Stege et al., 2003). DANMAP was the first systematic and integrated surveillance system for antimicrobial use and resistance in humans, animals and food, and it is held as a gold standard to which other countries aspire (DANMAP, 2012).

Echoing these studies in livestock, the first investigations into antimicrobial use in companion animals were conducted in Scandinavia and adopted similar methodological approaches to produce estimates at a population level. For example, Heuer et al. (2005) quantified antimicrobial use via the Danish VetStat system. Odensvik et al. (2001) analysed the sales records of veterinary wholesale companies in neighbouring Norway and Sweden, whilst Holso et al. (2005) studied veterinary prescriptions sent to pharmacies in Finland. More recently, trends in antimicrobial use in companion animals have been assessed using the Norwegian national prescribing database between 2004 and 2008 (Kvaale et al., 2013) and the Danish VetStat system between 2012 and 2016 (Bager et al., 2017).

In the UK, the Veterinary Medicines Directorate (VMD) has collated and published Veterinary Antibiotic Resistance and Sales Surveillance (VARSS) reports for almost 20 years (Goodyear, 2007) [the earliest versions are unavailable online to cite]. Mandatory resistance monitoring is heavily skewed towards food-producing animals, for example, that conducted in abattoirs (UK-VARSS., 2019). Sales data have been analysed based on a product's UK licensing for use in either food-producing animals and/or non-food animals (small animals and horses) resulting in a broad-brush picture being produced (Goodyear, 2007). More recent analyses have separated out products licensed for use in dogs and cats, with products licenced for multiple companion animal species excluded, although these account for a minority of sales. Canine and feline antibiotic product sales were 66.5 mg/kg in 2018, a 9.5 mg/kg (12%) reduction since 2014 (Figure 2.2) (UK-VARSS., 2019). Over the same time period, following the setting of targets within the livestock sector, a 53% reduction was observed in antibiotic sales for food-producing species down to 29.5 mg/kg in 2018 (RUMA., 2019, UK-VARSS., 2019). Amongst dogs and cats, sales of HPCIAs (see Section 1.2) account for one per cent of the total weight of antimicrobials sold. Since 2014, use of third- and fourth-generation cephalosporins has remained stable, whilst sales of fluoroquinolones have decreased by a third (UK-VARSS., 2019).

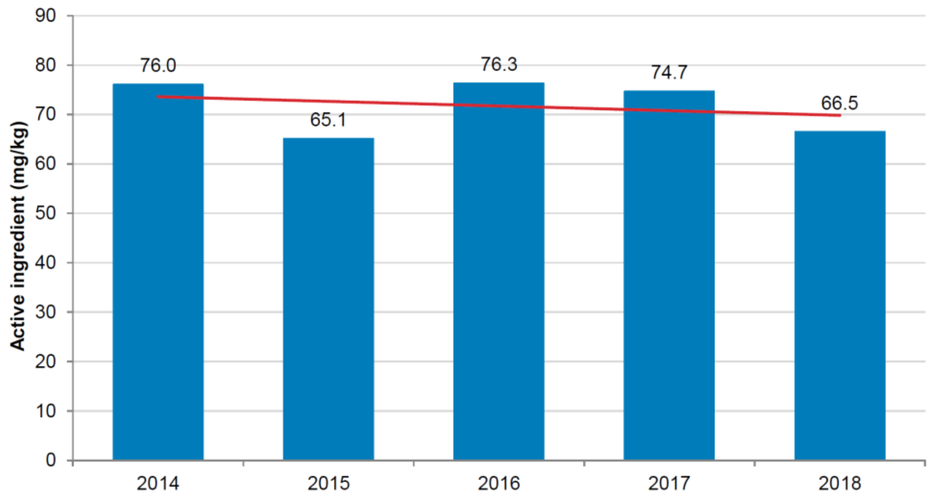


Figure 2.2: Active ingredient (mg/kg) of antibiotics sold for use in dogs and cats between 2014 and 2018 in the UK (UK-VARSS., 2019). Reproduced under the terms of the Open Government Licence v.3.

The European Surveillance of Veterinary Antimicrobial Consumption (ESVAC) project began in 2009. It is coordinated by the European Medicines Agency (EMA) and collates antimicrobial sales data for 31 countries (ESVAC, 2019). Its most recent annual report estimated companion animal antimicrobial use based on sales of tablets—such formulations are rarely used in livestock. International comparisons, however, are hampered by limited data, e.g. regarding population sizes in order to adjust antimicrobial consumption for total animal biomass. In total, the UK was the second-highest consumer of veterinary antimicrobials in tablet form behind France (14.3 and 15.2 tonnes, respectively) (ESVAC, 2019).

These studies provide valuable insight into the aggregate amounts of antimicrobials being used across companion animal populations. They enable monitoring of longitudinal changes and international comparisons to be made (Weese et al., 2013). However, they are limited in the level of detail they can provide, partly due to relying on a product's licensing to attribute its use in companion animals. Furthermore, the outcome measure used in these studies (mg/kg) bears no relation to the frequency of deployment: falling use calculated in this way (mg/kg) could reflect the same number of dispensing events masked by a move towards using antimicrobials with lower (lighter) doses. Also, by relying on sales data, these studies are a further step back from the product being dispensed and given to the companion animal. They are also unable to investigate the clinical context underpinning such use and its ‘appropriateness’.

2.2.2. From teaching hospitals to primary care studies

In parallel to the Scandinavian studies based on sales data, research was also being conducted into antimicrobial use at an individual animal level in North American veterinary teaching hospitals. This echoes the initial framing of antimicrobial resistance as a problem of antimicrobial use in secondary and tertiary care in human medicine (Charani and Holmes, 2019). Such single-site studies considered inpatients (Weese, 2006, Black et al., 2009, Baker et al., 2012) and outpatients in American (Wayne et al., 2011) and Italian (Escher et al., 2011) companion animal hospitals.

As interest in antimicrobial use in primary care as a driver for antimicrobial resistance grew (Costelloe et al., 2010), study locations were extended to first opinion veterinary clinics. In Canada, Murphy et al. (2012) asked first opinion veterinarians (n = 84) to submit study diaries to establish their antimicrobial usage patterns, whilst in Madrid, Gomez-Poveda and Moreno (2018) reviewed the records of 300 dogs attending veterinary clinics to estimate antimicrobial use. The impact of diagnostic work up on the management—including antimicrobial use—of 151 dogs attending first opinion clinics in Denmark with signs of UTIs has also been examined (Sorensen et al., 2018). Manual data extraction is labour intensive and therefore the sample size and number of sites included in these studies is limited. Using clinical data from routinely collected veterinary sources—as done by the VetCompass™ and Small Animal Veterinary Surveillance Network (SAVSNET) systems—can help overcome such problems (O'Neill, 2013, Sanchez-Vizcaino et al., 2015). Early examples of studies adopting this approach were Mateus et al. (2011) and Radford et al. (2011). These analyses are further discussed in Section 2.2.4 which scrutinises patterns of antimicrobial use estimated from routine data sources.

2.2.3. Surveys of veterinarians

Surveys of antimicrobial prescribing practices offer an efficient means by which to increase sample sizes and form a considerable part of the literature to date (Figure 2.1). In these studies, veterinarians are asked to report whether and which type(s) of antimicrobial they would use in certain clinical situations, allowing researchers to assess patterns and ‘appropriateness’ of antibiotic usage. A note of caution, however: such estimates are subject to recall and scrutiny bias when respondents might misremember or supply answers that are socially desirable. Furthermore, the survey respondents’ reported use may differ from non-responders causing selection bias, too.

The earliest such study identified was undertaken by Watson and Maddison (2001), who asked companion animal veterinarians in Sydney to report their 'general patterns' of antimicrobial use. This illustrates one limitation of this approach—it does not allow for case-by-case variation and instead assumes that, for example, all abscesses are equal. Unlike many of the studies that followed, the authors included a scenario of 'acute, undifferentiated illness' with 82% of respondents opting for empirical antimicrobial treatment in such situations (Watson and Maddison, 2001). Without such a scenario, surveys struggle to capture the use of antimicrobials amidst diagnostic uncertainty. The prescribing of antimicrobials 'just in case' as a strategy to manage such uncertainty is reported by qualitative studies of companion animal veterinarians (Hopman et al., 2018, Smith et al., 2018).

Subsequent surveys went beyond estimating patterns of antimicrobial use to assess 'appropriateness' against national guidelines. Studies were conducted in New Zealand (Pleydell et al., 2012), the UK (Knights et al., 2012, Lloyd et al., 2016), Denmark (Jessen et al., 2017), Australia (Hardefeldt et al., 2017a, Hardefeldt et al., 2018a), and Belgium (Van Cleven et al., 2018). At this point, it is pertinent to consider the assessment of appropriate antimicrobial use (Box 2.1).

Box 2.1: Assessing appropriateness.

Appropriate antimicrobial use is conceptualised as having multiple dimensions: i) using the correct choice of agent for a specific condition; ii) at the correct dose and frequency of dosing; and iii) for the correct duration of treatment (Weese et al., 2013). This presumes a specific condition can be diagnosed. In addition to the use of antimicrobials for 'inappropriate' conditions, studies have also found evidence of under- and over-dosing (Regula et al., 2009), including by UK companion animal veterinarians (Hughes et al., 2012). In Denmark, Sorensen et al. (2018) found that the duration of antimicrobial treatment for canine UTIs was longer than recommended whilst, in the UK, Summers et al. (2014) concluded that a quarter of prescribed daily antimicrobial doses for canine pyoderma were below the minimum recommended dose, in the minority of cases with data available to assess this.

At a population level, evaluating appropriateness is challenging without standardised, evidence-based definitions of appropriate use, e.g. those incorporated into clinical guidelines (Wayne et al., 2011, Weese et al., 2013). There have been limited trials evaluating optimum antimicrobial treatment protocols for common veterinary conditions (see Chapter 6 for a fuller discussion) and therefore antimicrobial use guidelines draw heavily on expert opinion.

Rantala et al. (2004) compared over 7,000 antimicrobial prescribing events in dogs and cats against the Finnish—expert, opinion-based—guidelines, concluding that ‘in some cases the use of antimicrobial drugs was not justified or reasonable’ (Rantala et al., 2004, p. 261). However, the terms *justifiable* and *reasonable* were not defined by the authors, and social scientists would argue that an understanding of the local context would reveal how such antimicrobial use might be both of these things ‘on the ground’ (Denyer Willis and Chandler, 2019).

In addition to data on the clinical situations in which antimicrobials are used, information about the veterinarian respondents themselves has also been collected in order to ask questions such as, ‘What type of veterinarian is more likely to use antimicrobials appropriately?’ For example, Hardefeldt et al. (2017b) found that, in response to hypothetical clinical vignettes, 88% of the reported uses of HPCIAs were contained within the replies of 50% of surveyed Australian companion animal veterinarians (with the other half of respondents reporting just 12% of HPCIA use) (total sample size = 892). However, no differences between the year of graduation or postcode-derived socio-economic variables were observed between these groups. In a UK study, Hughes et al. (2012) reported that the odds of clinicians (n = 460) working in a veterinary referral hospital prescribing the incorrect antimicrobial dose were half those of veterinarians who did not (odds ratio (OR): 0.5, 95% confidence interval (CI): 0.3–0.8), whilst locums were more likely to prescribe antimicrobials off label than clinic partners (OR: 4.8, 95% CI: 1.3–18.0).

Surveys have also asked companion animal veterinarians to report or rank factors influencing their antimicrobial use (Knights et al., 2012, Jacob et al., 2015, Lloyd et al., 2016, Jessen et al., 2017, Sarrazin et al., 2017, Van Cleven et al., 2018, Zhuo et al., 2018). A survey of UK companion animal veterinarians found that clinical presentation was the most important factor, followed by bacterial culture, ease of antimicrobial administration, and financial constraints, with client expectations being the least important (Hughes et al., 2012). Echoing these findings, client expectations for antimicrobials have been ranked as a minor influence across a number of studies and settings. These include UK veterinarians in perioperative situations (Knights et al., 2012), those working at a US veterinary teaching hospital (Jacob et al., 2015), those working in Australia (Zhuo et al., 2018, Norris et al., 2019), Belgium (Van Cleven et al., 2018), and the Netherlands (Hopman et al., 2019a). Whilst a high proportion of a sample of Australian veterinarians reported experiencing client pressure to prescribe, they also stated that their clients’ and colleagues’ expectations had minimal influence on their antimicrobial use (Norris et al., 2019). However, in another Australian study, the most frequently selected factor limiting antimicrobial stewardship was client pressure (24% of 97 respondents) with client finances in third place (11%) (Hardefeldt et al., 2018b). These discrepancies in findings might be due to differences in the question framing, with antimicrobial use being seen as a clinical matter over which veterinarians have control versus antimicrobial stewardship, a relatively new 'arrival' that might be difficult to enact.

Veterinarians also rated economic factors as of low importance when deciding whether/which antimicrobials to use (Van Cleven et al., 2018, Hopman et al., 2019a). When surveyed, only a small minority (9%) of a sample of Flemish veterinarians (n = 284) felt financial restrictions—presumably of the owner—were an important factor. In terms of profit from antimicrobial sales, almost three-quarters of veterinarians surveyed in Australia (72%, n = 172) strongly disagreed that this influenced their decision to prescribe (Hardefeldt et al., 2018b).

These self-reported data imply that antimicrobial deployment is predominately a clinical decision, with contextual factors such as the influence of owners playing a minimal role. However, survey respondents may have felt compelled to give socially desirable answers that portray veterinarians as professionally autonomous clinicians practising the 'pure' form of veterinary medicine taught at university (Clarke and Knights, 2018). One might ponder how well the complex on-the-ground realities of providing care are represented by the ranking of individual, stand-alone factors from a predetermined list. Questions also remain regarding the factors scrutinised: what about those who act sub-consciously, or the diffuse prevailing conditions that are taken for granted. The study authors are typically veterinarian-researchers located within veterinary university departments. Therefore, they might struggle to identify idiosyncrasies of the context in which companion animal veterinarians work, or to distance themselves from recreating the socially acceptable representations of veterinary work.

Use of information/guidelines

When investigating which veterinarians are more likely to use antimicrobials inappropriately, another area of interest has been the information sources upon which they draw, e.g. clinical experience, pre-/post-qualification education, and the published literature (Hughes et al., 2012, Knights et al., 2012, De Briyne et al., 2013, Barbarossa et al., 2017, Hardefeldt et al., 2017a, Van Cleven et al., 2018). UK companion animal veterinarians reporting use of pharmaceutical company information were found to be more likely to prescribe second- and third-generation cephalosporins compared to those who did not (OR: 1.87, 95% CI: 1.04–3.37) (Hughes et al., 2012). However, when asked directly, Australian veterinarians stated that manufacturer promotional material had minimal or no impact on their antimicrobial prescribing (Norris et al., 2019), a finding echoed by UK 'experts' (Currie et al., 2018).

Linked to the interest in the role of information and education in guiding appropriate antimicrobial use, a number of surveys have studied veterinarians' knowledge, attitudes, and beliefs surrounding antimicrobial use and antimicrobial resistance (AMVA., 2015, Fowler et al., 2016, Zhuo et al., 2018, Norris et al., 2019). When Australian veterinarians of all sectors were surveyed, Norris et al. (2019) found that the greatest disconnect between personal use of antimicrobials and concerns about antimicrobial resistance was shown by companion animal veterinarians. Recently, the adequacy of veterinary undergraduate education in this regard has come under scrutiny, with student knowledge regarding 'appropriate' antimicrobial use being deployed as a surrogate measure for subsequent practice (Dyar et al., 2018, Hardefeldt et al., 2018a). These surveys are typically characterised by low response rates, introducing the possibility of selection bias, as individuals more interested in the topic are those who participate in the survey. Furthermore, considering the high policy priority given to antimicrobial resistance, respondents may have also felt compelled to provide socially acceptable answers. Therefore, it is questionable how generalisable the results are, with the levels of awareness and knowledge likely to be overestimated.

The role of clinic policies

Another form of information available to veterinarians is the clinical guideline or policy. The introduction of guidelines is positioned as a key step in optimising antimicrobial use (Weese et al., 2013). Professional bodies such as the British Veterinary Association (BVA), the BSAVA, and the Federation of European Companion Veterinary Associations (FECAVA) have provided guidance on appropriate antimicrobial use (BVA., 2015a, BSAVA., 2018, FECAVA, 2018). Surveys suggest that a minority of UK small animal practices have local antimicrobial use policies (Hughes et al., 2012, Lloyd et al., 2016), an observation replicated elsewhere in the world (Chipangura et al., 2017, Hardefeldt et al., 2017a, Jessen et al., 2017, Hardefeldt et al., 2018b). Encouragingly, two-thirds of a sample (n = 71) of UK veterinary students had heard of the BVA's 'Responsible Use of Antimicrobials' policy (Dyar et al., 2018). However, a survey of 254 US veterinarians conducted in 2015 found 88% were unaware of the existence of professional antimicrobial use guidelines, with over three-quarters welcoming more guidance in this area (AMVA., 2015). In Australia, livestock veterinarians typically indicated guideline recommendations as having a 'strong' influence on their antimicrobial decisions, whilst their companion animal counterparts rated them as a 'moderate' influence (Norris et al., 2019). This suggests that the impact of introducing guidelines might vary between settings.

Jessen et al. (2017) investigated the impact of the introduction of Danish prescribing guidelines for companion animal veterinarians (n = 151). Almost two-thirds (65%) of the respondents reported the guidelines had altered their habits. The main barriers to adherence were: confidence in old prescribing practices (46%); unavailability of licensed products (34%); difficulties dosing the drug (e.g. due to limited tablet sizes) (31%); costs (30%); lack of time for consulting the guidelines (25%); a limited number of antimicrobials available on site (23%); and owners' difficulties in administering drugs (18%). This finding hints at the potential clash between standardised, expert opinion-based guidelines and individual veterinarian's empirical experience amassed over their career working as a largely autonomous professional (Allerton and Jeffery, 2020).

International surveys of companion animal veterinarian antimicrobial use have been undertaken. This reflects the broader move towards representing antimicrobial resistance as a problem of connectivity (Box 2.2).

Box 2.2: Antimicrobial resistance: a problem of connectivity.

Anthropological interrogation of accounts of antimicrobial resistance reveals how the phenomena is framed as a problem of connectivity, for example between countries or between animal and human health (Chandler, 2019). Examples of this can also be identified within the companion animal literature.

Reflecting calls for international co-operation to tackle the global threat posed by antimicrobial resistance (O'Neill, 2016), collaborative efforts have enabled increased sample sizes and inter-country comparisons. As described in Section 2.2.1., ESVAC—co-ordinated by the EMA—collates national veterinary antimicrobial sales data for 31 European countries. In terms of surveys, the Federation of Veterinarians of Europe (FVE) surveyed veterinarians in 25 countries about the antibiotics they commonly used (De Briyne et al., 2014) and factors influencing their prescribing habits (De Briyne et al., 2013). Recently, an EU-funded study examined antimicrobial use and the presence of multidrug-resistant bacteria in dogs from three European countries (Joosten et al., 2020).

Another rendering of connectivity is through adopting a One Health approach. Knowledge, attitudes, and beliefs surveys have compared medical, veterinary, and dental professionals, particularly their attitudes regarding antimicrobial use and their profession's contribution to antimicrobial resistance (Dyar et al., 2018, Zhuo et al., 2018).

In these survey studies, assessing knowledge or reported behaviour has been used as a proxy for measuring enacted practices. As a consequence, antimicrobial use is framed as a 'behaviour change' issue with efforts to intervene focused on improving individuals' (deficient) knowledge. For example, Hardefeldt et al. (2017a) found no difference in the appropriate use of antimicrobials for surgical prophylaxis in veterinarians working in a clinic with an antimicrobial use policy compared to those working in a clinic without one. However, they concluded that, 'the adoption of antimicrobial use policies by veterinary practices . . . should be promoted' (Hardefeldt et al., 2017c, p. 307). The interest in information provision fixing 'inappropriate' antimicrobial use has informed the interventions evaluated (see Section 2.2.7. for further details). Social scientists have questioned whether this linear model of behaviour change is over simplistic, too reliant on the agency of the individual (Cohn, 2014, Will, 2018), and obscures structural drivers of antimicrobial use (Denyer Willis and Chandler, 2019).

A recent quantitative survey sought to further investigate the context in which individual companion animal veterinarians work by studying how factors combined to produce antimicrobial use. Hopman et al. (2019a) investigated the links between veterinarian demographics, attitudes, working environment, and antimicrobial use. A Categorical Principal Component Analysis of survey data was undertaken to produce a model with three dimensions. The first—'social responsibility'—was characterised by well-considered antimicrobial prescribing, self-confidence, independence, and recognition of their role in public and animal health, whilst being uninfluenced by owner's demands and working in a well-equipped clinic. This dimension was positively associated with more experienced veterinarians and working in dedicated companion animal clinics or referral centres. The second dimension—scepticism'—was illustrated through the attitude of 'no harm done by trying antimicrobials'. It was linked to risk avoidance behaviours at an individual animal level and ignorance of the possible (public health) risks of antimicrobial use in companion animals. This dimension was positively associated with being a male and a more experienced veterinarian. The final dimension—risk avoidance—was related to fear of the possible consequences of not prescribing antimicrobials, for example, after surgical procedures. This was illustrated by a 'better safe than sorry' habit and was negatively associated with veterinarians working part-time and in urban clinics (Hopman et al., 2019a). This study begins to consider how contextual factors combine to produce the environment in which antimicrobials are deployed. It is debatable how well quantitative methods can describe these complex, shifting, socially situated practices and in the last few years, there has been an increased use of qualitative methods to study this phenomenon (Section 2.2.6).

2.2.4. Utilising routinely collected electronic data

Although surveys are a relatively low cost and accessible means by which to estimate antimicrobial use, they are subject to problems of reliability and generalisability due to relying on a self-selected sample of veterinarians reporting their recalled antimicrobial use. Extracting and analysing patient clinical data from routinely collected veterinary sources can help overcome these problems. Although such studies are time consuming to set up, once automatic extraction procedures are in place, they enable larger—and more complete—datasets to explore antimicrobial use across animal populations of interest. The first such study was undertaken using the clinical records of a Finnish veterinary teaching hospital (Rantala et al., 2004). In the UK, electronic patient records from a teaching hospital were interrogated to assess the first-choice therapy for dogs presenting with diarrhoea (German et al., 2010). Multi-sited projects were also undertaken: Regula et al. (2009) studied antimicrobial usage based on the records of eight mixed-animal practices in Switzerland. Hopman et al. (2019d) retrospectively analysed antimicrobial procurement records to compare 100 Dutch companion animal veterinary clinics. The same approach was used to investigate longitudinal trends and seasonality of antimicrobial use (Hopman et al., 2019b). Using clinic-level, aggregate data, however, prevents the investigation of antimicrobial use at an individual (dog) level. In Australia, Hardefeldt et al. (2018c) analysed a database of insurance claims spanning 813,172 dog-years to calculate antimicrobial use. This, however, represented a subset of dogs attending veterinary clinics as only 30% of dogs are estimated to be insured in Australia (AMA., 2019). It is unclear how representative they, or their treatment, are of the broader primary care population as a whole.

As research networks and electronic data management capabilities have developed, larger studies with greater numbers of participating clinics have become possible. There are two UK-based surveillance systems—VetCompass™ (Royal Veterinary College, RVC) and SAVSNET (Liverpool University)—that collate data from the electronic patient records of veterinary clinics (O'Neill, 2013, Sanchez-Vizcaino et al., 2015). These systems have enabled larger, multi-site studies of antimicrobial use in companion animal care (Mateus et al., 2011, Radford et al., 2011, Buckland et al., 2016, Singleton et al., 2017). Studies have also focused on the use of specific antimicrobial substances in cats (Burke et al., 2017, Singleton et al., 2020), dogs (Singleton et al., 2020, Tompson et al., 2020) or antimicrobial use as part of the care for specific conditions such as pyoderma (Summers et al., 2014), gastrointestinal disease/diarrhoea (Singleton et al., 2019a, Singleton et al., 2019c), pruritus (Singleton et al., 2019b), or respiratory disease (Singleton et al., 2019d). Whilst analysis of routinely collected clinical data enables more robust and accurate estimates of antimicrobial use, such analyses are unable to easily comment on ‘appropriateness’. This is because there is a lack of standardisation and detail in the recording of diagnoses with free text comments often being used (Kvaale et al., 2013, Hur et al., 2020). The VetCompass^{TM} methodology has recently been extended to Australia where natural language processing techniques have been used to automate processes of the data labelling of free text (Hur et al., 2020). This approach opens the door for future studies investigating ‘appropriate’ use in large datasets derived from clinical records.

2.2.5. Levels of antimicrobial use in UK dogs

In this section, I report usage patterns of antimicrobials. To do this, I turn to the VetCompass^{TM} and SAVSNET studies (Mateus et al., 2011, Radford et al., 2011, Buckland et al., 2016, Singleton et al., 2017) due to their UK focus and methodological strength.

Direct comparison between these studies is hampered by the use of slightly different study populations, classes of antimicrobials considered, and different follow-up durations, as described in Table 2.2. For example, SAVSNET studies are based on antimicrobials usage in consultations (i.e. outpatients only) whilst VetCompass^{TM} studies include all entries within a patient’s record (i.e. emergency, surgical, in- and outpatients use); SAVSNET includes topical antimicrobial treatments whilst VetCompass^{TM} analyses exclude them. Despite these differences in approach, the results across these studies are broadly in agreement. All studies found that antimicrobials are frequently used in pet dogs (Table 2.3) and that broad-spectrum amoxicillin-clavulanate was the most frequently prescribed agent. Over a two-year period, one in four UK dogs (25.2%, 95% CI: 25.1–25.3%) received antimicrobials, with CIAs accounting for 60% of UK antimicrobial events in dogs (Buckland et al., 2016). HPCIAs have been estimated to make up around 5–6% of total events (Table 2.3), with fluoroquinolones being the most commonly used HPCIA in dogs, constituting approximately 4–5% of total antimicrobial events (Buckland et al., 2016, Singleton et al., 2017). Fluoroquinolones are one of the few available antimicrobials suitable for the treatment of serious *Salmonella* spp. and *E. coli* infections that cause a substantial burden of serious illness in humans (WHO, 2019).

Table 2.2: Summary of the VetCompass™ and SAVSNET studies investigating antimicrobial use in pet dogs in the UK

Lead author (year)	Mateus et al. (2011)	Radford et al. (2011)	Buckland et al. (2016)	Singleton et al. (2017)
Title	Antimicrobial usage in dogs and cats in first opinion veterinary practices in the UK	Antibacterial prescribing patterns in small animal veterinary practice identified via SAVSNET: the small animal veterinary surveillance network	Characterisation of antimicrobial usage in cats & dogs attending UK primary care companion veterinary practice	Patterns of antimicrobial agent prescription in a sentinel population of canine and feline veterinary practices in the UK
System Used	VetCompass™	SAVSNET	VetCompass™	SAVSNET
Objective	To provide baseline data of patterns of AM usage in dogs and cats	To describe the antibacterial prescribing patterns in a population of 16 small animal veterinary practices	To quantify the frequency and quantity of systemic antimicrobial use in cats and dogs.	To describe a near real time ongoing prescription surveillance system from a diverse range of veterinary premises
Sample	11 practices (18 branches) 34,928 dogs	16 practices (32 branches) 15,727 dogs	374 clinics 963,463 dogs	216 practices (457 branches) 413,870 dogs
Timeframe	2007	2010 (3 months)	2012–2014	2014–2016
Inclusion criteria	Animals with a consultation recorded in first opinion practices	Consultations carried out by a vet (RCVS registered), where owners presented animals for the investigation of disease (both initial and follow-up consultations),	All dogs and cats that had at least one electronic patient record entry	Booked appointments
Exclusion criteria	Data from referral practices	Consults addressing prophylactic treatment such as vaccinations and puppy checks.	Practices engaged mainly in referral and emergency care were excluded. Written prescriptions (a small minority) were excluded.	Not reported
Antimicrobials considered	Systemic and topical antimicrobial agents.	Systemic antimicrobial agents	Systemic antimicrobial agents	Systemic and topical antimicrobial agents

Table 2.3: Antimicrobial use in dogs by veterinarians in the UK

	Author, year	Mateus et al. (2011)	Radford et al. (2011)	Buckland et al. (2016)	Singleton et al. (2017)
	Study duration	1 year	3 months	2 years	2 years
All agents	% of dogs (95% CI)	45.1	-	-	28.4 (27.2–29.7)
	% of consultations (95% CI)	-	-	-	18.8 (18.2–19.4)
Topical agents	% of dogs (95% CI)	-	-	-	12.9 (12.3–13.5)
	% of consultations (95% CI)	-	-	-	7.4 (7.2–7.7)
	% of total events (95% CI)	22.6	-	-	39.6 (38.5–40.6)
Systemic Agents	% of dogs (95% CI)	-	-	25.2 (25.1 - 25.3)	19.6 (18.4–20.7)
	% of consultations (95% CI)	-	35.1	-	12.2 (11.7–12.7)
	% of total events (95% CI)	77.4	-	-	64.9 (63.8–66.0)
Critically important Agents	% of total systemic events (95% CI)	60.5*	-	60.3#	-
Highest priority critically important agents	% of total events (95% CI)	-	-	-	5.4 (4.6–6.1)
	% of total systemic events (95% CI)	-	-	6.4	-

95% CI = 95% confidence interval; * WHO 2007 classification; # WHO 2012 classification

Variation in antimicrobial use

Database studies have been used to investigate variation in antimicrobial use. When longitudinal trends were considered, total antimicrobial use by Dutch companion animal clinics decreased between 2012 and 2015 and, in the UK, a statistically significant negative linear trend was observed for the percentage of canine consultation resulting in antimicrobial use between quarter 2 of 2014 and quarter 1 of 2016 (Singleton et al., 2017) (Figure 2.3). These data concur with the decline in the total tonnage of canine and feline antimicrobials sold in the UK between 2014 and 2018 (Section 2.2.1.) (UK-VARSS., 2019).

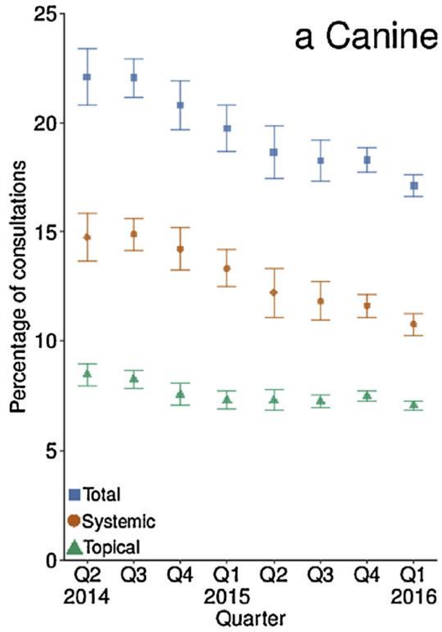


Figure 2.3: Total, systemic, and topical antimicrobial agent prescription in dogs as a percentage (95% CI) of total consultations in a sample of UK first opinion clinics between 2014 and 2016 (Singleton et al., 2017), reproduced with permission.
(n = 918,333 electronic health records from quarter 2 in 2014 to quarter 1 in 2016).

Radford et al. (2011) found that the percentage of dogs receiving antibiotics varied by approximately twofold in a sample of 16 UK small animal veterinary practices (26% to 55%). Practices found to be high antibiotic users in dogs were also high users in cats, a finding replicated by Singleton et al. (2017). In Australia, total antimicrobial and HPCIA dispensing was also found to vary between clinics (n = 137). Emergency and referral centres dispensed antimicrobials in 25% of consultations and high-importance antimicrobials in 4% of consultations (Hur et al., 2020). The corresponding results for first opinion clinics were 13% and 4%, and the authors suggest that this is due, in part, to differences in case mix and preventative healthcare consultations, such as vaccinations, being conducted in first opinion clinics. In the Netherlands, clinic level data (n = 111) from 2014 showed a 20-fold difference in their total antimicrobial use (the number of Defined Daily Doses per Animal per Clinic per year $DDDA_{clinic}$ 0.37–7.50, a standardised measure enabling researchers to combine use across antimicrobial classes and compare sites) and a 500-fold difference for HPCIAs ($DDDA_{clinic}$ 0.001–0.70) (Hopman et al., 2019d). The authors speculate these findings could be due to differences in case mix, clinic type, clinic prescribing policies, or veterinarians' habits (Hopman et al., 2019d). They conclude by calling for further, in-depth research into these underlying factors.

The first report of seasonal variation in antimicrobial use was based on Australian insurance data (Hardefeldt et al., 2018c). The rate of antimicrobial prescribing in dogs was found to be 13% higher in spring (Relative risk (RR): 1.13, 95% CI: 1.12–1.14, $p < 0.001$) and 12% higher in summer (RR: 1.12, 95% CI: 1.11–1.13, $p < 0.001$) than in winter. Seasonality was also investigated using antimicrobial procurement records from Dutch companion clinics (Hopman et al., 2019b) with antimicrobial use highest in July–August and lowest in February–March. Hardefeldt et al. (2018c) postulate that the patterns of seasonality observed could be linked to peaks in diseases seen in warmer months, e.g. allergic dermatitis.

Geographical differences have also been investigated. In the UK, at a regional level, spatial analysis suggests higher antimicrobial use in southeast England, south Wales, and southwest Scotland (Buckland et al., 2016), whilst variation in antimicrobial use in dogs has been observed in Norway, possibly due to differences between rural and urban areas (Kvaale et al., 2013). In Australia, logistic regression modelling of insurance data suggested dogs and cats attending urban clinics had 35% higher OR of having a claim submitted and 6% higher OR of having an antimicrobial prescribed, compared to those from rural areas (Hardefeldt et al., 2018c). The authors hypothesised that this may reflect differences in disease occurrence, owner expectations, or veterinarians' behaviour (Hardefeldt et al., 2018c). However, this study was not designed to investigate the potential causes of the patterns observed.

Recently the SAVSNET team used multivariable mixed effects logistic regression to investigate dog-, clinic-, and owner-related factors influencing the likelihood of prescribing antimicrobials in consultations ($n = 281,543$) with unwell dogs ($n = 155,732$) from 173 practices comprising of 379 clinics (Singleton et al., 2020). They found that dogs who were vaccinated (OR: 0.93, 95% CI: 0.90–0.95), insured (OR: 0.87, 95% CI: 0.84–0 90), and neutered (OR: 0.90, 95% CI: 0.88–0.92) were less likely to receive systemic antimicrobials than those who were not. A similar pattern was observed for systemic HPCIAs. This suggests a link between owners engaging with preventative healthcare measures and not using antimicrobials, although this cross-sectional study is unable to demonstrate a causal pathway or comment on the possible mechanism through which this occurs. In terms of clinic-related factors, mixed practices (those treating companion animals and large animals) were associated with significantly increased odds of systemic antimicrobial use compared with companion animal-only practices (OR: 1.15, 95% CI:1.01–1.30). RCVS-accredited practices were also less likely to prescribe a systemic antimicrobial (OR: 0.79, 95% CI: 0.68–0.92). No clear association between antimicrobial use and the owner-related factors considered—their neighbourhood deprivation, companion animal population density, and rural or urban status—were observed. However, the authors noted that the simplified measure of deprivation used (a collapsed version of the Index of Multiple Deprivation)—may struggle to describe the realities of owners' circumstances (Singleton et al., 2020).

2.2.6. Qualitative studies

Over ten years after the first quantitative investigations into antimicrobial use in companion animals, Mateus et al. (2014) published the first qualitative study, in which UK veterinarians were interviewed. This was followed by similar projects in Australia (Hardefeldt et al., 2018b) and the Netherlands (Hopman et al., 2018). Recently, researchers have considered the perspectives of other social actors by interviewing companion animal owners in the UK (Dickson et al., 2019) and the US (Redding and Cole, 2019a), enabling a more rounded understanding of decisions to deploy antimicrobials. There has also been a slight shift away from research being conducted by veterinarians situated in veterinary schools (Cartelet et al., 2018). For example, a multidisciplinary team—including social scientists—in Scotland have undertaken a programme of research into antimicrobial use in companion animals. Their interest has extended beyond veterinarians (King et al., 2018) to veterinarians and owners (Smith et al., 2018) and owners at home (Dickson et al., 2019). They have also considered the perspectives of policy makers and the 'experts' (Currie et al., 2018). In doing so, antimicrobial 'misuse' is rendered less of a clinical problem that veterinarians, alone, are able to define, study, apportion blame for, and propose answers to.

As with much of the quantitative research, the framing of these studies often adopts a behavioural stance—in which antibiotic use is positioned as the result of choices made by individuals (Will, 2018)—with the authors adopting a pragmatic rather than a social theory informed approach (Table 2.4). Descriptive, thematic coding frameworks have been produced providing list of factors or themes that shape antimicrobial use. In the section below, I describe how qualitative studies have helped to provide a more nuanced understanding of antimicrobial use based on insight provided in the following areas: interactions with owners, risk management, time pressures, and clinic dynamics.

Table 2.4: A summary of qualitative and mixed methods studies investigating antimicrobial use in companion animals

Country	Author, year	Theoretical approach
Veterinarians		
UK	Mateus et al., 2014	Thematic analysis to identify factors associated with antimicrobial usage.
	Cartelet et al., 2018	Thematic analysis of veterinarians' experience prescribing antimicrobials, attitudes about antimicrobials and antimicrobial resistance
	King et al., 2018	Thematic analysis to identify behavioural drivers of veterinary prescribing (barriers and facilitators).
Netherlands	Hopman et al., 2018	An iterative analysis guided by the questions 'which factors influence the decision to prescribe antimicrobials' and 'which factors influence which antimicrobial to prescribe'.
Australia	Hardefeldt et al., 2018b	Thematic analysis to identify barriers to and enablers of implementing antimicrobial stewardship programs in veterinary practices.
Veterinarians and owners		
UK	Smith et al., 2018	A behavioural framework to identify key behaviours emerging from participant accounts which were amenable to change.
Owners		
UK	Dickson et al., 2019	An interpretative phenomenological analysis of the relationship between pet owners and their companion animals as a key context for antimicrobial resistance-related behaviours.
US	Redding and Cole, 2019a	'Conventional content analysis' of knowledge of and attitudes toward the judicious use of antimicrobials.
Policy makers, academics and leaders		
UK	Currie et al., 2018	Delphi study to identify veterinary behaviours which experts believe contribute to antimicrobial resistance and form vital aspects of antimicrobial stewardship.

Interactions with owners

Based on interviews with companion animal veterinarians, Mateus et al. (2014) identified three main ways in which owners shape antimicrobial prescribing: their (veterinarian-perceived) compliance with drug administration instructions; their willingness or ability to pay for medicines or diagnostics; and their expectations and the pressure they exert on veterinarians to provide antimicrobials. These findings were replicated by Hopman et al. (2018) whose veterinarian interviewees also described the influence of owner convenience.

Qualitative studies add more nuance to the representations of veterinarians being under a constant, unyielding pressure to prescribe antimicrobials from owners (BVA., 2014). When interviewed, UK veterinarians reported that it was 'increasingly rare' for owners to directly ask for antimicrobials (King et al., 2018) and, if they did, most would accept veterinarian recommendation that they might not be needed (Cartelet et al., 2018). A study that considered the perspectives of both veterinarians and owners found that the former felt the latter applied pressure for antimicrobials, whilst the latter felt the former were responsible for 'overuse' (Smith et al., 2018). Furthermore, the perceived owner anxiety and expectation for antimicrobials were often inferred by veterinarians, rather than explicitly stated by owners (Smith et al., 2018).

Clients—and their desire for their companion animal to recover quickly—have been framed as an obstacle to appropriate antimicrobial prescribing (Smith et al., 2018). Having interviewed veterinarians, King et al. (2018) described how owners see antimicrobials as a clear pathway to their animals' recovery, avoiding having to 'wait it out' to see if they recovered. Mateus et al. (2014) reported a mismatch between what veterinarians felt they should be doing as professionals with regards to antimicrobial use and their perception of what owners expected, i.e. affordable care and a 'quick fix' for their companion animal.

Studies of owner perspectives have provided further insight into this 'pressure'. Smith et al. (2018) described how owners were pushed into making financial and other sacrifices to ensure their companion animal—a family member—got better. The owners interviewed described experiencing their animal's suffering viscerally (Smith et al., 2018). Dickson et al. (2019) reported how owners anticipated feelings of 'intolerable guilt' if their companion animal died due to their complacency. Minimising their companion animal's suffering and getting their veterinarian to realise how sick their pet was were key concerns amongst US owners (Redding and Cole, 2019a). Adopting the 'better safe than sorry' approach may help reduce the immediate anxiety of owners whilst supporting antimicrobial use (Dickson et al., 2019).

Managing risk

Echoing this ‘better safe than sorry’ approach of owners, veterinarian interviewees also described cautionary prescribing of antimicrobials to mitigate against potential future clinical complications, especially if existing patterns of antimicrobial use were known to work (King et al., 2018). Cartelet et al. (2018) reported how veterinarian’s decision making is fraught with uncertainty and the focus is typically on lowering the perceived risk to the companion animal. A Dutch veterinarian described how ‘I think it is because it has become a habit and because one is afraid to leave it out in case it would then go wrong’ (Hopman et al, 2018, p. 109). In addition to managing clinical risk, using antimicrobials were also used to help reduce the risk of dissatisfied owners seeking care elsewhere (Mateus et al., 2014). Smith et al. (2018) described the tension between appropriate antimicrobial use, client satisfaction, and running a viable business.

Time pressures

Qualitative studies have provided insight into the time pressures faced by companion animal veterinarians. Time constraints—linked to fixed duration consultations—hamper in-depth conversations and the undertaking of cytological testing to guide antimicrobial selection (Mateus et al., 2014). Veterinarians also described the implicit—but sensible—assumption that owners would want the most effective and quickest treatment in order to return their companion animal to good health (King et al., 2018). Dutch veterinarians reported prescribing antimicrobials as a ‘quick fix’ for themselves and/or owners (Hopman et al., 2018).

Clinic dynamics

Beyond the consultation, qualitative studies have begun to investigate the broader context in which antimicrobials are used. Hardefeldt et al. (2018b) reported the hierarchical structure of many clinics to be a major barrier to antimicrobial stewardship, although no further details were provided. Mateus et al. (2014) described the general influence of senior veterinarians have in mentoring and supporting less experienced colleagues in handling complex clinical cases, whilst Hopman et al. (2018) found younger graduates were more likely to be prudent users of antimicrobials. King quotes a senior veterinarian who explained ‘the new grads are initially more prone to not give antibiotics because they were taught, well actually it’s bad, and they stand their ground more. But then as they get in to practice and get more experience and maybe they just get worn down or maybe the daily life . . . then they start giving antibiotics more loosely’ (King et al., 2018, p. 5). Meanwhile Hopman et al. (2018) quotes a more junior colleague who said ‘look, I am always happy to talk about the matter [antimicrobial use], but it remains his word. Nevertheless, to put things bluntly, I must do what he says if I want to keep my job' (Hopman et al., 2018, p. 110).

These qualitative studies have provided additional insight into antimicrobial use by companion animal veterinarians and have begun to consider broader social context. However, echoing the quantitative studies, their framing is typically orientated around the behaviour of individuals rather than the structural conditions in which prescribing takes place. When seeking to understand antimicrobial use, they have made limited used of social theory as a 'tool' to help unpick this complex and contingent practice.

2.2.7. Antimicrobial use interventions in companion animal veterinary sector

There have been a handful of studies attempting to evaluate efforts to alter antimicrobial use by companion animal veterinarians. A recent systematic review investigating the effect of guidelines and recommendations on antimicrobial use in companion animals identified few studies and these were of insufficient quality for their impact to be investigated (Ekiri et al., 2019). The authors concluded that further assessment of the impact of existing guidelines and voluntary initiatives are required. This systematic review was conducted as part of the supporting activities to the evaluation of the implementation of the UK antimicrobial resistance five year strategy for 2013–2018, which included a limited foray into the companion animal veterinary sector (Box 2.3) (Eastmure et al., 2019a).

Box 2.3: Evaluation of the UK Antimicrobial Resistance Strategy 2013–2018.

The UK strategy—published in 2013—had the objective of slowing the development and spread of antimicrobial resistance (UK-Government, 2013). This was operationalised via three overarching aims: i) to improve the knowledge and understanding of AMR; ii) to conserve and steward the effectiveness of existing treatments; and iii) to stimulate the development of new antibiotics, diagnostics, and novel therapies. The strategy contained one explicit reference to companion animals: Under the activities needed to meet the strategy's aims, 'conserve and steward the effectiveness of existing treatments by . . . encouraging animal keepers to work closely with their veterinary surgeons to prioritise diagnosis of disease in livestock and companion animals, and to encourage early use of appropriate diagnostic testing, in particular, bacterial culture and sensitivity tests' was listed (UK-Government, 2013).

The evaluation—published six years later—consisted of six elements intended to provide a coherent account of the strategy's implementation and of the evidence underpinning the proposed mechanisms of change (Eastmure et al., 2019a). The evaluation adopted a One

Health approach and included a companion animal case study based at the RVC's first opinion companion animal teaching hospital in Camden (Eastmure et al., 2019c). This is despite the evaluation authors noting that veterinarian–owner interactions and decision making may be influenced by commercial factors (Eastmure et al., 2019c). Time constraints and convenience meant this site was selected instead of smaller, privately run clinics, more representative of how the vast majority of companion animal veterinary care is delivered in the UK (Ana Mateus, personal communication).

The case study included interviews with veterinarians (n = 10) and a focus group with companion animal owners (sample size not provided) (Eastmure et al., 2019b). Veterinary participants of the case study were not familiar with the UK antimicrobial resistance strategy. and the evaluation findings suggest there are lower levels of awareness regarding antimicrobial resistance compared to the livestock veterinary sector. The most frequently recognised stewardship initiatives (amongst this limited sample) were the BVA's 'Are you antibiotics aware?' campaign and the BSAVA's PROTECT poster for responsible antibiotic use in practice (Eastmure et al., 2019b), which are discussed further in Chapter 9 of this thesis. Beyond awareness, the report does not evaluate the impact of these initiatives on antimicrobial use or resistance. The authors highlighted a general lack of antimicrobial prescribing data for companion animals identifying this as a missed opportunity by which to 'effect change'. (Eastmure et al., 2019a).

Within the evaluation report and various appendices, it is difficult to tease out the findings arising from the owner focus group and, unlike the veterinarian participants, no owner quotes are provided. Instead, the report describes veterinarian perspectives of companion animal owner expectations for antimicrobials (Eastmure et al., 2019b). The evaluation proposes that the role of non-pharmaceutical prescriptions in reducing antimicrobial use should be further explored with companion animal owners (Eastmure et al., 2019a).

The case study found veterinarians play a central role in communicating and educating companion animal owners about 'appropriate' antimicrobial use, with their findings indicating that antimicrobial resistance is rarely discussed during consultations. The commonalities between human and companion animal primary care settings—i.e. the insufficient time to explain antimicrobial decision making—were emphasised (Eastmure et al., 2019c).

Weese (2006) analysed prescribing data from a Canadian veterinary hospital between 1995 and 2004, during which time prescribing guidance was introduced. A significant decrease in antimicrobial prescriptions was observed over these nine years. It was unclear, however, to what extent this was driven by the guidance or changes in case mix or broader antimicrobial awareness, particularly given the limited promotional activities accompanying the implementation of the hospital's guidelines (Weese, 2006).

In Denmark, a reduction in total antimicrobial use in companion animals was observed in surveillance data collated by the VetStat system between 2012 and 2016 (from 12.4 to 11.2 DDDA per day, a 10% decrease) (Bager et al., 2017). During this period, a move away from broad-spectrum towards narrow-spectrum agents was also observed, with a 36% reduction in the use of the HPCIA cefovecin (absolute figures not provided). These changes coincided with the introduction of treatment guidelines in 2012 by the Danish Small Animal Veterinary Association; these included the recommendation that use of CIAs should be reduced as much as possible (Bager et al., 2017).

In primary care, the prescribing habits of 14 Flemish small animal practices were compared one month before and 20 days after the introduction of antimicrobial use guidelines (Sarrazin et al., 2017). The proportion of canine consultations in which antimicrobials were prescribed fell from 80% (95% CI calculated to be 76–84%, based on the published data) to 68% (calculated 95% CI: 64–72%). However, the longer-term impact—and therefore the sustainability of the intervention—was not assessed. Furthermore, an unanticipated, but statistically insignificant, increase in the relative number of HPCIA prescriptions was observed (+5%, absolute figures not provided, $p = 0.06$).

Brief details of an Australian pilot scheme were provided in a conference abstract (Taylor and Archinal, 2016). Clinics appointed a practice champion and developed a clinic policy, whilst prescribers were required to complete online training and attend a discussion evening. When the lead author was contacted for further information, she explained how she ran this grassroots pilot with little funding and in her spare time (Alison Taylor, personal communication). Without financial support, the scheme and its evaluation proved unsustainable.

A stepped wedge trial (Hopman et al., 2019c) evaluated a stewardship programme in 44 Dutch first opinion clinics. This multifaceted approach included benchmarking activities, social pledges, veterinarian education, and owner information sheets. Changes in total clinic antimicrobial use—calculated using a DDDA approach—were modelled using a mixed effect time-series model and the effects of the stewardship programme estimated using a step function. When the antimicrobial usage for the 12 months prior to the intervention was compared to the 12 months during the intervention, a 15% reduction was observed (95% CI: 7–22%, $p < 0.01$). A reduction in third generation cephalosporins and fluoroquinolones use was also noted; however, this was not statistically significant (-6%, 95% CI: -23–+28%, $p = 0.66$). Clinics were compensated for their involvement in the stewardship programme and its evaluation based on the veterinarian's time used. Echoing Taylor's experiences above, it is uncertain if this intensive approach—including the provision of locum staff to cover clinical duties—is feasible in a 'real world setting'. Outside of a research context, it is unclear which commercial, professional, or governmental bodies would provide these.

Two further trials are currently being written up; one conducted by the SAVSNET team in the UK (David Singleton, personal communication) and a pilot study for a cluster randomised trial of antimicrobial stewardship on appropriate antimicrobial prescribing (Laura Hardefeldt, personal communication). These trials are not detailed on a trial register nor in a published protocol and so further comment on their approach and findings awaits their publication.

A mixed-methods study conducted in the US evaluated providing information to owners via a poster in the consulting room (Redding and Cole, 2019b). Fewer than half of the owners ($n = 111$) who participated in the evaluation noticed it and just 10% could recall its message. The veterinarians interviewed were sceptical about the poster, describing no difference in the pressure they felt to provide antimicrobials. Despite these muted findings and not evaluating the impact of the poster on antimicrobial prescribing, the study authors conclude that posters 'might be useful as part of an active, multi-modal education strategy' (Redding and Cole, 2019b).

To conclude this section, I reflect on the limitations of the studies conducted to date: namely their design, the limited range of interventions evaluated, and the choice of outcome measures. Studies have been of small scale (Redding and Cole, 2019b) or of limited duration of follow up (Sarrazin et al., 2017), thus making it difficult to assess the generalisability and sustainability of the changes in antimicrobial use observed. The use of before and after study designs (Weese, 2006)—rather than randomised-controlled trials—hampers the direct attribution of changes in antimicrobial prescribing observed to the deployed interventions. This is especially true given the interest in improving the general population's awareness of antimicrobial use and resistance in last twenty years or so (Will, 2020). This limited evidence base of low methodological quality has been noted elsewhere (Ekiri et al., 2019).

The studies in this section evaluated the impact of providing information to change individual's behaviour. In human healthcare settings, educational strategies have had mixed effects and there have been calls for stewardship interventions to go beyond the knowledge deficit model (Chandler, 2019). No interventions were identified that sought to alter antimicrobial use through strategies other than education in the companion animal veterinary sector. The focus on educational interventions has obscured other contextual issues raised in the qualitative studies, such as time pressures on companion animal veterinarians.

The outcome measures of the trials conducted to date focused on changes in antimicrobial use or knowledge, a surrogate measure of antimicrobial use. No reports have included information on the impact on owner satisfaction or clinic sustainability, nor on companion animal health and welfare. This is despite research evidence that 'overprescribing' is linked to veterinarians' concerns about dissatisfied clients 'shopping around' if antimicrobials are withheld. Furthermore, monitoring the unintended consequences, e.g. an increase in re-consultation or mortality rates, would enable a better understanding of whether reducing access to antimicrobials is having an adverse impact on animal health. Conversely, trial evidence ruling this out would help reassure companion animal veterinarians and owners concerns in this regard.

2.2.8. Use of diagnostic testing in companion animal antimicrobial stewardship

Improved use of diagnostic testing has been proposed as a means by which to improve 'rational' decision-making regarding antimicrobial use in companion animal care by informing: i) the decision to treat and, ii) the choice of treatment (Sorensen et al., 2018). Technologies currently available include in-house cytology and offsite culture and antimicrobial susceptibility testing in commercial laboratories, the results of which are not available immediately. Diagnostic testing requires samples—urine, faeces, purulent matter, etc.—to be obtained from the companion animal.

Despite guidelines encouraging the use of testing and recognition of its importance amongst companion animal veterinarians (Jacob et al., 2015), there is an increasing body of evidence demonstrating limited use of testing even when deploying HPCIAs. Medical record review of an Italian veterinary hospital revealed that the minority of antimicrobials prescribed to 1,071 cats and dogs there were guided by microbiological analyses (5%) or susceptibility testing (2%), and thus the use of diagnostic testing was the most poorly adhered to of the antimicrobial stewardship principles (Escher et al., 2011). In a US veterinary hospital, the medical notes recorded a confirmed diagnosis of infection, e.g. a positive culture result, in only 18% of 435 dogs receiving antimicrobials (Wayne et al., 2011).

In primary care, an unpublished analysis from Buckland et al. (2016) showed evidence amongst 365,330 cats and dogs who received antimicrobials over a two-year period of only 8,828 (2%) culture and sensitivity tests (Dave Brodbelt, personal communication). Cytology was performed in 6% of 235 dogs receiving antimicrobial treatment according to medical note review in a sample of Spanish clinics (Gomez-Poveda and Moreno, 2018). Confirmation of diagnosis through culture was conducted in 6% of cases, whilst 4% of cases had an antimicrobial susceptibility test (Gomez-Poveda and Moreno, 2018). Culture and susceptibility was performed in 4% of 486 canine disease events treated with antimicrobials according to study diaries submitted by veterinarians working in Canadian first opinion clinics (Murphy et al., 2012). In 151 cases of suspected canine UTIs managed in Danish first opinion clinics, most had dipstick analysis (99%), 80% had a urine sample examined under the microscope, whilst the management of 56% cases included culture (Sorensen et al., 2018). The authors found that antimicrobials were frequently ‘overprescribed’ regardless of diagnostic work-up and suggested this was due to inaccurate tests being conducted under clinic conditions and a mismatch between test results and veterinarian decision-making (Sorensen et al., 2018).

Questionnaire studies have also asked veterinarians about their diagnostic use. Twenty-two per cent of a sample of companion animal veterinarians in Washington State, US (n = 166) reported not ordering culture and sensitivity testing in practice (Fowler et al., 2016). In Italy, 91% of a sample of 266 companion animal veterinarians report using microbiology and susceptibility testing: of these, 69% sometimes used it, 20% frequently used it, and 2% always used it (Barbarossa et al., 2017). Regarding HPCIA use, only 12% of a sample of 284 companion animal veterinarians working in Belgium reported performing culture and sensitivity testing when deploying these medicines in accordance with the national guidelines (Van Cleven et al., 2018). The limited amount of diagnostic testing described above may reflect that veterinarians report rarely perceive encountering multidrug resistance pathogens in their work (Jessen et al., 2017, Hardefeldt et al., 2018b). In contrast to their practising colleagues, a quarter of veterinary students surveyed would hypothetically use culture and sensitivity testing in response to every scenario they were presented with (Hardefeldt et al., 2018a). This perhaps reveals a misalignment between university teaching on stewardship and the on-the-ground realities of practising veterinary medicine.

Chipangura et al. (2017) reported that 91% of South African companion animal veterinarians they surveyed (n = 181) prescribe antimicrobials empirically before using culture and sensitivity testing. Hardefeldt et al. (2018b) described how the trial deployment of antimicrobials acted as a form of diagnostic test for the presence of an infection. In Italy, in a sample of 242 companion animal veterinarian reporting to use microbiology and susceptibility testing, 34% often adopted empirical treatment and a further 8% always adopted it whilst awaiting the test results. On the receipt of the negative results, the discontinuation of antimicrobials was observed in only approximately one-third of Danish dogs originally suspected as having UTIs (Jessen et al., 2017) and 37% of a sample of US hospitalised dogs (Black et al., 2009). This suggests that culture and sensitivity results alone are not always sufficient to discontinue antimicrobial therapy.

When surveyed, companion animal veterinarians reported that they were more likely to deploy culture and sensitivity testing when treatment with the initial choice of antimicrobial had failed (De Briyne et al., 2013, Fowler et al., 2016, Jessen et al., 2017). Analysis of study journals submitted by veterinarians in Canada identified that chronic or recurrent disease events in cats and dogs (n = 1,807) were significantly more likely to have culture and sensitivity testing performed compared to those described as acute (OR: 2.5, 95% CI: 1.1–5.0) (Murphy et al., 2012). When companion animal veterinarians (n = 391) in New Zealand were surveyed about culture and sensitivity testing habits, 60% said they would recommend it for cases of recurrent pyoderma, 89% for recurrent cases of ear infection, and 87% for relapsing or persistent UTIs (Pleydell et al., 2012). These findings may reflect that the additional cost of diagnostic testing is easier to justify in cases where the initial treatment has failed. This is despite that using diagnostics to inform an effective first choice of antimicrobials can save money in the long term, but this assessment is only possible with the benefit of hindsight.

Questionnaire surveys have sought to explore the observed patterns of culture and sensitivity testing using the framing of barriers and facilitators. A key obstacle for veterinarians recommending culture and sensitivity testing to owners is its cost (AMVA., 2015, Fowler et al., 2016, Jessen et al., 2017, Sarrazin et al., 2017, Eastmure et al., 2019b, Hopman et al., 2019a). Others barriers include previous positive experience with empirical treatment (Jessen et al., 2017), doubts regarding whether the owner would comply with the resulting treatment advice, and veterinarian communication style (Fowler et al., 2016). Multivariable modelling of factors affecting New Zealand veterinarians' reported culture and sensitivity use concluded that companion animal veterinarians were more likely to order diagnostic tests than mixed animal practitioners, as were veterinarians who had recently attended continuing professional development (CPD) (Pleydell et al., 2012). However, the model accounted for only about a half of the variation in test ordering, suggesting that the reality is more complex than the factors considered by the study.

In the sections above, I have described patterns of frequent antimicrobial use and limited diagnostic testing uptake, and the reasons proposed for these observations. Taken together, this evidence has led to clear calls for stewardship of antimicrobials in the companion animal veterinary sector. This mirrors the wider discourse in public health and veterinary medicine at large for improved use of antimicrobials in an era of drug resistance.

2.2.9. Antimicrobial stewardship

As the goal of this thesis is to help inform the design of antimicrobial stewardship interventions, it is worth taking a moment to consider the use and definition of this term within the literature reviewed in this chapter. The earliest use identified was in 2009 by a team investigating antimicrobial use and resistance in dogs in an American intensive care unit (Black et al., 2009). They referred, in passing, to how, in human intensive care units, 'Antimicrobial education, stewardship, and antimicrobial rotation programs have shown promising results' (Black et al., 2009, p. 490). This reflects the term's origin in North American hospital care (Charani and Holmes, 2019) but no definition or further information is provided.

Over time, the number of papers cited in this chapter that include the term stewardship in their main text (mentions in the references were excluded from this analysis) have increased (Figure 2.4). This reflects the growing interest in explaining and intervening in antimicrobial use, in addition to measuring usage levels. However, the term itself remains undefined—perhaps obvious or taken for granted by those working in this field.

In Australia, Hardefeldt et al. (2018b) found that, although awareness of the stewardship 'movement' was widespread, some veterinarians were unsure what the term meant. The authors themselves did not provide their own definition of stewardship in the paper, and neither did the authors of another study focused on medical, pharmacy, nursing, dentistry, and veterinary students (Dyar et al., 2018). They found that fewer than half of survey respondents (44%) had heard of antimicrobial or antibiotic stewardship and propose that curricula need to be strengthened to address this knowledge gap.

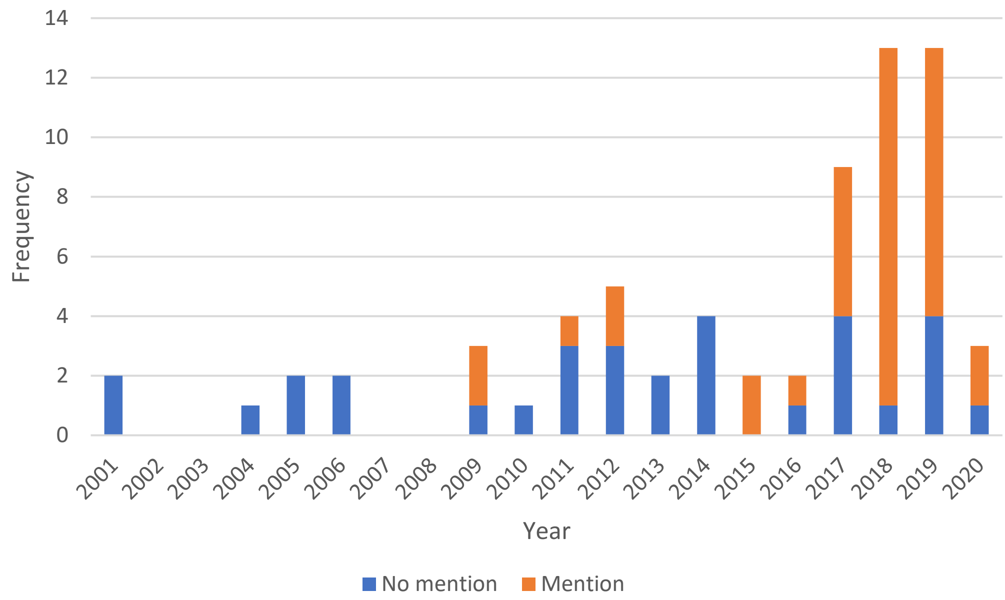


Figure 2.4: The annual frequency of papers included within this literature review of antimicrobial use in companion animals including dogs and whether they included the term 'stewardship' in their text.
[n = 68; 2020 data up until August 2020 only].

In an interview study—conducted to inform the design of a stewardship intervention—Hopman et al. (2018) described stewardship as 'a multifaceted and dynamic approach to preserve the clinical efficacy of antimicrobials by optimising antimicrobial use while minimising the emergence of antimicrobial resistance and possible other adverse effects' (Hopman et al., 2018, p. 111). In their subsequent paper, reporting the results of the intervention evaluation (Hopman et al., 2019c), they provided further details describing how stewardship entails 'increasing awareness of (inter)national practice guidelines, use of diagnostic microbiology and use of alternatives to antimicrobials' (Hopman et al., 2019c, p. 2), a further illustration of how knowledge is equated with practice.

In the UK, Smith et al. (2018) described how antimicrobial stewardship is synonymous with 'responsible' use of antimicrobials. Reflecting their paper's interest in veterinarian–owner interactions, they adapted Fishman's stewardship definition (2006) that 'prescribing practices that ensure that antimicrobials will continue to be effective for future generations' (Fishman, 2006, p. 53) to include the responsible use of antimicrobials by companion animal owners. For society as a whole to reap the future benefits of stewardship, the need to be responsible now extends to all antimicrobial users from professionals to individual consumers of veterinary care.

Similarly, Redding and Cole (2019b) wrote how an important aspect of stewardship is to educate companion animal owners about the indications for antimicrobial use and their dosing regimes. They proposed that a poster targeting owners could help promote their acceptance of stewardship, perhaps positioning owners as barriers in this regard. This offers an illustration of sectoral attitudes in which owner pressure to prescribe are blamed, and that overlooks complex, structural issues.

In summary, the term antimicrobial stewardship is diffuse and pliable depending on the authors' focus of interest. If it is defined, it is often described in overarching terms—co-ordinated, dynamic, multi-faced—rather than through implementable actions.

2.3. Conclusion

This chapter has provided a narrative synthesis of the literature regarding antimicrobial use by companion animal veterinarians. Based on large-scale epidemiological studies, we know that antimicrobials are widely used in the veterinary care of UK dogs, although this use appears to be declining. Whilst there have been some attempts to compare usage between clinics, there has been no investigation of antimicrobial use in the corporate veterinary group context, a setting in which an increasing number of UK companion animal veterinarians work. Efforts to explain patterns of antimicrobial use have largely relied on self-reported data from companion animal veterinarians collected through either via quantitative surveys—ranking factors or responding to vignettes—or through interview studies.

A striking feature of the studies identified—over fifty in total—is the similar world view or philosophical starting point they adopt. This body of research—as with much of the public health 'tradition'—is situated within a scientific paradigm that expects the social world to be understandable through the elucidation of sets of rules, in the same way that the natural world comes to be known. Furthermore, that these rules can become known through self-reporting; that individuals, when asked, can provide an account of their behaviour. Whilst these accounts might be labelled as correct or incorrect beliefs or knowledge, within this paradigm they are often taken as a true representation of a social phenomenon. However, this mode of understanding 'the social' has been countered, including through evidence that knowledge and beliefs rarely predict behaviour, but also because social phenomena tend to operate in registers that are invisible and illegible to those operating within them (Cohn, 2014, Will, 2018). In other words, to describe a social—or rather a bio-social (Lock, 1993, Landecker, 2016)—phenomenon requires analysis that moves beyond individual accounts, and situates these together with other materials and observations that help to render visible and legible the social, political, and economic structures that shape practice (Broom et al., 2020). The models we used for making sense of the world also influence the types of stewardship intervention that might be imaginable: providing education becomes inevitable when analysis points to a knowledge deficit; information may explicitly be provided in order to alter the balance of ‘pro’ and ‘con’ factors when an individual is understood to make rational cognitive decisions to weigh up whether to use antimicrobials ‘appropriately’.

What if antimicrobial use in companion animals might be viewed from a perspective in which the elements shaping antimicrobial use might be diffuse and perhaps imperceptible by those involved at the interface of their deployment? One in which the focus is shifted beyond an individual’s decision-making to include structural factors? There is increasing appetite for adopting fresh perspectives—such as those informed by social theory—when seeking to tackle the complex problem of antimicrobial use (Chandler et al., 2016). Such a perspective is yet be applied to investigation of the deployment of these medicines in companion animals, yet it holds great potential for explaining the wider reasons—beyond individuals’ rationales—for antimicrobial practices.

Chapter 3 Methodology

3.0. Introduction

In May 2017, I replied to an advertisement seeking a PhD student to undertake a mixed-methods study investigating antimicrobial use in companion animals. The advertisement provided an overview of the project: it was to have epidemiological and anthropological components, it was to be informed by One Health and multispecies ethnographic approaches, and it would be overseen by two veterinarian-epidemiologists and an anthropologist, who were based at the RVC and London School Hygiene and Tropical Medicine (LSHTM), respectively. I sent off my application and thus began my journey in bringing this interdisciplinary, mixed-methods project 'to life' beyond the brief details given in the advertisement.

Throughout my degree, supervisory meetings have been invaluable: not only were they a vital source of guidance and content expertise, it was also fascinating to observe how senior researchers with differing disciplinary philosophical paradigms and theoretical assumptions, methodological expertise, analysis techniques, and institutional affiliations approached answering the research question. Their diverse ways of thinking and valuing helped to guide me—and this thesis—towards a deeper understanding of the complex and contextual bio-social phenomena of antimicrobial use in companion animals (Greene, 2007).

This thesis draws upon epidemiological and anthropological approaches. These are not merely methodologically different but reflect different epistemological positions. Therefore, before providing detailed descriptions of the methods used for these two components of my study, I first reflect upon my own theoretical orientation and on the opportunities—and challenges—posed by mixing methods.

3.1. Theoretical orientation

All research is informed by particular theoretical perspectives, whether or not this is formally acknowledged. In social research, reflection on the positions that inform the types of questions we ask is considered critical to high-quality research (Guba and Lincoln, 1994). One's theoretical orientation incorporates the philosophical perspective from which the research is conducted, which in turn impacts what the researcher tunes into, acting as an 'intellectual tunnel' (Hamilton and Taylor, 2017). However, it is not necessarily the case that theoretical orientation will entirely define method. For example, within public health research that is orientated around a positivist epistemology, research may be either quantitative or qualitative. Likewise, research within a constructivist epistemology may incorporate quantitative tools alongside qualitative methods (Green and Thorogood, 2004).

In this project, I adopt a philosophical perspective that enables a vantage point different from previous studies into antimicrobial use in companion animals (as described in Chapter 2). Rather than considering decision making at an individual level, I set out to explore the technical, physical, cognitive, economic, political, and historical landscapes or networks in which antimicrobial use is situated. My perspective is informed by social theory regarding: the existence of multiple realities; efforts to decentre the human; studying multispecies entanglements; biopolitics; and using care to think with. This orientation marks my point of theoretical departure from previously conducted research into antimicrobial use by companion animal veterinarians.

3.1.1. Multiple realities

My research is influenced by material-semiotic approaches, in particular, actor network theory, that have been adopted by science, technology, and society (STS) studies (Law, 2019). A characteristic of these approaches is that they allow for multiple realities to exist.

Material-semiotics is the study of how all manner of actors (human and non-human) and arrangements (organisations, inequalities) are produced through the making of diverse associations (Michael, 2017). Such associations between actors are considered both material—they are between physical actors that can be shaped and reshaped by these encounters—and semiotic—they carry meaning and are relational (Law, 2019). Within these approaches to social analysis, actor network theory emerged as part of the developing STS interest in the social construction of scientific knowledge (Michael, 2017). In their pioneering study, 'Laboratory Life', Latour and Woolgar (1979) described the enactment of scientific activities there, challenging the distinction between social and technical actors (Michael, 2017). This interest in the analysis of non-humans—such as animals and technologies—in the process of scientific innovation was later generalised by actor network theory-informed studies to investigate the production of 'the social' in a range of empirical settings (Rock et al., 2014, Michael, 2017).

Influenced by post-modern critical approaches, these analyses also considered the 'modes of ordering': the practices and processes through which hierarchy and power operate within organisations (Michael, 2017). For example, within a UK farm animal veterinary clinic, Lindsay Hamilton used material-semiotic approaches to ethnographically trace the workplace interactions that sprang up and around animal manure as it transformed from 'excreta' to a ‘diagnostic sample’ to ‘turd’ and eventually to ‘rubbish’ (Hamilton, 2007). She describes how veterinarians were able to maintain their positions of power and prestige within the clinic despite being elbow-deep in muck (Hamilton, 2013).

The development of material-semiotic approaches is closely linked to the ontological turn (Kohn, 2015). This is the ongoing phenomenon in the social sciences concerned with how we think about, study, and describe (cultural) differences in a post-colonial, globalised, and yet fragmented world (Heywood, 2017). Meanings of ontology differ: for some it is concerned with the study of ‘reality’, whilst others view it in terms of ‘becoming’ or ‘becoming with’ (Kohn, 2015). Through seeking a better understanding of ‘being’ in the world, rather than simply describing it, the ontological turn has reinvigorated traditional areas of anthropological concern such as social construction, the political economy, and what it is to be human (Kohn, 2015).

The ontological turn can also be linked to the ‘crisis of representation’ that began in the 1970s and captures the significant challenges made to many aspects of traditional empirical social research—including how we study and write about culture (Clifford and Marcus, 1986, Zenker, 2014). A circulating idea when studying culture—‘the customs, civilisation and achievements of a particular time or people’ (Pool and Geissler, 2005, p. 8)—is that of relativism: a person's beliefs, values, and practices should be understood in context and based on their own culture, rather than being judged against another (Eriksen, 2015). Cultural relativism holds that there is only one ‘true’ reality (ontology) but that forms of knowing or understanding the world (epistemologies) may vary (Heywood, 2017). Linked to this, anthropologists have presented their ethnographic accounts as objective endeavours describing the differences between their ‘scientific’ knowledge of reality and their interlocutors’ ‘folk’ beliefs.

As part of the ontological turn, however, whose vision represents ‘reality’ has been questioned (Heywood, 2017) and the development of the material-semiotic approaches allow space for realities (worlds)—as well as worldviews—to vary (Kohn, 2015). Beyond considering the multiple identities of an object, the ontological turn enabled academics to reflect upon the multiple ways there are of ‘performing’ it or ‘enacting’ it (Mol, 2014). Material-semiotics also accepts that research is necessarily partial and selective and, by being so, it represents a further enactment of the object of interest (Michael, 2017). These ways of viewing the world, or rather worlds, underpin my research endeavours.

3.1.2. Decentring the human

Prior to the ontological turn, nature has been seen as the constant 'taken for granted' backdrop against which to investigate socially constructed culture (Heywood, 2017). However, post-modernist thinking has caused such influential Cartesian dualities to be challenged. Perhaps one of the earliest scholars to problematise the culture–nature divide was Mary Douglas through her investigation of the boundary between purity and pollution across different societies (Douglas, 2002, Eriksen, 2015). Regarding human health, Margaret Lock's theory of 'local biologies' contested modernist assumptions of universal material bodies by describing the evolutionary, historically, socially, and politically contingent forms of the menopause (Lock, 1993).

The ontological turn has seen a move towards understanding 'naturecultures' (Haraway, 2003a). Bruno Latour, a leading proponent of actor network theory, advocated that researchers should not seek to classify things into the 'natural' and 'social' worlds, and instead adopt a flat ontology that collapses distinctions between human and non-human actors (Latour, 1993). For example, actor network theorists John Law and Marianne Lien considered the multiple practices that produce a salmon, which they describe as a nature–culture entity (Law and Lien, 2018). Drawing on insights from South America, Eduardo Viveiros de Castro (2012) and Philippe Descola (2013) have proposed that the depiction of nature as separate and as the real world is a modern, western viewpoint with other societies having different ways of organising and aggregating beings, as well as who is considered to be capable of agency and knowledge. These contributions have offering fresh perspectives—for western academics at least—from which to view the world. They call into question bio-social approaches which hold the biological and social worlds as separate, yet co-producing, entities. The tension between understanding naturecultures and a bio-social approach is not fully resolved within the theoretical viewpoint adopted in this thesis.

Recognising the impossibility of separating nature and culture has prompted a flurry of thinking about how to study 'the social' (Buller, 2014); for example, who is included in the 'public' when we discuss public health (Rock et al., 2014, Rock, 2017). Previously, animals have been included in ethnographic accounts as symbols of human society, rather than as societal members in their own right, who have their own biographies and agency (Kirksey and Helmreich, 2010, Kirksey et al., 2014). Reflecting post-modern perspectives, feminist material-semiotic scholar Donna Haraway describes how animals are not just 'good to eat' and 'good to think with', they are also—and importantly—'good to live with' (Haraway, 2007). Reflecting our changing understanding of 'the social', approaches are developing which seek to be less anthropocentric and are necessarily, 'inclusive, troublesome, emergent and messy' (Buller, 2014). Such methodological and theoretical developments include the emergence of multispecies ethnography, considering relational encounters, and following methodologies, as described further on.

Multispecies ethnographies reflect upon how a multitude of organisms' lives shape—and are re-shaped—by social, economic, political, and historical factors (Kirksey and Helmreich, 2010, Fuentes, 2019). Proponents position it as a powerful tool to decentre the human (Hamilton and Taylor, 2017), and—rather than anthropocentrically defining animals, plants, and microbes through their non-human-ness—these actors are viewed through the lens of their more-than-human-ness (Haraway, 2007). Furthermore, informed by feminist approaches, multispecies ethnographers explicitly attend to and acknowledge ideas of interspecies power and domination within their endeavours, seeking to act as advocates for their more-than-human compatriots through their writing (Hamilton and Taylor, 2017).

A means by which to decentre the human within ethnography is to think beyond its historical focus on the spoken and written word and embrace multisensory experiences. The inclusion of landscapes of smells, tastes, touches, and sounds supports the inclusion of the non-verbal 'social' (Hamilton and Taylor, 2017). Just as anthropologists are increasingly thinking across species boundaries, they are also collaborating outside of their traditional disciplinary silos by engaging with artists, for example, to creatively explore interspecies entanglements in cultural, economic, and political systems (Kirksey et al., 2014, Swanson, 2017). Whilst such efforts are beyond the feasibility of this PhD, a commitment to tuning into and recording non-verbal communication and the spatial ordering of actors within fieldnotes can help take a small step to decentre the human.

A further move away from anthropocentrism is to revise the 'units' of study away from individual humans to consider networks—as with actor network theory—or hybrids or the entanglements between them and more-than-human actors (Michael, 2017, Fuentes, 2019). Nading (2013) describes how 'scholarship on human-animal 'entanglement' . . . instead of alienating humans from other life forms, brings their intimate relationships into sharper relief . . . life is the ongoing, dynamic result of human and nonhuman interactions over time' (Nading, 2013, p. 60). Donna Haraway writes vividly of her shared life with Cayenne, an Australian sheep dog, explaining that together they are 'messmates' (Haraway, 2007). More broadly, she describes human-animal interactions as 'knots in which diverse bodies and meanings coshape one another (Haraway, 2007, p. 3). Her work—with its interest in companion animals (Haraway, 2003a)—has an obvious relevance to this research.

Within the veterinary sector, in her-more-than-human ethnography of a UK veterinary school, Megan Donald (2018) charted the entanglements between humans, animals, ethics, and empathy as veterinary students became ‘sensuous scientists’. In doing so, she rendered visible the more-than-human-politics at play in veterinary practice (Donald, 2018). More broadly, Fudge and Palmer (2011) explain veterinary sciences as ‘a locus of anxiety about the intertwined nature of human and animal worlds’ (Fudge and Palmer, 2011, p. 3) concluding it is impossible to segregate animal and human wellbeing and health.

Beyond ‘charismatic megafauna’ (Brown and Nading, 2019) such as our canine companions, social scientists have also considered our ‘knotting’ with microbes, insects, and parasites (Paxson, 2008, Helmreich, 2009). Hinchliffe and Ward (2014) drew on the analogy of folding to describe the ways in which the lives and immunities of intensively farmed pigs, farmers, and microbes were interconnected. Perhaps one of the most fundamental challenges to ideas of human exceptionalism and the nature-culture divide is the discovery that the human body is home to—and relies upon—microbial inhabitants (Haraway, 2007, Fuentes, 2019, Lorimer, 2019). These studies illustrate how boundaries between units of study that comprise of ‘human’ and ‘non-human’ are being broken down.

Previously, John Law and Annemarie Mol have, separately and collaboratively, fruitfully used actor network theory in a variety of settings—Devonshire dairy farms caught up in the Foot and Mouth Disease outbreak, Cumbrian sheep farms, Dutch hospitals—to produce rich insights regarding the dynamic interactions between humans and more-than-humans there (Mol, 2002, Law, 2008, Law and Mol, 2008). Whilst the account provided in this thesis does not demonstrate the specific deployment of actor network theory, unlike a recent analysis of antibiotic use in the UK dairy industry (Begemann et al., 2020), a general interest in looking beyond individual actors—people, animals, tools or artefacts, technologies, skills, architectures, and words (Law, 2019)—to explore their relational encounters is derived from this body of scholarship

When tracing networks of humans, animals, and microbes multispecies ethnographers have moved across landscapes and seascapes as they follow knots of genes, cells, and organisms (Kirksey and Helmreich, 2010). As part of the broader ontological turn, the relevance of single site ethnographic approaches to fragmented societies that are subject to macro-level processes, such as climate change, have been queried. As a consequence, methodologies where anthropologists follow things—objects, technologies, ideas, narratives—as they move between settings have grown in popularity. This resonates with current materialist interest in objects—such as medicines—as commodities, circulating between different social settings as they are produced, traded, and consumed (Rapport, 2014b, Hardon and Sanabria, 2017). Anna Tsing (2015) tracked the Matsutake mushroom as it circulated around the globe and the various forms of life that sprang up alongside—and entangled with—this valuable commodity. By doing so, she renders visible the physical and emotional connections people make with the mushrooms as they enter and leave their lives.

In terms of antimicrobials, Clare Chandler and colleagues proposed developing a theoretical framework in which antimicrobial resistance is followed. Their interests lie with the making and remaking of the concept as it moves between settings and the ways in which it is rendered coherent (Chandler et al., 2016). Informed by these theoretical developments, rather than focusing on the moment of prescribing, I set out to trace ideas regarding 'appropriate' antimicrobial use beyond the clinic walls of my fieldwork sites, for example, as it moves through the veterinary press and antimicrobial stewardship materials.

Beyond animals, the careful consideration of networks composed of more-than-humans offers a means by which to de-centre the human and to draw attention to the social roles of tools, technologies, and architectures. In doing so, the ways these actors are quietly, and unassumingly, embedded in social life—and their roles as infrastructure (Chandler, 2019)—can be rendered visible. For example, antimicrobials are held to be the foundation on which 'modern' medicine is based, enabling procedures and configurations of healthcare that were previously unimaginable (Antibiotic-Action, 2015, Chandler, 2019). They have also help to transform agriculture by facilitating the intensive forms of animal production seen today (Kirchhelle, 2018). As a consequence, Clare Chandler (2019) proposes that antimicrobials act as societal infrastructure and as 'part of the woodwork that we take for granted, and entangled with our ways of doing life, in particular modern life' (Chandler, 2019, p. 1). This insight alerts us to the need to investigate the diffuse and ingrained roles antimicrobials have as powerful social actors, beyond their immediate curative effects (Denyer Willis and Chandler, 2019).

3.1.3. Multispecies entanglements

Efforts to decentre the human and adopt multispecies approaches have become more urgent as awareness of anthropogenic environmental change and ecological damage has grown (Nading, 2013). For example, the One Health movement coalesced in the late 1990s with a desire, at least initially, to protect wildlife and the environment (Zinsstag et al., 2011). Originating in veterinary academia, it emphasizes the interconnectivity of human and animal health with that of the environment and calls for collaborative, multidisciplinary approaches to protect them (Robinson et al., 2016). Projects have sought the input of social scientists, partly to provide insight regarding ‘irrational’ or ‘risky’ behaviours or the local acceptability of interventions seeking to improve health (Craddock and Hinchliffe, 2015). With their growing interest in the reconfiguration of multispecies entanglements and their impact on health, anthropologists have cautiously welcomed social science involvement in One Health initiatives (Brown and Nading, 2019).

However, anthropologists have also been among those critiquing the One Health movement. Concerns include the overlooking of structural determinants of health inequalities and how the framing of ‘one-ism’ overlooks local context in favour of the global processes (Hinchliffe, 2015, Wallace et al., 2015). Social science, with its ability to foreground uneven geographies, reframe problems, and pay close attention to interspecies relations can help address this (Craddock and Hinchliffe 2015). In terms of animal–human–microbe entanglements, doubts have also been raised about the focus on animals as vectors of disease, rather than as kin, resulting in a focus on technical fixes to zoonoses (Wolf, 2015, Rock, 2017). Brown and Nading (2019) propose that an anthropological approach can help inform viewpoints that are neither dominated by technological concerns regarding pathological spill-over nor overly sentimental about our entanglements with more-than-humans, a stance that I sought to adopt.

Antimicrobial resistance is positioned as a One Health problem and, therefore, successful efforts to tackle it require consideration of more-than-human uses of antimicrobials (PHE, 2015, Robinson et al., 2016, Wernli et al., 2017). However, despite this extended gaze, policy documents (Kamenshchikova et al., 2019) and media articles (Morris et al., 2016) remain anthropocentric when describing the potential consequences of antimicrobial resistance. When animals are considered, it is typically livestock who are scapegoated for being the unnecessary recipients of antimicrobials and threatening human health (Buller et al., 2015, Kamenshchikova et al., 2019). Therefore, this project seeks to adopt a structural One Health approach (Wallace et al., 2015) and, in Section 3.1.4, I describe how drawing upon the theory of biopolitics supports my endeavours in being critically engaged.

3.1.4. Biopolitics

With increasing attention being paid to what it enacted in practice, a helpful theoretical lens is that of biopolitics. A philosopher and historian of ideas, Michael Foucault developed this theory to describe the strategies and mechanisms of knowledge, power, and subjectivation used to manage human life by societal authorities (McHoul and Grace, 2015). It has subsequently been extended to consider more-than-humans (Nading, 2013). Blue and Rock (2011) illustrated how the ignoring of feline bodies entangled in the UK emergence of Bovine Spongiform Encephalopathy (BSE) slowed the official response and understanding of the risks to human health by this disease. They proposed the concept of 'trans-biopolitics' to describe the practices that determine whose lives are worth prolonging, whose are expendable, and whose are rendered insignificant (Blue and Rock, 2011). By doing so, the inherent power relationships in shared interspecies lives in technological, industrial, and global formations are rendered visible (Blue and Rock, 2011). To date, efforts to tackle antimicrobial resistance—such as the O'Neill report (2016)—have largely overlooked companion animals and the trans-biopolitics at play within antimicrobial stewardship requires further investigation.

Foucault's concept has supported the development of critical approaches, for example, revealing the role of the political economy and structures of power when investigating the causes of ill health (Rock et al., 2014). Laurie Denyer Willis and Clare Chandler (2019) drew upon ethnographic research conducted in East Africa to reveal how antimicrobials operate as a 'quick fix' for health and sanitation systems bearing the scars of political and economic injustice (Figure 3.1). They propose the deployment of antimicrobials obscures the need for longer-term, structural investment to address these inequalities (Denyer Willis and Chandler, 2019). Medicines—and the resulting alleviation of suffering—are also unequally accessible due to structural inequalities. Anthropologists have argued that initiatives seeking to reduce the 'overuse' of antimicrobials need careful evaluation and local tailoring to ensure that those in need can still access them (Chandler, 2019). Without this, narrowly focused interventions could have the unintended consequence of increasing the suffering of already-vulnerable members of society. In terms of companion animals, when considered in combination with 'trans-biopolitics', these insights alert us to the need to reflect upon the unintended consequences of limiting antimicrobial use on animal health and welfare.

Figure 3.1: Antibiotics as a quick fix (Denyer Willis and Chandler, 2019), reproduced with permission.

3.1.5. Using care to think with

I conclude my theoretical orientation with some reflections on using to care to think with, an increasingly popular approach in recent years (Brown and Nading, 2019, Denyer Willis and Chandler, 2019). Care joins together the several lines of thought presented; namely an interest in relational, multispecies approaches and the consideration of the power that comes with such entanglements.

From an actor network theory perspective, Annemarie Mol (2008) found care to be relational and contingent based on a web of shifting elements and concerns that do not always easily align. Rather than being enacted from position of complete knowledge or control, Mol and colleagues have proposed that caring operates through the process of 'tinkering'—juggling to try and find the 'best' way to care on a moment-by-moment basis (Mol et al., 2010, Law, 2019). They have also troubled the dichotomisation of 'warm and loving' care versus 'cold and rational' technologies in healthcare, instead proposing that care practices are enacted through a web of actors including thermometers, oxygen masks, and, from our perspective, antimicrobials (Mol et al., 2010).

Linked to the idea of antimicrobials as infrastructure, considering the embedded role of antimicrobials in 'the institutional, ethical, and everyday forms of care' has been proposed as a productive avenue through which one can create a space to think differently about antimicrobial use (Denyer Willis and Chandler, 2018, p. 105). Reflecting on the spaces and places occupied by medicines helps to render visible what is made possible by their use, and the alternative forms of care that are absent—or perhaps squeezed out by the central role of pharmaceuticals—within 'modern' healthcare (Denyer Willis and Chandler, 2019, Dixon et al., 2021). The latter is associated with the social process of pharmaceuticalisation–which has seen a move from clinical care towards pharmaceutical intervention (Denyer Willis and Chandler, 2019). Pharmaceuticalisation has also seen a transition towards defining care through access to medicines, as observed in Global Health discourses (Dixon, 2021). This contrasts with stewardship messages which seek to limit antimicrobial use in order to protect their future efficacy, a subtle shift from caring for patients to caring for medicines (Dixon et al., 2021).

Mol identified two—sometimes conflicting—logics underpinning Western healthcare; patient choice and patient care (Mol, 2008). She proposes that the logic of choice has come to dominate and—whilst intended to disrupt patriarchal modes of biomedicine—it has resulted in patients' needs for care being neglected. Most veterinary care providers in the UK are private and, therefore, companion animal owners are both customers and proxy patients and, as such, might be exposed to both logics of choice and care. Drawing on these concepts may help better understand decision making regarding antimicrobial use within the companion animal veterinary setting.

Care has also been proposed as a means to investigate more-than-human worlds (de la Bellacasa, 2017). This interest has its roots in feminist social sciences, with some arguing that the concept lies at the very heart of such endeavours (de la Bellacasa, 2012). Emerging in the 1970s, feminist approaches have sought to trouble the classic, male-centred accounts of societies and to speak up for powerless societal groups (Eriksen, 2015). Such concerns towards care extend beyond women to include other marginalised groups, e.g. more-than-humans (Haraway, 2007, de la Bellacasa, 2017, Hurn and Badman-King, 2019). Martin et al. (2015) highlighted the asymmetrical distributions of power involved in practices of care. They posed questions requiring further consideration by anthropologists: 'Who has the power to care? Who has the power to define what counts as care? . . . Who is excluded from care?' (Martin et al., 2015, p. 3). These questions helped inform my notetaking during fieldwork.

Clarke and Knights (2019) adopted on a feminist, post-humanist feminist perspective during their ethnographic study set in UK companion animal veterinary clinics. They concluded that care for animals within this setting is enacted through a framework that is not only anthropocentric in its origins and continuation, but also masculine. They describe the impact this has on the female and animal 'bodies' that inhabit this space (Clarke and Knights, 2019).

Also, in the veterinary world, John Law observed multiple objects of care for veterinarians working in the UK Foot and Mouth Disease outbreak (Law, 2010): caring for the animal—both in life and death; caring for the farmer; caring for oneself; and caring for the bigger picture to minimise the collective suffering of animals.

In summary, antimicrobial use might be considered as an act of care–a relational, contingent process involving human, non-human and technical actors. Building on the ideas of Law (2010), this thesis will explore the particular notions of care held by UK companion animal veterinarians as they juggle the needs of their patients, owners-who act as both proxy patients and clients–the bigger picture, and finally themselves. In addition to caring for the shared resource of effective antimicrobials, it will consider how the bigger picture might extend to include the need to care for the clinic and its viability. The distribution of power between female and male, and more than human and human actors in the clinic will be traced and how—in combination with other facets of care—they shape practices of antibiotic use.

These theoretical insights help shape what I 'tuned into' during this research and how I enacted the methods described below.

3.2. Mixing methods

Understanding—and intervening in—the complex problem of antimicrobial resistance is increasingly recognised as necessitating efforts that cross traditional disciplinary boundaries and that draw upon multiple methods (Smith, 2015, Chandler and Hutchinson, 2016). Working across different methods, sites, scales, and species enables a broader understanding of the phenomenon or object of study (O'Cathain et al., 2010). From its conception, this collaborative PhD studentship and its research question were recognised to lend themselves to a mixed-methods approach. Deploying epidemiological methods on a large dataset facilitates the production of robust, generalisable statistics that convey magnitude and variation; meanwhile, anthropological approaches allow for in-depth, contextualised, and nuanced understanding that is theoretically rich (Greene, 2008).

Despite the attractions of a mixed-methods approach, the work of drawing connections across different paradigms of thinking is not without complications. For example, there were recurring discussions between my supervisors and me regarding whether this thesis should be written in the third or the first person. This illustrates the deep-seated differences between the disciplinary paradigms of epidemiology and anthropology. Conventionally, epidemiology is written in the third person as an objective account of a reality that exists independently of the observer (Pool and Geissler, 2005). Anthropology adopts a less positivist perspective and it is therefore customary to write anthropological accounts in the first person. In the end, we agreed on a rather clunky solution: that I would follow the disciplinary norms and switch between voices when writing. This simple example demonstrates the difficulties in producing a single account of the findings from research paradigms with fundamentally different world views. As such, a triangulation protocol in which the findings of the different research methods are formally synthesised (O'Cathain et al., 2010) was not deployed, as this implies a discoverable truth about antimicrobial use that we are trying to reveal. Instead, this thesis recognises that, for a range of research evidence to be drawn upon, a 'tolerance of epistemological diversity' (Lambert, 2013, p. 44) is required.

3.3. Epidemiological study

The epidemiological study aimed to answer the following research question: What is the quantitative variation in HPCIA use in dogs attending first opinion veterinary clinic belonging to large corporate veterinary groups? It also acted to generate ideas and avenues for investigation during the ethnographic fieldwork.

3.3.1. Design

A VetCompass™ dataset spanning June 2012–June 2014 inclusive that had previously been used to quantify UK antimicrobial use (Buckland et al., 2016) was analysed. Due to the time constraints of this PhD project, the study population was limited to dogs, the most common UK companion animal species (O'Neill, 2013). The percentage of antimicrobial dispensing events comprising of HPCIAs was selected as the outcome measure, given the interest in these agents (UK-VARSS., 2019). In addition to the previously applied inclusion and exclusion criteria (Table 3.1) (Buckland et al., 2016), only data from corporate veterinary groups with over thirty clinics were retained (Figure 3.2).

3.3.2. Data cleaning and processing

The Buckland et al. (2016) definition of an antimicrobial agent and its application to the dataset were re-used (Table 3.1). In brief, these were medicines that destroy or inhibit the growth of bacterial microorganisms and authorised for systemic use. Additional HPCIA coding based on the WHO's definition (2019) was added. As per Buckland et al.'s approach, an antimicrobial event was defined as an independent record (line) in the treatment data field of the Electronic Patient Record (EPR) derived dataset and, consequently, multiple events could arise from a single consultation or across multiple visits.

Table 3.1: The inclusion and exclusion criteria of the epidemiological VetCompass^{TM} study (adapted from Buckland et al., 2016)

	Inclusion criteria	**Exclusion criteria**
Antimicrobial event	An electronic record of the dispensation and administration of medicines that destroy or inhibit the growth of bacterial microorganisms and authorised for systemic use (i.e. injectable, tablets/capsules, and oral suspensions)	An electronic record for the dispensation and administration of other antimicrobial agents (e.g. antiviral, antifungal, biocides) or those be delivered topically (e.g. medicated creams, topical solutions for treatment of eye or ear infections).
Dog	Dogs with a unique patient identifier who had at least one electronic patient record entry.	Dogs without a unique identifier or groups of dogs included under a single unique identifier.
Clinic	First opinion clinics situated in the United Kingdom and participating in VetCompass^{TM} during the study period.	Clinics engaged in the provision of solely referral and/or emergency care services. Clinics belonging to veterinary groups with five or fewer clinics

The variable 'any HPCIA' was generated and coded as positive for all antimicrobial events linked to a unique dog identity number if one or more of these events comprised of a HPCIA. Dog age was calculated as the period between the birth date and the antimicrobial dispensing date; ages < 0 or > 24 years were coded as missing. Age was grouped *a priori* into quartiles to allow for non-linearity of effects and to facilitate interpretation. Dog sex was coded as male, female, or missing. The 20 most prevalent dog breeds in the dataset were taken as categories, the remaining pure breeds were pooled together ('other purebreds') as were 'cross breeds'. The clinic postcode was used to derive its region in the UK.

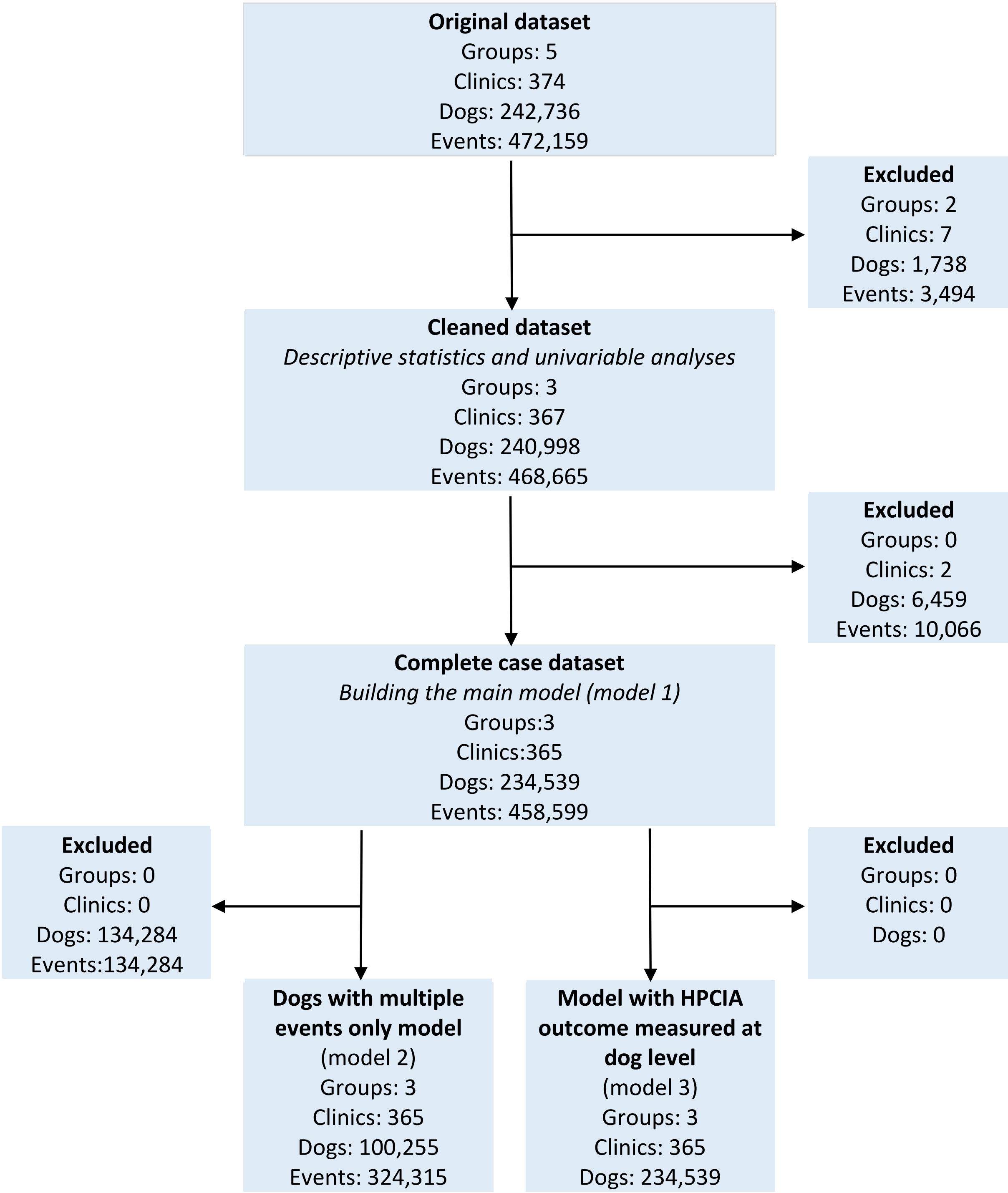


Figure 3.2: The flow of data through the VetCompass™ epidemiological study including the hierarchical models.

3.3.3. Descriptive and univariable analyses

Counts and percentages were calculated for each categorical variable (dog sex, breed, clinic region). After reviewing its distribution, dog age was summarised for each quartile using median and interquartile range (IQR). The Pearson chi-square test and the Mann Whitney U test, as appropriate, checked for differences between the sample characteristics of each veterinary group (Kirkwood and Sterne, 2003).

The total and average (mean, median) number of antimicrobial events and HPCIA events per dog were calculated. From the total number of antimicrobials events, the continuous outcome measure of the percentage of events compromising of HPCIAs was calculated at dog, clinic, and veterinary group levels along with 95% CIs. The distribution of the percentage of HPCIA events at a clinic level was plotted graphically. The composition of HPCIA events by veterinary group was investigated using percentages and 95% CIs.

3.3.4. Hierarchical modelling

A multilevel logistic regression model was built for the binary outcome of whether an antimicrobial event comprised of a HPCIA (yes versus no) using complete cases (antimicrobial events with full data on dog identification number, dog age, dog sex, dog breed, clinic identification number, clinic region, veterinary group identification number) in the dataset. This was with the aim of investigating the clustering of HPCIA use within dogs and clinics; data at individual veterinarian level were not available. Dog identity number and clinic identity number were added as random effects whilst veterinary group was included as a fixed effect. Clinic and animal identities were included as random effects due to the large number of individual identities at both levels and where the interest was in adjusting for clustering at these levels rather evaluating individual animal or clinic differences. A screening criterion of a univariable p-value < 0.25 was applied when considering the inclusion of additional fixed effects (dog age, sex, breed, clinic region) (Hosmer and Lemeshow, 2004).

Model development used a manual backwards stepwise elimination approach. Models without dog identity number, clinic identity number, or veterinary group were not considered, as this would have prevented the investigation of HPCIA use at these levels. Likelihood ratio tests were used to compare the performance of the new, smaller model to the original. The estimated coefficients of the remaining variables were compared to those from the full model with all variables included to check there was no sizable change in their magnitude (Hosmer and Lemeshow, 2004). Pair-wise interaction effects between age quartile and percentage of HPCIA events in each veterinary group were evaluated. However, limited computational power prevented the inclusion of an interaction term in the hierarchical modelling.

Model performance was assessed using Receiver Operator Curve (ROC) statistics and Hosmer Lemeshow residuals (Hosmer and Lemeshow, 2004, Statalist, 2017). ORs and 95% CIs were calculated for each fixed effect variable. The intraclass correlation coefficients (ICCs) at a dog and clinic level were calculated to assess the clustering of HPCIA use, that is, the correlation among observations within the same cluster (Dohoo et al., 2003).

Due to the imbalanced structure of the dataset with most dogs having a single antimicrobial event, the analyses were re-run: i) in the same model using a dataset limited to dogs with multiple antimicrobial events only (model 2), and ii) a model with a binary outcome of whether a dog received any HPCIAs (model 3) (Figure 3.2). The ICCs and performance of these models were compared to the main model (model 1) to assess the robustness of the estimates produced.

Data analyses were conducted in Stata 16 (StataCorp, Texas, USA) and statistical significance was set at the 5% level. The software QGIS, version 2.18.15 (QGIS development team, Switzerland) was used to map the model results related to clinic region. These analyses were covered by the VetCompass™ research ethics approval from the RVC's Ethics and Welfare Committee (SR2018-1652).

3.4. Ethnographic study methods

Ethnography forms the integral methodological approach of anthropology. 'Classic', early ethnographies include those of Malinowski (1922) and Evans-Pritchard (1937 (1976)). These pioneering studies entailed anthropologists spending lengthy periods of time becoming immersed 'in the field' in order to develop a rich and insider or 'emic' view (Russell Bernard, 1995) of the cultural phenomena being studied. These principles continue to inform ethnographic efforts—and their core method of participant observation—to this day. However, the approaches adopted by these early studies have also been problematised; for example, the ethnocentric and colonial lenses utilised by these white anthropologists when studying 'primitive' cultures (Pool and Geissler, 2005). Partly in an attempt to distance anthropology from its colonial roots, there has been a move towards conducting fieldwork at 'home' (van Ginkel, 1994) using ethnographic methods to make the familiar strange and the strange familiar (Myers, 2011).

Ethnographic approaches—including participant observation—have been fruitfully deployed in human healthcare (Mol, 2002, Pope, 2005) and veterinary settings (Hamilton, 2007, Clarke and Knights, 2019). Hamilton and Taylor (2017) promote ethnography for studying multispecies spaces due to its emancipatory, inclusive and boundary challenging nature. Clarke and Knights (2019) described observing consultations, surgery, and 'lurking around' in order to develop a nuanced understanding of everyday life as a veterinarian and their social interactions.

Historically, anthropologists presented their written ethnographies as neutral, scientific accounts of their observations (Rapport, 2014a). However, the influential collection of essays 'Writing Culture', published in 1986, distilled increasing concern across the discipline regarding this view. Drawing from the other contributions in the tome, Clifford summarised how ethnographic writing can be considered contextual (i.e. it draws from the social milieu that the anthropologist inhabits as she/he writes), rhetorical (it uses—and is used by—the expressive conventions of language), institutional (it is shaped by the academic traditions and disciplines the work contributes to and the audience that reads them), political (it has authority to describe, analyse and publish a 'culture') and historical (the listed factors change through time) (Clifford, 1986). As Clifford wrote, 'they assume that the poetic and the political are inseparable, that science is in, not above, historical and linguistic processes' (Clifford, 1986, p. 2). Latterly, Hamilton and Taylor (2017) proposed that ethnography's characteristic poetic writing and thick description has much to offer when attempting to document more-than-human entanglements. It is within this framework, that my ethnographic endeavours sit.

3.4.1. The researcher as a research tool

As described in Section 3.2, I have written the anthropological parts of this thesis in the first person. Writing myself into the research in this way enables more 'space' to critically reflect on my role, responsibilities, and relationships when answering my research question. For example, I live in the Midlands and therefore this became the area from which fieldwork sites were recruited. Prior to undertaking this degree, I worked as a (human) primary care researcher and so feel at relative ease navigating this literature compared to the veterinary or social sciences counterparts. As a white, middle-class young(ish) woman, I was sometimes mistakenly assumed to be a veterinarian and, until corrected, this influenced how others responded to me. I am a companion animal owner with 'soft spots' for particular dog breeds with whom I have shared my life. This all influenced what I attuned to during fieldwork and how I wrote about it. As Rabinow (2007) noted, 'the material which the anthropologist has gone to the field to find, are already themselves interpretations' (Rabinow, 2007, p. 150).

During the first year of my PhD, I read about antimicrobial use in livestock, which spilt over into reading—with increasing unease—about intensive farming methods. I also read about the development of multispecies ethnography and efforts to 'give voice' to marginalised, more-than-human groups (Hamilton and Taylor, 2017). I read the work of social scientists who accompanied live animal exports and spent time in abattoirs (Hamilton and Taylor, 2013) and I thought, 'I really don't want to have to do that'. In excusing myself from bearing witness to these spaces and uncomfortable human–animal entanglements, I felt I could no longer contribute to their continued existence. I therefore became vegan.

During my fieldwork, I was hesitant about revealing my newly acquired status to those working in veterinary clinics. By no longer supporting the livestock sector, I was undermining the sustainability of the livelihoods of their veterinarian colleagues, university friends, and partners who worked with farm animals. I was also concerned about being accused of being overly sentimental towards animals, particularly their killing, which—in the form of euthanasia—forms part of all veterinarian's work (Morris, 2009, Hurn and Badman-King, 2019). In straightening out my position with regards to animals, I had made things more complicated with my human informants. Although One Health approaches—in which the needs of humans, animals, and the environment are equally prioritised—are often touted, I found it was difficult to enact. I include this story to illustrate my shifting position towards animals during this thesis: a small step taken to 'decentre the human' and to take seriously my roles and responsibilities towards my more-than-human study participants.

Being reflexive in this way is currently seen as best practice by authorities in this field (Pope, 2005). Throughout this project I have reflected on my position and include some reflections amidst the description of my ethnographic methods in the following sections. It is important to note, however, that, for some, a reflexive awareness demonstrates the impossibility of studying others except as a means to better understand oneself (Rapport, 2014a). This is particularly pertinent when attempting multispecies ethnography with a cast of more-than-human actors (Hamilton and Taylor, 2017).

My ethnographic fieldwork took place between January and September 2019. During this time, I aimed to spend three days a week in my fieldwork clinics (Section 3.4.2). The rest of my time was spent reading and reflecting on and analysing my fieldnotes, attending university, or other meetings. Whilst in the clinics, I undertook participant observation (Section 3.4.3) with nested, informal interviews with participants. I also conducted more formal semi-structured interviews, and one focus group, with veterinarians working at my fieldwork sites (Section 3.4.4). I complemented these data by compiling a log of the antimicrobials available at each clinic (Section 3.4.5) and undertaking documentary analysis (Section 3.4.6). In the following sections, I describe my fieldwork sites and my approaches to data collection and analysis.

3.4.2. Fieldwork sites

My fieldwork was predominantly conducted in three first opinion companion animal veterinary clinics in the Midlands of the UK. Whilst clinics are the foci of antibiotic decision-making, it resulted in the voices and experiences of companion animal owners being largely absent from this body of work, a limitation that is further discussed in the concluding chapter. Each clinic belonged to a different corporate veterinary group, two were commercial enterprises and one—clinic three—was operated by a national charity. Moving between all three of my fieldwork sites—both physically and within my data—and adopting a comparative approach helped me to render visible the assumptions underpinning daily life at each location.

My route into these clinics was via the professional networks of one of my veterinary supervisors—deals that were brokered 'vet-to-vet'. The corporate groups he approached were eager to participate in the project: by welcoming in an independent observer, they were able to demonstrate their business' commitment to tackling antimicrobial resistance and providing high-quality care. By allowing their clinic to host me, I was aware of becoming a part of their enactment of corporate responsibility.

Fieldwork sites were mutually agreed with multiple levels of managers: I provided a list of clinics close to my home—to maximise the time I was able to spend there—and the corporate group managers approached local senior veterinarians who they thought would be amenable to my presence. At each of the clinics they proposed, there was a veterinarian interested in antimicrobial stewardship. Whilst this might not be typical of all clinics, it provided the opportunity to observe how stewardship was enacted and how 'appropriate' antimicrobial use was agreed upon—and sometimes disagreed upon—on the ground.

In addition to each having a staff member interested in antimicrobial stewardship, selecting fieldwork sites that were all in the Midlands and willing to participate in research created a context for investigation that may well have differed from other UK veterinary clinics. Recruiting a mixed practice as an additional fieldwork site was considered as this would have enabled the comparison of antimicrobial deployment in companion animal clinics to their livestock counterparts within the same organisation. However, this proved unfeasible in the time available and, instead, comparing private and charity clinics became the major analytical avenue. Observing antibiotic use in a mixed practice could have resulted in an analysis with a different focus and thesis with a different flavour.

My three fieldwork sites belong to corporate groups who currently participate in the VetCompass™ programme and my initial research plans involved linking observations with quantitative analyses of antimicrobial use. However, the available VetCompass™ dataset pre-dated one corporate group joining the scheme. The remaining two groups were contributing data at this time however another fieldwork clinic was yet to open. The final clinic–the only one whose antimicrobial data was included in the dataset–had no veterinarians still working there from this time. Therefore, it was not possible to more closely link the epidemiological and anthropological components of my study.

Clinic one was located within a 'pod' inside a pet superstore that was situated in between discount home stores on an out-of-town retail park. Clinic one belonged to corporate veterinary group that operated a joint venture partnership scheme ('like Specsavers') and targeted a high throughput of price-sensitive clientele, partly through offering special deals. Veterinarians working there described the socio-economic status of their clients as 'a real mix', ranging from those living in affluent neighbouring villages to those residing in deprived urban housing estates and struggling to get by financially. The corporate group emphasized the freedom and independence of its branch partners whilst providing business coaching, human resources, and marketing support. On a day-to-day basis, the clinic largely operated as a stand-alone 'unit' overseen by the senior veterinarian.

Clinic two was located in a well-to-do market town in a single storey building that had been extended and remodelled over the years. It had been acquired by a corporate veterinary group, on the retirement of its founding veterinarian, about a decade ago. This group targeted the 'Waitrose sector', i.e. owners who were willing to pay more for better quality. Clinics within this group were organised into hub and spoke sites: clinic two was a hub and provided out-of-hours care for the patients of the surrounding spoke clinics. The practice management software (PMS) allowed clinical records to be accessed from different sites within the group and by Head Office, who monitored the clinic's activity. There was almost constant communication between clinic staff and colleagues at Head Office, where clinic management operations, such as staff rotas, were undertaken.

Clinic three was situated in a residential estate just outside a city centre. It was housed in a purpose-built building that had been opened by a minor member of the Royal family about 30 years ago. It was part of a charity that provides veterinary care for animals owned by people on low incomes (such as the long-term sick or some pensioners). It was oversubscribed and the large waiting room—seating over 30—often overflowed into the carpark. The veterinary care provided was closely audited by clinic managers to ensure that as many animals as possible were helped and that the clinic operated within its limited financial resources. Out-of-hours care was provided onsite by a separate (private) corporate veterinary group with separate staff and policies.

In addition to these clinical practice settings, as a non-veterinarian, I also sought to immerse myself in the wider veterinary sector. To achieve this, I attended veterinary conferences, clinic management seminars, tradeshows, and Crufts. The London Vet show, for example, provided my first glimpses of veterinary-industrial complex in action (Chapter 6). I also sat in on an introductory One Health module and lectures—including a public dissection—at RVC. I attended meetings discussing antimicrobial use in companion animals at the Department for Environment, Food and Rural Affairs (DEFRA) and the VMD, a veterinary referral centre and the headquarters of a corporate veterinary group. Whilst the information gained from such encounters cannot be used directly as 'data' in this thesis, they provided me with insight into veterinary work and antimicrobial use beyond those written in the literature, helping to inform subsequent avenues for data collection and analysis (Goodwin, 2006).

3.4.3. Participant observation

Participant observation is suited to studying how organisations work, the roles played by different actors there, and the interactions between them. By deploying this method, this project is able to produce 'thick description' (Geertz, 1973) of life inside the veterinary clinic and answer calls for in-depth exploration of issues of power, professional identity, and reputation with respect to veterinary prescribing of antimicrobials (Wood, 2016). This approach is also suited to studying the shifting, messy entanglements of more-than-human actors that are socially, politically, economically, and historically contingent (Wolf, 2015).

A typical day 'in the field' involved arriving with clinic staff at the start of their shift and staying until they left. These long days enabled me to demonstrate my commitment to understanding their work, for example, by not 'clocking off' at 5pm sharp just as a series of emergency cases arrived. One criticism of contemporary healthcare ethnography is that researchers fail to achieve 'immersion' instead relying on periodic and relatively short-term observations (Pope and Mays, 2006). Within the constraints of my three-year PhD programme, I sought to mitigate against this by including weekend, bank holiday, and night shifts in my observation schedule in order to study as broad a range of situations, individuals, and practices as possible. The duration of my fieldwork placements (around three months per clinic) helped me to become embedded in the clinic teams, who became less self-conscious of being observed, therefore minimising the Hawthorne effect (Pope and Mays, 2006).

Whilst I tried very hard to witness all aspects of daily life, it was not possible for me to be in two places at once. I was sometimes called in to witness—or was later told about—interesting cases, those that demonstrated clinical or surgical expertise, or that were felt to be relevant to my project. Senior veterinarians enjoyed teaching their staff, sometimes adopting an almost showman-like persona. Calling me over to observe selected cases was another facet of this, which not only educated me but also helped define our respective places in the clinic hierarchy. As a younger, female, non-veterinary-qualified visitor, I complied by diligently recording their insights in my notebook. During my fieldwork, I also reflected upon situations where my presence was, conversely, unrequired; not only in terms of gaining a 'representative' sample, but also what was deemed irrelevant to the portrayal of veterinary work.

When undertaking participant observation, the researcher is required to be an active, engaged participant in the situation they are studying (Pope, 2005). Prior to beginning my fieldwork, I was concerned about how active I could be without having a veterinary qualification or work experience upon which to draw. However, my first fieldwork site (clinic one) was hectic and often requiring *'all hands to the deck'* to cope with the workload. Doing the washing up was my 'way in' as no specialist skills were needed and yet it enabled me to contribute something to the collective effort. From there, I progressed to fetching things, turning the lights off during ultrasound examinations, and tidying up. Helping with the cleaning, such as sweeping and mopping, enabled me to learn unwritten clinic rules regarding what is clean and dirty. As I became more familiar to and accepted by the clinic staff, I was asked to help hold animals during examinations. My role was to act as the 'bum stop', the lowest skilled job that involved standing behind the cat or dog to prevent it reversing off the table. More experienced operators managed 'the front end' with the increased risk of being bitten. Being an active participant, rather than just an observer, provided me with insight into the bodily sensations associated veterinary work—the backache from standing all day, the sneezing fits induced by inhaling cat fur, and the—sometimes eye-watering—smells.

An outsider on the inside

My non-veterinary background produced the 'culture shock' deemed necessary by some for fruitful ethnographic endeavours (Rapport, 2014a). It facilitated a 'fresh pair of eyes' (an 'etic' view) on taken-for-granted situations and illuminated the unwritten rules surrounding companion animal veterinary work that become self-evident from an 'emic' view (Russell Bernard, 1995). During my fieldwork, I experienced the quiet victories of being accepted by the teams I was observing, such as being allowed to use the staff entrance. However, there were still reminders that I was not fully 'one of the them', for example, the veterinarians privately discussing the access code to the controlled medicines cupboard.

My lack of veterinary expertise meant that veterinarians and support staff would explain things to me, helping to render visible the assumptions surrounding their daily practices. I also believe that my non-clinical background helped lessen feelings of peer review and scrutiny, encouraging the sharing of clinical dilemmas, for example, uncertainty regarding whether to use antimicrobials. I repeatedly explained that I was not there to judge whether antimicrobial use was 'right or wrong' but to understand what it is like working in veterinary clinics and how antimicrobial use fits into the bigger picture.

In addition to the emotional burden of undertaking fieldwork, I experienced a self-imposed pressure to control my bodily responses in my bid to become an insider. I did not want to contravene the unwritten rules of how to behave in the clinic—particularly in the 'back room' areas—by fainting or vomiting. Clinic staff shared tips such as breathing through one's mouth when confronted with a particularly malodorous situation. However, I continued to struggle with the ripe, cabbage-like smell of pus. At one site, having been spotted gagging, I was subsequently called over to watch the lancing of every abscess. My inability to share in the team's fascination in the quantity, colour, and texture of the resulting pus demonstrated my place as an outsider on the inside, and was often met with hilarity.

Note taking

Another feature that marked me as an outsider was the presence of my notebook, from which I was rarely separated. On one occasion, I left it on the side in the office when I went to the bathroom. On my return, I felt a rising sense of panic as a nurse read extracts to assembled colleagues. This taught me to keep my notebook safe, the value of having illegible handwriting, and the copious use of abbreviations. More importantly, this inversion made me reflect upon what I recorded and the burden of being observed.

I sought to take detailed notes describing relations, language, metaphors, and sense-making in engagements between those at the interfaces of companion animal veterinary care were made. Brief jottings and written reminders were noted at the time and expanded upon during quiet moments during or at the end of the day. I sought to capture 'the intricate ordering and distribution of bodies, technologies, architectures, texts, gestures and subjectivities' that make up veterinary care (Law, 2010, p. 67) and the place(s) antimicrobials had within this. Informed by multispecies approaches, I paid attention to the spatial layout and entanglements between more-than-human bodies. I also noted both verbal and non-verbal gestures and communication between more-than-human participants (Kirksey and Helmreich, 2010).

3.2.4. Interviews

Within periods of observation periods, informal, conversational interviews were undertaken with veterinarians, support staff, and owners to clarify arising issues. During consultations, veterinarians would often leave the room to collect equipment or dispense medications, and this offered an opportunity—albeit brief—to ask owners about their companion animal without disrupting the flow of the consultation.

Semi-structured interviews were also conducted with veterinarians working at fieldwork clinics. These provided the opportunity for interviewees to talk more reflectively in a one-to-one environment. In total, nine interviews were conducted at clinics one and two, lasting between 25 minutes and an hour. At clinic three, the oversubscribed charity clinic, hospital managers were concerned about the potential disruption caused by interviewing veterinarians individually and therefore it was agreed to run a focus group during their team meeting. Despite my best efforts, the senior veterinarian overruled my request to interview her separately from her team (Kirtzinger, 2006), jokingly asking the four junior veterinarians present, 'You're not scared of me, are you?'. The interviews and focus group followed a topic guide (Appendix 1) but with flexibility to follow up issues raised by participants and were digitally recorded.

I had also intended to formally interview veterinary support staff, as they have been overlooked by the qualitative studies conducted to date (Chapter 2). However, they had less control over the schedule of their working day, which I was keen not to prolong or make more troublesome. Instead we chatted informally as they went about their work.

3.2.5. Antimicrobial logs

At each fieldwork site, with permission, I catalogued the in-house stocks of antimicrobials to aid comparison of the clinics. Undertaking these stocktakes provided me with the opportunity to reflect on the location, size, and accessibility of the dispensary—and therefore medicines—in everyday life at each clinic.

3.2.6. Documentary analysis

During—atypically—quiet spells in clinic, I read whatever was lying around—product brochures, journals such as the Veterinary Record, and trade magazines, including the Veterinary Business Journal. I undertook a more systematic reading of the Veterinary Record and the Veterinary Times at RVC's Hawkshead campus library. Reading these journals in print format enabled consideration of their layout and the distribution of advertisements. This led to the Convenia® case study presented in Chapter 6 and helped me understand how the 'issue' of gender is portrayed in veterinary work (Chapter 7).

I also collected clinic, national, and international policies, flowcharts and diagrams describing 'appropriate' antimicrobial use, veterinary care pathways, or the spread of antimicrobial resistance. I was interested in the associations, assumptions, and power relationships rendered visible and invisible by such representations. By doing so, the social, cultural, and political values influencing their development and what they subsequently project can be investigated (Leach and Scoones, 2013).

My documentary analysis was informed by the approach of Bowker and Star (2000), who described how apparently neutral classification systems influence social interactions and word views. The standards and categories produced by such systems act as infrastructures—disappearing from view—but operating to produce advantage for some and, conversely, disadvantage for others (Chandler, 2019). The work of Lynteris (2017) with its more-than-human interest also had resonance: he examined the representation of inter-species relations—and anthropocentrism—through the analysis of diagrams of how zoonotic diseases circulate.

In Chapter 9, inspired by Will (2020), I consider existing initiatives seeking to encourage antimicrobial stewardship in the UK companion animal sector using a critical discourse analysis approach. The goal of such Foucauldian-inspired analyses is to illuminate and critique structures of power that are produced—and re-produced—by the construction of versions of social worlds and the individuals and institutions within them (Hodges et al., 2008, McHoul and Grace, 2015).

3.2.7. Data analyses

Data collection and analysis ran concurrently, mutually informing each other. I closely read and reread my fieldnotes and other documentary sources to review the data being collected and develop further ideas for investigation. Interview recordings were listened to multiple times and key sections transcribed. Quotes were selected to illustrate themes emerging from the interviews and from the analysis of fieldnotes and other documents.

In previous research projects, I have utilised software (NVivo 12, QSR International Pty Ltd, USA) to help organise data and record the thematic coding process of qualitative data (Tompson et al., 2015, Tompson et al., 2016, Tompson et al., 2017, Tompson et al., 2018). However, I found the process of adjusting the coding structure in light of emerging themes to be constrained by the somewhat inflexible and linear structures embedded in the design of this software. Therefore, for this PhD project I adopted a manual approach that would not be feasible in larger, multi-investigator ethnographies (Bikker et al., 2017). Whilst less commonly used these days, this low-tech approach encourages an intimate knowledge of the data and, 'has much to recommend it' (Ziebland, 2006, p. 69).

During the iterative process of analysis, I annotated my fieldnotes with different coloured pens and Post-it sticky notes as I developed and refined categories to produce explanations (Pope and Mays, 2006). Initially, low-level codes situated in the data were developed into more abstract themes (Ziebland and McPherson, 2006), and the relationships between themes was summarised on boards (Figure 3.3). I used comparisons to draw out similarities and differences between sites. Moving to a new space or setting, and shifting between emic and etic perspectives, alerted me to the enacted 'common sense' and supporting infrastructures (Chandler, 2019) in each location. I reflected upon and made explicit 'What is normal here?', exploring why things make sense and the supporting material and semiotic infrastructures.

Figure 3.3: A small portion of my analysis. Orange notes describe broad topics, green notes indicate codes grounded in the data and pink notes more abstract themes.

Analysis sought to weave together human and non-human agencies at play in the use of antimicrobials, drawing data sources to describe the interdependencies involved in antimicrobial use in companion animals. The empirical fieldwork data was considered in response to—and building on—the existing theoretical literature. Interim findings were discussed at meetings with my supervisors.

3.2.8. Presentation of ethnographic findings

In the reporting of my results, I draw most heavily on fieldwork clinics one and two as these commercial enterprises reflect the conditions under which the vast majority of UK companion animal veterinarians work. That is not to negate the importance of clinic three in this study; its inclusion helped me to make sense of much of what I had observed at my previous fieldwork sites.

Anthropologists strive to 'take seriously' what matters to their interlocutors and have problematised accounts of antibiotic use that centre on 'good' and 'bad' individual behaviours (Denyer Willis and Chandler, 2019). Broom et al. (2020) recently advocated efforts to tackle antimicrobial resistance that foster collective responsibility and solidarity. As such, this study sought to move beyond blaming veterinarians for being 'inappropriate' users of antimicrobials or owners for 'irrationally' demanding antimicrobials. I have therefore steered away from presenting cases of 'inappropriate' or 'poor' (Currie et al., 2018) antimicrobial use. Instead I focus my attention on cases that shed light on the broader structures in which these actors are situated and antimicrobials are deployed.

When talking about animals, I seek to take seriously the experiences of the more-than-human actors within the veterinary clinic. However, I am equally conscious that, as a human, I cannot put myself in their position, nor fully understand their sensory or emotional experiences (Hamilton and Taylor, 2017). Therefore, my accounts and descriptions necessarily centre on human actors and their entanglements with more-than-human companions. In a small gesture of solidarity, I use female pronouns when talking about companion animals, another marginalised group in the veterinary setting (Clarke and Knights, 2019).

3.2.9. Ethical considerations

Ethics committee approval for this ethnographic study was given by that of LSHTM (reference number: 16126). The committee did not require consideration of the involvement of more-than-human research participants beyond laboratory animals. No reflection of my entanglements with potentially vulnerable companion animals was deemed necessary and—as others have noted—the machinery of ethical review has not kept pace with the development of multispecies research approaches (Han, 2020).

The project was conducted in accordance with the Association of Social Anthropologists of the UK and the Commonwealth Ethical Guidelines for good research practice (2011).

3.2.9.1. Potential harms

Undertaking observation is an intense process for all parties involved, especially in the often physically confined spaces of the veterinary clinic. Therefore, I made it clear to everyone that I would not be conducting observations in staff rooms as I felt it was important that staff were able to take a proper break, not just from their work. The observation schedule was designed so that I did not spend extended periods of time with a single research participant and I offered to adjust the schedule if they were having a 'bad day'.

When preparing my fieldwork protocol, I wrote briefly about the potential emotional burden on me (the researcher) focusing on pet euthanasia. During fieldwork, I witnessed how the term for this procedure—put to sleep—is apt. The animal peacefully slips away so much so that, on the first few occasions, I felt compelled to ask, 'Is she actually dead?' Far more upsetting was witnessing the owners, who were often distraught at their ending their companion's life. In these consultations, it was difficult to remain an emotionally detached researcher, a stance I had adopted in my previous biomedical career. This was further complicated by my own companion animal being euthanised during my fieldwork, blurring the distinction between my professional and personal lives. Therefore, I began to excuse myself from these consultations, not only to protect myself but also these owners. Witnessing their grief felt voyeuristic when it was adding little novel insight that was strictly relevant to my project.

3.2.9.2. Informed consent

Written informed consent was sought from all those taking part in the study. Prior to beginning a clinic placement, I would visit to meet the team, explain my research—emphasizing the voluntary nature of participation—and answer any questions they might have. I would leave study information sheets and consent forms covering the observations (see Appendix 2) for them to sign, if happy. When in clinic, I carried a bundle of these uncompleted documents with me in case locum staff were working that day.

I treated permission to being observed as an ongoing process and not just the initial signing of the form. I agreed my observation schedule with clinic managers who circulated it to staff to inform them of when and where I would be and offer opportunity for staff feedback. At the start of each session, I would also check if it would be OK to join them. A separate information sheet and consent form covered the semi-structured interviews with veterinarians (Appendix 3).

Informed consent was also obtained from companion animal owners whose consultations I observed. To minimise disruption, I asked receptionists to distribute information sheets and consent forms (Appendix 4) to owners on arrival, to be read in the waiting area. In the consultation room, the veterinarian would introduce me and ask if it was ok for me to observe. I would then ask if they had any questions and complete the consent form as the consultation began.

At clinic three, there were typically three veterinarians working at once and they would often switch between lists of patients to help each other out. Therefore, the owner due to be seen by the veterinarian I was observing might be seen by someone else and a different owner who had not received the study paperwork would be seen instead. In these situations, following verbal assent for my presence, I would remain in the consultation room, but not make any fieldnotes.

3.2.9.3. Privacy and confidentiality

Pseudonyms—rather than names or initials—were used when describing people in fieldnotes and in subsequent study documentation to prevent identification of participants. In the fieldnote extracts presented in this thesis, I have also altered biographical details to add a further layer of anonymity.

When in clinic, completed study documentation and the digital recorder were kept in a locked locker. Digital recordings were uploaded to a secure, restricted-access LSHTM server and deleted from the recording device at the first opportunity. The laptop used to write up this thesis was password protected and encrypted.

Chapter 4 Setting the scene: caring in precarious times

4.0. Introduction

In anticipation of the upcoming chapters—in which I delve into the ways antimicrobials are embedded within the companion animal veterinary clinic and how animal–human–microbe relations unfold and care is enacted there—I sketch a picture of clinic operations and situate it within the UK companion animal veterinary sector. This is with the aim of acquainting the reader with the systems, processes, and imperatives that frame the findings of this thesis.

4.1. Clinic life as a dynamic, contingent performance

'The clinic' is the central stage of this thesis, upon which the drama of clinical practice, veterinary business, and human-animal-microbe-medicine relations are played out. Informed by material-semiotic approaches, in particular actor network theory (Mol, 2002, Law, 2010) and multispecies lenses (Kirksey and Helmreich, 2010, Brown and Nading, 2019), I consider the clinic to be a performance space, more than the entanglement of its material elements; greater than the building or the medicines that line its shelves. The clinic is animated by actors; a shifting cast of humans, companion animals, and microbial beings, each bringing their own histories and personalities to these encounters. These characters entwine with materials, infrastructures, and established processes ('scripts'), moving through the different performance spaces of the clinic to enact daily life: the veterinary nurse carrying the drowsy dog, carefully wrapped in a towel, from the operating theatre back to the kennels, clutched to her body. These entanglements are more than just verbal. They are physical, tactile, odoriferous, visual, and emotional.

For the 'performance' of clinic life to be sustained, actors and materials for the sets, props, and drama are needed. This includes a supply of companion animal bodies to be 'fixed', and a constant stream of veterinarians and support staff to undertake this—sometimes physically and emotionally draining—care work. These activities also require specialist knowledge and access to equipment and consumables, including pharmaceuticals. The longevity of the clinic depends on its financial sustainability: this entails making sufficient profit for private clinics and operating within allocated financial resources for those run by charities. Nurturing the clinic's financial health ensures the ongoing ability to care for companion animals and provide its human workers with continued employment. Throughout my observations, alongside caring for animals, I found caring for the clinic to be a thread running through daily life.

In the four paragraphs below, I seek to situate the clinic: firstly, within the companion animal 'sector' and then by describing the networks of actors, materials, and infrastructures that transverse the physical boundary of the clinic building. By doing so, I illustrate how the clinic is not a bounded, stand-alone entity; rather, it is one opening into a network of people, infrastructures, norms, and processes that cluster in particular spaces to form a 'clinic'.

The clinic is nestled in a broader ecosystem of companion animal care. There are other local first opinion clinics—competitors who can poach clients, their animals, and staff. There are clinics belonging to the same corporate group, between which staff, medicines, clients, and ideas might be shared, a circulation choreographed by the group's head office. There are veterinarian referral centres offering access to specialists and high-tech equipment. There are also non-clinical sites of companion animal care; for example, dog groomers, doggy day care, boarding kennels, breeders, and communities of dog walkers. And then, there are the numerous domestic settings where the vast majority of companion animal care occurs.

The clinic has porous boundaries; human and more-than-human bodies flow to and fro across its threshold. Ill companion animals are brought in by their owners, perhaps accompanied by the microbes that made them sick. They leave, hopefully having been made better or with medicines that can help restore their health. Healthy animals attend for routine vaccinations or neutering operations, rites of passage in companion animal lives to standardise their bodies and mitigate risk, including that of unplanned offspring, cancer, and serious illness. Staff come and go, filling vacancies, bringing with them different ideas and practices of care, and leaving at the end of contracts and/or in search of opportunities elsewhere.

The clinic is a site of consumption and, subsequently, waste production. Deliveries of pharmaceuticals and consumables arrive at the front door. Meanwhile at the back door, there is the weekly visit from the pet crematorium operative who collects clinical waste and the frozen, bagged bodies of deceased (mostly euthanised) companion animals. If requested by the owner, the latter are returned a week later having been rendered into ash, ready for their collection. Representatives of veterinary suppliers visit bringing with them samples and stories about new products and their abilities to enhance care. Other hidden infrastructures sustaining the clinic include the utilities. For example, the ingress of fresh water is essential for cleaning the clinic and hydrating its inhabitant bodies. The sewerage system pipes waste products—dirty water and excrement (microbial bodies included)—away from their site of production into effluent treatment plants. Similarly, money circulates through the clinic with vertical corporate infrastructures extracting profits away from these 'front-line' sites of care to shareholders or business partners.

The clinic is also sustained by communications with telephone and email enabling clients to make appointments. The post (electronic and paper) supplies test results from external veterinary laboratories and facilitates processing insurance claims. The PMS computer system records the appointments schedule, the clinical notes of each companion animal, and the financial history for clients. The card machine accesses the wireless Internet to enable payments to be processed. The PMS allows auditing of care and billing practices to be undertaken by managers in the clinic, or in some business models, at distal locations. Auditing in this way can be thought of an act of caring for the clinic, ensuring its sustainability. Anonymous information may also be extracted from the PMS and contribute towards veterinary epidemiological research programmes. Electronic information, therefore, also moves across the physical clinic building boundaries.

4.2. Caring in precarious times

'The veterinary profession is in the midst of unprecedented change. With corporatisation, Brexit, a retention crisis, gender shift, technology and well-being issues, the profession is a perfect example of a VUCA world . . . First coined by the US military, VUCA stands for volatile, uncertain, complex and ambiguous.'

An extract from an article in Veterinary Practice Magazine (Dunn and Curtis, 2018)

'When your life is precarious and challenging, yet you manage to provide some simple security for your [companion] animal, you will be rewarded with gratitude, consistent affection and love.'

An excerpt from *Four-Legged Therapy. How fur, Scales and Feathers Can Make Life Worth Living* (Rickard, 2018b)

I now move on to describe the contemporary companion animal veterinary sector in which individual clinics are situated. As described in Chapter 1, the majority of veterinary care for the UK's nine million dogs (PFMA, 2019) is delivered via clinics ran by private providers. In 1999, the Veterinary Surgeons Act (1966) was altered to allow non-veterinarians to own veterinary clinics, paving the way for the development of corporate veterinary groups owned by shareholders and venture capitalists (Anonymous, 2018a). Ten years later, 400 (10%) of the 4,115 UK veterinary clinics (across all veterinary sectors) belonged to corporate groups. By 2018, the largest six corporate veterinary groups ran 35% of clinics (1,781 out of 5,068) employing over 12,000 veterinarians and veterinary nurses. Some estimates suggest that corporate groups will own between 60% and 70% of veterinary clinics by 2027 (Anonymous, 2018a).

In the sub-sections that follow, I outline several challenges facing the companion animal veterinary sector that place the long-term survival of clinics under threat. I consider the need to for clinics to be profitable in order for these private ventures to be sustainable, the difficulties recruiting and retaining veterinarians, the threat of Brexit to European veterinary recruitment, and the erosion of trust in professionals. Belonging to a corporate veterinary group can help, to some extent, mitigate these challenges faced by companion animal veterinary clinics. I conclude this section by reflecting on how this veterinary care work is situated in a broader society also preoccupied by precarity.

4.2.1. Achieving financial sustainability

Clinic profitability has been threatened by the rapid increase in the number of clinics which has acted to 'dilute' the market and intensify competition (Waters, 2018b). Data from the RVCS indicate that the number of companion animal clinics across the UK has rapidly increased to 3,337 in 2017, a 40% increase from 2007 (Waters, 2018b). Furthermore, profits from the sales of medicines, traditionally an important source of clinic income, have been squeezed by the advent of online veterinary pharmacies (Henry and Treanor, 2012). A 2018 survey of independent veterinary clinics estimated that 16% were making a loss (Sheridan, 2018), whilst, the corporate group Pets at Home reported that 12% of its 471 clinics were struggling, with 30 likely to close (Kelly, 2018).

4.2.2. Shortages of veterinary workers

Fears of a recruitment and retention crisis in the UK veterinary sector are also growing (Kernot, 2017). From a sample of nearly 2,000 companion animal veterinarians, 44% felt they were likely or very likely to be looking for a new job in the next two years. Of these, 17% wanted to take a break from—or completely leave—veterinary work (BEVA/BSAVA., 2019). Across all veterinary disciplines (n = 3,549), less than one-third of survey respondents (32%) would keep on being veterinarians even if they could re-start their working lives, but one in five (21%) stated they would definitely choose a different career path. The survey identified that the most disliked element of veterinary work was the clients (Figure 4.1). The tension between veterinarians and companion animal owners/clients is a theme that I return to throughout this thesis.

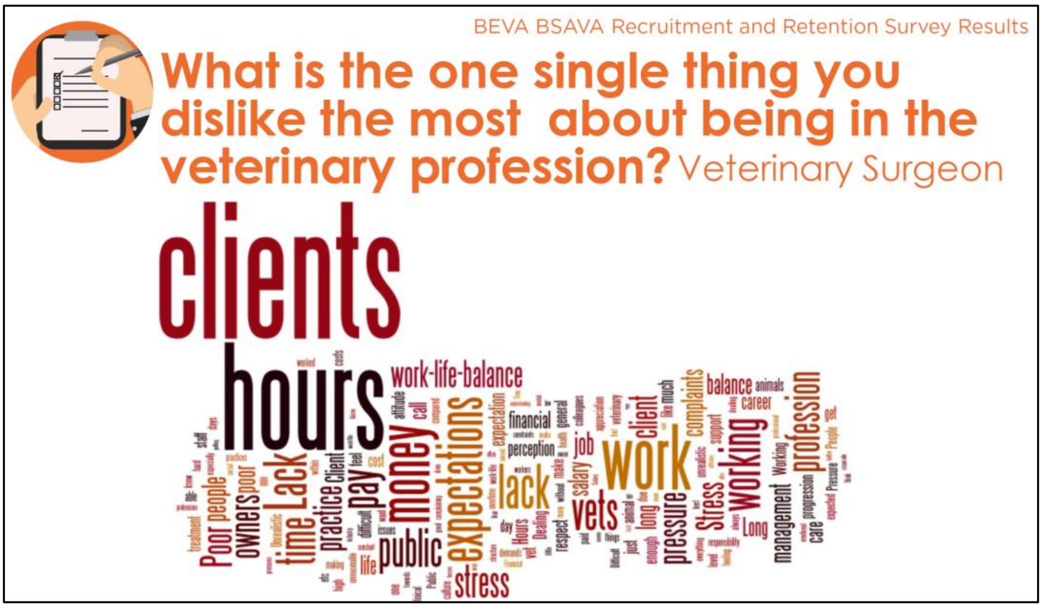


Figure 4.1: A word cloud reproduced from the 2019 BEVA/BSAVA retention and recruitment survey identifying disliked elements of veterinary work (BEVA, 2019), reproduced with permission.

Linked to the problem of retention, it is estimated that nearly half of clinics have a shortfall of veterinarians, especially to cover out-of-hours shifts (Kernot, 2017). A 2018 UK survey across veterinary disciplines found that, of the 976 respondents responsible for recruitment, 55% had found it difficult or very difficult to recruit a newly qualified veterinarian in the last year, rising to 93% for an experienced veterinarian (BEVA/BSAVA., 2019). The issues of recruitment and retention are hotly debated in the veterinary press, with various causes proposed. These include work-life balance, low levels of well-being, compassion fatigue, an increasingly feminised workforce, the associated rise in part-time working, and the misalignment between graduate expectations and the realities of undertaking veterinary work (Pearson, 2018).

4.2.3. Transnational flow of veterinarian workers

One strategy to cope with the insufficient supply of veterinarians has been to recruit from overseas. The number of veterinarians added to the UK professional register who graduated from the European Economic Area and Switzerland (EEA) has more than doubled since 2010 (Figure 4.2) (RCVS., 2014, RCVS., 2018). By 2017, the majority of newly registered veterinarians had qualified overseas (1,137, 56%) with most (976, 47%) coming from the EEA. Five countries contributed to two-thirds of this EEA total: Spain, 167; Romania, 150; Italy, 144; Poland, 110, and Portugal, 73 (RCVS., 2018). The top reasons given by non-British citizens working as veterinarians for coming to the UK were: to work abroad (51%); to gain experience (50%); better career opportunities (47%); better pay and work conditions (41%); and that veterinary work has a better status in the UK (31%) (Robinson et al., 2020). Data from 2017 estimates that the median annual salary before tax in the UK was €48,996 compared to €18,000 in Spain, €24,000 in Italy, and €25,885 in Poland (Limb, 2018).

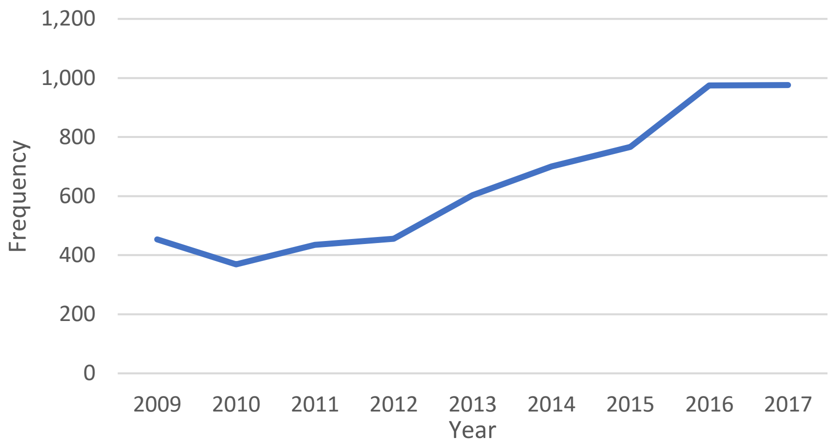


Figure 4.2: The annual frequency of newly registered veterinarians who qualified in the from the European Economic Area and Switzerland (RCVS., 2018, RCVS., 2014).

By 2017 almost one in three (9,571, 31%) of the total of 30,686 veterinarians on the UK professional register had qualified overseas (RCVS., 2018). This means there is a significant proportion of the workforce who are immigrants and, for whom, English is not their first language. Drawing on the narratives of veterinarians who had moved to the UK, Enticott (2019) described how novel modes of organising veterinary labour—both in public health and in private livestock and companion animal work—have 'inscribed mobility within the profession' (Enticott 2019, p. 723). The veterinary profession is now also predominantly female, accounting for 60% of practising veterinarians (RCVS., 2018). Ideas of intersectionality and social capital will be revisited in Chapter 7 as, to date, there has been limited exploration of how the experiences of undertaking veterinary work are shaped by being an immigrant (Enticott, 2019) and a woman (Clarke and Knights, 2019, Treanor and Marlow, 2019). For example, personal experiences of undergraduate veterinary training and antimicrobial use whilst living abroad could combine with different social expectations of how they should enact care influencing antimicrobial deployment.

The shadow of Brexit loomed large over my fieldwork, with European veterinarians voicing feelings of unease as they navigated the bureaucracy of applying for settled status (Anonymous, 2017a, Enticott, 2019). Previously, UK membership of the EEA, a single market, guaranteed free movement of goods, capital, services, and people between member states (Anonymous, 2020a).

The protracted nature of Brexit and the uncertain future of this source of veterinary staff added to feelings of uneasiness about clinic sustainability.

4.2.4. Erosion of trust in professionals

Whilst veterinary clinics have been coping with the sector-specific threats to profitability and staffing, there have also been broader societal changes in our willingness to complain, and our trust in experts and their advice (Rolfe et al., 2014). These changes have broadly coincided with the rise of the Internet, democratising access to and sharing of information, albeit sometimes inaccurate or unreliable (BVA., 2019a). A 2018 market research survey of 1,000 pet owners found that 63% would air any dissatisfaction about their veterinary clinic or the care received online (Kernot, 2018). Meanwhile, nearly three-quarters (72%) of a sample of 100 companion animal veterinary clinics worried about the impact a client complaint may have on their reputation, the latter of which was identified as a key element to business success (Kernot, 2018).

When veterinarians across all sectors were asked what three things would make the profession better, a quarter responded, 'more respect or recognition from the public', with female veterinarians more likely to report this than their male counterparts (29% vs 19%, respectively) (Robinson et al., 2020). The most commonly cited threat to the profession was client expectations and/or demands (55%), with those in their twenties (59%) or thirties (61%) or working in the companion animal sector (63% compared to 29% of farm animal veterinarians) more likely to report this (Robinson et al., 2020). However, caution is required when interpreting these findings as they are confounded by female veterinarians being younger, having lower status in the clinic hierarchy, and being more likely to work with companion animals.

The BVA is the largest membership group for the profession in the UK. It seeks to, 'champion, support and empower' veterinarians (BVA., 2020). A BVA survey of over 500 veterinarians found that 82% of respondents have had their diagnosis or profession opinion challenged by the clients using information from the Internet (BVA., 2019a). This is one of a number of surveys commissioned by the BVA to highlight the knowledge of veterinarians, their trustworthiness, and value for money (Loeb, 2020). One might interpret these activities as attempts to champion a profession whose social standing feels challenged. In Chapter 9, I explore how these efforts extend into the 'Trust your Vet' campaign, which frames veterinarians as experts and inappropriate antimicrobial use a result of a failure of owners to trust their veterinarian.

4.2.5. Safety in numbers

Joining a corporate veterinary group is one strategy to mitigate the challenges facing clinic sustainability. As recognisable 'brands' employing communications specialists, corporate groups can help with advertising and the promotion of clinics to potential clients. The organisations have business and change management teams experienced at identifying aspects of the clinic threatening its overall sustainability and turning these around—for example, by increasing profits and minimising outgoings. They also have better bargaining power to negotiate discounts from veterinary wholesalers and rebates from the suppliers of veterinary products by buying in bulk. This enables the acquisition of medicines and veterinary products for less than their list price at a time when the mark-up possible to add for their onwards sale to owners is being constrained by competing clinics and online pharmacies.

Corporate groups provide support with staffing, enabling access to out-of-hours services and, in some models, the circulation of staff between clinics to cover rota gaps or annual leave. They provide access to specialist human resources expertise and offer tailored graduate training schemes to attract veterinarians to fill vacancies in clinics. Several corporate veterinary groups run recruitment schemes targeting European universities, initiatives beyond the means of individual independent clinics. They also offer the infrastructure to help manage owner complaints and mitigate any arising harm to the clinic.

The benefits of the corporatisation of the companion animal veterinary sector have also been financially experienced by investors. For example, Independent Veterinary Care, the largest corporate veterinary group in the UK, has been sold multiple times in last the decade, earning venture capitalists huge returns on their investments (Pound, 2019); meanwhile, growth in the salaries of those undertaking front-line veterinary care work have stalled (Waters and Limb, 2018). The purchasing power of corporate groups has also pushed up the market value of clinics, placing them out of reach of most individual veterinarians seeking to acquire a business (Anonymous, 2018a).

4.2.6. Caring for those living in precarity

As described above, UK companion animal veterinary clinics are facing several threats to their ongoing sustainability. For those working in clinics, providing care in these uncertain times could be viewed through the anthropological lens of precarity, which highlights 'experiences and feelings of anxiety, disenfranchisement and loss of hope for the future' (Kasmir, 2018). The veterinary profession has a long-standing problem with suicide, which has been linked to occupational stress, the stigmatisation of mental health issues within the profession, a reluctance to seek help, and access to lethal drugs (Mellanby, 2005). As a consequence, the suicide rate amongst veterinarians is four times higher than the general population (Figure 4.3) (Westgate, 2013). The state of precarity heightens the pressures faced by veterinarians.

Figure 4.3: The controlled drug cupboard at Clinic two, on which are displayed the Vetlife helpline contact details.

In addition to caring for the clinic, veterinarians also care for companion animals and their owners living in precarious times, characterised by the receding role of the welfare state (Kasmir, 2018). It is estimated that nearly three million people now work in the gig sector of the UK economy, vulnerable to fluctuations in working hours, pay, and a lack of employment rights (BEIS., 2018, Broughton et al., 2018). Over ten million people in the UK have been identified as living on a 'financial tight rope' necessitating a short-term, reactive approach to money (MAS., 2018). A further 13 million—typically working-age families—are categorised as vulnerable due to a lack of savings (MAS., 2018). In such circumstances, regular pet insurance premiums may prove unaffordable: it is estimated that 67% of dogs and 84% of cats in the UK are uninsured, meaning that about 12.4 million owners are liable to meet veterinary bills themselves (ABI, 2018). The People's Dispensary for Sick Animals, an animal welfare charity, estimates that having a medium-sized dog costs around £65 per month or £7,000 to £11,000 over the course of its life (PDSA, 2019a) whilst just under a quarter (24%) of surveyed owners reported having a companion animal was more expensive than anticipated (PDSA., 2019). With 22% of the UK population having less than £100 in savings (MAS., 2018), an episode of ill health for their companion animal could result in financial hardship.

Another aspect of these precarious times is the decline in social housing. The number of UK households living the private rental sector has increased by almost two thirds between 2007 and 2017 (from 2.8 million to 4.5 million), with most households (62%) spending less than three years in the same accommodation before moving (ONS, 2019). As less than 10% of private landlords accept companion animals—citing the risk of damage to their property—such re-housing can break up multispecies families, resulting in companion animals being rehomed at short notice (MHCLG, 2020).

It is into this tableau that the imperative to alter antimicrobial use in companion animals arrives, as does the doctoral fieldworker clutching her notebook.

In the following chapters I report my research findings against the backdrop described above. Given the growing number of clinics belonging to corporate veterinary groups, in Chapter 5 I use a quantitative hierarchical model of dogs attending clinics nested within corporate veterinary groups to investigate the variation in HPCIA use. In Chapter 6, I ask how do the infrastructural arrangements of the companion animal veterinary sector support current ways of working with antimicrobials? For example, the role of consultation fees and medicines sales in shaping the expectations of the actors involved. In Chapter 7, I focus on daily life in the clinic and reflect upon how caring for antimicrobials enacted within the social-materials worlds there, amidst other—more established—foci of care. Given the workforce changes described, I also ask what are the intersectional experiences of providing care—and their implications for antimicrobial use—within this setting? In Chapter 8, I investigate how do social appetites for certain forms of canine bodies necessitate contingent forms of veterinary care and the impact this has on antimicrobial use. In the final results chapter (Chapter 9), I consider whether antimicrobial stewardship campaigns targeting companion animal owners might offer a means by which to shore up a profession whose expertise and social standing feels undermined in these precarious times.

Chapter 5 Exploring the use of Highest Priority Critically Important Antimicrobials (HPCIAs) in dogs by veterinarians working in UK clinics belonging to corporate veterinary groups: A VetCompass™ study

5.0. Introduction

> *'The issue to address, regarding antimicrobial use in companion animals, does not lie so much within the quantity but rather within the quality of antimicrobials used.'*
>
> Joosten et al. (2020)

This chapter presents an augmented version of the quantitative component of a mixed methods paper that was published in the peer-reviewed journal *Preventative Veterinary Medicine* (Appendix 5) (Tompson et al., 2020). This work was also presented at the 2020 annual conference of the Society for Veterinary Epidemiology and Preventative Medicine, and an abridged version was published in the conference proceedings. The extended word count of this PhD thesis enables a fuller exploration of the insights derived from the ethnographic fieldwork and, therefore, the qualitative components have been separated and are reported more fully in subsequent chapters.

The aim of this chapter, therefore, was to describe the quantitative variation HPCIA use in dogs attending first opinion veterinary clinic belonging to large corporate veterinary groups. These analyses focused on HPCIAs due the policy interest in the veterinary use of these medicines (UK-VARSS., 2019). Companion animal veterinary guidelines recommend that HPCIAs should not be used as routine first-line treatment (Allerton, 2018, FECAVA, 2018). This is because they play an important role in human healthcare as there are few therapeutic alternatives available to treat severe, life-threatening infections from non-human sources (WHO, 2019). Therefore, the frequent deployment of HPCIAs in companion animals could offer a surrogate measure of 'inappropriate' antimicrobial use. HPCIAs available for use by companion animal veterinarians in the UK are third- and fourth-generation cephalosporins, fluoroquinolones, and macrolides (NOAH, 2019).

I undertook this quantitative analysis with support from my doctoral supervisors. In addition, Dr Dan O'Neill provided guidance on the form of the dataset and commented on the journal manuscript. Dr Ruby Chang advised on the statistical model, its interpretation and the journal manuscript. Alec Tompson produced Figure 5.3 using mapping software based on results that I provided.

5.1. Results

5.1.1. Descriptive results

The cleaned dataset contained 468,665 antimicrobial events across 240,998 dogs, with 294,016 (62.7%) of these events arising from veterinary group C (Table 5.1). Of the total antimicrobial events, 29,984 comprised of HPCIAs (6.4%, 95% CI: 6.3–6.5%): this percentage differed between veterinary groups ranging from 4.9% (95% CI: 4.8–5.0) in group B to 15.6% (95% CI: 15.2–16.1%) in group A ($p < 0.001$). However, the canine and clinic characteristics of antimicrobial events also varied between veterinary groups (Table 5.2), potentially confounding this univariable finding, although this is accounted for in subsequent multivariable analyses.

Table 5.1: The distribution of dogs, antimicrobial and HPCIA events by veterinary group in a UK VetCompass™ dataset from 2012–2014

Distribution of events is reported in total and at a clinic level

Vet. Group	No. dogs (%)	No. AM events (%)	No. HPCIA events (%)	Percentage of antimicrobial events comprising of HPCIAs (95% CI)	No. clinics (%)	Median clinic percentage of AM events comprising of HPCIAs (IQR)
A	12,565 (5.2)	25,909 (5.5)	4,044 (13.5)	15.6 (15.2–16.1)	90 (24.5)	13.8 (10.9–19.9)
B	83,754 (34.8)	148,740 (31.7)	7,280 (24.3)	4.9 (4.8–5.0)	117 (31.9)	3.7 (2.1–6.1)
C	144,679 (60.0)	294,016 (62.7)	18,660 (62.2)	6.3 (6.3–6.4)	160 (43.6)	5.3 (3.6–7.7)
Total	240,998 (100.0)	468,665 (100.0)	29,984 (100.0)	6.4 (6.3–6.5)	367 (100.0)	5.9 (3.4–10.4)

No.: Number; AM: Antimicrobial; HPCIA: Highest priority critical important antimicrobial; CI: Confidence interval; IQR: Interquartile range.

Table 5.2: Characteristics of the antimicrobial events (n = 468,665) in a UK VetCompass^{TM} dataset 2012–2014 and comparison by veterinary group

Vet. Group	Median dog age at event, years (IQR)		No. in bitches (%)		No. in crossbreeds (%)		No. in England (%)	
	No.		No.		No.		No.	
A	25,898	6.1 (2.6–9.8)	25,892	11,706 (45.2)	25,889	4,182 (16.2)	25,465	25,465, 100.0
B	147,293	4.8 (1.8–8.6)	148,550	69,461 (46.8)	148,321	31,043 (20.9)	148,740	137,030, 92.1
C	291,490	4.0 (1.3–8.0)	291,734	135,974 (46.6)	290,495	60,392 (20.8)	294,016	265861, 90.4
Total	464,681	4.3 (1.5–8.2)	466,176	217,141 (46.6)	464,705	95,617 (20.6)	468,221	428,356 (91.5)
p-value	-	< 0.001	-	< 0.001	-	< 0.001	-	< 0.001

No.: Number; IQR: Interquartile range.

The types of HPCIA used varied between veterinary groups (Figure 5.1). The higher percentage of HPCIA events in group A was largely composed of fluoroquinolone use which contributed 13.4% (95% CI: 12.9–13.8%) to the total antimicrobial events in this group; This compared to 4.5% (95% CI: 4.4–4.7%) in group B and 4.2% (95% CI: 4.2–4.3%) in group C. Group B—which had the lowest percentage of HPCIA events—had six third-generation cephalosporins events (0.0% of antimicrobial events), suggesting they were not routinely stocked by clinics in this group. The corresponding results in groups A and C were 2.1% (95% CI: 2.0–2.3%) and 1.9% (95% CI: 1.9–2.0%) respectively. Macrolide use was low across all groups (n = 1,137, 0.2% of antimicrobial events).

At a clinic level (n = 367), the median percentage of HPCIA events was 5.9% (IQR: 3.4–10.4%) with a range of 0.0% (10 clinics) to 69.9% (1 clinic). When plotted graphically, a positively (right-handed) skewed distribution with a long tail was revealed (Figure 5.2). The median number of antimicrobial events per dog was 2 (IQR: 1–4, range: 1–60), whilst the median number of HPCIA events was 0 (IQR: 0–0, range: 0–60).

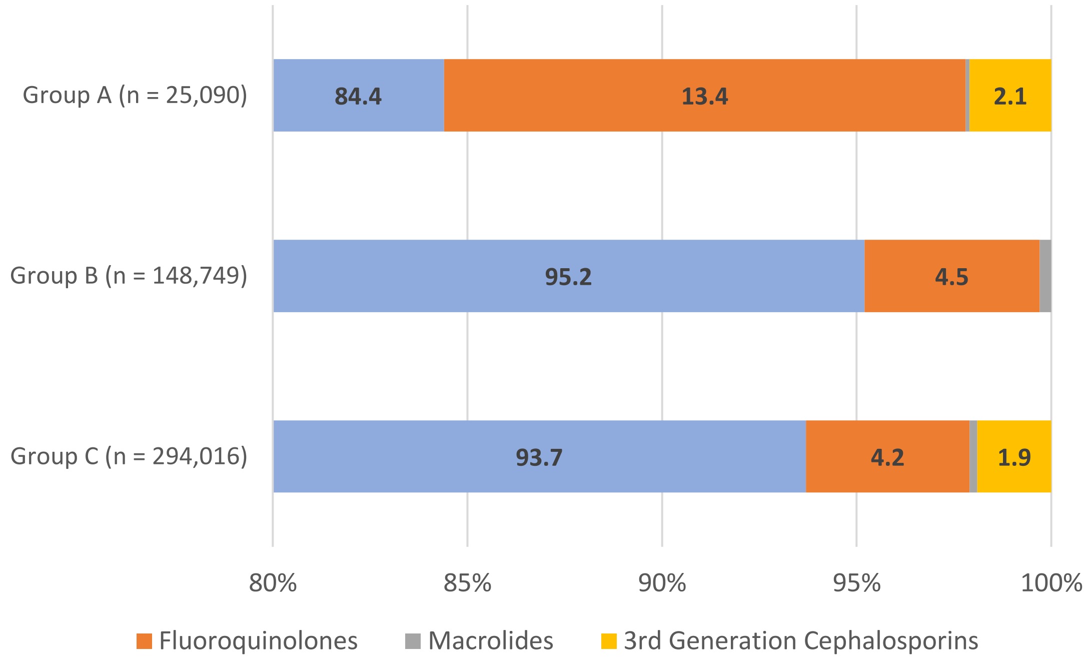


Figure 5.1: The composition of highest priority critically important antimicrobial events as a percentage of total antimicrobial events in a UK VetCompass™ dataset 2012–2014 (n = 468,665).

[NB: The X-axis starts at 80%, blue indicates non-HPCIA events].

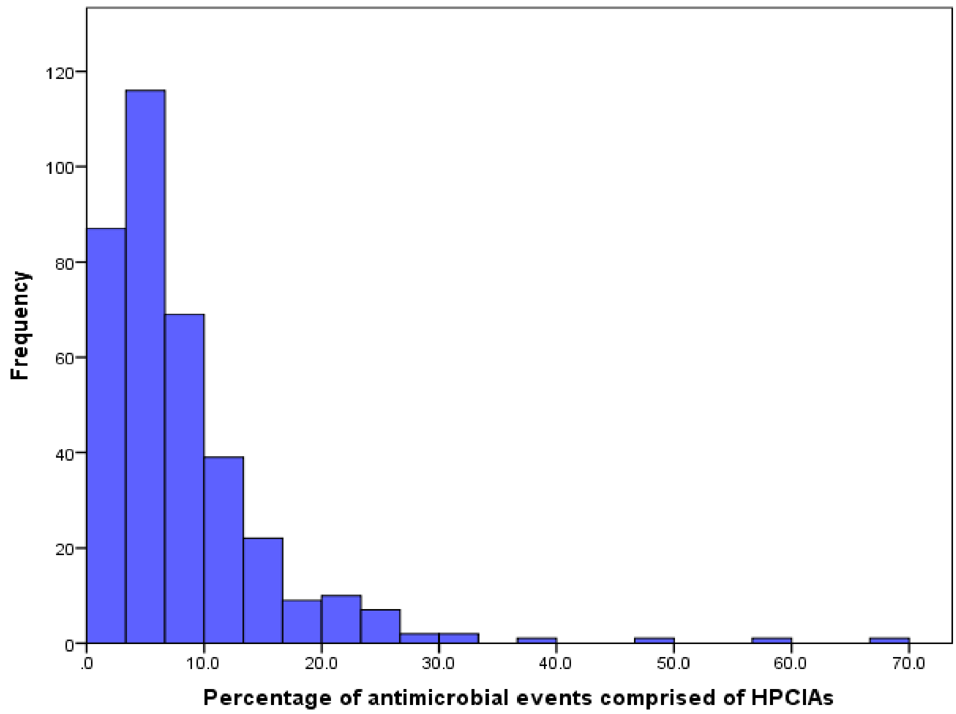


Figure 5.2: The distribution of the percentage of antimicrobial events comprising of highest priority critically important antimicrobials by clinic in a UK VetCompass™ dataset 2012–2014 (n = 367).

[HPCIA: Highest priority critical important antimicrobial].

5.1.2. Hierarchical modelling results

All variables met the univariable screening criterion for inclusion in the multivariable model building stage ($p < 0.25$). At this point, dog sex was not statistically significant and, therefore, the models comprised of clinic and dog as random effects, and corporate veterinary group, age quartile, breed, and clinic region as fixed effects.

Table 5.3 reports the main model (model 1) results. The odds ratio (OR) of an antimicrobial event comprising of a HPCIA was statistically significantly different between veterinary groups ($p < 0.001$) and was positively associated with increasing quartiles of age. Compared to the south east, the OR of an antimicrobial event comprising of a HPCIA was statistically significantly reduced in Scotland (OR: 0.26, 95 CI: 0.14–0.49) and the north west (OR: 0.47, 95% CI: 0.30–0.73). There was no further statistically significantly differences geographically and these results are presented visually in Figure 5.3. The nine breeds with the greatest OR of an HPCIA event were classified as ‘small’ (Table 5.3) (KC, 2020a).

Table 5.3: The results of the main hierarchical model (model 1) investigating HPCIA events in a UK VetCompass™ dataset of antimicrobial events 2012–2014 (n = 458,599)

Variable		No. (%)	Odds of HPCIA Exposure (95% CI)	p-value
Vet. group	B	146,802 (32.0)	1.00	<0.0001
	A	25,417 (5.5)	7.34 (5.14–10.49)	
	C	286,380 (62.4)	2.04 (1.56–2.70)	
Age quartile	<1.5 years	113,060 (24.7)	1.00	<0.0001
	1.5 to <4.3 years	116,388 (25.4)	2.12 (1.97–2.29)	
	4.3 to <8.2 years	113,029 (24.6)	2.95 (2.73–3.18)	
	8.2 years and over	116,122 (25.3)	5.02 (4.64–5.43)	
Clinic region	South East	78,224 (17.1)	1.00	0.0017
	Scotland	18,765 (4.1)	0.26 (0.14–0.49)	
	Northern Ireland	5,567 (1.2)	0.41 (0.17–1.01)	
	North West	45,192 (9.9)	0.47 (0.30–0.73)	
	North East	42,324 (9.2)	0.69 (0.41–1.14)	
	West Midlands	46,924 (10.2)	0.71 (0.45–1.11)	
	East Midlands	54,458 (11.9)	0.71 (0.45–1.11)	
	Greater London	41,402 (9.0)	0.74 (0.49–1.11)	
	East of England	65,092 (14.2)	0.80 (0.55–1.16)	
	South West	45,011 (9.8)	0.88 (0.59–1.40)	
	Channel Islands	926 (0.2)	0.98 (0.14–6.80)	
	Wales	14,714 (3.2)	1.02 (0.53–1.96)	

No.: Number; HPCIA: Highest priority critical important antimicrobial; CI: Confidence interval

Table 5.3 (cont.): The results of the main hierarchical model (model 1) investigating HPCIA events in a UK VetCompassTM dataset of antimicrobial events 2012–2014 (n = 458,599)

Variable		No. (%)	Odds of HPCIA Exposure (95% CI)	p-value
Breed	Crossbreed	94,069 (20.5)	1.00	< 0.0001
	Staffordshire bull terrier	27,753 (6.1)	0.74 (0.65–0.84)	
	Border collie	10,330 (2.3)	0.83 (0.68–1.01)	
	Rottweiler	5,947 (1.3)	0.95 (0.74–1.23)	
	Labrador retriever	35,097 (7.7)	0.96 (0.86–1.08)	
	German shepherd dog	14,686 (3.2)	1.03 (0.87–1.22)	
	Golden retriever	7,350 (1.6)	1.04 (0.84–1.30)	
	Springer spaniel	7,708 (1.7)	1.22 (0.98–1.51)	
	Jack Russell	22,303 (4.9)	1.28 (1.13–1.45)	
	English springer spaniel	6,228 (1.4)	1.39 (1.11–1.74)	
	Boxer	9,463 (2.1)	1.48 (1.22–1.79)	
	All other pure breeds	107,008 (23.3)	1.55 (1.43–1.68)	
	Border terrier	5,234 (1.1)	1.70 (1.34–2.15)	
	Cavalier King Charles spaniel	11,941 (2.6)	1.85 (1.57–2.18)	
	Cocker spaniel	19,289 (4.2)	1.98 (1.73–2.26)	
	Bichon fries	7,611 (1.7)	2.09 (1.72–2.54)	
	Lhasa apso	6,490 (1.4)	2.31 (1.89–2.84)	
	West highland terrier	18,115 (4.0)	2.47 (2.17–2.81)	
	Shih tzu	12,618 (2.8)	2.61 (2.24–3.03)	
	Yorkshire terrier	14,634 (3.2)	2.83 (2.47–3.23)	
	Pug	5,849 (1.3)	3.12 (2.52–3.86)	
	Chihuahua	8,836 (1.9)	3.31 (2.80–3.92)	

No.: Number; HPCIA: Highest priority critical important antimicrobial; CI: Confidence interval

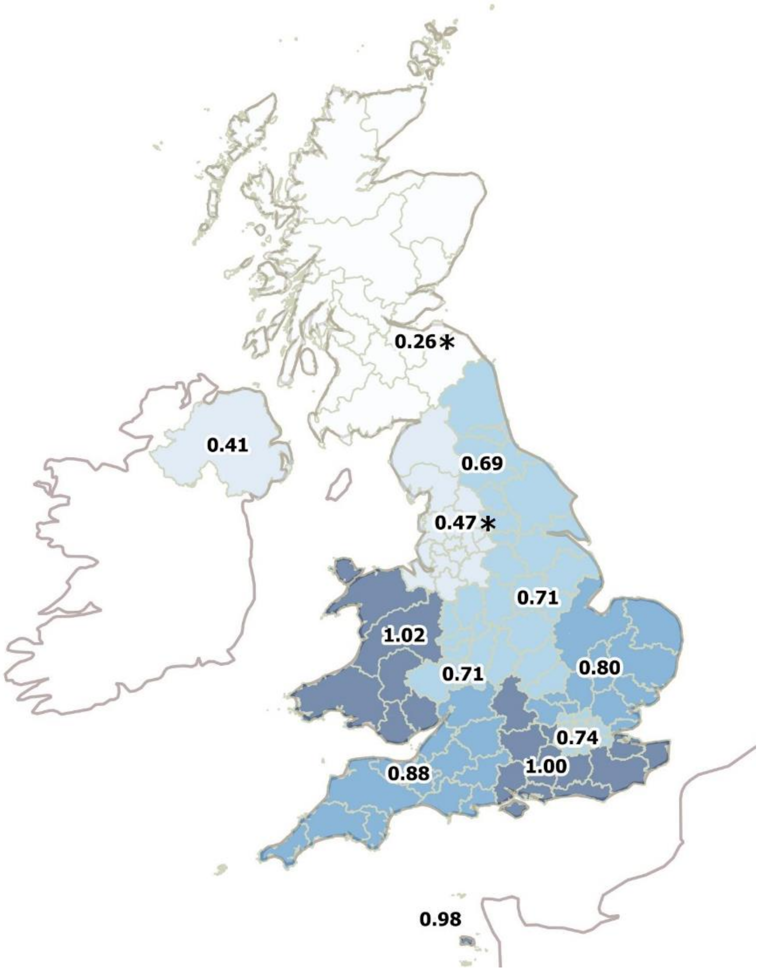


Figure 5.3: The odds ratio of an antimicrobial event comprising of a highest priority critically important antimicrobial by clinic region based on the main hierarchical model (model 1) using a UK VetCompass^{TM} dataset of antimicrobial events from 2012 - 2014 (n = 458,599).
[* = statistically significant at a p< 0.05 level compared to the reference region (South East)].

The area under the ROC for the main model (model 1) was 0.983 (95% CI: 0.983–0.984) and the Hosmer–Lemeshow test was non-significant (p = 0.314) suggesting an acceptable model fit. When dog identity number was removed as a random effect from the main model (model 1), the area under the ROC fell to 0.712 (95% CI: 0.709–0.715, Hosmer–Lemeshow p-value 0.231) suggesting that the information contained with dog identity number variable makes a sizeable contribution to the model's performance.

Comparison of the ICCs in the main model (model 1) suggests HPCIA use is more strongly clustered within a dog (0.710, 95% CI: 0.710–0.719) than within a clinic (0.089, 95% CI: 0.076–0.104). These estimates were broadly similar across the models 1 to 3 (Table 5.4). The removal of veterinary group identity number from the main model (model 1) increased the clinic level ICC only slightly to 0.118 (95% CI: 0.102–0.136).

Table 5.4: Intraclass correlation (ICC) estimates of an antimicrobial event comprising of an HPCIA within individual i) dogs and ii) clinics events in a UK VetCompass™ dataset of antimicrobial events 2012–2014

Model	No. AM events	Dogs nested within clinics		Clinic	
		ICC (95% CI)	Standard error	ICC (95% CI)	Standard error
Model 1: Main model—all events	458,599	0.710 (0.701–0.719)	0.004	0.089 (0.076–0.104)	0.007
Model 2: Dogs with multiple events only	324,315	0.727 (0.718–0.735)	0.005	0.086 (0.073–0.101)	0.007
Model 3: Any use of HPCIA measured at a dog level[a]	-	-	-	0.105 (0.089–0.123)	0.009

[a]n = 234,539

No: Number; AM: Antimicrobial; ICC: Intraclass correlation; CI: Confidence interval; HPCIA: Highest priority critically important antimicrobial.

5.2. Implications for care and antimicrobial use

Based on a large VetCompass™ dataset, the study quantified the variation in the percentage of antimicrobial events comprising of HPCIAs between clinics and three different veterinary groups. It also identified that relative HPCIA utilisation was more strongly clustered within dogs than within clinics.

The main hierarchical model suggests that the cost influences antimicrobial choice: the odds of an antimicrobial event comprising of a relatively costly HPCIA were higher in low-weight breeds in which smaller—less expensive—doses are indicated. Singleton et al. (2020) also observed that the odds of a consultation resulting in the prescription of a systemic HPCIA were greatest in toy breeds. In the future, a minimum price could be applied to a HPCIA dispensing event, deterring their use in smaller dog breeds. Recognising that companion animal veterinarians make decisions based on more than clinical factors alone is important when considering how to alter antimicrobial use.

The model also revealed that the odds of an antimicrobial event comprising of a HPCIA increased as dogs ages. This could be partially explained by the contraindication for fluoroquinolones in young dogs (Allerton, 2018) or by longitudinal changes in the common conditions treatable using antimicrobials across a dog's life course. Hur et al. (2020) also found that younger dogs (those aged less than one year) received significantly fewer ‘high importance’ antimicrobials per 1,000 consultations compared to dogs aged older than one year ($p < 0.0001$).

The model findings perhaps indicate an increasing north-south gradient in the odds of an antimicrobial event comprising of a HPCIA (Figure 5.3). However, the database was largely derived from clinics in southern England and, therefore, the estimates produced for elsewhere in the UK lack precision. A more geographically diffuse dataset would have been able to detect smaller differences and confirm—or rule out—the possible north-south gradient.

The study estimated that the odds of an antimicrobial event comprising a HPCIA was more tightly clustered at a dog level, perhaps reflecting their deployment in dogs with ongoing conditions receiving veterinary care. Less clustering was calculated at a clinic level suggesting that companion animal veterinarians working in the same clinic do not automatically share ways of working with antimicrobials. This limited clustering was also seen in work by Singleton et al. (2017) where clinic premises explained little of the variance reported in antimicrobial use.

The percentage of antimicrobial dispensing events comprising of HPCIAs varied widely between veterinary groups largely due to variation in fluoroquinolone use. At a clinic level, a skewed distribution was observed. In the Dutch livestock sector, when defined daily antimicrobial dose per animal was plotted by farm a similarly skewed pattern was noted (Bos et al., 2015). The Netherlands Veterinary Medicines Authority used this as a basis to benchmark establishments and require that any above the 75th percentile—an arbitrary threshold—worked with their veterinarian to reduce their antimicrobial use. A similar approach could be adopted in the companion animal veterinary sector to tackle the ‘long tail’ of clinics using a higher proportion of HPCIAs. However, careful attention should be paid to the selection of any future benchmarking metric: for example, a clinic may have a high percentage of antimicrobial events comprising of HPCIAs despite a relatively small denominator (total antimicrobial events), thus masking a limited frequency of HPCIA events. Alternatively, veterinarians might be careful users of HPCIAs but frequently prescribe non-HPCIAs, that also contribute to the development of the antimicrobial resistance. Future benchmarking could account for both absolute as well as relative usage of antimicrobials overall, as well as HPCIAs.

From the anonymised clinical data shared with VetCompass^{TM}, it was not possible to quantify the clustering of HPCIA use at an individual veterinarian level or include the influence of owner characteristics. This highlights a limitation of using an Electronic Patient Record (EPR) derived dataset, a system that was designed predominantly to record the clinical and administrative details of companion animals and their owners, rather than a specifically designed epidemiological research tool. Future studies could quantitatively investigate these factors.

This chapter has provided a solid footing to this investigation aiming to understanding antimicrobial use in companion animals. The subsequent results chapters seek to build on the findings presented here by utilising the rich and in-depth insight offered by ethnographic fieldwork and documentary analysis. Chapter 6 concentrates on the context and supporting infrastructures in which front-line actors make decisions regarding antimicrobial use.

Chapter 6 Thinking beyond the individual: the veterinary-industrial complex

'In the face of . . . temptations, how can small animal veterinarians resist the siren call of the antibiotic prescription?'

Fergus Allerton

Lead of the PROTECT-ME initiative promoting rational antimicrobial use in companion animals (Allerton and Jeffery, 2020)

6.0. Introduction

Most research into antimicrobial use in companion animals conducted to date has focused on the moment of prescribing and the individuals involved. As described in Chapter 2, existing efforts to explain patterns of antimicrobial use have largely relied on companion animal veterinarian reported data collected via quantitative surveys or through interview studies. Most studies have framed antimicrobial use as the result of an individual's behaviour which has caused the structural factors supporting their use to be obscured. Therefore, the aim of this chapter is to shift our attention upstream and render visible aspects of the infrastructure (Chandler, 2019) that support current ways of caring with antimicrobials in the companion animal veterinary sector.

This chapter draws on my ethnographic fieldwork together with analysis of documentary materials. Guided by my anthropologically informed approach, I do not seek to blame the individuals involved at the interface of antimicrobial use. For example, rather than unquestioningly reproducing circulating discourses blaming owners or veterinarians 'irrationally' demanding or using antimicrobials (BVA., 2014, Smith et al., 2018), I intend to examine the praxis of the companion animal veterinary sector that fosters the conditions to support these expectations (Buller et al., 2015, Broom et al., 2020). By expanding our gaze, I hope to widen the range of interventions 'on the table' when considering how to alter antimicrobial use in this sector.

As a starting point, I consider the need to charge fees for veterinary advice and medicines, and how this promotes a 'business model of busy-ness'. Using the lens of 'dirty work' (Hughes, 1971), I reflect upon why the financial aspects of companion animal veterinary work are rarely discussed, especially with respect to antimicrobial use. I propose that antimicrobial stewardship—i.e. a range of approaches and interventions seeking to 'optimise' antimicrobial use (Dyar et al., 2017)—requires an inversion to a way of delivering care partly orientated around the provision of medicines and products.

I then move on to explore how the need to protect both animal health and welfare and the fees structures supports a type of care that values resolving problems at the first consultation. This is supported by practices of co-prescribing and veterinary products comprising of multiple active agents, including topical treatments for otitis externa that contain several antimicrobials in their formulation. It anticipates the difficulties busy owner-workers have in attending the clinic on multiple occasions or giving medicines to their companion animals at home. My analysis draws out how this form of care is in tension with a slower, targeted approach advocated when using antimicrobials 'appropriately'.

Next, I consider the role of the veterinary-industrial complex, adapted from the medical-industrial complex observed at play in the primarily private US human healthcare system by Kaufman (2015), and its role in informing 'appropriate' medicines use. I explore the influence of the pharmaceutical sector in shaping the evidence landscape available to veterinarians and owners, and draw upon the theory of trans-biopolitics (Blue and Rock, 2011) to explain the absence of information needed to answer public health questions regarding antimicrobial resistance in the marginal group of companion animals. I describe how veterinarians 'substitute' antimicrobials for new non-antimicrobial products developed by the private sector, a strategy that does not require structural changes to models of care.

Finally, I trace how information about 'appropriate' antimicrobial use is made and remade, through the case study of the third-generation cephalosporin, cefovecin (Convenia®, Zoetis). I consider how 'facts' gain legitimacy as they are disseminated and cited through the scientific literature and veterinary press. I propose that gaps in evidence enable moulding of 'appropriate' antimicrobial use messaging to extend those deemed 'at risk' and to meet the pre-existing goals of pharmaceutical companies.

This chapter highlights the unique set of conditions that companion animal veterinarians work under compared to other clinicians in the UK. In this moment of One Health, translocating interventions from human to veterinary medicine can seem a tempting option when seeking to alter antimicrobial use. During this chapter, I touch upon why using the 'test of time' or 'delayed prescribing' strategies advocated to delay or avoid antimicrobial prescribing in human primary care (Venekamp et al., 2015, Spurling et al., 2017) may have limited traction in this setting.

6.1. 'There's no NHS for pets'

The 'antimicrobial resistance community'—as the constellation of experts, advocates, funders, and multilateral agencies often refer to themselves—is dominated by researchers and policy makers concerned with human health, and is heavily influenced on the global stage by a UK derived agenda (O'Neill, 2016). For example, the UK's Five Years Antimicrobial Resistance Strategy aims not only to address antimicrobial resistance at home but to lead by example on the global stage (UK-Government, 2013). Anthropologists have raised questions about translocating interventions across contexts from Europe to low- and middle-income country settings. The applicability of transposing interventions from human to animal healthcare settings also requires reflecting upon.

When thinking through antimicrobial use, the base-case for many UK researchers and policy makers is the National Health Service (NHS). The infrastructure of this public service, including its materials, staffing, patient-interface, and value system—including costing model—is often invisible; it becomes a taken-for-granted backdrop to policy questions (Bowker and Star, 2000). However, the companion animal veterinary sector is assembled in a markedly different way, and it is important to render visible the ways in which this network functions in the UK.

In the following section, I describe some key differences between human and veterinary medicine in the UK to aid orientation. I propose that the delivery of care via a largely private system that charges fees for access, medicines and other products supports a 'business model of busy-ness'. I draw on the sociological theory of 'dirty work' (Hughes, 1971), to consider how this adds further complexity to owner–veterinarian relationships, and makes it difficult for the veterinary profession to openly discuss these factors with regard to antimicrobial use. I also describe how access fees and medicines sales encourage a 'covering multiple bases' approach to care that strives to get things sorted at the first clinic visit; an approach that could be considered in tension with targeted approaches advocated when using antimicrobials 'appropriately'. For example, the deployment of culture and sensitivity testing, as advocated by antimicrobial stewardship schemes, introduces time delays, additional consultations, and extra fees.

6.1.1. Fees structures

In the UK, the vast majority of human healthcare is provided for free at the point of access via the NHS. Under this system, citizens are taxed and make National Insurance contributions instead of being presented with a bill for the healthcare costs they incur (Hobson-West and

Timmons, 2016). As a consequence, users remain shielded from directly experiencing the financial burden of their care, naïve to its monetary costs and how quickly these can accrue.

As described in Chapters 1 and 4, most of companion animal veterinary care is delivered by private providers, with increasing numbers of clinics operated by large corporate veterinary groups. A routine appointment with a companion animal veterinarian costs approximately £40 and is usually scheduled for 15 minutes (Corah et al., 2019). This fee covers the veterinarian taking a history from the owner, undertaking a physical examination of the companion animal, the veterinarian's expert opinion and treatment plan. The supply of medicines—such as antimicrobials—are subject to further charges. In theory, additional procedures incur further costs even if conducted within the time limits of the consultation. Out-of-hours (emergency) consultations are subject to higher fees—around £140—reflecting the increased costs of hiring staff to work these unsocial shifts. Emergency veterinary covers usually runs from 7pm on weekday evenings until 9am the next morning. At the weekend, routine consultations are typically available on Saturday morning with the out-of-hours team staffing the clinic from Saturday lunchtime until 9am on Monday. This care is usually centralised with one clinic contracted to provide the service for a number of surrounding clinics.

In the interview extract below, Jenny described how consultation fees created expectation amongst owners:

'I think that's where the complaints come from . . . It's not specific to antibiotics, it is that people like to feel something tangible. They come away, they spent thirty, thirty-five, forty pounds on a consultation and, genuinely, the complaints I have had have been, "She only looked at my dog, she didn't give me anything. I'm not paying for that" . . . people would complain because they didn't see the value in your time. People don't really, from my experience, seek antibiotics.'

Jenny, area manager veterinarian, clinic two

Meanwhile, Chloe reported how out-of-hours fees and fears of being negatively compared to her peers led her to prescribe antimicrobials in a case of canine diarrhoea:

'The owner came in on a Saturday afternoon so obviously there was a surcharge and I did a clinical exam and the dog was absolutely fine, it was eating, doing well and the owner had probiotics at home and I, sort of, said, "Well if there's only a tiny amount of blood [in the diarrhoea] and he's bright then I don't think there's any indication for antibiotics" . . . But quite

early on in the conversation the owner said he wanted antibiotics, 'He's had antibiotics before and they've really helped' And I, sort of, pushed a little bit but I just supplied them in the end, which isn't ideal . . . but he's been in with the surcharge, if he has to come in again and the next vet gives him antibiotics and fixes him then, you know, they are going to have a problem with me . . . I mean that's very rare that that happens.'

Chloe, salaried veterinarian, clinic two

My fieldwork revealed that veterinarians are adept at tinkering (Mol et al., 2010) with the fees they charge, for example, by waiving the £15 cost of clipping a dog's claws as a goodwill gesture towards their clients. The practices surrounding 'appropriate' billing illustrate how front-line veterinarians juggle caring for companion animals, their owners, themselves, and the clinic. Shielding owners from the full cost of their companion animal's care can help avoid distressing arguments over affordability or accusations of profiteering, but they can, ultimately, threaten the sustainability of the clinic.

There is less room for flexibility when it comes to charging for procedures that use consumables—such as point of care testing to check for elevated white blood cell levels indicative of an infection—or external suppliers—such as sending away samples for microbiological culture and sensitivity testing at a veterinary laboratory. The latter costs in the region of £70 which is passed onto the client. Owner reluctance or inability to pay is considered to be a key obstacle in improving rates of culture and sensitivity testing to inform the deployment of antimicrobials in companion animals (Fowler et al., 2016, Jessen et al., 2017). It is a barrier that has not had to be addressed in the NHS, where the cost is not passed onto consumers of healthcare.

A routine, follow-up consultation for the same condition has a reduced fee (around £30), the rationale being that the history-taking only needs to cover the period since the animal was last seen. This implies that there is continuity of care (i.e. that the same veterinarian sees you for both consultations). However, changes to the nature of veterinary work have undermined this assumption. These include veterinary clinics opening for extended periods in a bid to attract clients—especially those working full time—away from their rival clinics, and to retain them. This means it is not possible for the same veterinarian to be present across all the opening hours. Moreover, increasing numbers of veterinarians are working part-time due to family commitments and/or to improve their work–life balance, rising from 11% in 2000 to 23% in 2019 (Robinson et al., 2020). Finally, in some staffing models, veterinarians work across multiple clinics within the same corporate group. In these situations, the clinical notes recorded on the

PMS are a crucial resource for the consulting veterinarians. The process of distilling episodes of care into written accounts is slower for newly qualified veterinarians, and especially those from the EU who had recently arrived in the UK. In addition to 'working out' how to enact their veterinary training, they have the additional burden of communicating their endeavours in English.

The consultation fees charged are the same for all veterinarians working in a first opinion veterinary clinic. This is unlike other professions, e.g. hairdressers or solicitors, whose fees rise depending on their experience and rank within their organisation. By treating all veterinarians as a standardised unit, the fees structure could therefore be acting to 'de-value' expertise accrued over time. It also places pressure on recent graduates by implying a consultation with them is equivalent to one with their more experienced colleagues. Veterinarians acting as clinic mentors confided that they try to reassure new graduates that they are worth the consultation fee:

'I tell them their opinion's enough . . . that they don't always have to prescribe something'

Anna, salaried veterinarian, clinic two

Conversely, when asked in interview if she had ever felt under pressure to prescribe antimicrobials by owners, recent graduate Monika replied:

'I wasn't really in the beginning, but then I was made of aware by Peter [the senior veterinarian] that people expect to be given something when they come here.'

Monika, intern veterinarian, clinic one

In such situations, providing access to prescription-only medicines could act as a means by which to solidify their nascent professional standing and align themselves with the prevailing clinic praxis regarding medicines use. This is an example of the social efficacy of medicines, i.e. how medicines can be deployed for their effects on social relations (Reynolds Whyte et al., 2007). By not recognising empirical experience, the fee structure in companion animal medicine foregrounds the role of the veterinarian as a gatekeeper to pharmaceuticals, a framing that equates care with access to medicines (Denyer Willis and Chandler, 2019).

6.1.2. Sales income sustaining the clinic

As in humans, antimicrobials for veterinary use are prescription-only medicines and are not available for over-the counter sales (RCVS, 2020b). They can only be prescribed by a registered veterinarian, who must first carry out a clinical assessment of the companion animal (RCVS, 2020b). Unlike UK human primary care, where regulations mean that most dispensing—providing the drug or medicine as written on a prescription—is undertaken at a community pharmacy and by a pharmacist, veterinarians often dispense the medicines they prescribe. The role of the pharmacist—who often forms an integral part of antimicrobial stewardship teams in human medicine (Charani and Holmes, 2019)—does not commonly exist in first opinion veterinary clinics. Veterinarians can provide prescriptions to be dispensed through online veterinary pharmacies following a consultation and for a fee (about £15 on top of the appointment charge).

Medicines sales are an important source of income for companion animal veterinary clinics with business models suggesting they should account for around 30% of clinic income, although it is difficult to find references for these commercially sensitive 'recipes'. In recent years, Internet veterinary pharmacies and, to a lesser extent, antimicrobial stewardship messaging have challenged this income (Bellini, 2020), which is essential for clinic sustainability. Clinics purchase medicines from wholesalers, adding a margin (in the region of 100%) before selling them onto owners. Mark-ups are higher on treatments for acute conditions as owners have less opportunity to 'shop around' for better offers. Episodes of ill health, therefore, offer commercial opportunities.

Renumeration structures support a 'business model of busy-ness'. Partners in veterinary businesses take home a share of the clinic profits whilst salaried veterinarians can receive financial bonuses for achieving clinic or personal turnover targets. Conversely, if employed veterinarians underperform, they experience additional scrutiny from clinic management. In general, the charging of fees for services and products provided combined with renumeration structures means that veterinarians are not penalised for 'over-using' medicines. In such a context, veterinarians might be nudged (Thaler and Sunstein, 2009) into dispensing a product, such as an antimicrobial, if they are 'on the fence' about the best course of action. Antimicrobial stewardship initiatives with their messages of 'appropriate' use ask veterinarians to invert this way of practising veterinary medicine and handle antimicrobials in a different manner to other products.

The potential conflict of interest between the prescription of antimicrobials for companion animal use and profiting from their dispensing was noted back in 2006 (Grave and Wegener, 2006). At the time, Grave and Wegener proposed separating these functions citing reduced antimicrobial use in Asia following the restructuring of human healthcare systems there. UK evidence about this conflict of interest is limited to the human sector: a recent cross-sectional study found that general practitioners working in English clinics with in-house dispensaries prescribed more expensive drugs that those based in clinics without such facilities (Goldacre et al., 2019).

Attempts to limit veterinarians' ability to sell antimicrobials have been strongly resisted by groups representing the profession. In 2011, the European Parliament's agricultural committee considered a proposal to restrict veterinarians from selling medicines directly to farmers and other animal owners in non-acute cases (Anonymous, 2011b). The FVE rejected the amendment on the grounds that it would put many veterinary clinics at risk with little proven benefits (Anonymous, 2011b). When the amendment failed to pass, the BVA President at the time was quoted as saying, 'Restricting the ability of vets to supply medicines would have little benefit but would cause significant harm to animal health and welfare' (Anonymous, 2011b). Similarly, a more recent interview study found that UK companion animals veterinarians had mixed views about decoupling of antimicrobial prescribing and dispensing, with some citing concerns about the impact on animal welfare and professional autonomy (King et al., 2018). Meanwhile, it was the least popular option to support 'responsible' use of antimicrobials when a sample of Dutch companion animal veterinarians were surveyed (Hopman et al., 2019a). These responses illustrate how the endeavours of caring for companion animals and caring for the clinic are entwined.

6.1.3. The dirty work of talking about money

In the almost 15 years since Grave and Wegener (2006) encouraged the provision of evidence to contradict their claim that profit leads to overprescribing of antimicrobials, no such information has been forthcoming. Here I turn to the sociological concept of 'dirty work' to explore why veterinarians, as a profession, are reluctant to publicly engage with the role medicines sales have in sustaining their clinics when discussing foci for antimicrobial stewardship schemes.

Dirty work—a form of stigma—describes jobs that, although socially important, have physical, social, and moral taints (Hughes, 1971). Ethnographer Lindsay Hamilton (2007) writes vividly of the work of cattle veterinarians and their daily, visceral encounters with muck. However, she argues that farm animal veterinarians avoid the stigma traditionally associated with this form of dirty work, instead using 'their right to bear muck' (Hamilton, 2007, p. 495) as a status symbol over their unsoiled administrative staff. Hamilton's farm veterinarian informants also emphasized how different they were from their companion animal counterparts. For them, 'the ambiguous signs of muck and blood became a badge of courage for physical masculine heroism. By contrast, however, small animal veterinarians are portrayed as effete "dandies" masquerading to conceal the blood, muck and bad smells welling up from behind the scenes' (p. 495). In a US mixed-practice veterinary hospital, Sanders (2010) explored how veterinary technicians (nurses) managed the personal toll of undertaking dirty work. In addition to the embodied experiences of dealing with body fluids, faeces, etc., Sanders identified emotional dirty work, in particular that associated with euthanasia, saying, 'The centrality of sickness, death, and sadness to the job was well known to the vet techs' friends, family members, and acquaintances . . . technicians observed that their job did prompt associates to sometimes ask some version of "How can you do that?"' (Sanders, 2010, p. 257). This was a question that rolled over in my mind as I drove home from long days at my fieldwork sites.

It has been proposed that, by simply working with animals, veterinary work is peripheralized and rendered dirty compared to the noble profession of medicine (Carbone, 2004). Veterinarians' inability to separate themselves from business models acts to marginalise them further from other professional groups: 'the veterinarian's role can feel at times closer to an auto mechanic . . . [they] must negotiate the type of services they can provide and perhaps even haggle over the cost of services, something physicians rarely do' (Morris, 2009, p. 38). Moreover, I suggest that profiting from medicines provided to ease animal suffering could be construed as morally dubious and therefore 'dirty work'. The internal conflict between fulfilling a vocation to care for animals within the context of a business model can exacerbate the emotional burden of those working in the companion animal veterinary sector, as described by Sanders (2010).

During my fieldwork, I observed how veterinarians distanced themselves from this form of dirty work when interacting with owners, if possible. For example, the PMS enabled them to communicate the costs accumulated during a consultation to the receptionist, who then handled receiving the cash or processing the card payment from the owner. The clinics also had copies of the BVA leaflet produced for when its members were faced with owners unhappy about their bill (BVA., 2013b). It describes how, 'veterinary practices have to run *like* a business' (emphasis added). More generally, the multiple fly-on-the-wall television series following veterinarians at work rarely include caring for the clinic or the financial considerations in their socially acceptable representations of the role. Beyond distancing, another coping strategy for professions undertaking dirty work is to develop a strong collective identity in response to 'doubters' (Ashforth and Kreiner, 1999). Therefore, using the lens of dirty work may shed further light on the complex relationship between veterinarians and companion animal owners described in Chapter 4 and further reflected upon in Chapter 9.

6.1.4. Implications for care and antimicrobial stewardship

The idea that selling medicines constitutes dirty work goes some way towards explaining why it has been problematic for the companion animal veterinary sector to openly consider altering this potential pressure to dispense antimicrobials. The effect of intervening to remove the mark-up added to the price of antimicrobials when sold on to owners has not been evaluated; however, it may be construed as too great a threat to clinic stability in these precarious times to be widely considered. Another option would be to remove antimicrobial sales from contributing towards achieving clinic or veterinarian turnover targets, which make up parts of renumeration packages, with the targets revised downwards accordingly. A similar initiative has been voluntarily introduced by some pharmaceutical companies for their employees who sell human antimicrobials (AMF., 2020).

Such an intervention would be relatively easy to implement in clinic and evaluate using the PMS. It could confirm the existing—socially desirable—survey findings from veterinarians that clinic finances do not influence their antimicrobial dispensing (De Briyne et al., 2013) and could help reassure owners in this regard. A limitation to this approach may be that it affects salaried veterinarians and clinic partners differentially, further complicating workplace hierarchies in difficult conditions. Moreover, any intervention of this nature would also require careful monitoring to ensure that 'over-prescribing' does not shift to other groups of medicines that continue to contribute to turnover targets.

6.2. Getting things sorted the first time

In this section, I move on from describing the fees structure to consider how it supports a 'system' of care orientated towards prompt intervention that, ideally, resolves problems via a single veterinary consultation. For example, when asked if he experienced pressure to prescribe antimicrobials by owners, Zac explained:

'From older generation clients, traditionally antibiotic use was much more and they are used to it and they request sometimes. It's only a few for the past few years that actually insisted on, not threaten, but they say "I want to use antibiotics because last time it helped. Why would we waste time?" It's again mostly money and people just wanting make sure that they don't have to come back again. It's just in case.'

Zac, senior veterinarian, clinic two

This necessity to quickly intervene is highly understandable—the first consideration of a veterinarian must be towards animal health and welfare, as set out by the profession's code of conduct (RCVS, 2020b). Front-line veterinarians are adept at managing immediate and future risks to companion animal's health through proactive approaches, for example, the traditional use of prophylactic perioperative use of antimicrobials in companion animals (Hughes et al., 2012). However, this model of acting swiftly and covering multiple possible causes of ill health can be in tension with the slower and more focused approach advocated by antimicrobial stewardship messaging.

6.2.1. The role of fees in shaping strategies of care

Consultation fees directly affect the care-seeking practices of companion animal owners. When money is tight, fees act as a barrier to accessing timely professional veterinary advice, meaning that companion animals may be sicker when presenting at the clinic. In other cases, they may prevent owners coming back for a follow-up appointment, especially if the condition of the animal has improved. Amidst uncertainty regarding if, or when, a companion animal will return, veterinarians are under an imperative to act then and there to protect animal health and welfare. Dealing with the immediate and tangible risk to individual health, perhaps by using antimicrobials, is in contrast to public health messaging around delayed or reduced antimicrobial use due to the nebulous, global risk of antimicrobial resistance (Tonkin-Crine et al., 2015).

The higher charges for out-of-hours care create peaks and trough in demand, for example, Monday mornings can be particularly busy as owners who have delayed seeking care over the weekend for their companion animal make contact. Likewise, veterinarians consulting on Fridays weave into their treatment plans strategies to help protect their clients from having to make costly visits over the weekend. One such tactic is to dispense antimicrobials 'just in case' to reduce the risk of the animal's condition deteriorating before routine consulting resumes on Monday morning. The fieldnotes extract illustrates this and hints at issues around time that I will discuss later in the chapter.

Fieldnotes extract: Clinic one

It's Friday evening and I'm in the prep room of the clinic. My feet are aching after a day spent observing and my mind wanders to my weekend plans. The nursing team are busy cleaning and undertaking their end-of-day routine ready for the clinic to close promptly at 7pm. They go around turning off lights in vacated rooms and switching off equipment such as the X-ray machine.

Veterinarian Helen is seeing the last few patients of the late afternoon clinic. She brings through a syringe with a sample of cells she has aspirated from a soft mass on a dog's jaw. She turns the microscope back on and prepares a microscopy slide of the sample. As she waits for the cytological stain to take effect, I tentatively ask, 'A penny for your thoughts?'.

Helen sighs, 'I'm just thinking about what to do if it's an abscess cos it's ten to seven on a Friday.' The nurses hover in the background—one has already put her coat on.

Typically, abscesses are lanced, drained and repeatedly flushed with saline to remove the purulent material that contains bacteria. As Jenny, a nurse, explained to me earlier in the week, 'Flush, flush, flush . . . the solution to pollution is dilution.' By removing the bacteria and the source of the infection, antibiotics were no longer deemed as always necessary. This procedure, however, requires time and several staff to restrain and sedate the companion animal in order to carry out the multiple steps. Whilst the clinic is open over the weekend for consultations, non-emergency procedures are not conducted due to reduced staffing levels. Therefore, re-booking the dog in over the weekend, when there was more time, was not an option.

Helen explains that, using the microscope she can see neutrophils, a type of white blood cell that forms part of the immune response. This indicates it is a pus-filled abscess and her plan is to prescribe Synulox® (a widely used, broad action combination of amoxicillin, a beta-lactam antibiotic, and potassium clavulanate, a beta-lactamase inhibitor). Her eyes glance at the clock as she hurries back into the consulting room. She says over her shoulder,

'We'll see how that goes and if it needs lancing next week.'

6.2.2 Covering multiple bases

Previous research into antimicrobial use by companion animal veterinarians has found that broad spectrum agents are widely used (Buckland et al., 2016, Singleton et al., 2017) despite calls for a targeted approach that 'matches the right drug to the right bug' (BVA., 2015a). By adopting this approach, veterinarians seek to maximise the chances of microbes being susceptible to their initial choice of antimicrobial amidst uncertainty surrounding whether the owner is able or willing to afford diagnostic testing or to return for a follow-up consultation if treatment is unsuccessful. I call this approach ‘covering multiple bases’.

Another means by which to manage this risk and handle diagnostic uncertainty is co-prescribing—dispensing multiple prescription medicines during a single visit. A large-scale epidemiological analysis quantified that co-prescription occurs in around 40% of UK companion animal consultations (Singleton et al., 2018). Their finding that the pairing of anti-inflammatories with antimicrobials was the most common combination concurs with my observations. Versions of, ‘Here’s something to ease your pet’s symptoms and something for any underlying infection’ were heard repeatedly. In this way, veterinarians were able to improve the animal’s immediate wellbeing, target a possible cause of the episode of ill health and/or reduce the risk of a secondary infection that the animal may succumb to in its weakened state.

Veterinary pharmaceutical companies also respond to demand for covering multiple bases by supplying single products that contain multiple active ingredients, for example, Dechra’s Canaural® ear drops for the treatment of otitis externa. This is an inflammatory disease of the external ear canal that leads to increases in wax production, local humidity, and pH—conditions conducive to painful overgrowths of bacteria and/or yeast or ear mites (Bajwa, 2019). Canaural® contains fusidic acid (an antibiotic active against *Staphylococci,* the most common bacteria pathogen in canine otitis externa); framycetin sulphate (a broad-spectrum antibiotic active against Gram negative organisms such as *Pseudomonas* spp. and *Proteus* spp.*),* nystatin (active against yeast), and prednisolone (a steroid anti-inflammatory for symptomatic relief) (NOAH, 2012). This convenient product, with its easy-to-use dropper, is popular with veterinarians and owners, but its multiple antimicrobial properties sit uneasily with stewardship messaging. It should be noted that Canaural® is a topical treatment and therefore the gut flora are not exposed to its antimicrobial effects, a major concern in the development and spread of antimicrobial resistance (Mateus et al., 2011). However, the use of topical antimicrobials in companion animals, especially for recurrent conditions, may be risky given the close and tactile nature of their interactions with their owners (Bager et al., 2017).

By deploying this product, veterinarians avoid the need for undertaking in-house cytology, which could enable identification of the overgrowth of the microbe or mite responsible for the infection and a more evidence-based approach to dispensing. As well as exposing their client to an additional cost and time burden spent waiting for the result, undertaking this extra work also has implications for the smooth running of hectic clinics in which veterinarians tend to remain in their consulting room as a succession of companion animals and their owners pass through their door. Preparing cytology slides is a multiple-step process that requires veterinarians to leave their consulting room. It involves staining and allowing drying time before the slides can be examined under the microscope. This work can be undertaken by a trained veterinary nurse but only if they are free to help and not busy with their own scheduled workload. Moreover, by using Canaural®, veterinarians could avoid having to interpret the slide: what if the results are inconclusive? How do you explain to your clients that the testing they have paid for is indeterminate? At one fieldwork site, the small laboratory was located at the far end of a corridor, away from the consulting rooms and the 'prep room' where the nurses worked. Undertaking cytology was not routinely embedded within pathways of care—either mentally or spatially.

6.2.3 Time costs money

Attending the veterinary clinic incurs an opportunity cost for owners, for example by leaving the workplace or other social commitments. Whilst taking time off to accompany your sick human ward to seek healthcare is increasingly tolerated by employers (for those outside of the gig economy, at least), the same cannot yet be said for absence due to more-than-human charges (Lufkin, 2018).

Owners might acquire a companion animal as an antidote to the pressures of modern life, for example, to alleviate feelings of social isolation or promote a better work–life balance. As this self-help guide describes, 'A well-loved pet is part of the family, yet offers somethings that friends and family cannot. They love you unconditionally and show affection without restraint. They can read you better than you can yourself. And they are always honest . . . How easy is it to find a space in our modern lives where empathy, honesty and love are made available?' (Rickard, 2018a, p. 14). Degeling (2009) previously described the 'sentimentalisation' of veterinary care in which companion animals, unlike livestock, are valued for their emotional attachments of their owners, not their productive capabilities. The owner-worker, however, must care for their companion animal around their productive commitments, i.e. work. Therefore, being asked to return to the veterinary clinic on multiple occasions can prove difficult. The use of antimicrobials has been hypothesised as a means by which to maximise workforce productivity amongst humans and livestock (Chandler et al., 2016). Companion animals, although not economic workers, are not immune from this link between productivity and antimicrobial use. The approach by the veterinarian of covering all bases to get things sorted the first time, avoiding multiple visits, can be met with relief by owner-workers. In addition to taking prompt action to restore their companion animal's ill health, the need to take additional time off work is avoided. Promptly deploying antimicrobials could be a facet of this approach.

The fees structure acts as a barrier to veterinarians experimenting with 'new' approaches to managing conditions, for example, by delaying antimicrobial use when appropriate. Owners are financially and temporally penalised if their veterinarian deploys the test of time unsuccessfully and they have to return for an additional consultation to access antimicrobials. This can lead to the professional ability of the veterinarian being questioned and accusations of prolonging episode of care and the animal's episode of ill health in order to accrue more fees. In such situations, it can be more straightforward to provide antimicrobials at the first visit and avoid these difficult encounters.

In terms of feedback loops, fees can deter owners from returning for follow-up consultations to confirm that their companion animal's condition has resolved or if it needs further treatment. In these situations, no news is good news, with veterinarians presuming their existing treatment approach has been successful, further reducing the impetus to try new methods. If they do return, co-prescribing may mean that the successful element of the treatment plan is masked. Furthermore, it remains unclear whether, for certain conditions and given enough time, the animal's immune system alone would have been sufficient to resolve the problem.

6.2.4. The charity veterinary clinic—an inversion

My final fieldwork site (clinic three) was a charity clinic providing free or subsidised veterinary services. The clinic management and staff prided themselves on their (perceived) low antimicrobial use. In this section, I reflect upon the supporting infrastructural arrangements that act as inversions to the context described in the private clinics above.

Hobson-West and Jutel (2020) described the 'complex dance' that takes place in encounters between veterinarians and their fee-paying clients. During the focus group, the veterinarians at clinic three reflected upon how this relationship and the form of the care provided was altered by the charity—rather than the owners—being responsible for meeting its financial cost. Salaried veterinarian Jon described how:

'You do more decision making here as a vet. In my previous job in private practice I would often hand the decisions to the client as to what they wanted to do depending on what cost x, y, and z. Whereas here, if we think something is necessary, we will do it, if we don't think it's necessary we won't do it. Whereas in private practice, I found that sometimes, I would do

things that I thought were unnecessary just because the client wanted to and sometimes, I wasn't able to do what was necessary because they wouldn't be able to afford it.'

Jon, salaried veterinarian, clinic three

This quote alludes to how Mol's logic of choice (2008)—and option listing—is deployed in mainstream companion animal veterinary care. However, decisions are also made within the context of the owner's ability and willingness to pay. In the charity setting, with the owners not 'footing the bill', Jon was able to act in a more patriarchal way—for example, by not offering antimicrobials. Similarly, Beth shared how she handled client requests at the charity clinic:

'I've had quite a few here where they [the owners] are like, "Oh can you not just do a blood test?" . . . Whereas in private practice, if they wanted to do that, then I would say "Of course we can, that's fine . . . this is how much it will cost" But here, you have to say, "if it needs a blood test, of course, then that's fine. But most of those cases, they don't." I would say that "that's something we could think about in the future".'

Beth, salaried veterinarian, clinic three

Here Beth uses a 'parking' technique to defer things to the future. This approach was facilitated by the veterinarians' ability to ask clients to return on multiple occasions, unlike their experiences in the private sector when dealing with busy owner-workers. The clinic's clients were companion animal owners receiving financial support from the government ('benefits') due to having limited income as a consequence of being unemployed, in long-term ill health or retired. They were therefore excused—or rather marginalised—from the prevailing societal model of good citizens being productive workers. As a consequence, the pressure to get things sorted the first time—whilst protecting animal welfare—was lessened.

A lack of time has been cited as a barrier to using antimicrobials appropriately within the companion animal veterinary sector (Eastmure et al., 2019b). However, appointments at the charity clinic were scheduled to last ten minutes, rather than the 15 minutes at my previous two private fieldwork clinics. In the focus group, the veterinarians grimaced when I asked how they fitted everything into this reduced timeframe—*'We don't!'* One enabling technique was the ability to ask clients to return, as described earlier. For example, rather than attempting to take a blood sample within the consultation, the client would be asked to make a follow-up consultation, perhaps with a nurse, for this to be undertaken. Another time-saving technique was to limit the shared decision making undertaken, as described by Jon. Vittorio elaborated further:

'In private practice you really have the time . . . you have a 15-minute slot but you can actually stretch it to 20–25 minutes cos you are not that busy and literally have a very nice conversation with the clients about . . . sometimes even private life, you know, "How are you doing?" And here, you barely have ten minutes, and so you really have to concentrate and go at the core of what you want to say, what you want to discuss.'

Vittorio, salaried veterinarian, clinic three

This quote also alludes to the different environment at the charity clinic, in which efficiency and helping as many animals as possible—more of public health-type approach—was prioritised over creating the atmosphere of the private clinic, where the owners and their companion animals were encouraged to feel like unique and important individuals. The environment within the charity clinic may support an antimicrobial stewardship 'mindset' in which protecting the public good of antimicrobial therapeutic efficacy is prioritised over the immediate gratification of healthcare consumers. Furthermore, the charity clinic was heavily oversubscribed and, rather than seeking to maintain or increase its client base, stringent eligibility checks took place. The fear of clients 'shopping around' for their veterinary care—a proposed barrier to antimicrobial stewardship—was not at play in this setting.

The clinicians working there had a target *maximum* spend limit per animal per year on medicines that they were encouraged not to breach—the opposite to the turnover targets seen in the private clinics. Graphs were circulated comparing the proportion of consultations resulting in antimicrobials use for each veterinarian. These audit results were discussed at one-to-one meetings held between the senior veterinarian and the salaried veterinarians. Higher users—typically those that had recently arrived from private clinics—were encouraged to reduce their usage to that of their colleagues.

Taken together, the relative ease with which veterinarians felt able to recall owners and the support not to dispense medicines, the veterinarians were empowered to 'use the test of time' and 'watchful waiting' instead of immediately prescribing antimicrobials. They confided in me that, at first, it was nerve wracking, but they soon adapted to this way of working. They agreed that all newly qualified veterinarians should spend time working in a charity clinic to learn this approach before going into private practice.

6.2.5. Implications for care and antimicrobial stewardship

The infrastructure described in the above section sheds light on the widely cited 'pressure to prescribe' clients are believed to place veterinarians under (BVA., 2014, Smith et al., 2018). I propose that previous research studying antimicrobial use in isolation has led to this phenomenon being linked to this group of medicines alone. Instead, I suggest that the infrastructure described here encourages the expectation of medicines and veterinary products use of all kinds. It also suggests that the phenomenon is more diffuse and nuanced than currently portrayed, i.e. owners verbally asking for antimicrobials in consultations. I propose that the infrastructure at play tilts pathways of care towards to the natural conclusion of the provision of medicines, often antimicrobials, or other products. Requests are rarely verbalised; instead, the actors involved respond to a number of articulated and unarticulated cues and assumptions that result in antimicrobials being dispensed. For example,

'I assume—whether that be rightly or wrongly—if they are coming in with an infection and they have told reception it's an infection, they are expecting a sort of antibiotic for that. Does that make sense?'

Alison, salaried veterinarian, clinic one

Related to this, due the high public awareness regarding antibiotics, requests for 'antibiotics' may, in fact relate to other, less well-known classes of medicines:

'They very often confuse antibiotics with any injection you give. Everything's an antibiotic. They've been on meloxicam [an anti-inflammatory] for six months, "Can I have some more antibiotic?".'

Esther, senior veterinarian, clinic three

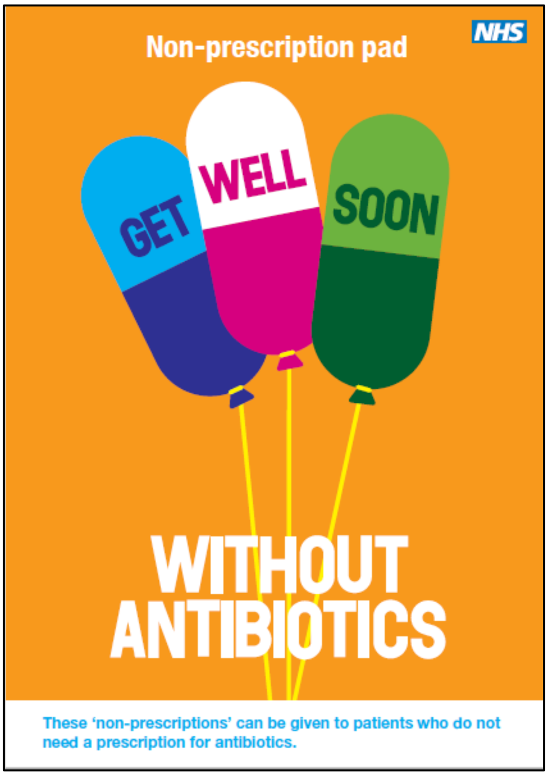
Careful consideration of these pressures can inform stewardship interventions beyond educating and/or shaming 'demanding' and 'ignorant' owners.

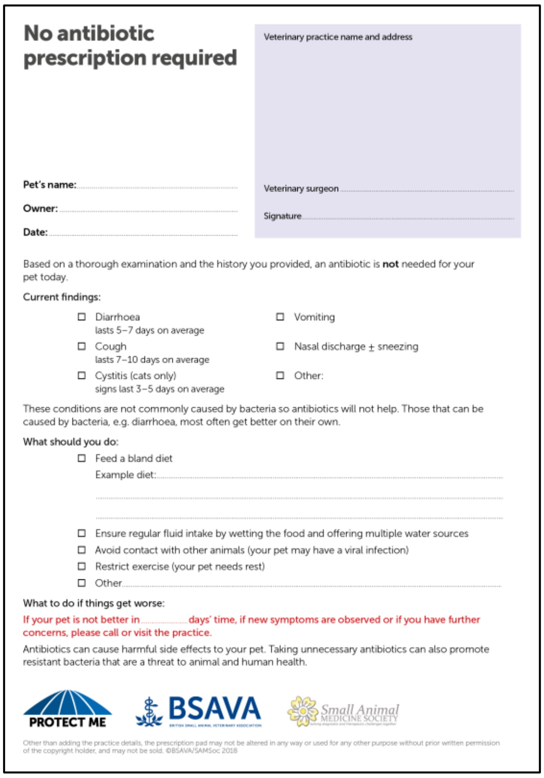
The charity clinic offered an inversion to the ways of working in the private clinics, demonstrating it is possible to practise veterinary medicine in a different way—a slower approach that uses medicines prudently. However, I wonder how transferable this approach is to private clinics with their in-built business models of busyness. Perhaps the global spectre of antimicrobial resistance is another supporting factor towards the foundation of an NHS for companion animals. However, in these neoliberal times—with the role of the state in retreat—

the moment when that might have been at feasible or, indeed, acceptable to the veterinary sector may well have passed (Enticott et al., 2011).

The inversion of the charity clinic—with its shorter appointments and lower antimicrobial use—also suggests that longer appointments alone might not be sufficient to reduce antimicrobial use. With the support of other structural factors, veterinarians working there were able to use antimicrobials in a 'prudent' manner, despite the limited consultation times.

Based on the insights reported in Sections 6.1 and 6.2, I suggest that the translocation of strategies from human primary care to the private companion animal veterinary sector that rely on deploying the test of time or watchful waiting to reduce antimicrobial use may be of limited resonance. Previous research identified that 'wait and see' approaches were unpopular with companion animal owners (Dickson et al., 2019). Recently the 'non-prescription' pad—in which verbal advice is rendered into a physical 'souvenir' of a healthcare consultation that can be substituted into the place of an antimicrobial—have been translocated from the human healthcare setting to the companion animal veterinary sector (Figure 6.1) (Allerton, 2018). Part of the advice includes when to re-consult if the animal's condition does not improve (i.e. watchful waiting). Future research could evaluate its use and popularity amongst companion animal veterinarian and owners. I did not observe its deployment amongst my—limited sample of—fieldwork sites.





No antibiotic prescription required

Veterinary practice name and address

Pet's name:

Owner:

Date:

Veterinary surgeon

Signature

Based on a thorough examination and the history you provided, an antibiotic is **not** needed for your pet today.

Current findings:

- ☐ Diarrhoea lasts 5–7 days on average
- ☐ Cough lasts 7–10 days on average
- ☐ Cystitis (cats only) signs last 3–5 days on average
- ☐ Vomiting
- ☐ Nasal discharge ± sneezing
- ☐ Other:

These conditions are not commonly caused by bacteria so antibiotics will not help. Those that can be caused by bacteria, e.g. diarrhoea, most often get better on their own.

What should you do:

- ☐ Feed a bland diet
  Example diet:
- ☐ Ensure regular fluid intake by wetting the food and offering multiple water sources
- ☐ Avoid contact with other animals (your pet may have a viral infection)
- ☐ Restrict exercise (your pet needs rest)
- ☐ Other

What to do if things get worse:

If your pet is not better in .... days' time, if new symptoms are observed or if you have further concerns, please call or visit the practice.

Antibiotics can cause harmful side effects to your pet. Taking unnecessary antibiotics can also promote resistant bacteria that are a threat to animal and human health.

PROTECT ME   BSAVA   Small Animal Medicine Society

Other than adding the practice details, the prescription pad may not be altered in any way or used for any other purpose without prior written permission of the copyright holder, and may not be sold. ©BSAVA/SAMSoc 2018

Figure 6.1: The non-prescription pads developed in the NHS (left) and by the British Small Animal Veterinary Association (right) to support reduced or delayed antimicrobial use.

In interview, several veterinarians across my fieldwork clinics reported encountering difficult cases of ear infections caused by *Pseudomonas* spp. bacteria which are able to acquire resistance to antimicrobials quickly. In one such instance, Peter described how he:

' . . . put it on first line [antimicrobials], didn't work. I swabbed it, came back with a very profuse growth of Pseudomonas, resistant to most things. Even resistant to enrofloxacin and marbofloxacin. Still had some sensitivity to polymyxin-B and gentamycin . . . so we actually went onto a six-week course of polymyxin-B and then we swabbed, and then it had become resistant to polymyxin-B. But then the new one had shown a sensitivity to marbofloxacin. So, it when onto marbofloxacin and we're waiting now for, a 10-day period after antibiotics to re-swab again'.

Peter, senior veterinarian, clinic one

This case illustrates the time-consuming and multiple consultations required to treat this case. If resistant infections were to become more common, this form of care would be in tension with the current structural arrangements that encourage 'getting things sorted the first time'. Similarly, several veterinarians described the difficulty of fitting diagnostic testing—with the associated time delays and additional costs—into existing models of care. Perhaps the imperative to care for antimicrobials, partly through the increased use of diagnostic testing, will necessitate a rethink regarding the current fee for services, medicines or diagnostic charging model seen in the companion animal veterinary sector.

6.3. The veterinary-industrial complex determining 'appropriate' medicines use

> *'I must admit that I used to use antibiotics much more than now appears it is necessary, but that's how we got taught at in Uni and obviously that was 19 years ago when I graduated so things have changed and there are more studies and improving synthesis but we used to routinely administer them. But now, as you can see yourself, also we are, kind of, a bit more aware and careful, trying to do it in more evidence-based medicine way'*
>
> Zac, senior veterinarian, clinic two

In continuation of my endeavours to extend our gaze beyond the individuals at the interface of antimicrobial use, I now switch my attention to the role of the veterinary pharmaceutical sector. I consider their role in shaping the evidence landscape available to veterinarians and owners, and the sector's influence in defining 'appropriate' use of medicines.

To date, there has been very little social science scrutiny of these entanglements and so I turn to ethnographic studies conducted in US healthcare, another largely private system, for inspiration. The 'medical-industrial complex' Kaufman (2015) observed enfolding patients, their families, and doctors when making healthcare decisions is highly relevant to the UK companion animal veterinary sector. His description of the 'more is always better' approach to medicine (Kauffman, 2015, p. 5), underpinned by the market-expanding goals of the pharmaceutical industry and the increasing array of treatments covered by insurance schemes, also has resonance (Kauffman, 2015). Dumit's (2012) work investigated how the pharmaceutical sector has extended the definitions of those at risk and requiring medicines also strikes a chord.

Whilst the companion animal industry is far smaller than its livestock and human healthcare equivalents, pharmaceutical companies have identified that treatment decisions are often less constrained by 'rational' cost-effectiveness calculations, presenting opportunities for business growth (Horspool, 2013). As the annual report for Dechra (2018), a veterinary pharmaceutical company, describes, 'The principal driver of growth in companion animal markets is the pet owners' compassion for their animals' (Dechra, 2018, p. 11). The sometimes-deep emotional bonds between owners and their companion animals represents opportunities to sell more medicines.

Below, I describe the mismatch between the evidence needed for public health purposes regarding 'appropriate' antimicrobial use and that required for market expansion by pharmaceutical companies, and how this renders visible the trans-biopolitics (Blue and Rock, 2011) at play when tackling antimicrobial resistance. I then consider how antimicrobial stewardship messaging offers new opportunities for novel products, which enables veterinarians to subvert the diffuse pressure to prescribe antimicrobials by using strategies of substitution. I conclude by considering one such case of substitution which has been widely taken up despite limited evidence of its effectiveness. This further illuminates the veterinary-industrial complex's orientation towards providing more—and new—products and medicines.

6.3.1. Evidence gaps: a mismatch between public health and pharmaceutical industry priorities

Antimicrobial stewardship messaging urges using the correct dose of the correct drug for the correct duration (BVA., 2015a). The uncertainty regarding the 'correct' duration of antimicrobial courses in companion animals in a longstanding concern (Morley et al., 2005). Below, I discuss the paucity of evidence regarding treatment duration for UTIs, a relatively common bacterial infection in dogs. Filling this evidence gap—and others like it—by confirming the efficacy of shorter antimicrobial courses would offer an avenue by which to reduce the selection pressure for antimicrobial resistance in the companion animal sector. However, the reliance of the veterinary sector on privately funded research means that this avenue remains under-investigated.

Antimicrobials are often the treatment of choice for canine UTIs (Weese et al., 2019) with urogenital infections being the second most frequently veterinarian-reported indication for prescribing antibiotics, after skin diseases (De Briyne et al., 2014). A Danish study found that 'over-prescription' of antibiotics was common in dogs with suspected UTIs, with the authors reporting a dissonance between diagnostic test results and antibiotic use (Sorensen et al., 2018).

The International Society for Companion Animal Infectious Disease (ISCAID) treatment guidelines for UTIs in dogs and cats were first published in 2011 (Weese et al., 2011) and have informed national guidelines such as BSAVA's PROTECT-ME (BSAVA., 2018). Back then, ISCAID suggested a course of antimicrobials lasting between seven to 10 days, whilst acknowledging the scarcity of objective data to support this recommendation (Weese et al., 2011). When the guidelines were revised in 2019, there was still a paucity of evidence and so the authors turned to human medicine where treatment regimens have been extensively studied (Weese et al., 2019). In this setting, there was enough data fifteen years ago to recommend that antimicrobial courses for uncomplicated UTIs in women be reduced from 7–10 days down to 3–5 days in length (Milo et al., 2005). Based on this evidence, the 2019 ISCAID guidelines for UTI treatment in cats and dogs were revised accordingly (Weese et al., 2019).

Considerable financial investment has been made by public bodies to understand antimicrobial use and tackle antimicrobial resistance, both at a national and international level (Kelly et al., 2016). These efforts have concentrated on human and livestock populations; the interest in the latter motivated by food safety concerns and facilitated by the ability to utilise existing disease surveillance infrastructures. Under these conditions, understanding antimicrobial use and resistance in companion animals has not been prioritised in the same way by public bodies. In a similar vein, some have argued that the veterinary care of companion animals, in general, is a 'private' good benefitting the owners—and their multispecies family—who pay for it: why should public funds be used to subsidise this care or research into its improvement (Hueston, 2016)? Therefore, the companion animal veterinary sector is more reliant on the private sector to conduct and/or fund research into this area. More broadly, ethicists have argued that the global problem of antimicrobial resistance calls into question the concept of private versus public goods (Van Katwyk et al., 2019).

The integral role that the private sector has in funding companion animal veterinary research—and therefore setting the research agenda—has meant that conducting studies that could result in reduced antimicrobial sales have not been prioritised. This echoes the observation of Dumit (2012) that in human healthcare, clinical trials have become marketing tools for the pharmaceutical sector. A 2015 systematic review was unable to locate any clinical trials that compared different durations of treatment with the same antimicrobial for canine UTIs (Jessen et al., 2015). The review did, however, identify a Bayer funded study that compared a three-day course of their product Baytril® (Enrofloxacin, a fluoroquinolone) with a 14-day treatment of Clavamox® (amoxicillin-clavulanic acid) supplied by their market competitor Pfizer Animal Health (Westropp et al., 2012). The study found that Baytril®'s was not inferior to the conventional treatment with the added benefit of a shorter course duration. Whilst the authors noted that the impact of this novel treatment protocol, involving a HPCIA, on the development of antimicrobial resistance should be investigated (Westropp et al., 2012), citation searching suggests that this recommendation—which may threaten the use of this product—has not been undertaken. In the meantime, the evidence of Baytril®'s effectiveness is 'out there' and available for use by sales representatives. Nevertheless, the PROTECT-ME and ISCAID guidelines advise that, for uncomplicated, symptomatic, canine UTI, either amoxicillin (with or without clavulanate) or trimethoprim/sulphonamide should be prescribed, rather than fluoroquinolones (BSAVA., 2018, Weese et al., 2019).

In 2009–2010, UK public and not-for-profit investment in veterinary research was estimated to be around £127 million (RCVS., 2013). In comparison, the public and not-for profit sectors contributed £3.5 billion for research and development activities in the human health sector, with private companies providing a further £4.5 billion (data also from 2009–2010) (UKCRC., 2012). Put simply, the amount of money available for veterinary research is dwarfed by the human sector.

Beyond this, the non-prioritisation of publicly funded research into antimicrobial use in companion animals illustrates the trans-biopolitics (Blue and Rock, 2011) at play when addressing antimicrobial resistance. Focusing on prolonging human lives through healthcare and safe food—and the rendering of companion animal lives as less significant to research—means that core questions regarding defining appropriate antimicrobial use in companion animals remain unanswered.

6.3.2. Stewardship: Creating a new market for antimicrobial substitutes

As a growing number of veterinarians become aware of the need to use antimicrobial prudently, demand for non-antimicrobial alternatives has grown. Suppliers have responded to this new market by introducing products appealing to the socially minded veterinarian, such as Peptivet Oto Gel® (Vetruus) aimed at treating otitis externa without the need for antimicrobials. The product summary describes how it, 'contains the patented peptide AMP20141, a new innovation in veterinary topical, which has been specifically developed to help veterinary practices manage their dermatology cases responsibly' (Viovet, 2020).

In the field, I observed this product being used by Chloe, the self-appointed antimicrobial champion at clinic two (see fieldnotes extract). She emphasized its newness, its ability to soothe the dog's discomfort, the reduced dosing burden, and the acceptability of keeping some of the product in case of future flare-ups. Under these conditions, the owner was quite willing to substitute antimicrobial use for this alternative product. This reiterates that medicines and other products have qualities beyond the antimicrobial properties.

Fieldnotes extract: Clinic two

A pensioner brings in her Labrador who has been rubbing her head. Chloe, the veterinarian, checks the dog: 'Her ear is red and smelly. It's too sore to examine'.

She reviews the dog's medical notes on the computer and says to the owner 'In the past you've had antibiotics and steroid drops . . . but there's this new product—Peptivet—that's really good . . . lots of good ingredients for soothing flare ups and restoring the skin barrier. Use it every other day. It's not like antibiotics so you don't have to complete the course'.

Owner: 'So it might last longer?'

Chloe: 'Yes but give me a call if there's not improvement'.

Owner: 'Absolutely, I don't want her to suffer'.

The owner leaves with her dog. Chloe smiles: 'Changing the world one appointment at a time!'

This case study, and other experiences in the field, leads me to question the idea that owners are welded to the idea of receiving antimicrobials, and it is possible to substitute these drugs with another product. Previously, I described how infrastructure in place supports the 'natural' conclusion of a consultation being the dispensing of a medicine or the provision of a product. By developing non-antimicrobial alternatives, the pharmaceutical sector is supporting veterinarians to move away from using antimicrobials without necessitating large structural changes to the sector. The sales of substitutions also contribute to clinic sustainability, replacing 'lost' antimicrobial revenues.

However, a note of caution: the efficacy of some of these novel products is unclear. For example, whilst there have been four published trials establishing the antibacterial effects of AMP20141 in vitro (identified via PubMed), I could not locate any published trials examine the effectiveness of AMP20141 or Peptivet Oto Gel in dogs. As Kaufman (2015) describes, healthcare professionals and their clients feel compelled to try new products arriving in the market place, especially in a sector that strives to be cutting edge and modern. I will consider this issue further in the next section.

6.3.3. The post-Pasteurian shift in treating canine diarrhoea

The increasing awareness of the need to optimise antimicrobial use has coincided with a developing understanding of the roles the microbiota plays in supporting human health (Young, 2017). Anthropologist Heather Paxson (2008) described how, although we live in typically

Pasteurian societies—demanding antibiotics and drinking ultra-pasteurized milk—there are increasing numbers of 'dissenters who insist that not all bugs are bad, not only that microbes are a fact of life but that many also enhance human life' (Paxson, 2008, p. 15). Since this was written, post-Pasteurian attitudes are becoming more common and their implications for more-than-human health have also been recognised (Figure 6.2). I now consider how optimising antimicrobial use and increased interest in microbial health have intersected to alter the ways veterinarians treat canine diarrhoea. This illustrates how the veterinary-industrial complex is orientated towards adding new products to pathways of care rather than disseminating information about ineffective practices and treatments, or the option of 'watchful waiting'. This has implications when attempting to share information about ineffective—and therefore 'inappropriate'—antimicrobial use in the sector.

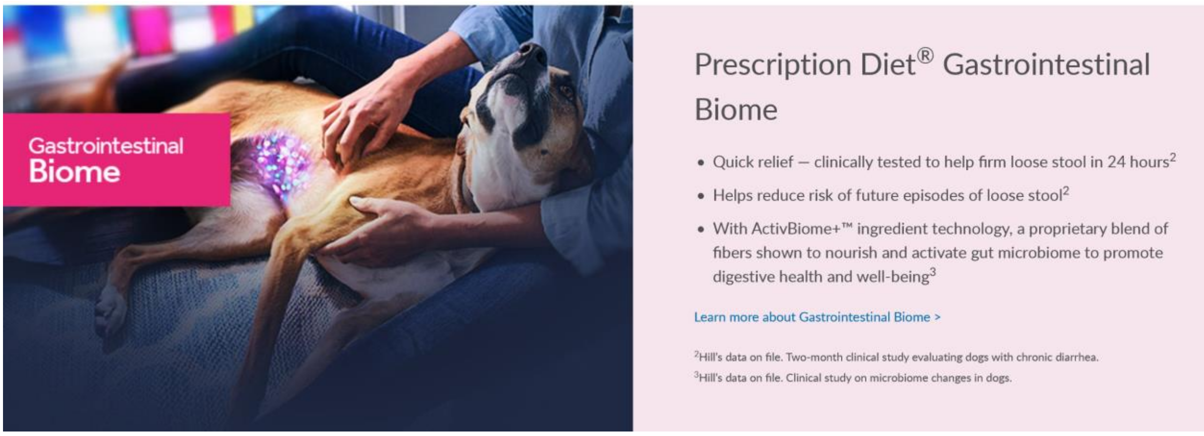


Figure 6.2: A screen shot of Hills Pet Food's website promoting its range promoting gastrointestinal health through the microbiome, launched in 2019 (Hill's, 2020).

Dogs are prone to getting diarrhoea due to their propensity to scavenge. However, most cases are mild and recover in a couple of days (PDSA, 2019b). A study examining records from a UK teaching hospital dating from 2001–2008 found that antibiotics were used in 71% of 371 canine diarrhoea cases that were admitted (German et al., 2010). In 2011, the BSAVA's PROTECT guidelines recommended that for acute, uncomplicated diarrhoea, 'antibacterials are not indicated unless cytology and or culture is positive' (Battersby, 2011), as often these are not of bacterial origin. Between 2014 and 2018, a longitudinal study observed a decline in the percentage of gastrointestinal consultations for UK dogs resulting in the dispensing of antibiotics (Singleton et al., 2019a). Over the same period, the use of gastro-intestinal nutraceuticals—including prebiotics, probiotics, and kaolin—increased (Figure 6.3). Sometimes gastrointestinal nutraceuticals and antimicrobials were co-prescribed, with the former provided to mitigate the negative effects on the microbiota caused by the latter.

Despite their widespread deployment, the evidence regarding the clinical impact of probiotic use for acute diarrhoea is limited. A recent systematic review (Jensen and Bjornvad, 2019) identified 12 studies that were typically of moderate to high risk of bias with the authors concluding that, 'The current data point toward a very limited and possibly clinically unimportant effect for prevention or treatment of acute gastrointestinal disease' (Jensen and Bjornvad, 2019, p. 1,849). Further high-quality studies are needed to confirm or disprove the effect of probiotic use on clinical outcomes.

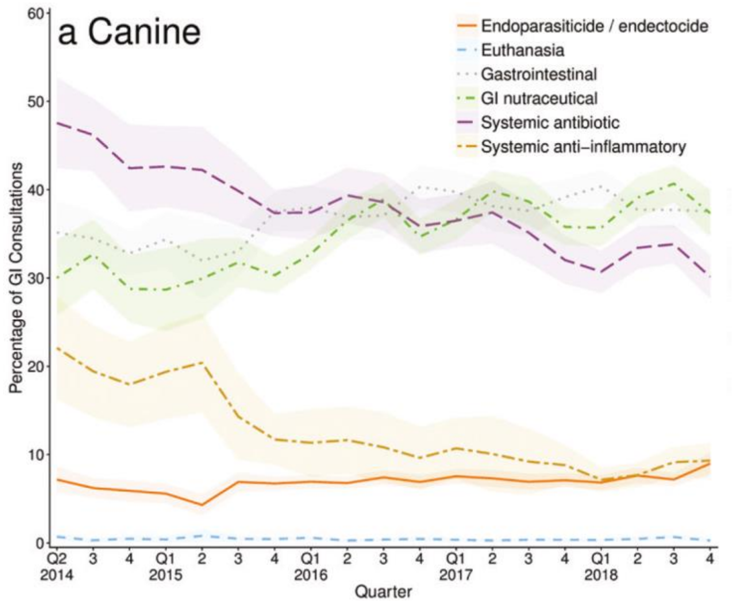


Figure 6.3: The percentage outcomes (95% confidence intervals) of canine gastrointestinal consultations between by quarter between 2014–2018 (Singleton et al., 2019), reproduced with permission.
[Shaded regions refer to 95% confidence intervals, calculated to adjust for clustering within veterinary clinic].

How does Jensen and Bjornvad's cautionary finding—that could reduce sales—reach front-line veterinarians and owners without the networks of pharmaceutical companies or corporate veterinary groups to promote it? Perhaps via recent veterinary graduates whose university curricula might include this finding or via its inclusion in CPD training. The study was not included in the research round-up column in the *Veterinary Record* (Aug 2019 to Nov 2019) whose news section did, however, report on Hill's Pet Nutrition's new range of microbiome-friendly products (Figure 6.3), citing the manufacturer's own unpublished data regarding the benefits to animal health (Anonymous, 2019c). This hints at the close links between publishers and product manufacturers in the veterinary sector, with the latter providing a valuable source of advertising income.

The *Veterinary Record* is the official journal of the BVA and is widely read (Nielsen et al., 2015). It is published on their behalf by the *British Medical Journal* (BMJ) Group whose human equivalent, the BMJ, does not run a similar 'new products' section. Despite being part of the same stable of journals, and both aspiring to the paradigm of evidence-based practice, this case study illustrates how the type of information companion animal veterinarians are exposed to might differ from their medical counterparts. I return to the mixed messages given regarding antimicrobial use by the veterinary press in the final section of this chapter.

The central role of the private sector in developing the veterinary evidence base has resulted in publication bias—i.e. trials with positive outcomes are more likely to be published whilst those with negative outcomes remain un-shared (Wareham et al., 2017). The establishment of compulsory clinical trial registers in human medicines enables this phenomenon to be traced, if not fully addressed (DeVito and Goldacre, 2019). I also propose that amongst published reports, the picture presented regarding the effects of probiotics is skewed. A recent randomised, placebo-controlled of Pro-Kolin Advanced for the treatment of canine diarrhoea, conducted and funded by its manufacturer (ADM Protexin), concluded that, 'The anti-diarrhoeal probiotic paste may accelerate resolution of acute diarrhoea in dogs and decrease the requirement for additional medical intervention' (Nixon et al., 2009, p. 1,286). A figure in the paper, reproduced below along with its caption, illustrates this focus (Figure 6.4). The graph also shows that 85% of dogs in the placebo arm got better without additional medical intervention (i.e. 'just' with time). However, this finding remains buried in the publication, perhaps because it is not aligned with the priorities of those conducting the trial. In a resource-limited setting, such as the NHS, this result might trigger prognostic research to enable identification of those requiring additional treatment to facilitate targeted approaches. However, in veterinary medicine, blanket use of probiotics in dogs with diarrhoea maximises the market and therefore such research is not undertaken. Within this report, messages about the safety of 'watchful waiting' or the 'test of time' are overlooked in favour of foregrounding the use of the probiotic products.

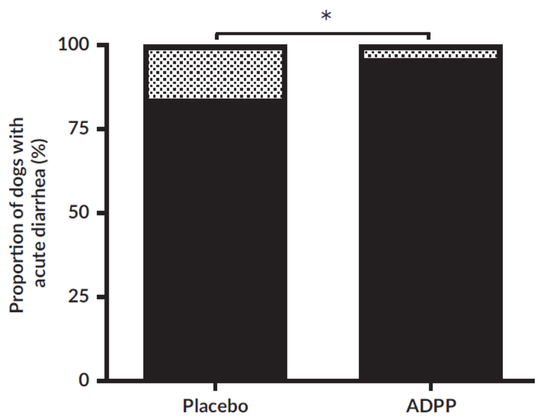


Figure 6.4: The frequency of dogs requiring additional medical intervention when treated with placebo (9/61) or with anti-diarrhoeal probiotic paste (2/57) for acute uncomplicated diarrhoea. Solid shading = diarrhoea resolved; dotted shading = additional medical intervention required (* $p \leq 0.1$) (Nixon et al., 2019), reproduced with permission.

6.3.4. Implications for care and antimicrobial stewardship

In this section, I have tried to tease out some of the ways in which the pharmaceutical sector shapes the broader context in which companion animal veterinarians and owners decide to use antimicrobials. One such way is by providing new products that veterinarians can substitute into care. This avoids the need for structural changes within the sector and is supported by the market expanding goals of the veterinary-industrial complex. Previous research identified that non-antimicrobial options would be welcomed by Dutch companion animal veterinarians (Hopman et al., 2019a).

In the UK, Singleton et al. (2020) recently reported that, based on mixed effects modelling, the proportion of consultations regarding respiratory clinical signs resulting in systemic antimicrobial prescription were slightly higher than gastrointestinal complaints (OR: 1.11, 95% CI: 1.06–1.17, $p < 0.01$). The authors propose that respiratory consultations could be the target of future stewardship efforts; perhaps these might include the development of antimicrobial substitute products, as seen for gastrointestinal conditions.

Research into companion animal health is a relatively low societal priority, and therefore the private sector plays a central role in shaping the available evidence base. One way by which to support 'appropriate' antimicrobial use in companion animals would be to publicly fund more research, outside of the veterinary-industrial complex and its orientation towards providing more medicines. Due to trans-biopolitics—in which human health is prioritised over companion animal health by society—a number of low hanging fruits remain with regard to what constitutes 'appropriate use' in the latter group. In the next section I explore how this ambiguity enables the pharmaceutical sector to mould 'appropriate' antimicrobial use messaging to align more closely with their organisation goals.

6.4. Who is at risk and of what?

I conclude this chapter with a case study that builds on several themes of this chapter: veterinarians using antimicrobials to manage risk; dealing with busy owner-workers and the sometimes complex and difficult relationship between veterinarians and owners. It traces the flow of information surrounding the 'appropriate' use of the antimicrobial cefovecin (Convenia®, Zoetis) and reflects upon how 'scientific facts' are made and re-made. By using this 'following' methodology (Chandler et al., 2016), I illustrate how evidence gaps allow ambiguity when prioritising which aspects of antimicrobial stewardship should be enacted. This enables the moulding of 'appropriate' use messaging to meet the broader, pre-existing goals of organisations and to extend the 'at-risk' population.

6.4.1. The 'cat antibiotic'

Cefovecin is a broad-spectrum antimicrobial belonging to the third-generation cephalosporin group within the beta-lactam class (Prescott, 2013). It acts against both Gram-negative and Gram-positive bacteria and is used to treat urinary tract, skin, and soft tissue infections in cats and dogs. Cefovecin is a relatively new antimicrobial and was first authorized for use in the EU (and the UK) in 2006 (EMA, 2013). Convenia® (Zoetis) is the only cefovecin licensed for use in companion animals in the UK (Zoetis, 2020a).

Cefovecin is marketed by the global animal health company Zoetis under the trade name Convenia®, a name that alludes to its key selling point—its convenience. A course of Convenia® is delivered via a single injection with its antimicrobial effects lasting 14 days (Zoetis, 2020a). Its 'charm' (Van der Geest and Whyte, 1989) is that veterinarians and owners need not worry about daily medicine administration at home; and it has proved particularly popular for cats, who can be difficult to administer tablets to (Mateus et al., 2011). In these situations, using Convenia® ensures the completion of the antimicrobial course, a key stewardship message (BVA., 2019c).

Whilst convenient, concerns have also been raised regarding Convenia's® long-acting nature. If an animal suffers an adverse reaction to the antimicrobial, then prolonged treatment may be required due the extended time taken for it to be cleared entirely from the body (65 days) (Zoetis, 2020a). Furthermore, this long sub-therapeutic tail (between 14 and 65 days) may foster the development of resistant microbes, such as extended spectrum beta-lactamase producing *Enterobacteriaceae* (Hubbuch et al., 2020).

In the first UK studies quantifying antimicrobial use in companion animals, cefovecin was found to be the second-most frequently used agent in cats, accounting for 15% of antimicrobial dispensing events in 2007 (Mateus et al., 2011), whilst another group estimated that by 2010, 13% of all feline consultations culminated in cefovecin dispensing (Radford et al., 2011). Subsequently cefovecin became the most frequently dispensed feline antimicrobial (Singleton et al., 2017), accounting for 30% of such events between 2012 and 2014 (Buckland et al., 2016).

Cefovecin (Convenia®, Zoetis) is classified as a HPCIA. This is due to the use of third-generation cephalosporins i) selecting for cephalosporin resistant *Salmonella* spp. and *E. coli* in animals, and ii) being one of the few therapies available to treat serious *Salmonella* spp. and *E. coli* infections in humans (WHO, 2019). A condition of the licensing of Convenia® by the EMA was that its Summary of Product Characteristics—a leaflet describing how the medicine should be used provided by the drug manufacturer—included the statement, 'It is prudent to reserve third generation cephalosporins for the treatment of clinical conditions, which have responded poorly, or are expected to respond poorly, to other classes of antimicrobials or first generation cephalosporins . . . Use of the product should be based on susceptibility testing and take into account official and local antimicrobial policies' (EMA, 2013). This message was reiterated in UK's datasheet for this product (Zoetis, 2020a) and in the BSAVA's PROTECT guidelines (Battersby, 2011). The latter coded third-generation cephalosporins as 'amber' in their traffic light system; a second- or third-choice antimicrobial that should only be used 'when others are inappropriate and/or ineffective, *and* culture and sensitivity testing indicates that they will be effective' [emphasis in the original]. When the guidelines were updated in 2018, the accompanying article explained how third-generation cephalosporins 'should be used *ONLY* where there are no alternatives or where the response to alternatives is expected to be poor' [emphasis in the original] (BSAVA., 2018). Companion animal veterinarians are therefore required to judge how the clinical and social context might influence potential future outcomes. The time constraints of consultations may limit full discussion of these factors with owners and/or prevent the training and assessment of their ability to administer tablets to their animal at home.

The 'issue' of Convenia® came up in the focus group conducted at the charity clinic, where it was not stocked due to its high cost:

Jon, salaried veterinarian [having previously worked in a private clinic]***: 'I missed it for like a few weeks and then I didn't [laughs] I got used to not having it and now I don't even think of it . .***

. I'd always kind of got the back of my mind that Convenia was quite bad practice. I remember we had a talk on it at Uni . . . There must be such a long tail on it that once it goes below the effective dose, it's going to be kicking around for ages.'

Esther, senior veterinarian: ***'It doesn't sound right, I don't think. Once it's in the system, it's in the system and, really? It's too good to be true.'***

Beth, salaried veterinarian: ***'I get a lot less here of people being like "Oh, I can't give my cats tablets" for some reason which is kind of like of the opposite of what you'd expect [the elderly and infirm form a large part of the clinic's clients] possibly they just go home . . . and they don't try, but in private practice you'd get a lot more. And possibly I offered it to people sometimes cos I was like, "We can try tablets or we do have an injection if that's easier for you but I'd prefer the tablets" and they'd say, "Oh definitely the injection". Whereas I don't have that option to give people here, "it's tablets or tablets".'***

Contrast this with an interview extract that illustrates the need to satisfy paying clients in private practice:

'For some cases as well, cats for example, owners, they are not very happy or it's difficult for them to give tablets or, and I try to give an injection, two weeks' cover, easy for everybody. Maybe it's not the best way but we need to give the cat antibiotics.'

Raul, salaried veterinarian, clinic two

As the studies cited above suggest, once released into the companion animal veterinary ecosystem, Convenia® use took on a life of its own, beyond the conditions it was licensed for. Analysis of UK veterinary prescribing records (n = 1,148) from 2012–2013, identified that nearly three out of ten of its uses in cats were not in line with the 'appropriate' uses defined in the datasheet (Burke et al., 2017). Furthermore, the reason for using Convenia® over other antimicrobials was rarely recorded: where available, the most frequently given reason was difficulty in orally medicating the cat (56%) (Burke et al., 2017). Culture and sensitivity testing were recorded in less than 1% of entries (n = 5), with clients declining such these tests in a further 14 (1%) of cases (Burke et al., 2017). As awareness of the gap between intended and enacted use grew, Convenia® utilisation in cats came under increasing scrutiny. Singleton et al. (2017) identified a stabilisation in the proportion of antimicrobial events comprising of third-generation cephalosporins in cats attending UK clinics between 2014 and 2016 (Figure 6.5). Whilst in the Netherlands, Hopman et al. (2019d) identified a threefold decrease in the use of cefovecin in 2015 compared to 2012 following the introduction of mandatory culture and sensitivity testing as part of the Dutch Government's efforts to reduce antimicrobial use across all veterinary sectors.

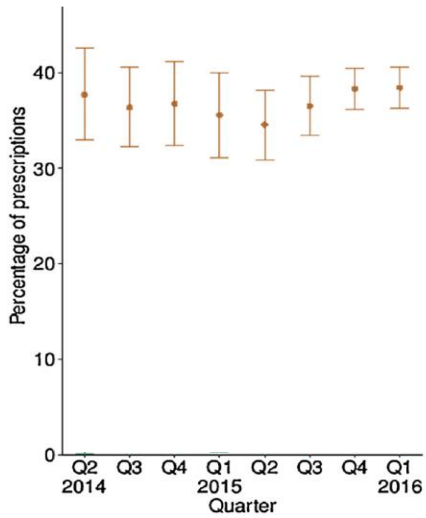


Figure 6.5: The percentage (95% confidence interval) of total feline antimicrobial events comprising of third generation cephalosporins by quarter between 2014–2016 (Singleton et al., 2017), reproduced with permission.

6.4.2. Extending those at risk

How did Zoetis respond to this squeeze on its sales of Convenia® to feline patients? In the following section, I describe how attention turned to 'optimising' the medicine's use in dogs who were re-branded as being 'at-risk' (Dumit, 2012). Previous research identified how Convenia® was not frequently used in medium and large dogs due to its high cost and the relative ease by which tablets could be administered (Mateus et al., 2011, Mateus et al., 2014).

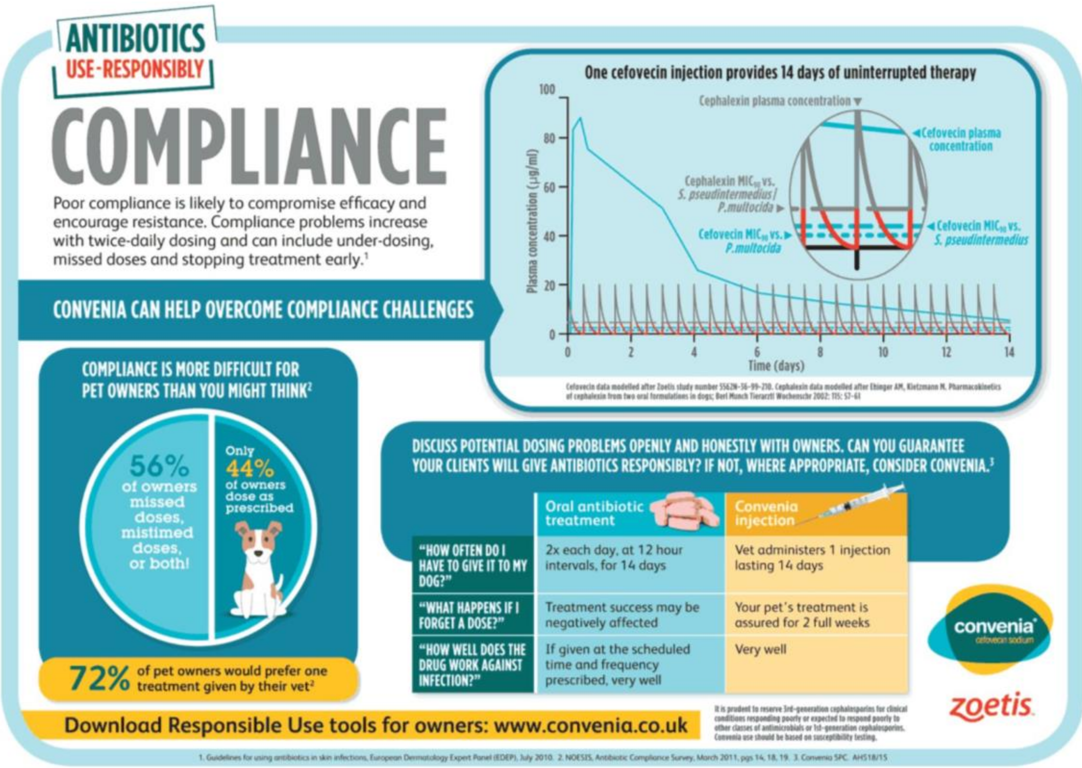
In autumn 2015, Zoetis ran a prominent campaign of adverts across two widely read UK veterinary publications (Nielsen et al., 2015): The *Veterinary Record* (a journal discussed in Section 6.3.3) and *The Veterinary Times*, a weekly newspaper and website that reports on a range of professional, clinical, practical, and management topics (Table 6.1).

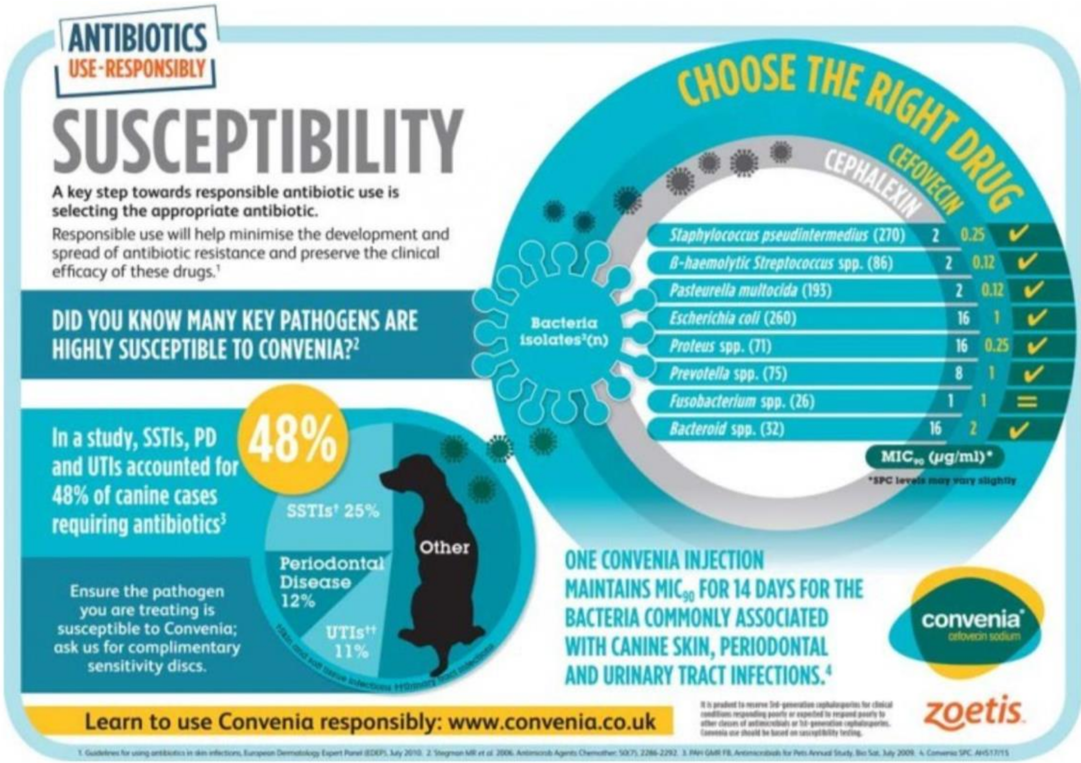
Table 6.1: The Convenia® UK advertising campaign schedule in 2015

The Veterinary Record	The Veterinary Times
19th Sept 2015, p. 272–273 (2x A5 adverts) 17th Oct 2015, p. 381–382 (2x A5 adverts) 21st Nov 2015, p. 508–509 (2x A5 adverts)	7th Sept 2015, p. 18–19 (2x A4 adverts, plus exterior banner) 14th Sept 2015, p. 16–17 (2x A5 adverts, plus box on front page) 26th Oct 2015, p. 14–15 (2x A5 adverts) 9th Nov 2015 2015, p. 16–17 (2x A5 adverts) 23rd Nov 2015, p. 16–17 (2x A5 adverts) 7th Dec 2015, p. 12–13 (2x A5 adverts) 14th Dec 2015, p. 22–23 (2x A5 adverts)

The campaign comprised of i) an image of dogs dressed up as cats next to the caption, 'dogs deserve the best chance of recovery too'; and ii) one of two infographics (Figure 6.6) describing how, by using Convenia®, there were increased chances of a) bacterial susceptibility due to its broad spectrum of action and b) ensuring owner compliance, and thus it was a responsible choice. These materials and messages form the basis of Zoetis' UK Convenia® website, which was accessible at the time of writing (Zoetis, 2020b).

The adverts in 2015 were printed in amongst other articles and, for the infographics at least, it is unclear on initial inspection that these are advertorials (Figure 6.7). At 2019–2020 prices, such a campaign would cost in the region of forty-two thousand pounds (estimated from information on the *Veterinary Record* and *Veterinary Times* websites, presuming no bulk buy discounts are available). Zoetis must have been confident in an uplift in sales in return for this sizable investment.





References

1. Guidelines for using antibiotics in skin infections, European Dermatology Expert Panel (EDEP), July 2010.
2. Stegman MR et al. 2006. Antimicrob Agents Chemother; 50(7), 2286-2292.
3. PAH GMR FB, Antimicrobials for Pets Annual Study, Bio Sat, July 2009.
4. Convenia SPC.

Figure 6.6: The Zoetis infographics that appeared in the *Veterinary Record* and the *Veterinary Times*, and available on the latter's website.

https://www.vettimes.co.uk/article/susceptibility/

https://www.vettimes.co.uk/article/compliance-use-antibiotics-responsibly/

Figure 6.7: Convenia® adverts ran by Zoetis in the *Veterinary Record* 17 October 2015, pp. 380–381.
[The ‘infographic’ is on the top left, the advert on the bottom right].

6.4.3. Moulding messages of ‘appropriateness’

A veterinarian wrote to *Veterinary Times* expressing his shock at the adverts which foregrounded Convenia®’s convenience and advocated its first-line use (Warman, 2015). The Zoetis UK business manager’s reply in the magazine emphasized that the campaign aimed to, ‘raise awareness of crucial considerations around the responsible use of antimicrobials’ and, with over half of owners missing and or mistiming doses, ‘we believe it is imperative this be taken into consideration when selecting the most appropriate antibiotic for the case’ (Flaxman, 2015).

The susceptibility infographic promotes the broad-spectrum action of Convenia® as a means by which to ensure effectiveness. This is an alternative slant to the conventional ‘appropriate use’ message of using a narrow-spectrum agent, informed by diagnostic testing where necessary, to limit effects on commensal bacteria (Battersby, 2011). This infographic mentions complimentary sensitivity testing discs, but this seems at odds with the more prominent themes of convenience and a single dose (implying a single visit). Promoting the broad spectrum of Convenia® speaks to the practices of prescribing antimicrobials just in case (Chipangura et al., 2017), and covering multiple bases with one product to get things sorted the first time, as described earlier in this chapter.

6.4.4. The marketing value of peer-review journal publications

The Zoetis adverts and letter (Flaxman, 2015) cite the European Dermatology Expert Panel (EDEP) antimicrobial guidelines. The panel was convened by Pfizer (Anonymous, 2011a) and tasked with producing suggested guidelines for using systemic antimicrobials in skin infections that were subsequently published (Beco et al., 2013). They categorise cefovecin as a second-line antimicrobial and, as such, should only be used when there is culture and sensitivity testing evidence that first line treatments will not be effective. However, they also proposed that, 'cefovecin can be included as first-line antibiotics where medication may be difficult, and/or compliance is, or likely to be, poor' (Beco et al., 2013, p.157), a suggestion subsequently taken up by Zoetis.

When proposing the use of cefovecin as a first-line drug for limited situations, EDEP cite a 2011 peer-reviewed paper published in a highly regarded veterinary journal (Van Vlaenderen et al., 2011). This modelling study was also funded by Pfizer—the parent company of Zoetis at the time. It simulates first-line treatment of superficial pyoderma, wounds, and abscesses with cefovecin or amoxicillin/clavulanic acid, drawing on unpublished Pfizer trial reports. The first line use of cefovecin is not in compliance with its EU authorisation (EMA, 2013), where such use would be off-licence but possible under the Cascade principle (VMD, 2019). Its US data sheet contains no such limitations (FDA, 2013). The model did not include routine culture and sensitivity testing, contravening both the US and EU authorisations for Convenia® use, nor did it attempt to evaluate the costs associated with antimicrobial-resistant infections, citing the paucity of data available (Van Vlaenderen et al., 2011).

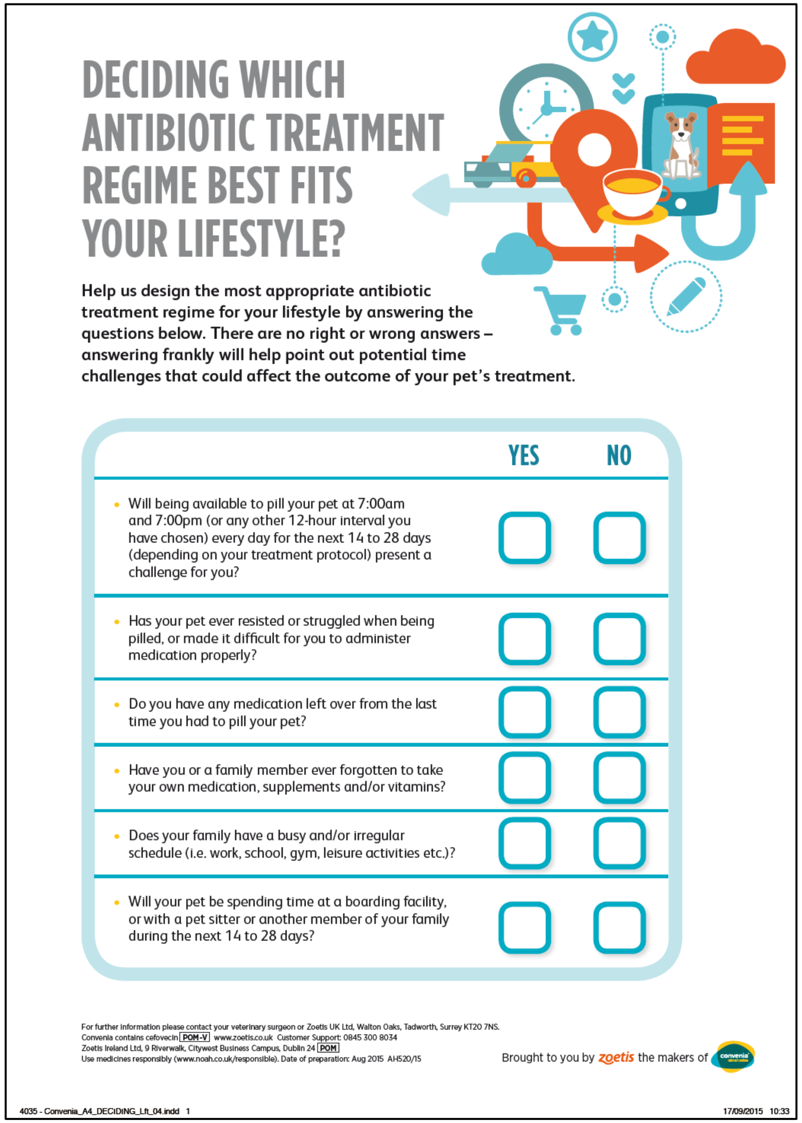
To recap, a modelling study that did not consider antimicrobial resistance concludes that Convenia® is cost-effective based on no culture and sensitivity testing under US licensing conditions. This is cited by EDEP guidelines, which suggest that Convenia® might be appropriate in certain situations. This in turn is used to promote the first line use of Convenia® in skin and urinary conditions by UK veterinarians as a responsible choice for antimicrobial stewardship. This illustrates how evidence for 'appropriate' antimicrobial use is extrapolated as it is cited and re-cited, moving across the different territories in which multinational companies operate. In this instance, peer-reviewed journal articles become powerful marketing tools (Dumit, 2012). Such a transnational approach overlooks the local, bio-social context in which veterinary care is provided, for example, local populations of microbes and their patterns of resistance.

6.4.5. Capitalising on strained veterinarian–owner relationships

A central theme of Zoetis' campaign is that owners cannot be relied on to complete antimicrobial courses at home, 'Can you guarantee your clients will give antibiotics responsibly?'. Such messaging taps into the veterinarian's responsibility towards animal welfare and experiences of liaising with busy owner-workers. It also resonates with the complicated feelings veterinarians have towards their clients (Figure 4.1) who are often framed as barriers to providing gold-standard care (Armitage-Chan, 2019). Convenia® offers an alternative to the potentially time-consuming and emotionally draining process of engaging with owners regarding the 'appropriate' antimicrobial use.

The Zoetis Convenia® website also takes advantage of the perceived pressure to supply antimicrobials from owners. It contains a webpage (Zoetis, 2020c) promoting how popular the drug is with owners, citing the UK Dog Satisfaction survey, an exercise undertaken by Pfizer. The website explains that, 'clients were delighted to be offered Convenia® for their dog', but no further information is provided regarding the context, the alternatives offered, or the phrasing of the questions to elicit the 'delighted' response. Companion animal veterinarians are known to be acutely aware of the perceived pressure from owners to provide antimicrobials (Mateus et al., 2014, Currie et al., 2018, Hardefeldt et al., 2018b). Here, the pharmaceutical company is exploiting the framing of demanding owners, to encourage companion animal veterinarians to utilise more Convenia®, a previously unreported aspect of this phenomena. Satisfied owners will not 'shop around' and seek care from rival veterinary clinics. Client satisfaction has been previously described as a barrier to enacting antimicrobial stewardship (Smith et al., 2018). Here Zoetis align the enactment of satisfying clients with antimicrobial stewardship.

The infographics refer to 'responsible use tools' to help owners make the 'appropriate' choice, available via the Zoetis Convenia® website (Figure 6.8): 'Help us design the most appropriate antibiotic regime for your lifestyle'. The checklists do not mention antimicrobial resistance, that Convenia® should not be used as first-line treatment, or the complementary susceptibility discs available to their veterinarian. In a setting where owners are framed as ignorant or uninterested in antimicrobial resistance (BVA., 2014), do these checklists better represent owner priorities than stewardship education materials? Or is it an attempt by Zoetis to foreground convenience in a bid to maintain sales in a market under pressure due to stewardship messaging? In the US, Zoetis acts more directly to encourage owner demand by including Convenia® in its pet rewards scheme (Figure 6.9) (Zoetis, 2019). Such rewards encourage increased consumption and/or owner pressure on veterinarians to prescribe antimicrobials.



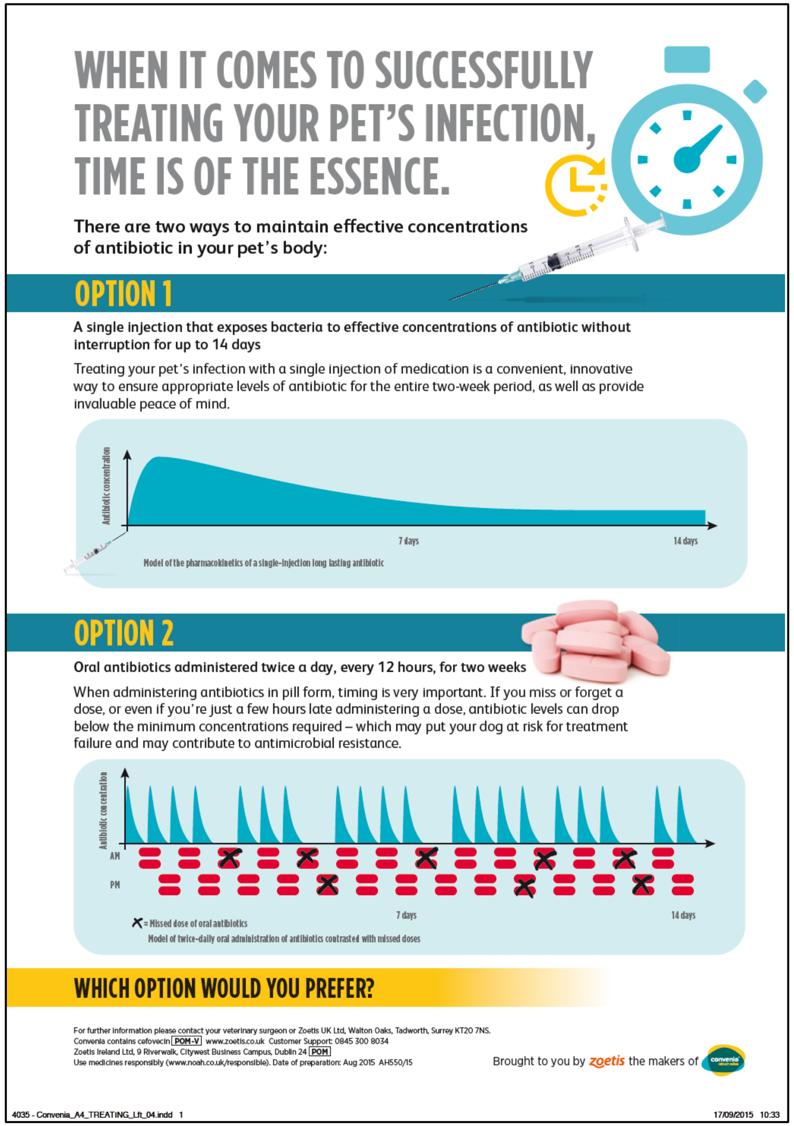


Figure 6.8: Responsible use tools developed by Zoetis the provider of Convenia®.

https://www.zoetis.co.uk/convenia/pet-owner-tools.aspx

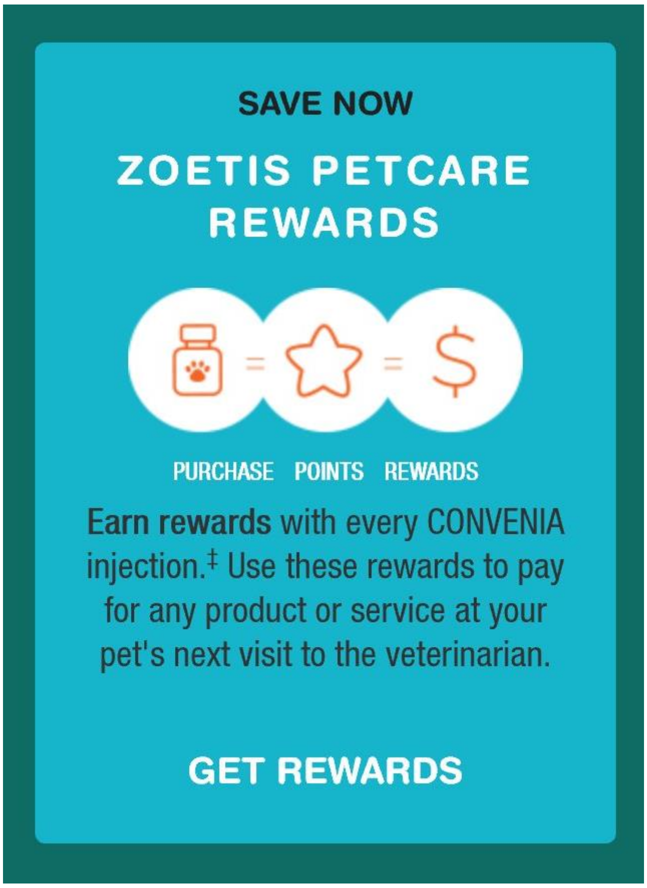


Figure 6.9: The Zoetis Petcare Reward Scheme (Zoetis, 2019).

Meanwhile, in Australia, Zoetis financially supported the development of the national appropriate antimicrobial use guidelines of antimicrobials in cats and dogs (AIDAP., 2013). Their logo appears on the front cover, they own the copyright to the guidelines, and become the 'voice' of appropriate antimicrobial use, 'Zoetis would like to thank the dedicated members of AIDAP [Australasian Infectious Diseases Advisory Panel] for all their hard work and contribution towards these guidelines' (p. 153). Australian veterinarians have expressed scepticism about the involvement of a pharmaceutical company in their national guidelines—calling it 'tainted information'—and the lack of independent guidelines has been identified as a barrier to appropriate antimicrobial use there (Hardefeldt et al., 2018b). These examples illustrate how 'appropriate' antimicrobial use can be moulded within different territories of the same multinational organisation.

6.4.6. Stewardship: A threat to accessibility

Convenia® is not a cheap option: whilst in the field, several owners commented on its price, justifying the additional cost for the extra convenience. Heavier animals such as dogs required larger—more expensive—doses and this prevented veterinarians from offering it due to its prohibitive cost (Mateus et al., 2011). Instead they demonstrated care towards their clients by offering cheaper, oral alternatives. Zoetis have identified this as a barrier, too, and developed the 'Convenia® access programme' (Zoetis, No date). This UK Zoetis website contains a case study describing how a business consultant worked with a UK clinic to overcome the 'Perceptions of cost and client acceptance hindering vets from offering Convenia®'. The pricing structure was altered to make it 'more acceptable to clients whilst maintaining the medicines [sic] contribution' to clinic income. The cost of Convenia® for medium and large dogs was adjusted to be equivalent to 14 days of oral treatment. Veterinarians also received training on 'appropriate' use of antibiotics and case selection, although no further details are provided about how 'appropriate' was defined. It resulted in an extra 200 'appropriate' cases receiving Convenia® over nine months. No data are presented regarding whether these cases had susceptibility testing or if there was a rise in 'inappropriate' Convenia® use.

This example further illustrates the 'dirty work' of selling medicines in the companion animal sector. Zoetis employs distancing techniques by framing themselves as a protector of animal welfare seeking to improving access to medicines. This resonates with concerns that antimicrobial stewardship schemes may have the unintended consequences of placing additional barriers in the way of those needing care (Denyer Willis and Chandler, 2019). It also provides insight in the use of pricing to alter the attractiveness of antimicrobials, an understudied and unremarked upon phenomenon in the companion animal sector to date. It offers an inversion to the public health strategy of working to reduce the accessibility of 'dangerous' substances—such as nicotine and alcohol—by increasing their price (Woodhouse, 2020).

6.5.7 Implications for care and antimicrobial stewardship

The contribution of using specific antimicrobial agents in companion animals to the problem of antimicrobial resistance remains unclear. For example, no one knows if the risk to health posed by the non-completion of antimicrobial courses in companion animals exceeds the risk of using third-generation cephalosporins in this group. This allows flexibility in approaches when deciding how to enact responsible antimicrobial use. Although this case study focuses on Zoetis, they are by no means unique in taking an interest in responsible use in order to promote their products. For example, Bayer supplied clinics with *'Your Guide to Antimicrobial Use in Practice'*, an information folder written by academic experts and featuring the Bayer logo and that of their product Veraflox® (pradofloxacin) (Anonymous, 2016a), a fluoroquinolone and a HPCIA (WHO, 2019). Whist Ceva Animal Health—a company marketing livestock and companion products—produces the Gram (Guidance for the Rational use of AntiMicrobials) book, 'a new reference for best practice . . . written by a panel of 10 independent European experts' (Anonymous, 2017d).

This case study illustrates that the role of the pharmaceutical sector in developing the evidence base and sharing knowledge about 'appropriate' antimicrobial use. Similarly, Merck employees recently published an article in a peer-reviewed journal (linking back to Section 6.4.4.) describing how their company was a case study for industrial involvement in antimicrobial stewardship efforts, ' . . . where 'doing well' and 'doing good' are not mutually exclusive' (Hermsen et al., 2020, p. 677). Meanwhile, an independent report ranking pharmaceutical companies for their antimicrobial stewardship efforts placed Merck a lowly eighth out of nine amongst large research-based organisations (AMF., 2020). These insights suggest that being *seen* to be 'doing good' is slightly different than 'doing good'. When seeking to understand and tackle antimicrobials in marginal groups—such as companion animals—relying on the private sector may be a necessity in the absence of governmental and public sector funding. However, as this case study illustrates, the motivation of pharmaceutical companies for undertaking such work is not entirely altruistic. This adds a further layer of complexity, as companion animal veterinarians navigate a limited and patchy evidence landscape. As one of the study veterinarians described:

'Those ones [stewardship materials] that are sponsored by the drug company? That just made me feel a bit cynical really. I did have a look through them and I should probably look at them a bit more closely but, yeah, I just feel a bit sceptical when they are sponsored by a drugs company that is promoting their drugs.'

Helen, salaried veterinarian, clinic one

6.5. Chapter summary

By drawing on ethnographic fieldwork and documentary analysis, this chapter has been able to render visible aspects of the infrastructure in companion animal medicine that support ways of working with medicines—in particular antimicrobials—and other veterinary products. This infrastructure includes: the sector's fees structure, income from medicines sales, and the renumeration packages for veterinarians. In this environment, strategies of care that cover multiple bases to protect animal welfare are encouraged especially when confronted with busy owner-workers. The evidence landscape in which veterinarians and owners make decisions is shaped by the powerful veterinary-industrial complex which prioritise generating evidence to act as marketing tools over public health need.

Previous research and interventions have focused on the behaviour of individuals rather than considering the structural issues highlighted in this chapter. Requiring veterinarians or owners to change their practises without addressing the broader context can lead to mixed messages

(Figure 6.10). For example, 'Asking people to reduce their use of antimicrobial pharmaceuticals, may run up against embedded assumptions and practices which continue to be supported by the resources of the pharmaceutical industry, including their own use of media to extend messages figured around 'a pill for every ill' (Davis et al., 2018, p. 1,164).

Figure 6.10: The front cover of the *Veterinary Times* (14 Sept 2015) featuring a news story reporting that veterinarians feel pressured to prescribe antibiotics by owners and an advert (top left) promoting the use of Convenia® (Zoetis).

Broadening our gaze to consider the political economy (Brown and Nading, 2019) of the companion animal veterinary sector enables us to consider a broader range of ways in which to intervene regarding antimicrobial use. Based on the issues raised in this chapter, Table 6.2 presents some suggestions.

Table 6.2: Possible targets for future interventions seeking to alter antimicrobial use in companion animals based on the findings of Chapter 6

Type of intervention	Description
Pricing interventions	A minimum fee per antimicrobial dose.
Fees structure	Introduce tiered system reflecting the experience/expertise of the consulting veterinarian.
Veterinarian renumeration	Removing antimicrobial sales from productivity targets
Medicine sales	Removing/limiting the 'mark-up' on the price charged for antimicrobials. Separating prescribing and dispensing functions in the veterinary sector.
Research & development	Improving the evidence base regarding 'appropriate antimicrobial use, particularly the duration of antimicrobial courses and the evaluation of placebo/'using the test of time' options. Development of non-antimicrobial alternatives to support substitution. Invest in the licensing of non-HPCIA alternatives for a greater variety of conditions. Set up a publicly accessible, compulsory veterinary clinical trials register to facilitate transparency and reduce publication bias. Make the results of clinical trials with negative results available.
Owners	Employers required to allow employees time away from work to attend the veterinary clinic to seek care for their more-than-human family members.
Veterinary press	Require full, accessible references to accompany advertising claims. Publish quality assessments of the data behind such claims. Clearly identify sponsored news stories reporting press releases of veterinary medicines.

This chapter identified that the evidence base regarding antimicrobial use in companion animals is skewed to meet the needs of the pharmaceutical sector, which can be understood in terms of trans-biopolitics. This paucity of public health information means that appropriate use guidelines are often based on expert opinion (Allerton, 2018) or even, in the case of the ISCAID guidelines (Weese et al., 2019), borrow information from the human sector. Investing in research to inform evidence-based approaches to 'appropriate' antimicrobial use would not only improve their trustworthiness of guidelines amongst front-line veterinarians, it would also reduce the current ambiguity that enables pharmaceutical companies to mould 'appropriate' use to meet their market-expanding goals. Antimicrobial resistance has previously been described as a moving policy target that is 'shifting its identity in accordance with the ideological positions of the actors involved' (Chandler and Hutchinson, 2016, p. 13). This chapter illustrates how, similarly, the form of 'appropriate' antimicrobial use changes in the companion animal sector depending on those enacting it.

The thorny question of who should make this investment remains unresolved: should it be those who profit from antimicrobial sales or those who face the biggest costs from the loss of therapeutic efficacy due to antimicrobial resistance? Or both? As in other populations, relying on industry to develop new antimicrobials—for example, an agent that is injectable but without the HPCIA status of cefovecin—has not worked. From the industry's perspective, it is more cost-effective to focus on expanding sales of existing products.

This chapter has shed light on the broader context and infrastructures surrounding the actors involved at the interface of antimicrobial use in companion animals. The following two chapters investigate the entanglements between these front-line actors: Chapter 7 concentrates on the experiences of veterinarians working in the companion animal veterinary clinic and how care is provided within the temporal and logistical constraints of this setting. Chapter 8 considers how the bio-socially produced forms of canine bodies necessitate particular forms of care to be delivered by clinic staff.

Chapter 7 Providing care in the intersectional space of the veterinary clinic

7.0. Introduction

This chapter centres on describing and reflecting upon everyday life in the companion animal veterinary clinic. Its aim is to explore how care is enacted in these spaces and implications this has for antimicrobial use and stewardship. Through an ethnographic approach, I aim to render visible the 'taken for granted', the mundane, and the humdrum in clinic life in order to provide fresh insight into the ordering, arrangements, and implications of the social and material worlds of the veterinary clinic. This is important because, by drawing attention to the unremarked upon, it enables me to offer additional—and previously overlooked—avenues for consideration when seeking to intervene regarding antimicrobial use.

My approach is informed by the work of empirical philosophers John Law and Annemarie Mol. Law (2010) proposed that veterinary care can be understood as a situated choreography with events and actors intricately arranged and ordered in space and time. Echoing Mol's *The Body Multiple* (2002), Law described veterinary care during the UK Foot and Mouth Disease outbreak as 'care multiple' entailing 'holding together and holding apart different and relatively non-coherent versions of care, their objects, and their subjectivities. It is the art of holding all those versions of care in the air without letting them collapse into collision' (Law, 2010, p. 69). In this chapter, I explore the ways in which the relatively recent imperative to *care for antimicrobials* is located and prioritised amidst these juggling acts of care.

As my fieldwork was predominately clinic based, I focus my attention on the enactment of care by the cast of more-than-human actors there. In the first section below—caring within constraints—I present a 'thick description' of daily life at my first fieldwork site, clinic one. Drawing on the approaches of Brown et al. (2019) and Kirk (2016), I trace how the clinic architecture shapes the delivery of care. I reflect upon how caring for the sustainability of the clinic includes being productive and minimising waste, for example, by using consumables 'appropriately'. I explore the implications of this—and the embodied nature of delivering interspecies care—has for managing microbes and infection control within the clinic. I conclude by proposing that, by not having 'a place' within the clinic—or indeed within the broader discipline of veterinary medicine—antimicrobial resistance remains an abstract, unanchored phenomenon that is difficult to prioritise or identify as a threat.

In the next section, I turn my attention to the entanglements and interactions between human bodies within the companion animal veterinary clinic. I consider how nationality, gender, age, and years since graduation combine to influence social standing within the clinic hierarchy. I draw upon anthropological contributions to the theory of intersectionality (Crenshaw, 1991) to help explore how these demographic knots shape the personal experience of providing care in, what Clarke and Knights (2019) describe as, the masculine anthropocentric environment of the veterinary clinic. I reflect upon how the role of local antimicrobial champion is undertaken within—and possibly as a challenge to—these prevailing conditions. Finally, I consider how the act of caring for companion animals—through the act of cleaning—is delegated to low-paid (typically female) workers.

7.1. Caring within constraints

In my efforts to explore the multiple foci of care within companion animal veterinary clinics, I begin with a 'thick description' of life within the 'shell' of the clinic building at my first fieldwork site. My approach is informed by sociologist Nik Brown et al. (2019), who explored the choreography of care at a cystic fibrosis outpatient clinic in the UK amidst concerns about the circulation of antimicrobial resistant microbes. Elsewhere, Robert Kirk (2016) studied how multispecies relations within the physical infrastructure of an animal laboratory shaped and reshaped one another. I draw, in particular, on their interest in how design and architecture influence the enactment of care. My description illustrates reoccurring themes running through my observations: i) the different foci of care at play; ii) time and space pressures; and iii) the prudent use of consumables. I return to these themes, and their implications for antimicrobial stewardship, microbial management, and infection control in the subsequent sections.

7.1.1. Clinic one: a thick description

Clinic one was situated at the rear of a pet superstore, part of a large retail group that co-owned the clinic along with the senior veterinarian, who I am calling Peter. It was located on the edge of town in a retail park where there was ample parking. Once in the shop, owners had to wind their way past displays of tempting products—including birthday cakes and prosecco for dogs ('pawsecco')—to reach the clinic. Sometimes whilst waiting for their appointment, they would browse the aisles or take the opportunity to stock up on dog food—a further illustration of the conflation of consuming veterinary care with consuming veterinary products (Chapter 6).

The clinic was a relatively young enterprise. Peter had been provided with a loan to start the business by the corporate veterinary group. This offered an accessible route to clinic ownership in a market where prices have been driven up by the buying power of large corporate groups

(Anonymous, 2018a). Daily clinic life was therefore orientated around building up the client base—e.g. through tempting introductory offers—and maximising the productivity of the space and staff working there. Busy morning clinics were followed by lists of procedures to be undertaken—neutering, investigations, dental work—that were sometimes unpredictably complicated or time-consuming. The sight of a veterinarian dashing out to quickly buy some lunch before their afternoon consultations began at 3pm was fairly common. On quieter days, Peter would collect cats from a local rescue centre—where there were always animals in need—to ensure that staff were fully occupied, and generating income for the clinic.

There was no direct outside access from the clinic and so inpatient dogs were led out of the backdoor into the superstore's stock holding area and from there outdoors via the loading bay. The nurses and their charges looked incongruous as they made their way across the expanse of concrete, between the industrial-sized bins and delivery lorries, to the strip of grass where the dogs could 'perform their business'. Sometimes a small stray cat, hidden under the hedge, waited for the leftover food—uneaten by the clinic's inpatients —that the veterinary nurses left for it. Unspoken acts of caring—and reducing waste—woven into the daily fabric of clinic life.

The clinic had been designed to take minimum retail space away from the shop floor (Figure 7.1). One of the consulting rooms also housed the X-ray machine whilst the office doubled as the staff kitchen. Using this approach, the clinic website was able to list an impressive list of facilities as part of efforts to attract clients. The clinic layout followed a locally adapted template used by the corporate veterinary group and informed by the requirements of the Practice Standards Scheme run by the RCVS. Under this model, having a staff room was deemed superfluous: There was a chair in the corner of the office next to the kitchenette but access to the office—and refreshments—was often out of bounds during business meetings. Most staff, therefore, ate their lunch alone in their cars. The limited office space meant that Peter arrived each day with supermarket bags full of paperwork, whilst his garage at home acted as a longer-term storage facility. Clinic life was seeping out of its physical shell.

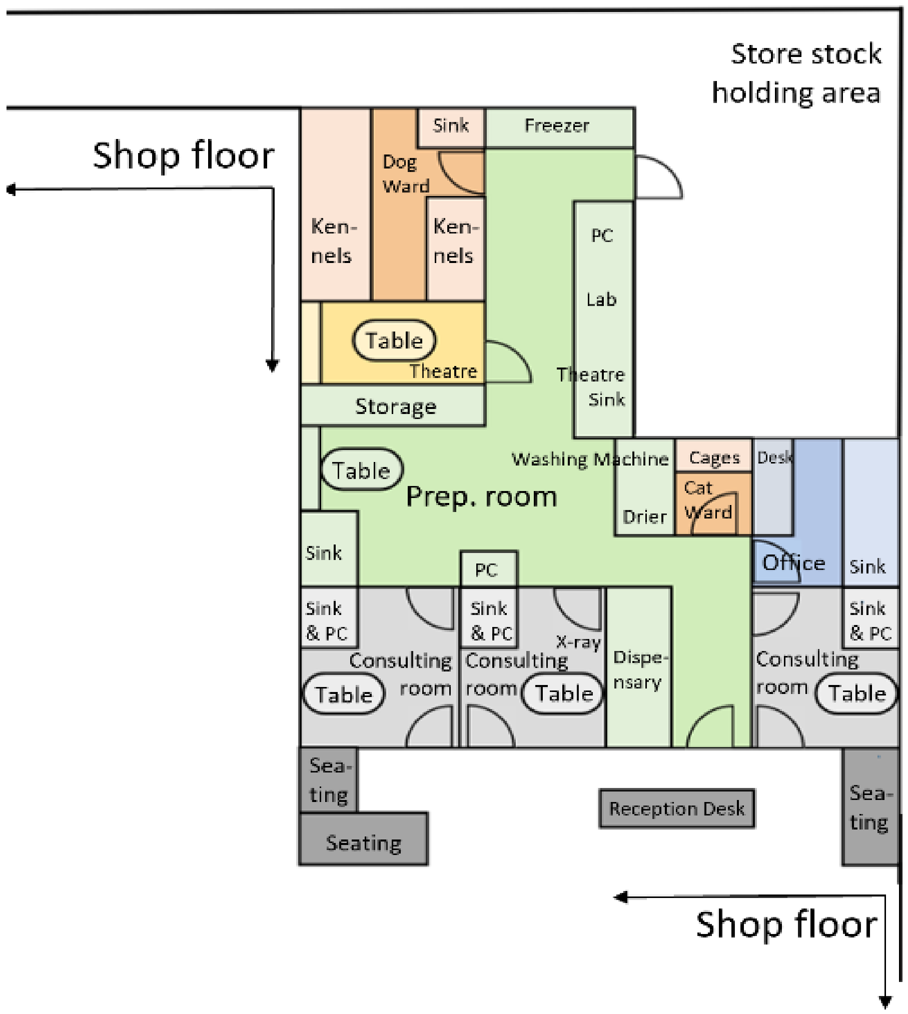


Figure 7.1: The floorplan of clinic one situated in the rear left-hand corner of a pet superstore which extends beyond the diagram.
[The diagram is based on fieldnote sketches with some details changed to protect anonymity].

When 'out back' within the clinic's space, it felt like a bubble separated from the outside world by the public space of reception and waiting area, which acted as a buffer zone. When sitting at the reception desk, you could just make out daylight through the shop's distant front doors. Receptionists would sometimes cross into the clinic interior seeking help with owner enquiries or to prompt a veterinarian to complete adding charges to a client's account so that the latter could pay and leave. The receptionists occasionally complained that staff working 'out back' were oblivious to their skilled work handling owners in person and over the telephone. However, having spent time behind the scenes, I know how all-encompassing—physically and emotionally—working in this busy, pressurised space could be. Periodically, dogs barking in the superstore would penetrate its walls, acting as an interspecies reminder of the world beyond.

The clinic itself was windowless: there were no idyllic country views to enjoy in between seeing clients, as might be expected from James Herriot scenes. Ventilating the clinic relied on a series of air conditioning units that also acted to heat or cool the space. Companion animal needs were prioritised over the comfort of the clinic's human workers. The high temperature in the operating theatre helped protect the patient from hyperthermia along with the recycled (human) baby socks and bubble wrap on her paws. Meanwhile, the staff working in the theatre perspired. The 'appropriate' temperature for the prep area was not universally agreed: some felt it should be warm for the comfort of its mammalian inhabitants whilst others felt a chillier environment provided a hostile environment for germs. This disagreement was played out through the repeated—and dramatised—adjustment of the air conditioning unit.

In addition to the kennels (the dog ward) at the rear of the clinic, there was also a much smaller cattery that was situated off the main prep area, its entrance next to that of the office-kitchenette. Inside there was barely room for two people and a bank of cages. If a patient was admitted with a suspected contagious disease, the cattery was converted into the clinic's isolation ward, fulfilling another of the RCVS' practice standards requirements. Under these emergency situations, normal species divides were suspended and feline patients were relocated to one end of the kennels. A staff member without companion animals at home would volunteer to undertake the care of the isolated animal, to prevent any accidental onwards transmission of pathogenic microbes at home. In this cramped hot space, they would spend most of the day wearing a full-length gown, mask, shoe covers, and gloves. Entering and leaving the isolation ward was logistically challenging and time-consuming. It opened directly onto the main clinic thoroughfare: should one disrobe inside or outside to limit the spread of microbes?

Ideally, there would be a vestibule to act as a buffer but there was no space within the restricted footprint of the clinic. Peter, the senior veterinarian, provoked a series of disapproving headshakes from his nursing team as he left the isolation ward in full personal protective equipment (PPE) and darted across the prep room. He explained over his shoulder that he, 'just needed to quickly collect something'. His path back into the isolation ward was immediately cleaned by a nurse using a mop and bucket that stood in the corner of the prep area, ready to clear up spillages. The nurses agreed that they would release 'a bomb' cleaning device in the prep area at the end of the day to thoroughly decontaminate and fumigate the space. In Section 7.2.7, I return to ideas of how gender and position in the clinic hierarchy intersect to inform expectations of whether individuals are likely to comply with rules.

The nursing team were responsible for nearly all the cleaning and disinfection in the clinic. In addition to using bombs to fumigate clinic spaces, they also cleaned surfaces using a range of antimicrobial products (disinfectants) which advertised themselves as killing 99.9% of bacteria. When it came to maintaining the clinic infrastructure, this was not a place for post-Pasteurian attitudes towards microbes (Paxson, 2008); instead, they were cleaned into submission. Obtaining perceived sterility was key in the sanctified space of the operating theatre, which had its own colour-coded cleaning equipment, in order to prevent secondary bacterial infections in surgical patients. Unlike physical surfaces, attitudes to entanglements between more-than-human bodies and microbes were less straightforward due to the embodied nature of delivering interspecies care (see Section 7.1.4 for further details).

Due to space constraints, corridors were multi-functional: the one linking the reception, the consulting rooms, and prep area doubled as the dispensary. Cupboards of tablets and topical preparations were arranged by bodily system along with antiparasitic treatments and a fridge for vaccines and medicines that require chilling. The physical proximity of the dispensary to the consulting rooms illustrating the integral role providing medicines and products has in veterinary consultations. The injectable and intravenous medicines were situated closer to the prep area, reflecting that most of their use occurred 'out the back'.

To this non-veterinarian's initial dismay, there was no single location for antimicrobial storage in the clinic and this made spotting their use difficult until I 'got my eye in'. They were scattered across cupboards, in the fridge, and stored with other injectable or intravenous pharmaceuticals. There was no alarm that sounded or red light that flashed each time antimicrobials were reached for: this was just a normal, hum-drum part of everyday clinic life. When reading the literature, I had had no such problems in spotting antimicrobial use in companion animals: these medicines were studied and discussed in isolation from other pharmaceuticals and products. Their antimicrobial properties—the focus of the researcher's interest—rendered them special and separate from other pharmaceuticals and products. However, there was no such segregation 'on-the ground': antimicrobials were part of a supporting cast of medicines and veterinary products that supported the delivery of care in the clinic.

The corridor that lead to the kennels and the clinic backdoor housed the freezer that stored the clinical waste and companion animal bodies prior to collection. It also stored the veterinarians' uniforms (nurses were responsible for washing theirs at home) and was home to a small laboratory. It contained a microscope, a centrifuge, and a point of care biochemistry and haematology machine with the associated computer terminal. One of the overhead cupboards had been historically damaged by overfilling (due to the lack of storage space) and periodically gave way—showering the microscope user with pipettes, materials needed to prepare and stain samples, and microscopy slides. This provides a micro-level example of the—sometimes challenging—context in which cytology is undertaken to inform antimicrobial use. All veterinarians undertook cytology, although the clinic antimicrobial champion, Alison, 'liked ears' and so these cases—that often-necessitated undertaking and interpreting cytology—were preferentially booked in with her, when possible.

As a novice fieldworker, it was difficult to know where to stand without getting in the team's way when 'out the back'. The prep area was where animals were readied for the operating theatre and also a space for minor operations (such as cat castrations), dentals, and grooming. I eventually settled next to the washing machine and tumble drier: it was warm and the smell of laundry helped to mask some of the more unpleasant odours. There was not space for industrial laundry equipment and so these smaller domestic machines were constantly in use from when staff arrived at 8.45am until they left soon after 7pm. It seemed eerily quiet when they were switched off at the end of the day: the wall of constant noise that accompanied the working day was suddenly rendered audible. This equipment struggled to keep up with the mountain of laundry and ensure there were adequate clean scrubs and operating gowns for staff to wear, and bedding and towels to keep the clinic's patients comfortable. During my time there, the sign stipulating the animal and human laundry was to be done separately fell off and someone discovered that a cooler washing programme was quicker. In addition to the tumble drier, laundry was also draped on clothes driers and on empty kennel doors in the dog ward to dry whilst inpatients recuperated close by. These adaptions—and their implications on microbial management—made 'keeping up' within the time and space limits a bit easier.

The inversion of the washing machine breaking down revealed the clinic's motley collection of towels to be crucial for enacting care that extended far beyond drying animals bathed after an episode of diarrhoea, for example, or to remove blood stains following surgery or dental work. They were used to cover the prep area table to stop the animal claws from distressingly slipping on its shiny metallic surface during examinations. They caught fur as animals were clipped and cannulated in preparation for surgery. They absorbed any bodily leaks arising from the chemically induced state of 'relaxation' following sedation. They were used to wipe human fingers and probes sticky with ultrasound gel. They swaddled animals following surgery, helping to keep them warm and comforted as they were returned to the kennel or cattery. They were draped over cat baskets and across kennel doors to dampen the bright lights and hubbub of noise, easing the anxiety of patients. They were used to carry animals between clinic spaces either wrapped in staffs' arms or acting like a stretcher for big dogs with a staff member at either end (there was not room for a trolley). They were used to dry surgical equipment prior to packing for sterilisation in the autoclave. The towel was a multi-purpose tool for delivering care.

The limited space in the clinic extended to storage and so stocks of clean towels were always running slightly short. The nursing team managed this by using fresh towels prudently and sharing them between patients. For example, in the mornings, whilst the veterinarians were consulting, the nurses would prepare for that day's procedures—drawing up medications and getting them checked, preparing equipment, and also the animals. The first animal on 'the list' would be brought out and catheterised enabling the administration of a 'pre-med' sedative. She would then be returned to the kennels or catteries to pass the time until the drug took effect. In the meantime, the nurses would begin preparing the next patient. Once the veterinarian allocated as lead 'ops vet' that day was nearing the completion of their morning appointments—the first patient, now sedated, would be brought back into the prep area in order to be anaesthetised, intubated, and the clipping and cleaning of its surgical site would begin. She would then be carried through the theatre by a veterinary nurse, slipping off their outdoor shoes at its entrance, who would place her on the operating table. The scrub nurse, gowned and gloved, would then undertake the final cleaning of the surgical site before covering the patient with sterilised surgical drapes. This way of working enabled the most efficient use of staff time with a succession of animals ready for their procedure in theatre.

The overlapping of animals, whilst productive, also had implications for the sharing of microbes. The same towel would remain on the work station table between patients unless obviously soiled. Staff were busy and would rarely wash their hands in between handling different animals (it would be very time-consuming otherwise with all the switching between patients). The sink was in the corner of the prep area and not always easily accessible, depending on the number of multispecies bodies crowded around the table. Furthermore, it sometimes contained dirty surgical instruments waiting to be rinsed or kidney dishes containing removed animal body parts waiting for disposal—more than enough to deter this fieldworker from washing her hands.

This prudency with towels extended to other consumables. Early on in my placement I watched as Peter undertook an ultrasound examination of a dog. When finished, he asked me to fetch some paper towel for wiping up the ultrasound gel. I returned with a big handful. As the other staff laughed, he spluttered, 'What are you doing? Trying to bankrupt me?'. Unwritten rules governed the 'appropriate' levels of use of consumables, shaped by the need to support the sustainability of the clinic. In addition to being financially costly, using high rates of consumables usage also produced a lot of waste. One veterinary nurse introduced a recycling bin, taking its contents with her at the end of her shift to dispose of at home. Prudency and 'appropriate' levels of consumable use helped to reduce monetary and physical waste.

The nursing team spent their afternoons caring for inpatients as well as cleaning and tidying up after the day's procedures. This included the washing and drying of surgical equipment and drapes, lint rolling them to remove any fur and packing it ready for sterilisation in the autoclave. The nurses taught me how to arrange the contents of the bundles so that, when opened in theatre, the veterinarian would be presented with the equipment in the order needed. They patiently explained that my attempts were not compact enough: they required larger, more expensive packets and fewer would fit in the autoclave at once. This increased the cost—and reducing the timeliness—of the production of sterilised equipment for theatre. 'Playing' at being a veterinary nurse was more difficult than it looked.

Peter had been visited by a representative ('rep') of a company selling single-use disposable scrubs and surgical drapes. Apparently, over time, repeated washing causes the tiny gaps between the fabric fibres to expand, allowing microbes to pass through them. With one eye on the financial sustainability of the clinic, Peter explained to me that once the cost of the staff time, the laundry, and autoclaving was factored in, the reusable versions were more expensive. The nursing team were not convinced, despite the workload this would remove from their hectic days, 'It just seems so wasteful, binning all that stuff each time'.

7.1.2. Clinic one: an extreme case?

In the previous section, I sought to describe the space of the clinic one and to begin to sketch out how care is enacted—and microbes managed—within its walls and amidst spatial and temporal limitations. The following interview extract, in which a recent discussion following an incident in the operating theatre was recounted, provides further illustration of these themes:

'It was basically a case that we'd had where one of the vets thought that an instrument might have touched her arm, so, it was like a minor break of sterility. She wanted to give that particular antibiotic injection because she felt that the course wasn't necessary . . . Like, what do you do in that instance? And then it was it like, bringing up, "well, if you think instruments have touched things then get new [surgical] kits". Well then that is like, "We've got limited stock of kits available for our busy days" and then, "How long does it take to autoclave things?" so that was then the nurses getting involved, like, with the cleaning and the

autoclaving and things like that. Rather than it just being about whether we used an antibiotic, it became more about sterility.'

Alison, salaried veterinarian, clinic one

I further explore the role of veterinary nurses in managing microbes and infection control in Section 7.2.8.

Whilst the tempo of daily life was organised around being efficient and productive, it was steeped in the enactment of care. Although easily overlooked, the 'low-tech' intervention of the towel played a central role in care and illustrated how the prudent use of consumables underscored daily clinic life.

Ways of caring were temporally and socially contingent with different individuals having different interests, abilities, and foci of care. These tensions—and the imperative to be productive—meant that, despite being a place of care, the clinic was not always a pleasant place to be. A veterinary nurse was chastised by Peter, the senior veterinarian, for turning away a dog scheduled for a spay, a procedure conducted under anaesthesia. The nurse vigorously defended her actions: the owners had not followed the clinic's guidelines regarding the period of fasting necessary prior to admission. Peter, who was visibly cross, countered that the day's timetable could have been revised so that the dog was operated on last in order to minimise the risk from the shorter duration of starvation. Afterwards, the nurse muttered to me, 'it's not right when he puts his business before safety'. Who knows what would have been the consequences of proceeding with the operation and who was 'right' in this situation? It does, however, provide an uneasy example of differing priorities when enacting care. To be clear, during my placement, I witnessed many examples of Peter prioritising 'caring for the animal' over 'caring for the business'.

In the preceding section, I concentrated on clinic one, as it was here that the spatial constraints were most evident. My subsequent fieldwork placements enabled me to reflect on what I had seen and to make sense of how the physical infrastructure shaped the enactment of care there (Kirk, 2016). These later fieldwork sites were located within older, stand-alone buildings with space for extension, if necessary. There were still bottlenecks; staff squeezed around the dental table at clinic two or the cramped dispensary in clinic three. However, based on my embodied experiences, the presence of staff rooms and windows at clinics two and three helped to lessen the sensation of being in a pressurised, constrained working environment.

In terms of temporal constraints, at my third fieldwork site, the charity clinic, staff also experienced time pressures similar to those encountered at clinic one. They had long surgical procedures lists—deploying the same ‘conveyor belt’ technique in preparing animals for theatre—and over-subscribed clinics with multiple extra patients added on. As described in Chapter 6, the charity offered ten-minute appointments, exacerbating the time pressures of delivering care in consultations. With more space, however, they were able to store greater stocks of the consumables required to support the delivery of this volume of care; for example, shelves filled with towels lined a long corridor in the clinic.

Clinic two was a slightly different situation: by targeting clients who were willing to pay more for a ‘high-quality’ experience, their business model was less reliant of maximising footfall of highly price-sensitive clients through the clinic. It was unusual for there to be more than one companion animal and their owner in the waiting room and the second consulting room was rarely used. There were often spare appointment slots and fewer, planned operations were undertaken. However, the veterinarians working there still experienced time pressures when emergency cases arrived, especially towards the end of their shifts.

The imperative to use consumables prudently was evident in all fieldwork sites. However, clinic two used more single-use, disposable consumables, e.g. veterinary incontinence pads (puppy pads) in the place of towels sometimes. Rather than wiping and rinsing thermometers in between patients, staff used specially designed, single use covers when inserting thermometers rectally. Owners sometimes commented positively on this; a simple act illustrative of the ‘higher quality care’ delivered there compared to its rivals. At all sites, the cost of consumables was passed onto owners, for example, they were included in the cost of standard quotes for procedures. Staff undergoing training had to learn how to undertake procedures not only within the allocated time but also using the allocated amounts of consumables.

To conclude, whilst the temporal and logistical constraints were most striking at clinic one, the spatial and temporal context, and the use of consumables, shaped the enactment of care and the management of microbes at each of my three fieldwork sites.

7.1.3. Finding a space for antimicrobial stewardship

Clinic one was bursting at the seams, both temporally and physically. Lunch breaks and evenings were eaten into by workloads whilst staff garages and cars stored the physical overflow of clinic ‘stuff’. It is onto this crowded stage that initiatives seeking to alter antimicrobial use arrived and had to find a ‘niche’.

During my time at clinic one, the head office of the corporate group distributed antimicrobial stewardship materials they had developed. The components included a poster demonstrating the WHO recommended handwashing technique that was stuck on the wall above the (inaccessible) sink. A bundle of owner education leaflets was also sent but, somehow, they never made it 'out front' where the reception desk was already occupied with fliers for a special deal on dentals. The stewardship materials suggested relocating HPCIAs to their own separate cupboard with a poster highlighting that they should not be a first-line choice. However, this would have required reorganisation of the dispensary and changing the currently used taxonomy of medicines. It would have necessitated the rerouting of common, and efficient, pathways staff took around the clinic as they went about consulting or caring for inpatients. This suggestion, therefore, was not taken up.

Amongst the circulated stewardship materials, an information folder (sponsored by a pharmaceutical company) was included (see Chapter 6 for further consideration of the role of pharmaceutical companies in providing in stewardship guidance). The clinic manager stuck a Post-it sticky note with the veterinarians' initials onto the front, ready for them to confirm they had read it. Every few days I would check on progress: the sticky note became increasingly dog-eared and the folder harder to locate. The team were swamped by more recent arrivals demanding attention, such as brochures from a recent rep visit, veterinary and business journals, and a sign-up sheet for an upcoming curry night. Hidden out of sight, reading the folder became an activity out of mind.

The arrival of the stewardship materials prompted me to ask if the clinic had a copy of the BSAVA's PROTECT poster (Battersby, 2011). This A1 sized document was neatly folded away in a filing cabinet as the limited wall space in the clinic had been used for valuable storage and there was not space for its display. Peter pointedly mentioned that the updated version (PROTECT-ME)—which had been distributed by the BSAVA in October 2018 (BSAVA., 2018)—was in veterinarian Alison's car awaiting completion of the locally preferred antimicrobial choices (it was now March 2019). Alison, a salaried veterinarian in her twenties, was an enthusiastic advocate for antimicrobial stewardship in the clinic. However, overhearing our conversation, she rolled her eyes, 'Yeah, I'm just waiting for some *spare* time, you know, in between *all* the consults, *all* the ops, *all* the phone calls . . . I'll do it if you block me some time out'. Peter did not respond: in practice, there was not space in the business model for such non-revenue-generating activities. This encounter also led me to ponder who should shoulder the burden of undertaking this public health activity that, in theory, could benefit us all. Should

Alison give up her evenings to complete the poster? Or should Peter subsidise these activities through his young business?

The micro-level challenges of finding space for antimicrobial stewardship within the clinic are also seen at the macro level, through the taxonomy of the veterinary profession and veterinary science. Recognised veterinary specialisms include cardiology, neurology, and orthopaedics, although, unlike in human biomedicine, there is no tradition of veterinarian training as infectious disease specialists. The role of the latter has expanded in human medicine to include expertise regarding antimicrobial resistance and its management, and is often supported by pharmacists, another role largely absent from veterinary cadres. As a consequence of the taxonomy of the veterinary profession, there is no recognised speciality to lead antimicrobial stewardship efforts across the profession. This classification was also reflected in the programmes of conferences I attended. Talks about antimicrobial stewardship had no obvious 'home' and appeared in the 'bits and bobs' streams with other thorny issues such as sexism in the profession (see Section 7.2.4).

To conclude, veterinary clinics can be crowded spaces, full both from a temporal and spatial perspective. These constraints shape not only work of caregiving and microbial management, but also the undertaking of antimicrobial stewardship activities. As a relative newcomer to the companion animal veterinary clinic—and indeed, to veterinary science as a whole—such stewardship activities are yet to become an established part of daily life that can be prioritised over existing—and competing—requests on time and space.

7.1.4. The embodied nature of interspecies care

In Section 7.1.1, I described how care is enacted and microbes managed within the time and space constraints of the companion animal veterinary clinic. It can be difficult for ethnographers to tease out 'taken-for-granted' aspects of a particular setting, and a key technique to do this is to draw out comparisons. To reflect on the embodied aspects of care giving and its implications for microbial management, I compare the everyday clinic scenarios described earlier with a gold standard scenario produced by an infection control education tool designed for the companion animal veterinary sector (AMRSim, 2019). Its creators—Glasgow School of Art and Design, the University of Surrey and Fitzpatrick Referrals—describe how the tool acts as a, 'graphical simulator . . . within which humans, animals, and bacteria interact according to rules observed from real-life' (n.p.). The animation renders visible sites of—normally invisible—microbial contamination and seeks to alter the perception of the normality of 'in-built risky behaviour'

(Figure 7.2). By comparing the tool with my observations, it helps illustrate the tensions between the multisensory enactment of interspecies care and gold standard infection control.

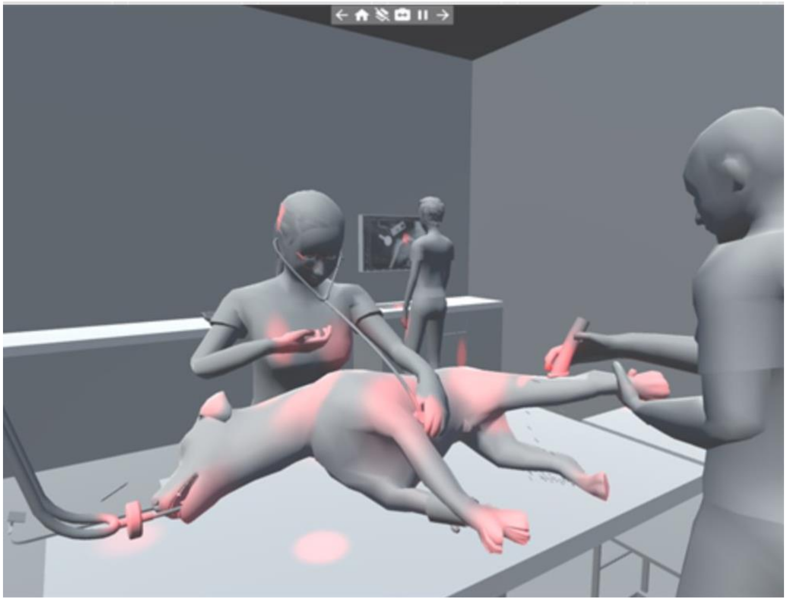


Figure 7.2: A screenshot taken from the AMRSim tool (AMRSim, 2019), reproduced with kind permission of the AMRSim project.
[The red areas illustrate the 'transfer of "invisible" contamination between animal, veterinary staff, surfaces, and equipment during a pre-surgical procedure if proper infection control methods are not being observed].

Whilst able to graphically represent veterinary care work, the simulator is less suited to depicting its tactile entanglements. The dog portrayed in the simulation has been rendered without fur, making her look almost robotic. When in clinic, an integral—instinctive—part of caring for anxious dogs was stroking their fur. The resulting calming effect soothed both the canine patients and their human carers. During anxious days in clinic, I found the ruffling of a dog's coat helped to ease my nerves; the interspecies contact of fur on fingertip triggered neural pathways and dampened the release of stress hormones (Allen et al., 2002). These automatic care strategies were not thought about, remarked upon, or associated with handwashing. Such multispecies interactions did not feel risky—rather, they felt health promoting. Conversely, whilst the wearing gloves introduced a barrier stopping the transfer of microbes, it also prevented the making of the tactile interspecies connection crucial for the delivery of this central care-giving strategy.

The simulator's reduction of the tactile aspects of care extends to the staff uniform which is shown devoid of personal touches such as jewellery and the equipment belts worn by some nursing staff. Cardigans helped to prevent the discomfort caused by scratches from patients or the chill from air conditioning units. However, long sleeves contravene infection control messages that encourages 'bare below the elbow' to facilitate thorough hand washing and to avoid the transfer of microbes on cuffs and sleeves (Jones, 2008). The depiction of staff as standardised—microbe spreading—units overlooks the personal and embodied experiences of delivering care.

The portrayed clinic appears largely empty with bare walls and worksurfaces devoid of the paraphernalia—such as patient paper work and cups of tea—that accumulate as part of the everyday functioning of the clinic. This representation is in contrast to clinic one, which was, as described, bursting at the seams. The emptiness extends to floor space with staff not having to squeeze past or climb over another to reach equipment. The 'luxury' of space makes thorough cleaning easier with fewer objects and bodies acting as obstacles, or the prompt re-contamination of a cleaned area, for example, by walking across freshly mopped floors. However, such space requires larger, costlier clinics, which may be unaffordable. By presenting the ideal scenario, the tool glosses over the realities of delivering care within these constrained spaces.

Part of the tool includes showing the impact of 'proper control methods', such as the wearing of aprons and single-use table coverings. Previously I described how the 'appropriate' use of consumables was shaped by an interplay of the resources available and the imperative to minimise waste, be that of time, finances or physical detritus. Plastic aprons and gloves were worn, but only for animals suffering from vomiting or diarrhoea, or for those suspected of having a contagious disease. Otherwise, such PPE made the delivery of care more difficult, with claws catching on the rustling aprons as patients were carried between clinic spaces. Instead, animals were clasped to the soft and sound-absorbing uniforms, which were rarely changed during shifts unless physically soiled; the fabric of uniforms provides a comforting home to more-than-human messmates of the mammalian and microbial types.

In summary, embodied aspects of companion animal care are at odds with gold standard infection control. Interspecies communication required tactile entanglement that enabled the conveyance of more-than-human communication as well as microbes.

7.1.5. Implications for care and antimicrobial stewardship

In this section I draw together some of the themes discussed previously and reflect on their implications. Antimicrobial resistance, unlike other threats or risk in daily clinic life, is intangible: one cannot rely on one's senses to detect it. This is unlike assessing the personal risk of being bitten or the risk to clinic sustainability from using consumables ‘inappropriately’. The following extract from fieldnotes illustrates a case when clinic staff deploy ‘traditional’, sensory means of risk detection of an infection suspected of involving antimicrobial-resistant pathogen(s). Similarly, in an ethnographic study of a UK dairy farm, Helliwell et al. (2019) described how antimicrobial resistance was imperceptible to the experiential knowledge practices of veterinarians and farmers who were skilled at identifying and diagnosing sick livestock.

Fieldnotes extract: clinic two

Veterinarian Chloe admits a cat who has been suffering from a recurrent ear infection that has not resolved despite antimicrobial treatment. Her plan is to collect a sample for culture and sensitivity testing and to give the ear a thorough clean. With help from nurse Lily, who holds the Siamese cat tightly to her body, Chloe manages to take a swab from the ear. Lily’s head is close to the cat’s when the swab is removed from the latter’s ear; it is covered in thick black discharge. Lily visibly gags, ‘Oh my God! That stinks! That’s awful’. She tucks her face into her hair from where a muffled, ‘That’s gotta be resistant . . . it’s vile’ is heard. The room quickly fills with a terrible smell—I cover my face with my notebook.

Subsequently, the culture and sensitivity results were received from the veterinary laboratory. They did not report any antimicrobial resistance: its microbial ‘nastiness’ did not live up to the physical revulsion it triggered.

During my fieldwork, the only time the potential location of antimicrobial-resistant microbes in the physical infrastructure of the clinic was explicitly considered was at clinic two. Five swabs had been sent by Head Office for sampling of the clinic and testing for resistant microbes. Veterinary nurse Niamh bounced ideas of where the samples should be taken from. Like amateur detectives, we walked around the clinic together seeing—with fresh eyes—familiar sights as potential habitats for resistant microbes. We eventually agreed on sampling sites that included the examination table in the main consult room (a high-throughput area for companion animals), the underside of the slip-resistant mat on the dental table (it was difficult to clean here), and inside the isolation ward (where very poorly animals receive multiple antimicrobials). Niamh got the results a week later—none of our sites had swabbed positive for resistant bacteria. I was a bit disappointed that our endeavours had not been fruitful but Niamh was pleased, ‘All that cleaning is paying off’.

The possibility of people harbouring and transferring resistant infections to the clinics’ companion animal patients did not occur to us when selecting sampling sites. This may have been due to prevailing discourses of the flow of infectious disease from (dirty) animals to (clean) humans (Lynteris, 2019). Previous research identified an occupational risk of UK companion animal veterinary clinic staff with regards to MRSA carriage: nasal swabbing positively identified MRSA in 12.3% of clinic staff (n = 220) attending MRSA-infected companion animals (n = 106) and 7.5% of their owners (n = 120) (Loeffler et al., 2010). A modelling study using data from US veterinary hospital records, staff interviews, and the published literature suggests that transmission of resistant bacteria resulting from contact with veterinary clinic staff was common (Suthar et al., 2014). However, any staff screening programme would have to be handled sensitively: what would happen to those who screened positive? What would be the impact on already stretched clinic staffing? Given these concerns, perhaps it was wise that we only sampled inanimate surfaces.

From a commercial perspective, being able to demonstrate your clinic is free from resistant microbes could act as a ‘selling point’. Conversely, knowledge that such microbes are present is commercially sensitive: a veterinarian confided in me that a sister clinic had had a case of a multidrug-resistant ear infection, ‘I don’t know if I should really be telling you this . . . ’. This additional complexity to antimicrobial resistance screening in a private healthcare system is perhaps not one encountered in the NHS. It may provide a financial deterrent to making tangible the risk presented by resistant microbes situated within the companion animal clinic.

One tool available to help veterinarians render visible local patterns of antimicrobial resistance is the IDEXX laboratories Pet Resist website (IDEXX, 2020). This provides the information by postcode area or district of the resistance patterns for the ten most commonly used antibiotics in UK veterinary clinics. In the past, small sample sizes have hampered the robustness—and therefore usefulness—of the local estimates of resistance produced. This illustrates how the context shaping the limited front-line use of culture and sensitivity testing in companion animals has consequences that extend beyond the management of the individual cases. The sparse testing means that the populations and distribution of resistant microbes within companion animals remain largely unelucidated. The usefulness and uptake of this relatively new website—it was launched in 2015—is further hampered by the unestablished place that antimicrobial stewardship activities have within the clinic, as described in Section 7.1.3. There is no formal routine within clinic life to consult the website.

Without a home in the clinic—be that in space or time—or an established space within the taxonomy of veterinary science, antimicrobial resistance remains floating and difficult to ‘pin down’. I suggest that, by not having a physical or temporal ‘place’, the identification of antimicrobial resistance as a threat to the 'cleanliness' of the companion animal veterinary clinic is hampered. In a setting where productivity is valued—and often time sensitive—it is difficult to prioritise stewardship activities whose benefits are intangible and nebulous. The business models that underpin the sustainability of the clinic do not 'naturally' allow space for such public health activities. Finding ways to foster a temporal and spatial home for antimicrobial stewardship activities will support its uptake in everyday clinic life.

Time spent in the clinic revealed how care was delivered within temporal and logistic constraints. The value of being productive echoes the findings in Chapter 6 regarding the 'business model of busyness'. Is it possible to re-imagine a 'slower' form of veterinary medicine? For example, inadequate consultation duration has previously been identified as a barrier to holding tricky conversations about not supplying antimicrobials (Eastmure et al., 2019b). In Italy, there is a movement towards 'slow medicine' (Bonaldi and Vernero, 2015), which encompasses, 'a respect for nature and the environment, a sense of justice, and an aversion to waste and consumerism' (Attena, 2019, p. 4). As described previously, veterinarians and clinic staff are already careful not to be wasteful in clinic. Although it is unclear whether there would be veterinary interest in the other features of slow medicine, it might provide a helpful thought experiment to imagine what slower forms of veterinary care could look like.

Time in clinic revealed the entanglement of bodies necessary for the delivery of interspecies care. Outside of the clinic, a UK interview study highlighted how reciprocal affection was an integral part of the relationship between owners and their companion animals but this also represented potential 'microbe transmission behaviours' (Dickson et al., 2019). The sometimes-strong emotional attachment underlying these 'risky' encounters also contributes to the context in which owners make decisions regarding antimicrobial use, the authors propose, further complicating animal–human–microbe-medicine entanglements.

Studying care of the often-overlooked group of companion animals can provide a fresh perspective on our societal understanding of what constitutes 'good' care and enable the examination of circulating assumptions and relationships (Ritvo, 2006, Brown and Nading, 2019). The embodied, tactile encounters I observed—whilst they might be considered 'risky' from a microbial management perspective—were central in the delivery of interspecies care. When seeking to optimise infection control procedures—for example, to help reduce reliance on antimicrobials—consideration should be given to ensure that the care-giving aspects of such activities are not stripped away too. Otherwise, infection control initiatives could have the unintended consequence of supporting the development of a system—which whilst aseptic—equates accessing care with accessing medicines (Chandler, 2019).

7.2. The clinic as an intersectional space

In this section, I turn my attention to the interactions between human actors within the clinic. This is with the aim of answering my research question regarding how intersectional engagements shape personal experiences of providing companion animal care, including the use of antimicrobials. I seek to tease out some of the power dynamics at play, how they shape socially acceptable forms of care and the consequences this might have for antimicrobial stewardship work. As described in Chapter 4, younger, more junior veterinarians are more likely to be women and this was reflected in my fieldwork sites. Rather than treating this clustering of demographic characteristics as confounding my findings, I instead turn to the anthropological theory of intersectionality (Crenshaw, 1991) to help me explore how these knots of characteristics shape the personal experience of providing companion animal veterinary care.

To begin, however, a story of a typically overlooked form of companion animal care—the out-of-hours service—delivered by a typically overlooked veterinarian—the Eastern European migrant worker.

7.2.1. Setting the scene: the night veterinarian

Gabi is 42 years old and qualified as a veterinarian over fifteen years ago back in her home country of Romania. She provides overnight veterinary cover every other week. Her partner is also Romanian and works at another clinic within the same corporate veterinary group. Between them, they care for their young daughters with Gabi bringing them with her when her shift starts at 6.45pm and they wait in the staff room for her partner to collect them on his way home from the 'day shift'.

Gabi consented to be observed for my research but declined to be interviewed as she was self-conscious about her English and did not want to be recorded. However, during the quiet spells during her night shifts we chatted. At other times she would search the Internet for how best to treat her inpatients (there were no other veterinarians to ask) or email veterinary hospitals with requests for educational visits, asking me to proofread her emails. She had a reputation for being unusual amongst night veterinarians, taking an active role in 'working up' the cases of her inpatients and planning their treatment, rather than babysitting them until the arrival of day staff in the morning.

When she first arrived in the UK—four years ago—she spent time at the clinic observing practice as she waited for her veterinary registration to come through. The worst part was trying to understand the owners: she hated it, 'I wanted to go and work in Debenhams'. Soon after formally starting work, she was required to attend an induction day at the veterinary group's headquarters. She was terrified about driving on British motorways for the first time and finding her way: in the end, her partner drove behind her in his car to reassure her—an act of unseen emotional labour.

Gabi cannot understand why young British veterinarians are quitting the profession, 'What have *they* got to worry about?'. She explains how she writes down everything in the notes, 'all the long conversations', in case of complaints. Amongst the day staff, Gabi's notes have a reputation of being rambling and sometimes difficult to follow.

One night, a male owner arrives with a young spaniel who has eaten part of a plastic toy. Gabi explains how she'll begin with physical exam and compliments the owner on the dog's 'amazing, clean ears'. The owner does not hold the dog as she attempts to measure its heart rate. Gabi chases the dog around the consulting room as he stands there. She explains each part of the examination, 'Femoral pulse is normal' perhaps deploying technical language to demonstrate her professional expertise and consolidate her social standing. The owner replies, 'Sorry I don't understand what you said. But it's normal—so that's ok'. Gabi's face flushes.

Gabi outlines her plan to give the dog an injection to induce vomiting. She leaves the room to collect the injection and returns with it and a surprisingly large stack of newspapers. She administers the injection and starts covering the floor near the dog with newspaper. The dog's tail stops wagging and she begins to wretch. She vomits quickly three times in succession. In addition to the plastic toy, she has eaten a quantity of sheep faeces. The room suddenly feels hot and is filled with an acrid smell. My stomach turns.

Gabi kneels down on all fours and, with gloves on, painstakingly goes through the green vomit with her fingertips eventually retrieving the toy. The owner leans on the table, checking his phone. The dog vomits again—it's just green fluid now. Gabi crawls around the floor tidying away the vomited upon paper. Whilst she is busy, the dog wretches and the owner watches as she vomits directly onto the floor. There is a pile of newspaper next to him: we briefly make eye contact and he shrugs his shoulders. Gabi cleans it up and wipes the floor, spraying it with cleaning product. After a while, the dog stops retching. She gives them a puppy (absorbent) pad to take in the car in case of further vomiting. After paying, the owner remarks, ‘it’s been an expensive episode’ [The consultation fee is £150, the injection another £80].

Afterwards, Gabi quizzes me about whether I can understand her, ‘He [the owner] makes me feel like I forget my English’.

7.2.2. Why consider intersectionality?

Actor network theory suggests that context is not a fixed entity. Instead, it is contingent upon and experienced differently by the various actors operating within it. Therefore, in this section, I explore how the context in which companion animal veterinary work is undertaken is experienced differently by different individuals. I refer to Crenshaw’s theory of intersectionality—how aspects of one’s identity (such as gender, race, class, social position) might combine to produce unique experiences of discrimination (Crenshaw, 1991)—to help understand the experiences of companion animal veterinarians working on the front-line. Being a young and/or female veterinarian who has recently arrived in the UK might combine to give very different experience of this work than being an older and/or male veterinarian who trained in the UK and has lived here all his life. For example, colleagues and clients may have different expectations and behave differently around you. Intersectionality acknowledges that one’s social identity arises from a complex and contingent entanglement of factors, rather than being the product of dichotomies, such as male versus female. Any antimicrobial stewardship intervention deployed into the veterinary clinic context will encounter such social complexities and considering intersectionality can help to minimise any harmful or unintended consequences of such efforts.

The BVA campaigns for an inclusive veterinary profession, partly through commissioning research into gender discrimination (Begeny and Ryan, 2018) and workforce diversity (BVA., 2019b). They report that, ‘The UK veterinary profession is only 3% non-white’ (BVA., 2019b, p. 1), their choice of language revealing how deep norms run within the sector. Recent initiatives to promote inclusivity include the British Veterinary Lesbian, Gay, Bisexual, and Transgender+ group founded in 2015 (BVA., 2015b) and, more recently, the British Veterinary Ethnicity and Diversity Society, ‘a peer-to-peer support network for Black Asian and Minority Ethnic (BAME) groups, non-British veterinary professionals and white allies’ (Robson, 2019, p. 166). One might suggest that, by categorising these ‘others’ together, a wide range of experiences are rendered into a homogenous—perhaps almost meaningless—unit. For example, included within this group are veterinarians who are: from BAME groups, who grew up and trained in the UK; overseas veterinarians from English-speaking countries who follow historically embedded pathways of migration that began during the British Empire (Brown and Gilfoyle, 2010); and overseas veterinarians from non-English speaking countries whose relatively recent movement has been facilitated by the EU (Enticott, 2019). Here, the use of the BAME classification appears a rather blunt tool if intending to support the range of companion animal veterinarians from minority groups in the UK.

7.2.3. The clinic as a multinational space

To date, there has been limited social science research into the experiences of being a migrant worker in the UK undertaking companion animal veterinary work. Novel ways of organising veterinary labour have 'inscribe[d] mobility within the profession' (Enticott, 2019, p. 723); however, Enticott's research focused on livestock veterinarians. Meanwhile, an organisation representing large corporate—predominately companion animal—veterinary groups estimates that 30% of their veterinary workforce are non-UK EU graduates (Waters, 2017) with several running residency programmes targeting this group.

Newly graduated EU veterinarians arrive in the UK, often their first experience of living abroad, and their employer provides them with renumeration and, in some cases, organises their housing and a vehicle, as they do in some UK graduate schemes. The resident veterinarians' progress is closely monitored during the programme—core skills include being able to complete a consultation within 15 minutes and 'price it up' accurately on the PMS. Employer benefits of operating the scheme include a source of labour to fill long running vacancies (see Chapter 4) that is cheaper than employing more experienced staff. Without an alternative body of empirical evidence to refer to, 'fresh' graduates can also be moulded more easily to follow the veterinary group's desired ways of working.

Under EU mutual recognition rules, the RCVS must automatically register graduates of EU veterinary schools wishing to practise in the UK (Loeb, 2019a). Despite international efforts to standardise training, the quality of the undergraduate veterinary education delivered in EU countries varies (Loeb, 2019b). One resident veterinarian from eastern Europe explained to me that, during their degree, the extent of their practical X-ray training was being shown a switched-off machine through a doorway. In contrast, UK undergraduate veterinary education is internationally recognised for its high quality (RCVS, 2019) and its inclusion of intra-mural rotations and/or extra-mural studies, which allow students to gain practical experience of veterinary work and to achieve their Day One Competencies prior to graduation (RCVS., 2020).

Within my fieldwork clinics, some overseas female residents aligned themselves more closely with the nursing staff—who were predominantly women—rather than the other veterinarians. They felt more comfortable helping with companion animal care behind the scenes instead of undertaking consultations (see Gabi's comments regarding language barriers). This was sometimes met with irritation as the relative newcomer 'got under the feet' of the nursing team and their ways of working. This group of staff, unlike veterinarians, is predominantly British, with 93% of nurses having qualified in this country (RCVS., 2018). At one site, uneasy 'jokes' were made when a veterinary resident undertook nursing duties, 'You come over here and take our jobs'. By doing so, she blurred the usually clear boundaries between the veterinarians and the nursing team in the clinic.

At clinic two, a young couple had recently arrived from a Spanish university and were undertaking the residency programme together, rotating across a number of clinics. One of the salaried veterinarians, Raul, who was responsible for mentoring them, had been recruited from the same university a couple of years beforehand resulting in a little pocket of Spain in a suburban veterinary clinic in the Midlands. 'Out the back', these three chatted in Spanish. Seeing my pen hovering over a blank page in my notebook, Raul apologised, 'It's easier for me to explain this way': the work of translating thoughts and action into English adding to the workload of non-UK EU graduates.

The experiences of 'starting out' as a veterinarian and enacting what they have been taught at university varies for each individual. In addition to the practical and emotional labour of making a new home in the UK, non-UK EU graduates grapple with developing their practical and communication skills. They also have the task of learning what is considered normal or 'appropriate' veterinary care in the UK, 'It's different to how it is in Spain. It's more demanding here. People spend a lot of money on their pets' (Anonymous, 2017a). This included assimilating how to deploy antimicrobials. In the focus group at clinic three, Vittorio explained about his arrival to the UK five years previously:

'If you are not stupid you kind of learn from your boss and you do what he does. Yeah, I was quite impressed. The first spay that I've done, I said, "Oh we need antibiotics" and [it] was said it wasn't necessary. And I spent the night thinking, like "it's gonna die" [laughs] and nothing happened because it was sterile and it was a clean surgery . . . there's a big difference between Italy and the UK.'

Vittorio, salaried veterinarian, clinic three

Non-UK EU veterinarians reflected on how patterns of use varied differed between their home country and the UK, typically describing the latter as very good. Although not included in the key competencies of their residency programme, part of becoming a UK companion animal veterinarian included learning local ways of working with antimicrobials.

In my, admittedly small, sample of fieldwork sites, the role of clinic antimicrobial champion had been taken on by UK graduates. This informal, self-appointed job included challenging and sometimes cajoling colleagues regarding their 'inappropriate' antimicrobial use. These UK graduates may have felt compelled to do this due to their university education extolling the importance and urgency of using antimicrobials 'appropriately':

'I guess, my passion for antibiotics and safeguarding them has come from an intercalation year I did at Uni . . . in that was a research project which I did about like beta-lactam resistance and stuff in certain, they were mainly human hospital pathogens and the research I did into that and things was eye opening. And I've tried to encompass that and bring that into the veterinary world a bit more. I try to think about the wider effects of antibiotics rather than just for the client I am seeing at the time and making them aware of it as well.'

Alison, salaried veterinarian, clinic one

'Some of the vets, actually, that came from Europe or trained in Europe that have recently qualified will reach very quickly for fluoroquinolones and I think that, the newly graduated vets from the UK wouldn't use a fluoroquinolone, especially not first line . . . we had it drilled into us at Uni that, you know, if you are using fluoroquinolones, you should be doing some testing first.'

Anna, salaried veterinarian, clinic two

By not having to undertake the additional labours of non-UK EU graduates— such as assimilation and practising veterinary medicine in a second language—UK graduates may have greater spare capacity to undertake this work. Their social capital (Muntaner et al., 2007) in the clinic hierarchy is greater, empowering them to feel more confident when approaching colleagues about their antimicrobial use, as well as being supported by their broader English vocabulary.

When undertaking this research, I was struck by the invisibility of non-native English-speaking veterinarians in representations of UK veterinary work. In the popular media, English—or Irish in the case of Supervet (Hobson-West, 2019)—veterinarians predominate. As a consequence, prior to undertaking my fieldwork, it did not occur to me to consider whether speaking another language would enhance my data collection. Despite 23% of veterinarians on the UK professional register being from non-UK EU countries, just 7% of the BVA's governing council graduated from non-UK EU universities (three out of 43 members with information publicly available) whilst all of the veterinarians sitting on the council of the RCVS attended UK universities. Perhaps the hierarchies observed at the micro-level within clinics are replicated across the veterinary profession as a whole. The looming threat of Brexit—and potential removal of the non-UK EU source of labour—has rendered this group more visible within the sector (BVA., 2017). However, most talk in the veterinary press is about—rather than by—this group of front-line veterinarians. Representation of *the* veterinary profession as a single, unified voice glosses over the multiplicity of intersectional experiences of undertaking this work.

7.2.4. The clinic as gendered space

'Gender is an issue—there, I've said it . . . and it's taking time for (mostly) older (mostly) male practice owners to adjust to a (mostly) female workforce.'

A corporate veterinary group senior partner quoted in a *Veterinary Business Journal* article discussing gender and the veterinary workforce (Anonymous, 2018).

Fieldnotes extract: Clinic two

Zac, the senior veterinarian, finishes a lengthy orthopaedic surgery. He exits the operating theatre leaving the dog under the care of the veterinary nurses who closely monitor their patient as she slowly comes around. He removes his disposable surgical gown, that is covered in blood, revealing his t-shirt soaked in sweat. He stuffs the gown into the nearest bin—meant for recyclable waste—and then wanders outside for a cigarette. Emily, a veterinary nurse, snatches the gown out of the bin and places it into a clinical waste bin labelled with biohazard warnings, 'It's like he's completely oblivious' she seethes.

I now move on to focus upon gender. As reported in Chapter 5, most veterinarians in the UK are women, who are, on average, younger than their male colleagues. This was reflected in each of my fieldwork sites, where the senior veterinarian was an older man—in his forties or fifties (although one was on secondment and his replacement was a woman). They were supported by a team of salaried veterinarians who were typically in their twenties or early thirties, and mostly women. Across my fieldwork sites, there were five salaried veterinarians who were men, two of whom were UK graduates, and twelve salaried female veterinarians, eight of whom were UK graduates. The gender balance was inverted amongst the large cast of supporting veterinary nurses and animal care assistants, just four of which were male.

In the UK, two of the ten large companies with the worst gender pay gaps are corporate veterinary groups (BBC., 2019) with far more men earning over £95,000 than women (23% vs 3%, respectively) (Waters, 2017). The gender pay gap is more than the result of the absence of women from senior positions: data suggest that women are likely to be paid less than their male colleagues at the same organisational level (Waters, 2018a). A study found that, for hypothetical veterinary job candidates who were identical apart from their gender, 'Elizabeth' was rated as less competent and offered a lower salary—between £1,100 and £3,000 less—than her male equivalent by veterinarians and clinic managers (Begeny and Ryan, 2018). Study participants who perceived that female veterinarians no longer face discrimination (44% of the sample) were disproportionately male, older (47 years old on average), and rated the male candidate as significantly more competent (Begeny and Ryan, 2018). In summary, male veterinarians are more likely to earn more and occupy senior positions, but be less likely to be aware of the ongoing discrimination faced by their female colleagues and employees.

The lack of women at senior levels of the veterinary profession has been ascribed to reduced career progression resulting from 'time off' during maternity leave and subsequent part-time working as they take on the majority of childcare (Knights and Clarke, 2019). Their male counterparts—whilst they might be fathers—are not expected to shoulder this additional burden in the same way, enabling them to 'get ahead' by accruing more professional experience, e.g. through full-time working (Tindell et al., 2020). It has been suggested that working mothers, on the other hand, see their career aspirations stall and fade (Anonymous, 2018).

Knights and Clarke (2019) have proposed that discussions regarding gender discrimination within the veterinary profession have simply repeated and reproduced arguments of female reproduction and parenting as the sole cause without consideration of the broader inequalities faced by women. Following their study of the construction and reproduction of gender in the veterinary organisations, they concluded, 'although feminized in numerical terms, the veterinary profession and its professional structure and culture remains gendered masculine' (Knights and Clarke, 2019, p. 1). Instead, they propose that the lack of senior female veterinarians is because women, 'repeat, recite and reproduce gendered discourses of limitation' (Knights and Clarke, 201, p.1) regarding their physical, intellectual, and emotional capabilities. This process appears to start early with fewer female veterinary students aspiring to own a veterinary practice than their male course mates (73% vs 83%, respectively) (Castro and Armitage-Chan, 2016).

Recently, business scholars Treanor and Marlow (2019) explored the overlap between the increasing feminisation and corporatisation of the UK veterinary sector in an interview study. They identified a discourse of blame: preference for predictable, flexible employment combined with a lack of entrepreneurial ambition resulted in women in occupying lower-status positions within corporate veterinary groups (Treanor and Marlow, 2019). In parallel to the idea of entrepreneurial masculinity, they propose that corporate masculinity operates to limit women's progression to being business partners in corporate groups.

In the following sections, I explore how such limitations and weaknesses ascribed to female—and younger—veterinarians 'come into play'.

7.2.5. Emotional and physical weakness

Tied up in the knots of nationality, gender, and seniority, is age. Echoing broader societal discourses, millennial veterinarians have faced criticism for being, 'lazy, entitled and always wanting something for nothing' (Sinclair, 2018). Meanwhile, older veterinarians reminisce about 'the good old days', bemoaning that young veterinarians are no longer willing to work 60-hour weeks as they did, partly motivated by the succession model of clinic acquisition (Henry and Treanor, 2012): 'Many of them have never had a job of any sort, so have not had the benefit of dealing with the public and delivering any form of customer service, or asked to exchange money for a product or service . . . aren't we just recruiting kids who haven't been conditioned and are unlikely to be resilient?' (Westgate, 2017).

When criticism of millennial veterinarians is considered in the context of the rapid feminisation of the veterinary workforce, one wonders how much of the concerns about their perceived lack of emotional strength or business sense ('snowflakey-ness') is another facet of the profession's masculine gender. I—a borderline millennial—spent an uneasy hour in a veterinary conference session that intended to explore the sector's retention crisis. The audience was filled with senior (male) veterinarians in their off-duty 'uniforms' of checked shirts and fleece gilets. They nodded vigorously in agreement with the business coach speaker, who strode up and down the stage exclaiming, 'We need to work with universities to ensure they recruit the *right* sort of people'. I left wondering whether 'the right sort of people' meant the male sort of people. Treanor and Marlow (2019) have previously described the circulating discourse within the veterinary profession whereby men are held to be more ambitious, committed, competitive, and focused upon income maximisation.

Women working in the companion animal veterinary sector may be shielded from some of the accusations of physical weakness to which their colleagues working in the equine and livestock sectors are exposed (Williams, 2014, Bonnaud and Fortané, 2020). However, although their patients are smaller, the work is physically demanding (see the following fieldnotes extract): it is not office work with added companion animals. I was struck by the absence of specialist lifting equipment for handling sedated dogs sometimes weighing 60 kg in clinics. Instead a blanket or towel would be used to transfer patients, a (female) member of staff on each corner. Sore backs seemed almost to be 'the norm'. The absence of asking for help and/or the installation of hoists could be interpreted as another aspect of masculine culture of veterinary work. Female colleagues could be anxious about drawing attention to this 'weakness' when compared to the template male body or threatening the sustainability of the clinic—and their livelihoods—by asking for additional, costly equipment.

Fieldnotes extract: Clinic two

It is early afternoon and Chloe is performing a dental on an anaesthetised Bull Mastiff in the prep room. She wears a plastic apron, gloves, and a surgical mask to protect herself from the spray of water, plaque, and microbes dislodged from the dog's mouth as she uses a highly pressured water jet. Chloe stops for a moment, stretching her back and wiping the hair from her eyes using the back of her gloved hand. Having regrouped, she re-examines the dog's teeth: one is diseased and needs removing. Always mindful of my research, Chloe explains that as she is removing the potential source of infection there is no need to dispense antimicrobials in this case.

She then uses pliers to begin to ease the tooth away from the jaw, muttering as she strains. She works away, trying different angles but the tooth will not budge. She exclaims, 'this mask is so hot!' and takes a momentary break.

Zac, the senior veterinarian, returns from his lunch break, 'Here let me', he tells Chloe. He squeezes in front of her, and, without PPE, takes the pliers and after a few moments successfully removes the tooth. He winks, wipes his hands on his trousers and leaves Chloe to complete the procedure, 'write it up', and tidy away.

7.2.6. Gendered encounters with clients

I did not tune into any differences in the way owners responded to female or male veterinarians. This does not mean that such differences do not exist: as a (relatively) young woman whose professional background is in a sector known to discriminate against women (Savigny, 2014), I may be socially conditioned to the 'normality' of such behaviour. One male salaried veterinarian was adamant that his female colleagues have a tougher time, with clients doubting and questioning their professional opinion. As reported in Chapter 5, female veterinarians were more likely to report that more public respect would make their job better (29% compared to 19% of male survey respondents) (Robinson et al., 2020). Furthermore, the 'complex dance' (Hobson-West and Jutel, 2020) undertaken between veterinarians and their paying clients limits the extent to which discriminatory behaviour by the latter can be challenged either by the front-line veterinarian or her boss.

As mentioned, fewer female veterinary students aspire to own their own veterinary practice. In addition to gendered discourses around women being less-able veterinarians, this may also reflect differences in the socially acceptable motivations for undertaking veterinary work: men are inherently entrepreneurial whilst women are caring (Treanor and Marlow, 2019). I undertook interviews with veterinarians at my fieldwork sites, during which I asked what led to them joining the profession. The women tended to answer along the lines of, 'I've always loved animals and I knew I wanted to be a vet from an early age'. Meanwhile, the men described role models—family members who were veterinarians or friendly local farmers—who had inspired them. These gendered differences could shape client expectations: women veterinarians are expected to be motivated by their love of animals and their maternal instincts to care. Therefore, being presented with a large bill from them could be less tolerable than by male veterinarians who, as businessmen, need to make a living.

One of the reasons proposed to explain the feminisation of the companion animal veterinary workforce is that women are more suited to this less physically taxing but emotionally charged work (Irvine and Vermilya, 2010), for example, supporting owners during the euthanasia of their cherished companion animal. Knights and Clarke (2019) report that women veterinarians are expected to be naturally good communicators, using their 'charm' to diffuse difficult situations with clients. Therefore, owner complaints about female veterinarians could be construed as not only challenging their professional ability as a veterinarian, but also their personal qualities as a woman.

Whilst in clinic, I observed how senior male veterinarians enjoyed playing 'the host' for favoured, long-term clients. At clinic two, Zac described that when he became senior veterinarian there:

'*You improve things and get a bonding to clients, that's the main thing really with the partnership and when you start having your own practice, you become friends sometimes with your clients and they get used to you and you get used to their animals. I've known animals for the past six years that they have been coming here*'.

Zac, senior veterinarian, clinic two

He and Peter, his counterpart at clinic one, came out into the waiting room to warmly greet favoured clients, asking support staff to organise refreshments. This special treatment extended to the waiving of some of their fees, a feel-good gesture that the senior veterinarian had in his power to enact and a more effective tool in creating goodwill, perhaps, than having to rely on one's personal 'charms'.

The option of fee waiving was not available to salaried veterinarians: whilst they could tinker with the fees applied to some extent, they had to balance caring for their client with the clinic rules regarding 'appropriate' charging to support its sustainability. When these favoured clients subsequently saw salaried veterinarians, the magnitude of their correctly charged bill could come as an unpleasant surprise. In these circumstances, following the rules, and doing the 'right thing', made life harder for salaried veterinarians. Similarly, the 'inappropriate' expectations of owners for antimicrobials were set if senior veterinarians had previously drawn on their professional experience and social capital to deviate from 'best practice' guidelines. This subsequently placed salaried veterinarians in a tricky position when the owners returned: do they publicly undermine their superior, more experienced colleague? Do they initiate a conversation in which they appear difficult and unhelpful? Or, do they supply the antimicrobials in contravention of the guidelines? Public education campaigns such as the 'Trust Your Vet' initiative (DEFRA, 2018) presents the profession as single, harmonious voice with no variation in antimicrobial use between veterinarians. In Chapter 9, I discuss the unintended consequences such representations might have.

7.2.7. A gendered profession and antimicrobial stewardship

Clarke and Knights (2019) have proposed that the male gendering of the veterinary profession results in women and animals being treated as subordinates. They suggest that this is partly enacted through, 'masculine beliefs in linear rational control and the supremacy of humankind, together with a desire to satisfy clients in commercial service encounters' (Clarke and Knights, 2019, p. 2). One way by which to demonstrate human mastery over nature is for veterinarians to prescribe pharmaceuticals, such as antimicrobials, rather than allowing nature to run 'her' course or rely on the 'natural ability' of the animal's immune system. Such gendering of the profession may be so deeply entrenched that it may not be recognisable to its members, nor easily measurable, and therefore 'fixable'.

The deeply embedded societal 'norms' of women as passive and receptive whilst men are active and autonomous (Martin, 1991, Clarke and Knights, 2019) shaped expectations of how veterinarians behaved in clinic. Older, male veterinarians were allowed more leeway when it came to following clinic rules. This included those regarding 'appropriate' antimicrobial use: they could not be expected to passively follow guidelines especially when they had their own library of empirical experience to draw upon. The younger antimicrobial champions struggled to challenge this knowledge, especially when turning to the patchy evidence landscape (described in Chapter 6) to back them up. As veterinarian Alison, the antimicrobial champion at clinic one, noted:

'It's difficult when you are trying to have that conversation with the boss who has way more many years' experience than me. Why should I be telling him how to treat his animals [laughs]?'

Alison, salaried veterinarian, clinic one

Chloe, the antimicrobial champion at clinic two, further explained:

'With, kind of, more senior vets, who have been practising for 20 years and things like that, I find it a bit more difficult to discuss, but occasionally I do [laughs] . . . vets that I kind of see every couple of months I, kind of, feel that I'm not really in a position to, not to tell them off but to discuss it. I mean sometimes I would be like, "Oh why was this started?" if we are working together but I wouldn't want to call them up and to question them cos I feel like that would be a bit rude [laughs] or inappropriate because I don't really know what I'm talking about either.'

Chloe, salaried veterinarian, clinic two

In a sector that values novel and cutting-edge approaches, senior veterinarians described themselves as willing to receive advice regarding their antimicrobial use, recognising the knowledge of their younger colleagues was more up-to-date:

'Hands up! I'm slightly old school, okay? But I'm definitely open to rethinking rather than actually just reaching for that bottle of Convenia or, you know, all the time . . . I mean, I've worked in a practice where there were injections already drawn up, pre-consult, of small-dog, medium-dog, large-dog doses of long-acting amoxicillin with a bit of steroid in. So, I've come through that . . . I've now got a young team of clinicians, vets, and nurses, and I cannot, for their sakes, continue to be old school. I can give a bit of wisdom as to, "Oh, back in my day" but, actually, we're not back in my day and we're in a different world now with antibiotic resistance and, so, different responsibilities as well.'

Peter, senior veterinarian, clinic one

By labelling themselves as 'old school' or 'old dogs learning new tricks', they deployed humour to defuse tension about their authority being challenged. They also described their younger female colleagues as 'the antibiotics police' and 'telling them off'; these descriptions are one short step away from the gendered term of being 'nagged' (Flood, 2020).

The broader antimicrobial stewardship literature is not immune from prevailing gender stereotypes, e.g. the portrayal of the valiant, male clinician battling to do their best for their patients whilst being hounded by women brandishing clipboards (Figure 7.3). Meanwhile, Dame Sally Davies, the UK Special Envoy on Antimicrobial Resistance and the former Chief Medical Officer for England has been described by the Sun Newspaper as, ' . . . the most deranged of the nanny-state zealots . . . She lives for taxes, bans, ending freedoms and choice' (The Sun, 2019). The 'nanny state' language of critique has not been applied to her male successor, however, who as Chief Medical Officer has been part of the COVID-19 pandemic response team and forced to make recommendations of far more intrusive restrictions to our daily lives.

Figure 7.3: Cartoon from taken from the social life of AMR series, a cartoon series based on a social science AMR research programme led by Professor Alex Broom (Broom, 2019), reproduced with permission.

7.2.8. Intersectionality and infection control

I now further explore intersectionality through differing attitudes towards PPE and cleaning. These examples illustrate how gender, age, and hierarchical position all combine in the clinic to shape infection control activities, an aspect of supporting 'appropriate' antimicrobial use.

As the fieldnotes extract in Section 7.2.5 alludes to, those higher up in the clinic hierarchy were able to exempt themselves from written and unwritten rules regarding 'appropriate' behaviour and use of PPE. They had the social capital to personally take on the additional risk of these atypical practices and deflect criticism or scrutiny. For example, unlike the rest of the nursing team, Becky—the senior veterinary nurse at clinic two—wore gloves when emptying the bins and mopping the floors. The gloves acted as more than a barrier between human and microbial bodies: they distinguished her from the rest of the nursing team, for whom 'lowly activities' such as cleaning were an uncontested part of their role. Becky's senior position enabled the additional costs for these consumables to be incurred.

The interest of senior veterinarians in optimising the use of consumables—and their associated costs—aligned with 'macho' attitudes of embracing the visceral nature of veterinary work (Hamilton, 2007). A (male) veterinarian visiting clinic two praised a (female) veterinary nurse, 'Oh! I like you! You don't wear gloves either!'. Clarke and Knights propose that part of the circulating 'anthropocentric masculinities' within the veterinary profession includes the tendencies of veterinarians, 'to neglect their own bodies in terms of rest, food, emotional nourishment and physical safety' (Clarke and Knights, 2019, p. 2). Within this context, wearing PPE, such as gloves, could be interpreted as a lack of emotional strength (squeamishness) and/or business sense, characteristics valued by some senior veterinarians.

At my fieldwork sites, cleaning was a highly segregated activity. In between appointments, veterinarians cleaned their consultation table and sometimes washed their hands. They also undertook the elaborate and ritualised hand and arm washing protocol to help ensure sterility during surgery. However, the vast majority of cleaning was done by the veterinary nurses, student veterinary nurses, and animal care assistants (collectively known as the nursing team) (Figure 7.4). Unlike the human healthcare sector, there were no specialist cleaners.

Figure 7.4: A display in the waiting room of Clinic two, made by the nursing team to promote their work as part of Veterinary Nursing Awareness Month.
[NB: the centrality of the role of cleaner].

At clinic two, who should clean the staff toilet was hotly debated: The nursing team arguing that, unlike in other areas of the clinic, that mess was associated with human-animals and therefore it was not part of their job. Eventually, Chloe, a salaried veterinarian, felt compelled to initiate a rota: each member of staff would be allocated a week during which they would responsible for cleaning the staff toilet. The rota was stuck to the back of the toilet door, next to details of the veterinary suicide prevention hotline (see fieldnotes extract).

Fieldnotes extract: Clinic two

It's late morning and I sit with the nurses in the prep room as they chat over cups of coffee. This week it's Zac's (the senior veterinarian's) allocated week to clean the staff loo and they speculate whether he will fulfil his duty. Becky, the senior veterinary nurse, exclaims, 'I can't take this anymore, I'm going to email him to remind him'.

Moments later he replies from the consultation room where he is seeing clients. Becky reads out his response, 'Who me 😊?!'.

Emily, Becky's deputy, senses her resolve is wobbling. Shaking her head, she says, 'On behalf of the girl team, I'm gonna be so cross if you do Zac's cleaning for him'.

Becky replies, 'At least it'll be done then and I won't need to worry about it all kicking off with the other vets who did their turn.'

Cleaning formed an essential part of care, not only of the clinic but also its patients. Following Haraway's interest in who cleans up 'the shit' in human–companion animal relations (Haraway, 2003b), Kirk (2016) propose that such activities form acts of care. This work was assigned to low-paid (typically young, female) workers: previous veterinary ethnographers have identified how the gendered and low-ranking nature of cleaning and tidying up helps to maintain (masculine) veterinarian dominance within the clinic (Hamilton, 2007, Clarke and Knights, 2019). Despite its low-ranking nature, having a clean space—e.g. within which to surgically operate—was crucial in allowing veterinarians to undertake their professional duties. Veterinarian confidence in the sterility of spaces and bodies, following the cleaning of wounds and abscesses say, also had implications for their antimicrobial use. The supporting cast of the nursing team—despite the low monetary value of their work—played a central role in managing microbes within the clinic. Both the private clinics where I undertook fieldwork utilised the provision of free or reduced-cost care delivered by student veterinary nurses in exchange for access to more-than-human bodies to train upon. Just as the business model relied on having a supply of companion animal bodies to fix, it also depended on this form of subsidised interspecies transaction.

7.2.9 Implications for care and antimicrobial stewardship

In this section, I explored the intersectional human entanglements that shape the forms of care delivered within in the clinic. To date, within the published literature, there has been limited in-depth consideration of how antimicrobial use in companion animals might be shaped by such interactions. Meanwhile representations of 'the profession' as a single unit erases the multiplicity experiences and voices undertaking veterinary work.

Over the last decade or so, an increasing proportion of companion animal veterinary care has been delivered by non-UK EU graduate migrant workers. These veterinarians—under-represented at a senior level within the profession—face a series of additional challenges compared to their UK graduate colleagues. Whilst corporate veterinary groups are keen to utilise this source of labour, further—social sciences-informed—insight is needed regarding how best to equip these individuals with the skills and support needed to make a smooth transition to providing companion animal care in the UK. This extends beyond clinical skills and knowledge to include, for example, UK guidelines on appropriate antimicrobial use, and 'softer' skills, e.g. communicating with owners.

In UK human healthcare, international medical graduates perform less well than their UK-trained colleagues in postgraduate examinations. In communication assessments, international graduates' scores were lower when managing the concerns of patients, explaining treatment plans, and building rapport (Verma et al., 2016). The authors propose that this is due to cultural differences: for example, candidates from societies with 'higher power distance', such as those in Eastern Europe, may provide less information whilst those from societies which are more averse to uncertainty, including East and Central Europe, may be less concerned with building rapport (Verma et al., 2016). Whilst such a research approach seems blunt from an anthropological perspective, it illustrates the potential need for tailored communication skills support for non-UK EU veterinarians working in the UK, especially given that antimicrobial overuse use has been proposed as a consequence of communication failure between veterinarians and owners (Smith et al., 2018).

In terms of antimicrobial use, specifically, the 'cultural features' of power distance, masculinity, and uncertainty avoidance have been proposed as a lens through which to understand variation in the human consumption of antimicrobials between Denmark, France, and Italy (Jeppesen Kragh and Strudsholm, 2019). Previous quantitative modelling, based on data from the Dutch companion animal veterinary sector, identified that the attitude of 'no harm done by trying antimicrobials' was linked to risk avoidance behaviour, as well as to being a male and a more experienced veterinarian (Hopman et al., 2019a). Future social science research could examine in detail how gender, age, and risk management strategies intersect for veterinarians—and also owners—and the implications this has for antimicrobial use.

I also considered the experiences of delivering care within what has been described as an anthropocentric and masculinised environment (Clarke and Knights, 2019). For new graduates, taking on the role of antimicrobial champions offers an opportunity to become an expert within the clinic: the newness of their training acting, for once, as an advantage. It is from this niche that champions can challenge prevailing hierarchies within the clinic. However, the role is not immune from prevailing gender attitudes circulating in the clinic and the veterinary sector. The gendering of stewardship work and caring for antimicrobials in this way has implications for other healthcare settings beyond companion animal veterinary medicine.

The champion model for promoting antimicrobial stewardship is reliant on having an enthusiastic individual motivated to challenge and cajole their colleagues. It relies on them feeling enthused enough about their work to 'take on' the additional conflict it may cause. However, King et al. (2018) reported a wearing down of graduates' 'appropriate' antimicrobial use over time. Reflecting the high levels of churn seen in the veterinary profession (Chapter 4), within six months of the completion of my fieldwork, the antimicrobial champions at each of the three clinics had moved on. It would have been a valuable exercise to revisit each site to see how things had changed in their absence; however, this was prevented by COVID-19.

There were no women veterinarians with young children working at my fieldwork sites, apart from Gabi, who combined working the nights shifts with caring for her school-aged children in the day. Most of the full-time female veterinarians were in their twenties and not looking to have families yet. It would be interesting to revisit them in the future to see if, or how, they have combined the roles of being a veterinarian and a parent. For example, is it possible to undertake the role of the clinic antimicrobial champion—and the additional workload that spilt out into evenings and days off—with motherhood? Or is this something that is given up on along with other career aspirations associated with working full time?

Recognising that different veterinarians have differing motivations and foci of care can help inform the design of antimicrobial stewardship materials. For example, senior veterinarians have additional concerns regarding the sustainability of their clinic, although data regarding the financial impact of stewardship schemes is sparse (Bellini, 2020). Producing evidence and materials that make the ‘business case’ for altering antimicrobial use is an under-investigated avenue. Meanwhile, complex, multi-stranded, resource-intensive interventions that have shown to be effective in trial conditions (Hopman et al., 2019c) may have limited transferability or sustainability in the ‘real world’.

7.3. Chapter summary

In this chapter, I sought to describe how care is located within the daily life of the companion animal veterinary clinic. Ethnographic methods enabled me to study enacted practices and the more-than-human entanglements of mammalian and microbial bodies necessary when delivering care. By rendering visible the ‘taken-for-granted’, I have been able to offer up previously overlooked avenues for consideration when seeking to intervene regarding antimicrobial use in the clinic.

Care was delivered within the temporal and logistical constraints of the physical clinic and also the business model of busy-ness (Chapter 6). As a relative newcomer, the imperative to care for antimicrobials is yet to find an established location, be that within time or space within the clinic or the broader profession. Future efforts could consider how to support antimicrobial stewardship in finding a ‘home’. This might include, for example, enabling front-line veterinarians to hold the conversations necessary to explain—and engage owners with—the decision not to provide antimicrobials (Eastmure et al., 2019b), in an environment in which productivity and timeliness is valued. Drawing on the ‘slow medicine’ movement may help guide this.

At a clinic level, the model of the antimicrobial champion has emerged. Further thought is needed about how best to support these individuals to undertake this role within the intersectional space of the clinic. This might include recognising that clinic actors have different and temporally contingent foci of care and developing stewardship evidence that addresses these differing concerns. For example, the ‘business case’ for altering antimicrobial use is an under-investigated avenue (perhaps partly linked to the ‘dirty work’ of being seen to profit from pharmaceuticals sales, Chapter 6). Developing this evidence will help antimicrobial champions engage senior veterinarians and corporate group headquarters in stewardship activities. If evaluation reveals that such activities do threaten clinic sustainability, then a broader, profession-wide discussion is needed about if and how this should be compensated. It is unrealistic to rely on the actions of individual antimicrobial champions to overcome these structural factors that support current ways of working with antimicrobials.

A drawback of the champion model is that it relies on a single individual who is not always around or who might leave the clinic. The vulnerability of this model has also been recently reported in UK human healthcare settings (Eastmure et al., 2019b). Promoting a network of like-minded individuals within and between clinics would offer more social support and a more sustainable model for change, as has been seen with animal welfare champions (Wensley et al., 2020). Consideration of how to empower more companion animal veterinarians to take on this role should therefore be given. For example, co-produced research with non-UK EU graduates could be conducted to identify the support and training they may require to become confident in teaching others about 'appropriate' antimicrobial use. Developing confidence and skills in this area could have additional benefits when communicating with owners in general and being more assured of their place within the clinic hierarchy.

At a profession level, the absence of infectious disease specialists in companion animal medicine means there are no 'natural' champions for leading efforts to tackle antimicrobial resistance. Whilst many sector leaders have pledged their commitment to the appropriate use of these pharmaceuticals, the pledges are made in the context of numerous other commitments and interests (Anonymous, 2016b). Perhaps a higher-level champion—as seen in UK human healthcare (PHE, 2017)—could help drive the stewardship agenda and initiate some of the trickier conversations around possibly reducing/removing the profit made on antimicrobial sales.

Compared to other daily risks encountered in the clinic, antimicrobial resistance was intangible and difficult to sensorially experience, and this made prioritising antimicrobial stewardship harder. Efforts to make local patterns of antimicrobial resistance more 'knowable' may help overcome this. For example, veterinarians could be encouraged to routinely visit the IDEXX Pet Resist website (IDEXX, 2020) and/or tailored update emails could be sent informing them of local patterns of resistance. The wider uptake of the screening of clinic premises could also be supported to provide additional insight. However, clinic-level data would be commercially sensitive and careful consideration should be given about how to support clinic owners and staff whose premises screen positive. This assistance should extend beyond advice regarding how to manage microbes in the clinic to help with reputation management. However, encouraging a better understanding of local patterns of antimicrobial resistance could have the unintended consequence of discouraging changes to existing 'inappropriate' patterns of prescribing. For example, if—under the current regime—low levels of resistance are identified this may reassure veterinarians that their habits do not need to change.

In this chapter, I also described the inherently tactile nature of interspecies care and how this can provide a fresh perspective through which to consider what 'good care' looks like in a range of settings beyond companion animals. I also discussed the possible tension between developing a system in which microbial transfer is minimised but, in doing so, the embodied elements of care have been drastically altered too. Ironically, the removal of care from health systems has been proposed as one mechanism by which they come to rely on the provision of pharmaceuticals such as antimicrobials (Chandler, 2019). Could embracing these tactile encounters as a fundamental part of care help shift the balance back the other way?

Ethnographic methods enabled me to study the everyday, easily overlooked upon acts of care undertaken in the clinic such as cleaning. The latter is largely undertaken by a low-paid, female workforce in a space centred around anthropocentric and masculine bodies (Clarke and Knights, 2019). As de la Bellacasa (2017) writes, 'Feminist interest in care has brought to the forefront the specificity of care as a devalued doing, often taken for granted if not rendered invisible' (de la Bellacasa, 2017, p. 53). Further consideration should be given to promoting and acknowledging this low paid—but high value—work when it comes to safely managing microbes within the clinic. Previously in human medicine, nurses have been described as 'brokers' when it comes to the enactment of antimicrobial use decisions (Broom et al., 2017). Within the companion animal veterinary sector, to date, their role in supporting 'appropriate' antimicrobial use remains largely overlooked and warrants further investigation.

Infection prevention and control procedures—including PPE—support reduced antimicrobial use partly by reducing the risk of healthcare acquired infections and therefore can form part of antimicrobial stewardship activities (Prescott and Weese, 2009, Stull and Weese, 2015). I reported how caring within constraints and the intersectional experience of delivering care influenced PPE use. These in-depth findings augment the results of a UK survey that found the use of infection prevention control procedures were shaped by time and financial constraints in a sample of 136 veterinarians (76% working with companion animals) and 116 veterinary nurses (84% working with companion animals) (Robin et al., 2017). Together these studies illustrate how educational interventions alone might not be sufficient to alter the complex, risk assessments that front-line clinic staff make when deciding whether to follow infection prevention and control procedures. Such studies would be complimented by an improved understanding of the epidemiology of veterinary healthcare acquired infections, including those resistant to antimicrobials (Walther et al., 2017).

In this chapter, I have concentrated on daily life in the clinic and the enactment of care by the human actors within this setting, reflecting on the implications this has for antimicrobial use and microbial management. In Chapter 8, I move my gaze slightly to consider how the socially produced forms of our canine companions prompt a contingent form of veterinary care with bio-socially produced imperatives to use antimicrobials.

Chapter 8 Caring for the companion animal: A bio-social case study

8.0. Introduction

Situated in this thesis investigating antimicrobial use in companion animals, and informed by its goal of looking beyond the moment of prescribing, this chapter considers how societal demands for particular dog breeds have consequences for canine health which, in turn, necessitates certain forms of veterinary care, including how antimicrobials are used. My focus shifts from the interactions between human actors in the clinic, as reflected upon in the previous chapter, to consider the prevailing social demands that produce the types of canine bodies arriving at the veterinary clinic's doorstep, bringing with them their associated health problems.

This chapter arises, in part, from a growing societal unease about the health of pedigree dogs, in particular brachycephalic (flat faced) breeds. Prompted by these broader social concerns, and a desire to look beyond the walls of the veterinary clinic, it is less grounded in empirical data and instead draws upon media articles both from the general and veterinary press. Rather than being a traditional fieldwork chapter, therefore, it is more akin to a narrative review illustrated with pieces of empirical data. This approach enables the decentring of individual actors in the clinic, and a consideration of the economic and social imperatives that contribute to current patterns of antimicrobial use in companion animals. This chapter offers a novel, upstream vantage point that differs from the existing literature which centres on those faced with deciding whether or not to deploy antimicrobials.

As a segue way to moving my attention from the human actors within the veterinary clinic to the social production of canine bodies, I begin the chapter with some reflections on the interspecies challenges of caring for more-than-humans, in particular 'the canine multiple'. I consider the hurdles encountered by companion animal veterinarians when seeking to 'get to know' their patients: the difficulties faced when obtaining histories, undertaking examinations, and obtaining diagnostic samples. These all have implications for reaching a diagnosis on which 'appropriate' antimicrobial use can be based.

Building upon approaches that de-silo the biological and the social, often termed 'bio-social' (Lock, 1993), I reflect upon the popularity of brachycephalic dogs in the UK. I propose that anthropocentrism has resulted in the phenotypic and genotypic forms of dogs for whom poor health and veterinary intervention is the norm. I consider the consequences of the surge in popularity of the French bulldog and its implications for how 'appropriate' veterinary care is enacted. As supply has struggled to meet demand, the value of these dogs has rapidly increased, their breeding has intensified, and has been subject to exploitation. I also examine how the selective breeding practices required to maintain a 'pure' dog breed have resulted in the loss of genetic diversity, which is experienced in the form of breed-specific diseases and a loss of hybrid vigour. This means that veterinarians are less able to rely on the dog's own ability to 'fight off' infection.

In this context of the 'veterinary-isation' of animals' lives—and using Haraway's concept of 'lively capital' (Haraway, 2012)—I consider how 'appropriate' veterinary care, including antimicrobial use, is socially, historical, politically, and economically produced. I conclude by suggesting that, rather than using antimicrobials as 'sticking plasters' for these broken bodies, we should consider a more radical, re-evaluation of the anthropocentric demands we place on our canine companions and their health.

8.1. Caring for resistant bodies

A central step in narratives of 'appropriate' antimicrobial use is reaching a diagnosis. This is illustrated by the interest in developing diagnostic technologies to enable front-line clinicians to rule in or rule out an infection as the cause of their patient's ill health (O'Neill, 2015). In this section, I will discuss some of the challenges faced by veterinarians when caring for companion animals and trying to reach a diagnosis, and the implications this might have for antimicrobial use. I call the interspecies delivery of care and the prising of diagnoses from enigmatic and, at times, unyielding companion animals 'caring for resistant bodies'. An extreme example is provided in the fieldnotes extract below. As I observed in clinic, successfully overcoming these obstacles and building a rapport with one's patients can be one of the rewards of providing veterinary care.

Fieldnotes extract: Clinic one

A couple have brought into the clinic their rottweiler—who acts as a guard dog for their convenience store—as she has a sore ear. Elizabeth, the locum veterinarian, leaves the consulting room to collect an extra-large muzzle explaining, 'When dogs don't want you to do something, you can't do it'. She asks the owners to muzzle their dog, leaving the consulting room to reduce the latter's anxiety. A few minutes later the door opens a crack and the owners ask for another chair, which is provided. Elizabeth paces up and down the corridor, checking her phone, as a series of loud crashes emanate from the room. After a while, the owners call her back in and she administers a sedative injection to the now-muzzled dog. Elizabeth leaves the room again whilst the drug takes effect.

Elizabeth returns to walk the drowsy dog into the prep area, directing the owners to the waiting room. Helped by two veterinary nurses, the dog is lifted onto the examination table: further sedation is administered through a catheter, the muzzle removed, and oxygen administered. Elizabeth looks in the first ear, 'That's fine' and moves onto the second, 'Oh that's a relief . . . it's disgusting'. Despite being heavily sedated, the dog flinches as she examines the ear with an otoscope, 'It's so sore in there'. The otoscope is covered in strong smelling, black gloop when removed.

Elizabeth and the veterinary nurses set to work flushing the ear with saline and cleaning it with cotton wool. They then use Osurnia® (Elanco), a liquid that sets as a gel to provide a week's doses of terbinafine, florfenicol, and betamethasone acetate to treat the dog's ear infection (otitis externa). This product avoids the need for the owners to medicate the dog at home.

The three of them carry the sedated dog back to the consulting room on a towel, struggling under her weight. Elizabeth administers the sedative reversal agent and they quickly remove the catheter, intubation tube, and put the muzzle back on. Eventually, the dog begins to come around, shaking its head (and sore ear) repeatedly. Elizabeth and Clara the veterinary nurse hastily retreat to the door, jangling the dog's lead to rouse her. They shut the door, leaving the dog to wake up properly and Elizabeth begins her afternoon clinic in a different consulting room. Clara rolls her eyes, 'And to think we're going to have to go through that all again next week to give the follow-up dose!'

The form of the companion animal is contingent and multiple (Mol, 2002). The dog relaxed at home in the company of its human kin differs from that participating in the veterinarian–owner–companion animal triad in the consulting room. Further forms are produced when dogs are separated from their families and admitted to the care of the clinic—accompanied by the symbolic handing over of their lead (leash) from the owner to clinic staff—and when anaesthesia administration renders their bodies passive, unconscious, and sometimes leaky. A last form is produced in the final act of care (Morris, 2009), the euthanasia of the companion animal, that renders it dead and inanimate. These multiple forms present challenges for owners trying to describe—and veterinarians trying to understand—what the companion animal is 'normally' like when at home and in good health. Care is enacted for the 'canine multiple'.

Snippets of information are gathered by history taking, physical examination, the signs and symptoms displayed by the companion animal, and are woven and rewoven together to reach a diagnosis. In the clinic consulting room, nervous companion animals are largely non-verbal, apart from yelps of pain when a tender abdomen is palpated or a sore joint rotated. This means that veterinarians rely on owners to provide a 'second-hand' history of their animal's ill health and symptoms, and, in this way, veterinarians could be likened to paediatric doctors (Hobson-West and Jutel, 2020). They are reliant on their client to detect changes in their charge's behaviour—for example, in their appetite or toileting habits. The histories presented to veterinarians can be patchy and shifting, shaped by the intensity of the entanglement between owner and companion animal.

Having taken a history, the next step in many veterinary consultations is to undertake a physical examination (Everitt et al., 2013). Animals have to be coaxed from their travel boxes or from hiding behind their owner's legs where they wait facing the door, ready to make a speedy exit away from this unfamiliar environment. Veterinarians try to build bonds with both their companion animal and human clients: complements paid in a sing-song voices; crouching down to the level of their patient; letting the wet nose of an unsure patient sniff their hand; stroking and fussing; and the—all important—jar of edible treats. Sometimes the nervous canine patient would acknowledge their veterinarian's efforts by licking their hands or face; others, however, remained unconvinced. The examination of some feline patients was accompanied with a low, rumbling growl that erupted into a hiss, a flash of claws, and teeth—cutting short the examination. Owners can be surprisingly passive, watching the veterinarian chase the dog around the consulting room floor in a bid to examine it. Following the veterinarian's request for help, their attempts at restraining their companion animal could be rather half-hearted, 'I don't want to hurt her' (is this what they pay the veterinarian for?). Clinics have a range of equipment to assist with the safe handling and examination of companion animals and administration of medicines, including muzzles, gauntlet gloves, crush cages, dog-catching poles, and cat restraining bags. However, one of the most effective tools was plenty of 'experienced hands'. Members of the nursing team would be called into consultations, often brandishing the ubiquitous towel (Section 7.1.1), to help hold and restrain resistant patients.

Thinking of these encounters through the eyes of companion animals, their resistance is understandable: they feel unwell—perhaps in pain—and are being subjected to unfamiliar procedures by unknown people in unusual surroundings with alien sights, sounds, and smells. It is only possible to properly examine some companion animals and/or collect samples for diagnostic testing following sedation, or even anaesthesia. These additional procedures have implications not only in terms of discomfort, time, and cost, but also risk. Veterinarians and owners face dilemmas balancing the benefits of a 'firm' diagnosis against the costs of subjecting a much-loved—and perhaps ill and/or elderly—companion to additional, invasive processes.

Part of the veterinarian's examination will include measuring vital signs of the companion animal. Elevated heart and respiratory rates and temperature can indicate that an immune response is underway to fight off an infection. However, they can also be elevated as part of the acute stress response triggered by being in the clinic and part of the veterinarian–owner–companion animal triad. Seeking veterinary care, therefore, can make companion animals appear sick(er). It takes confidence and skill to discount elevated vital signs as not requiring veterinary intervention: When is it normal for parameters to be abnormal? As Cartelet et al. (2018) write in their study of companion animal veterinarian antimicrobial use, diagnosis is 'a combination of art, science and experience, that always involves some degree of risk' (Cartelet et al., 2018, p. 298).

Dependent on the ability to collect the necessary samples from resistant bodies, veterinarians have access to cytology, haematology, and biochemistry testing—either as point-of-care testing or the slightly cheaper (but slower) offsite laboratory testing. Parameters such as elevated counts of neutrophils—a type of white blood cell—indicate a bacterial infection. However, such findings do not indicate the location of the infection within the 'black box' of the resistant companion animal body. Here, diagnostic technology becomes a piece in the jigsaw, rather than providing the solution to the puzzle.

In summary, when caring for resistant bodies, veterinarians face challenges—and the satisfaction of overcoming them—not typically encountered by their human medicine counterparts. The difficulties in undertaking an examination and collecting samples can necessitate alternative pathways to reaching a diagnosis and 'understanding' a companion animal, who has been rendered into a different form by simply being brought into the clinic. The difficulties in taking a sample from companion animals has largely been overlooked in discussions surrounding the low uptake of diagnostic testing in this sector. For example, unlike in a GP consultation, a veterinarian cannot ask a feline patient to pop outside to the toilet and return with a urine sample for testing. Instead, time, specialist equipment (such as non-absorbent cat litter or, in the case of a cystocentesis, a long needle), sedation, and skilled staff are required.

'Caring for resistant bodies' also has implications for owners at home. Preventative strategies—such as regular teeth brushing or ear cleaning—are promoted to avoid ill health and the possible deployment of antimicrobials. However, such activities are typically not welcomed by companion animals, making these caring activities more difficult, especially for owners living without human kin to help restrain these resistant bodies.

From a bio-social perspective—that recognises how the biological and social worlds continually co-shape one another—the challenges faced by veterinarians when caring for resistant bodies are recorded in local populations of microbes. Turning to antimicrobials as a means by which to cope with diagnostic uncertainty shapes the selection pressures acting on local populations of microbes with those carrying resistance genes able to survive. In this way, the social practices surrounding diagnostic uncertainty—both current and historic—are documented in the genomes of microbes (Landecker, 2016). Section 8.2 continues my investigation into the entanglements of social and biological worlds in the companion animal veterinary sector.

8.2. Caring for broken bodies

Attending VetCompass™ team meetings alerted me to impact of pedigree dog breeding on contemporary canine health. The veterinary epidemiologists there have undertaken a range of studies investigating breed-specific disorders or comparing the prevalence of conditions across different breeds; examples include O'Neill et al. (2018) and Hall et al. (2020). This formative exposure has proved to be a strong influence in how I approach and write about this topic. As a consequence of this veterinary-epidemiology starting point, the experiences and opinions of companion animal owners regarding their shared lives with pedigree dogs have been somewhat overshadowed. As a small step in redressing this balance—and, hopefully, sounding less moralising—I include some reflections on my own entanglements with pedigree dogs in the fieldnotes extract below.

Fieldnotes extract: 'The world's greatest dog show'

I'm on the train heading to the National Exhibition Centre. The carriage is a full with a mix of sales reps and day trippers, all on their way to Crufts. Two ladies show one another photos of their dogs, 'Have you been before? It's the highlight of my year' and 'It's worth going just for the free goody bags.'

The scale of the show is overwhelming: vast halls of exhibitors selling everything you might need—and more—for your dog; dozens of show arenas hosting back-to-back classes of dogs who are carefully scrutinised by judges; rows and rows of temporary kennels full of dogs of every shape and size, surrounded by their owners and all the paraphernalia necessary to get them 'show-ready'. I spend a happy hour watching the agility classes amidst a crowd gasping and shrieking with every twist and turn.

One hall is dedicated to 'Discover dogs', a showcase of 200 dog breeds organised by the Kennel Club that aims to inform members of the public of the 'right' dog breed for them. The stands are hosted by owners, breeders, and canine representatives of each breed. They are decorated with pictures and bunting; some emphasize how they are working with the Kennel Club and researchers to tackle breed-associated health problems. A popular strategy to promote their breeds is a mnemonic spelling out its name with its attributes; 'loyal', 'faithful', 'best friend', 'spirited', and 'fun' feature heavily.

My heart quickens when I spot the stand of a relatively rare breed of terrier. I had previously become aware of—and smitten with—this obscure breed due to a minor member of the Royal Family being photographed with one. After I walk past shyly a couple of times, the lady running the stand spots me and offers me a seat. She gives me a terrier to hold: 'Oh she's gorgeous', I coo, as I stroke the dog's wiry fur and admire her foxy features. Her owner's eyes shine as she describes, 'I had her mother and grandmother, too. They've been fantastic little dogs to share my life with'. I leave the stand 20 minutes later, covered in dog hair and clutching a list of breeders. I'm convinced that this is the dog breed for me.

Previously, I had checked the Kennel Club's Breed Watch website and found the terrier to be a 'category two' dog breed with visual points of concern that can cause pain or discomfort. But having met an example of the breed 'in the flesh', somehow this knowledge melted away. How could such an endearing little dog be possibly harbouring potentially serious health problems?

On the train journey home, I browse the websites of breeders with a sense of urgency—'how quickly can I get a puppy?' I daydream about mine and Katie's (my puppy's provisional name) shared life together; going for wholesome country walks, attending puppy play dates, and watching television, curled up together, in the evenings. I ring my sister, a veteran terrier owner. When I tell her of my plan, she's unconvinced; 'But you've never owned a dog before, let alone a terrier, let alone a terrier puppy . . . and what about when you work in London? You can't leave her alone all day'. Our conversation leaves me feeling cross and my plans deflated.

Even with hindsight, it's hard to explain my certainty and the rush which I wanted to acquire a dog. Furthermore, it was not just any dog; it had to be a puppy and it had to be that particular breed. I suppose by obtaining a pedigree dog—in addition to breed-specific health complaints—one buys into known 'personalities', a family history, and community of dog owners. 'Rationally', I knew about the 'Adopt Don't Shop' campaign, and the thousands of dogs in shelters needing homes. But on the other hand, there's the newness of a puppy, untainted by previous owners, a substitute baby perhaps . . .

I would like to think that my desire to obtain a puppy was driven an innate desire to form strong human–animal bonds that was reawakened by my time at Discover Dogs at Crufts. In all truth, however, I cannot rule out a more consumerist motivation—especially given the speed and ease with which I disregarded the breed's known health problems. Buying a terrier puppy was going to improve *my* quality of life, after all.

The popularity of dog breeds in the UK is linked to their social desirability, rather than their physical fitness (Ghirlanda et al., 2013, Packer et al., 2017). Social trends are recorded in the bodily forms of dogs and their health. This, in turn, has consequences for the workload and case mix presented to companion animal veterinarians and types of care they undertake. Over the past decade, the popularity and numbers of brachycephalic—or flat faced—dogs has dramatically increased in the UK, despite growing concerns about their health and welfare (Honey, 2017). In this section, I reflect upon the impact this has had, not only on veterinarians and their support staff, but also on the animal bodies bred to meet this demand.

Brachycephalic dog breeds are characterised by—and coveted for their—short muzzles, wide heads, prominent eyes, and rolls of skin. However, these traits also place them at an increased risk of a number of health conditions; the most critical of these is brachycephalic obstructive airway syndrome (BOAS) (O'Neill et al., 2015). This predisposition to narrow airways results from deliberate selective breeding strategies to encourage flat faces and thick necks: the bodily form of these dogs prioritised over their basic functioning. Brachycephalic dogs' distinctive noisy breathing—as they struggle to sufficiently oxygenate themselves—is normalised by their owners (Packer et al., 2019), who draw comfort from their companion's loyalty. This trait is indicative of the animal's hypoxic state preventing it from exercising like other dog breeds.

Veterinary interventions punctuate the lives of brachycephalic dogs. Due to selective breeding for a large flat skull shape, they have higher rates of birthing difficulties necessitating surgical intervention such as caesarean section (Evans and Adams, 2010). Dogs can also undergo surgery in an attempt to widen their congenitally narrow nostrils and/or correct folded eyelids to prevent eye lashes rubbing on the surface of the eye. These invasive procedures are rites of passage in increasing medicalised ('veterinary-ised') lives. The morphology of these breeds also predisposes them to medical conditions: their distinctive skin folds trap moisture and skin debris, providing an ecosystem than encourages the overgrowth of bacteria and/or yeast, resulting in painful, recurrent skin and ear infections (Seppanen et al., 2019). In addition to inward turning eyelashes, their eyes are also vulnerable to injury due to their prominent position. Analysis of insurance claims suggests that brachycephalic dogs are three to four times more likely than non-brachycephalic dogs to injure their corneas (Anonymous, 2017b). In these circumstances, antimicrobials provide a valuable 'sticking plaster' (Denyer Willis and Chandler, 2019) to help patch up broken companion animal bodies. They provide a safety net in case sterility has been breached during surgery and from post-operative infection. Antimicrobials also offer the means by which to alleviate painful medical conditions caused by the form of animal bodies bred to meet anthropocentric demands. These opportunities for antimicrobial use do not arise in breeds with less veterinary-ised lives.

The care work undertaken by veterinarians and support staff is made riskier when looking after brachycephalic dogs, whose bodily homeostasis is precariously balanced. Muzzles do not fit their flattened faces and can be easily dislodged with the knock of a paw. Their loose skin and the tendency for companion animals to be overweight (O'Neill et al., 2018) makes venepuncture trickier. Their respiratory distress is exacerbated by stress and, therefore, procedures might take longer as patients are given breaks to allow their breathing to return to 'normal' and their temperature to drop. Extra-careful monitoring of anaesthetised brachycephalic dogs is recommended when undergoing surgery or imaging due to their higher risk of complications than non-brachycephalic dogs (Gruenheid et al., 2018).

Providing veterinary care for brachycephalic dogs can make the working day longer and harder, with greater emotional labour. However, at each of my clinic fieldwork sites, staff did not blame or resent these troubled canine individuals: it was not their fault that they were born with these 'broken bodies'. Working with them offered the opportunity to 'do good' by improving their welfare and reducing suffering. Some organisations have positioned veterinarians as key players in advising members of the public about the additional care requirements brachycephalic breeds and deterring their acquisition (BVA., 2018). However, on the ground, owners rarely—if ever—sought pre-purchase advice. The interaction between expert and lay knowledge made more complicated by accompanying financial interactions (Hobson-West and Jutel, 2020). Beyond my fieldwork sites, providing care for brachycephalic dogs has offered an opportunity for some enterprising veterinarians to develop specialist expertise and target a growing sector of the market. They offer care using specially developed treatment protocols in a 'non-judgmental' space. The interdependence of the veterinary profession and brachycephalic dogs is knotty and not straightforward.

During my fieldwork, I witnessed and heard of several distressing cases involving brachycephalic dogs (see fieldnotes extract below). I experienced, first-hand, the conflicting emotions staff have when caring for brachycephalic dogs and their owners: 'animal lovers' who seem unwilling to consider to the lived experience of their companion. For example, sitting at reception one day, I was aware of a pug gasping for breath having made the short walk into the clinic from the car park. The dog's owner smiles, describing the pug as her 'little snuffle monster'.

Fieldnotes extract: Clinic two

As we fold laundry together, student veterinary nurse Lily (19 years old) tells me what happened yesterday when I was away, 'It was so sad'.

A young couple had taken their six-month old French bulldog away with them to the coast. It was the first warm weather of the year and the first time the young dog had experienced such temperatures. Lily explains to me how whilst playing on the beach the dog developed heat stroke and respiratory distress due to her narrow airways. 'In April?' I query. 'Yeah, in April'.

The distraught owners sought local veterinary help and the dog was given steroids. On the journey home, however, her condition deteriorated further and she was rushed into the clinic.

Lily recounts how the team tried to resuscitate the dog who was held up and 'all this fluid just kept draining from her mouth and nose'. Despite their best efforts the young dog passed away shortly after. Becky, the senior veterinary nurse, chips in, 'You were crying, I was crying. I think we all were crying'.

Lily pauses for a moment, looking at the towel she's folding and then says, 'She was such a pretty colour. They must have paid a lot of money for her'.

Caring for dogs with broken bodies during their shortened and 'veterinary-ised' lives places an extra burden of emotional labour on all those involved: the owner, the veterinarian and support staff and, most of all, the companion animal. In these circumstances, and in the spirit of interspecies solidarity, human efforts to limit veterinary access to antimicrobials due to concerns about their loss of efficacy in human healthcare seems unjust towards our brachycephalic canine companions, bred to meet anthropocentric demands. Perhaps rather than focusing on antimicrobial use alone, a broader conversation about companion animal welfare is needed—one in which the wants and needs of humans are de-centred, and the health and happiness of our more-than-human messmates foregrounded.

8.3. The lively capital of French bulldogs

Here, I situate the care described in the previous section by reflecting upon how societal changes in preferred bodily forms of canine companions also places pressure on dog populations as well as individual dogs. One of the starkest surges in UK canine popularity in recent years has been that of the French bulldog (Figure 8.1). The breed's origins can be traced back to the social upheaval faced by lace makers during the Industrial Revolution of the nineteenth century (KC, 2020c). They emigrated from Nottingham to France taking their dwarf toy bulldogs with them. The latter were crossed with local flat faced breeds and, after three decades, a new breed—the French bulldog—emerged and was introduced to the UK. It was formally recognised by the Kennel Club in 1873 (KC, 2020c), who more recently recorded a thirtyfold increase in the number of French bulldog puppies registered (O'Neill et al., 2018).

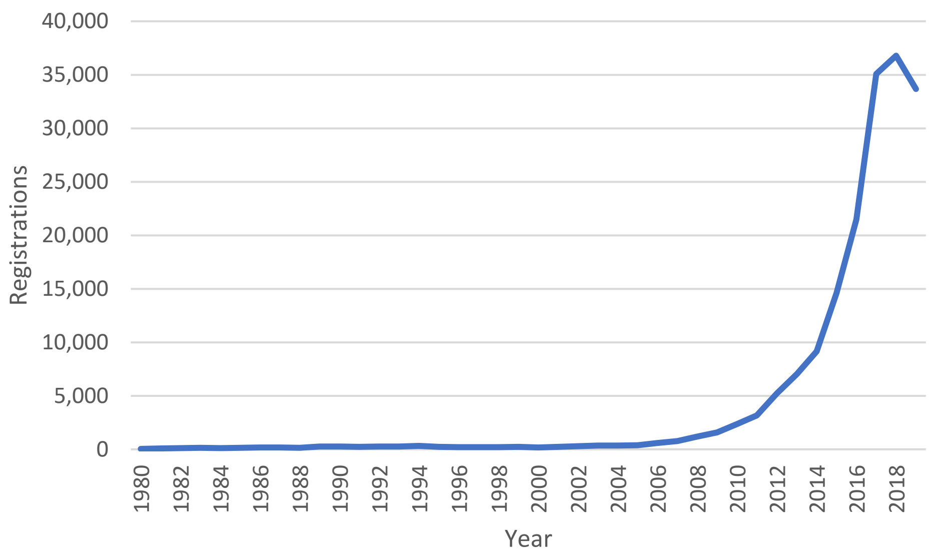


Figure 8.1: The frequency of French bulldogs registered with the UK Kennel Club by year (KC., 2015, KC, 2020b).

In the last ten years or so, the supply of French bulldogs has struggled to keep up with soaring demand. As a consequence, online searches reveal that prices for puppies hover around the two thousand pound mark, rising to seven thousand pounds during the COVID-19 crisis (Mills, 2020). Caring for these animals—these 'lively capital' (Haraway, 2012) with high monetary value—shifts the options 'on the table' when it comes to veterinary care (Hobson-West and Jutel, 2020). With financial stakes this high, veterinarians are extra-compelled to minimise the risks of negative outcomes for these dogs with already-fragile physical health. This form of care can be expensive and, as a consequence, insurance premiums for brachycephalic breeds are high (Anonymous, 2020b). As a result, rescue centres are receiving increasing numbers of French bulldogs, left by their owners who cannot afford their veterinary fees (BBC., 2017).

The expanding market for French bulldogs has offered entrepreneurial opportunities to be capitalised upon. Echoing the industrialisation of animal production seen in the livestock sector, the breeding of French bulldogs has intensified with the number of puppies born per dam (mother) and sire (father) increasing between 1980 and 2014 (KC., 2015). Unscrupulous breeders (‘battery breeders’) have set up ‘farms’ where dogs are kept in poor conditions and used to breed large volumes of puppies. Recent UK regulation has partially driven such enterprises abroad, with an estimated 70,000 puppies per year being illegally imported back into the UK (Bowles and Richards, 2016). These dogs are then sold on via a chain of dealers or agents (Douglas, 2017). This has led to calls for licensed puppy farms in the UK—state-sanctioned enterprises to meet the human demand for these types of animal bodies (Loeb, 2018).

The conditions in which puppies are raised has long-term consequences for their health, both physically and psychologically. The cramped, unhygienic conditions of puppy farms with exposure to many other dogs during breeding and subsequent transportation provides the ideal conditions for the development and spread of disease, whilst the effects of associated psychological traumas are lifelong (Bateson, 2010). It has been estimated that one in five of puppies bought over the Internet—a key tool in the puppy trade—die within six months (Bowles and Richards, 2016). Poorly puppies are sold on to unwitting new ‘pet parents’: when surveyed, almost three-quarters believed their breeder to be ‘responsible’, yet researchers rated just 10% of the sampled UK breeders as such (Douglas, 2017). The subsequent ill-health of their new puppy, therefore, can come as a nasty and anxiety-inducing surprise.

The intensification of puppy production to meet the market for particular canine bodies also has implications for veterinarians and support staff. I witnessed how providing care for young dogs was an enjoyable part of the job: staff would crowd around and coo over puppies—this was a part of clinic life I was more than happy to join! However, caring for puppies also brought anxiety: these animals were vulnerable—both in terms of their size and their immune system development. Their owners, understandably, were protective their new arrival and, perhaps a cynic might argue, their recent investment.

For newly acquired puppies and dogs, a common presentation observed during fieldwork was diarrhoea. This could have any of a number of non-infectious and infectious causes, such as anxiety and/or a change in diet arising from being re-homed, parasites, or allergies. In unvaccinated puppies, the highly contagious parvovirus—a relatively rare but very infectious and often fatal disease—is a concern (Goddard and Leisewitz, 2010). Initial symptoms of the virus are vague—weight loss, depression, lethargy, fever—whist later clinical signs include vomiting and diarrhoea, which can range from mucoid to bloody (Goddard and Leisewitz, 2010). I observed the emotional, physical, and financial cost labour of caring for puppies with parvovirus. Kept in isolation, the cases I witnessed followed the same, sad decline to death, despite the best efforts of the clinic team and multiple pharmaceuticals—including antimicrobials like metronidazole. These cases were tragic and memorable for everyone involved. Therefore, it was difficult to dismiss cases of diarrhoea in puppies as just a tummy upset or to provide some probiotic paste to help restore microbial equilibrium, as seen in older dogs (Singleton et al., 2019c). Something faster and stronger was needed: a quick return to good health helping to reassure all the actors involved.

Metronidazole is an antimicrobial that was traditionally used to treat canine diarrhoea, although it is no longer recommended for uncomplicated acute episodes (BSAVA., 2018). In addition to its antimicrobial effects against species of Clostridia and the parasite *Giardia* spp. (NOAH, 2020), it is also held to have upregulating immunomodulatory effects (Becker et al., 2016). Metronidazole exemplifies how antimicrobials have properties and charms that extend beyond their antibacterial and antiparasitic properties. When faced with sick, vulnerable puppies whose history is shrouded in mystery, using antimicrobials offers a means by which for veterinarians to mitigate against a start in life that may have been far from ideal.

8.4. Hybrid vigour

Societal demands for certain forms of canine bodies have consequences that extend beyond sculpting their phenotype (physical form); selective breeding practices also shape canine genotypes. In the section below, I rehearse the story of how modern dog breeds came 'to be'. In doing so I foreground the role of genes and dogs considered to be 'pure-bred' amongst our canine companions.

The dog breeds with which we share our lives are believed to be the result of two genetic bottle necks, marked by acute reductions in population size and a loss of genetic diversity (Figure 8.2). The subsequent smaller populations of pedigree animals carry a reduced range of genes to pass onto their progeny. The first canine genetic bottle neck occurred around 7,000 to 50,000 generations ago, when dogs were domesticated from the wolf population (Lindblad-Toh et al., 2005). The second occurred more recently, beginning in the nineteenth century, when intensive selective breeding produced the diverse morphology of breeds we see today.

Our interest breeding dogs to keep as companions took off in the UK during the reign of Queen Victoria (Franklin, 1999). The UK Kennel Club was set up in 1873 to govern the emerging activity of dog showing and has been key in setting the templates for—and maintaining the boundaries of—the 200 or so modern dog breeds it recognises today (KC, 2020e). The organisation writes the standard for each breed—a description of the 'ideal' conformation to which breeders aspire—and maintains registers of canines recognised as 'pure bred', i.e. both their parents were on the breed register. The Kennel Club has played an integral role in shaping the range of canine bodies—and their resulting health problems—we see today. In some cases, their breed standards have normalised and encouraged the production of extreme morphologies and the 'broken bodies' veterinarians care for (see Section 8.2).

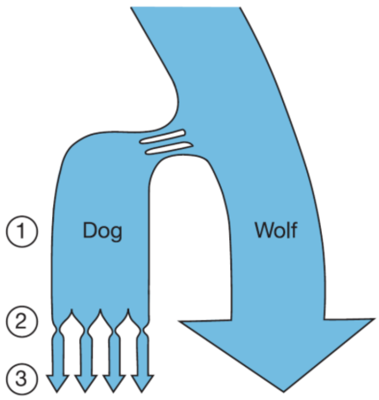


Figure 8.2: Key events in dog breeding history including genetic bottle necks when the domestic dog diverged from wolves and the creation of modern dog breeds (Lindblad-Toh et al., 2005), reproduced with permission.
[1 = Pre-breed domestic dogs; 2 = Breed creation; 3 = Modern breed].

The intensive selective breeding policed by the Kennel Club discourages outbreeding, leading to losses of genetic diversity (Figure 8.2). For example, analysis of the Jack Russell terrier population—a relatively common type of dog not recognised by the Kennel Club—reveals it has maintained a high degree of genetic variability when compared to German shepherd dog, rottweiler, and boxer dog populations, breeds which are overseen by the Kennel Club (Mellanby et al., 2013). As a consequence of the loss of diversity, many of the modern dog breeds have a high prevalence of specific diseases with genetic components. Selective inbreeding results in the expression of deleterious recessive genes causing conditions such as epilepsy, chronic kidney disease, and diabetes mellitus to manifest (O'Neill, 2014).

Changes in the social popularity of dog breeds can place additional pressures on their genetic health. Market demands results in populations being rapidly expanded from a limited pool of individuals. This was observed in the French bulldog population and exacerbated by a few—very socially desirable—sires fathering a large number of puppies (KC, 2020c); the societal centring of male bodies extending to our more-than-human companions. The preference for a few individuals drawn from the larger breed population acts as an additional genetic bottleneck, encouraging inbreeding and the associated health consequences (KC., 2015).

In addition to predisposing animals to specific diseases, the effect of inbreeding on health can be more generalised and harder to pin down. For example, crossbreed dogs live, on average, just over one year longer than pure breed dogs, a finding that suggests hybrid vigour (O'Neill et al., 2014). Evidence indicates that dog breeds with higher levels of inbreeding have lower levels of genetic diversity in their immune system, as assessed through the number of sets (haplotypes) of dog leukocyte antigen class I and class II genes (Beuchat, 2017). This, in turn, is proposed to reduce the functioning of the immune system (Bateson, 2010). I could not locate any biomedical research that investigated the association between canine genetic diversity and susceptibility to infectious illness. However, veterinarian Nicolae at clinic two was adamant, ‘At home [in Bulgaria], stray, mixed-breed dogs have quicker healing times, cos of their stronger immune systems’. When working in the UK, he ‘propped up’ the immune system of pure breed dogs by using antimicrobials to fight primary infections and to avoid the risk of secondary infections. In interview, Monika—also from Eastern Europe—explained:

‘Most of the pets back home are street ones, like adopted from the streets, so most of them know how to take care of themselves and, just because of the inter-crossing between all the breeds, I think they just become more adapted to life and it’s kind of a bit harder for them to get sick, so people don’t really have to do much. But here, they get sick quite fast [laughs] and most people don’t really seem to be aware of what’s going on or what they need to do’.

Monika, intern veterinarian, clinic one

Selective breeding practices have resulted in dogs that are socially desirable but vulnerable to infectious illness. This places an additional burden not only on the dogs themselves, but also on their owners and the veterinarians seeking to care for them.

In the last twenty years or so, there has been a growing awareness of the negative impact on animal welfare in pedigree dogs caused by selective breeding (O'Neill, 2014) and the work of the Kennel Club—and Crufts, its annual showcase event—has come under increasing scrutiny (Osborne, 2016). They have responded by updating their breed standards to encourage less extreme phenotypes and banning the breeding of closely related dogs (Anonymous, 2009b). They have also funded a programme of research into canine welfare and extended their accredited breeder system (O'Neill, 2014). However, the orientation and organisation of this sector remains around the different dog breeds: it is a system that comprises numerous actors beyond the Kennel Club, and continues to have a profound impact on canine welfare and companion animal veterinary work (Rioja-Lang et al., 2020).

8.5. Implications for care and antimicrobial stewardship

I began this section by describing how companion animal veterinarians and support staff enact care for the 'resistant bodies' of their more-than-human patients. They face challenges obtaining histories, undertaking examinations, and obtaining diagnostic samples. In such situations, it may not be feasible to arrive at the firm diagnosis that is held so central in narratives of 'appropriate 'antimicrobial use (O'Neill, 2015). In these situations, veterinarians can draw upon their empirical experience to inform their likely diagnosis and whether, in such situations, antimicrobial use is warranted. When working from a human health-orientated position to optimise antimicrobial use, it is easy to overlook the daily challenges of caring for resistant bodies. The limited use of diagnostic testing in the sector has largely been framed as a consequence of owners being unable or unwilling to pay for them. However, obtaining samples for testing also incurs costs in terms of time, workload and more-than-human distress.

I then moved onto consider the entanglement of the social and biological worlds with regard to dog breeding and its impact on canine health, veterinary care work and antimicrobial use. Whilst I have focused on brachycephalic dogs, in particular French bulldogs, they are by no means unique amongst 'modern' dog breeds in having 'broken bodies' and 'veterinary-ised' lives. For example, dogues de Bordeaux have a life expectancy of just five and a half years (O'Neill, 2014). In these situations, antimicrobials, together with other drugs, can act as a safety net during corrective surgery, to prop up weak immune systems and/or as a sticking plaster to reduce the suffering from medical conditions caused by their bodily forms. Antimicrobials can also be used to mitigate against the health consequences of dogs bred by intensified and exploitative production systems and to help protect the 'lively capital' that these dogs embody. Charged with protecting this vulnerable and valuable canine bodies, veterinary use of antimicrobials 'makes sense'.

This section has provided a partial illustration of the roles that antimicrobials have in alleviating canine ill health caused by anthropogenic activities. When seeking to optimise antimicrobial use in companion animals, care needs to be taken to ensure they are still accessible for treating those animals in need. Meanwhile, most high-level efforts to 'rationalise' antimicrobial use—such as the O'Neill report (2016)—have been motivated by concerns about the impact of antimicrobial resistance on human health. Efforts to protect human health by reducing antimicrobial use in companion animals without addressing the anthropogenic welfare issues they face seems doubly unjust.

The anthropocentric demands placed on canine bodies have resulted in 'local biologies' that require intensified forms of veterinary care. Focusing on antimicrobial use in these dogs enables us to overlook the harmful interspecies entanglements that create these canine bodies. Although treated as biological categories, dog breeds are bio-social endeavours produced by a society that prioritises the bodily form of its canine companions over their health. As a nation of self-professed 'animal lovers', myself included, this raises some uneasy—and to date largely unaddressed—questions. Donna Haraway explored the grass roots movement in the US that mobilised to record, publicise, and tackle the problem of epilepsy in her beloved Australian Shepherd Dogs (Haraway, 2007). Perhaps we need to draw upon feminist approaches—such as Haraway's and that of de la Bellacasa (2017)—to invoke interspecies solidarity and reassess our entanglements with our canine companions.

8.6. Chapter summary

One of the central tenants within appropriate antimicrobial use is reaching a correct and firm diagnosis. However, as described in this chapter, the care of resistant bodies and understanding the 'canine' multiple both present challenges when veterinarians seek to 'know' their patients. Within the existing literature and stewardship materials describing appropriate antimicrobial use in companion animals, there is little discussion of what to do in cases of uncertainty when a firm diagnosis cannot be reached. This mismatch between the representation of veterinary medicine and its enactment could place additional pressure on front-line veterinarians, especially those who have recently graduated. Future research could consider strategies to handle diagnostic uncertainty amidst a backdrop of antimicrobial stewardship.

This chapter has also sought to render visible parts of the 'upstream' social context that produces breed-specific canine ill health. Whilst extending far beyond the bounds of the clinic, this context impacts the forms of veterinary care and antimicrobial practices enacted, the concern of this thesis. In the companion animal sector, antimicrobial stewardship initiatives have been tightly focussed on those entangled at the interface of antimicrobial deployment. As this chapter illustrates, such a vantage point obscures the prevailing conditions shaping veterinary work and separates the stewardship 'agenda' from broader conversations about canine ill-health. Linking up with other initiatives to tackle the more diffuse, structural drivers of antimicrobial use is a currently, unexplored avenue that may result in improvements in animal welfare stretching far beyond optimising antimicrobial use.

Most efforts to intervene regarding antimicrobial use in animals have been motivated by concern about the potential loss of antimicrobial therapeutic efficacy in human healthcare. Meanwhile, as described in this chapter, antimicrobials have a role in alleviating canine ill health suffering caused by anthropogenic—and anthropocentric—activities. Therefore, efforts to protect human health by reducing antimicrobial use in companion animals without addressing the anthropogenic welfare issues they face seems doubly unfair.

As my fieldwork was predominately clinic-based, I have concentrated on the enactment of care by the more-than-human actors there. Future anthropological studies could consider how companion animals are cared for in non-clinical settings, e.g. dog grooming parlours, doggy day care, and, most importantly, the home. Taking seriously owners and their lay understanding of the canine multiple will help the development of a fuller understanding of caring for companion animals. It will also enable a more in-depth consideration of the societal appetites that drive demand for companion animals with broken bodies. Based on my time in the field, I am convinced that this must be part of a broader, society-wide reflection on the anthropocentric demands we place on companion animal bodies: of how we can shift demand to healthier dogs, both phenotypically and genotypically, who require less veterinary-ised lives.

Chapter 9 Antimicrobial 'misuse': A consequence of owners failing to 'Trust your vet'?

9.0. Introduction

'*We experience increasing complaints, vilification on social media, malicious complaints to the Royal College, increasing rudeness, threats of violence, intimidation, unrealistic expectations . . . I am finding it increasingly difficult to provide a service to people who are aggressive, selfish and ungrateful.'*

'The veterinary profession is grossly underpaid in comparison to medical, dental, legal or similar and I feel that it is soul-destroying to work the hours we do, with the stress, and get paid relatively very little…I feel totally undervalued.'

Respondent comments to the 2019 RCVS' Survey of the Veterinary Profession
(Robinson et al., 2020)

In this chapter, I consider existing initiatives encouraging antimicrobial stewardship in the UK companion animal sector using a critical discourse analysis approach. The goal of such a Foucauldian-inspired analysis is to illuminate and critique structures of power that are produced—and re-produced—by the construction of versions of social worlds, and the individuals and institutions within them (Hodges et al., 2008, McHoul and Grace, 2015).

The approach of this chapter was inspired by a recent discourse analysis of UK public health campaigns encouraging 'responsible' antimicrobial use in humans by Will (2020), a science and technology sociologist. Will traced how various theories of behaviour change have been drawn upon to produce different versions of citizens who consume antimicrobials 'appropriately' over two decades. She reports how behavioural economics—in which citizens are 'nudged' into changing their behaviour via non-reflective forms of thought such as 'following the herd' (Thaler and Sunstein, 2009)—are increasingly used. Rather than educating the public about the rationale behind 'appropriate' antimicrobial use—such initiatives have had limited impact in the past—Wills describes how antimicrobial stewardship campaigns are seeking to capitalise on public ignorance and misunderstanding to mobilise behaviour change. Within this context of behavioural economics and nudging people, Will provocatively (in her own words) develops the concept of 'a shrug'—a strategic retreat from engaging with the public in this regard (Will, 2020). In this moment of One Health, I became interested in whether the same behavioural thinking and changes in relations between 'experts' and 'non-experts' could be observed in UK companion animal sector antimicrobial stewardship initiatives.

Relevant stewardship initiatives and campaign materials were identified via observation at fieldwork clinics (Figure 9.1), articles in the veterinary press, and Internet searches. I take the 'Trust your Vet' campaign as my particular object of interest. This initiative was launched in 2018 and targets companion animal owners (DEFRA, 2018). Analysis entailed the consideration of how the content—text and images—and structure of statements within these materials were used to produce particular effects and affects. I also reflected upon the explicit—and implicit—statements; what is said and what is left unsaid. I considered the materials in light of my ethnographic findings, in particular, the orientation of the veterinary sector around the provision of products; the dirty work of talking about money; variation in antimicrobial use between veterinarians; and handling diagnostic uncertainty.

Figure 9.1: An antimicrobial stewardship campaign 'at work' in a consulting room at Clinic two.

I consider the 'Trust your Vet' initiative through the heuristic device of being a boundary object between social worlds (Star and Griesemer, 1989). Such entities adapt to the needs of actors belonging to different communities (e.g. governmental and professional organisations, veterinarians, companion animal owners). Although their meaning is plastic and deployed for different ends, boundary objects maintain sufficient coherence to enable a shared meaning to be formed. They are able to converge multiple interests and hold meaning for all involved (Dowrick et al., 2020).

When 'Trust your Vet' is viewed as a boundary object, the particular work that it does can be rendered visible. Through this analysis, I consider how the framing of antimicrobial misuse as a consequence of the failure by companion animal owners to trust their veterinarian sheds light on the broader UK veterinary profession and their relationship with owners (see introductory quotes to this chapter). The campaign could be interpreted as an attempt to 'shore up' a profession whose expertise, social standing, and, even, economic sustainability is under threat. I then consider what 'Trust your Vet' does in different spaces within the clinic; in care spaces, diagnostic spaces, and in client interfaces. Positioning veterinarians as infallible experts regarding antimicrobial use could have unintended consequences for professionals 'on the ground'. I reflect upon the *responsibilisation* (Lupton, 1995) of owners for 'inappropriate' prescribing and consider whether an information campaign targeting veterinary care consumers is sufficient to re-orientate a broader system.

I conclude by reflecting upon the framings of different antimicrobial stewardship interventions: does the urgent problem of antimicrobial resistance require more paternalistic models of healthcare in which the healthcare professional knows best? I explore whether more collaborative approaches—such as shared decision making—might be a fruitful avenue to consider in the companion animal veterinary sector for achieving 'appropriate' antimicrobial use.

I begin, however, with a chronology of antimicrobial stewardship initiatives relevant to the companion animal veterinary sector in the UK.

9.1. UK antimicrobial stewardship initiatives targeting companion animal antimicrobial consumption

The companion animal veterinary sector in the UK has been the focus of six main antimicrobial stewardship initiatives. Table 9.1 provides a chronology of these campaigns; all have concentrated on providing information to trigger changes in antimicrobial use and I first describe those targeting companion animal veterinarians.

In 2011, the PROTECT scheme, a collaboration between the Small Animal Medicine Society (SAMSOC) and the BSAVA was launched targeting companion animal veterinarians (Battersby, 2011). Its focus was a large poster explaining the PROTECT principles (Table 9.2) with information about surgical prophylaxis, situations where antimicrobials are not indicated unless cytology and/or culture support their use, and a template for the development antimicrobial use protocols at clinic level (Figure 9.2). The advice was revised in 2018 with instructions regarding monitoring and education added to became PROTECT-ME (Table 9.2; Figure 9.3)

(Allerton, 2018, BSAVA., 2018). The PROTECT-ME campaign also included a 'non-prescription pad', an idea borrowed from human healthcare and discussed in Chapter 6 (Figure 6.1).

Table 9.1: The chronology of UK national level antimicrobial stewardship initiatives targeting antimicrobial use in companion animals

Date	Intervention
Veterinarian audience	
Nov. 2009	British Veterinary Association: 'Responsible use of antimicrobials in veterinary practice, eight-point plan, and poster'.
Oct. 2011	British Small Animal Veterinary Association, Small Animal Medicine Society: 'PROTECT' practice materials.
Nov. 2015	British Veterinary Association: 'Responsible use of antimicrobials in veterinary practice, seven-point plan, and poster'.
Nov. 2018	British Small Animal Veterinary Association Small Animal Medicine Society: 'PROTECT-ME' updated practice materials.
Companion animal audience	
Nov. 2013	British Veterinary Association: Antibiotics—your role as a pet owner'.
Jan. 2017	British Veterinary Association et al: 'Are you antibiotics aware?' poster campaign.
Apr. 2018	British Veterinary Association et al: 'Trust your Vet' poster campaign.

Table 9.2: The PROTECT/ PROTECT-ME principles produced by the British Small Animal Veterinary Association and the Small Animal Medicine Society (Battersby, 2011, BSAVA., 2018)

	2011 version	2018 version
P	Practice policy	Prescribe only when necessary
R	Reduce prophylaxis	Reduce prophylaxis
O	Other options	Offer other options
T	Types of bacteria and drugs	Test effectively
E	Employ narrow spectrum	Employ narrow spectrum
C	Culture and sensitivity	Culture appropriately
T	Treat effectively	Tailor your practice policy
M		Monitor
E		Educate others

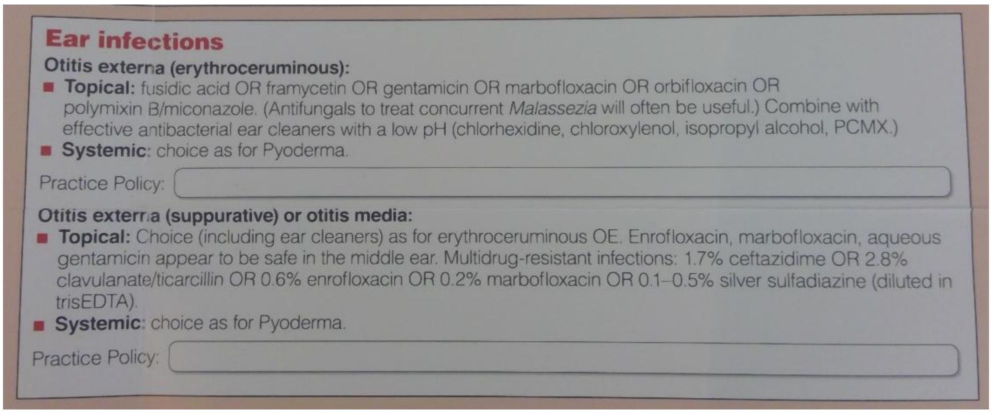


Figure 9.2: An extract from the PROTECT poster showing the locally adaptable template format (Battersby, 2011).

As reported in Chapter 7, at my first fieldwork site there was no space for the display of the PROTECT/ PROTECT-ME poster, nor had the clinic's antimicrobial champion had time to complete it. At the second clinic, the head office of the corporate group had distributed completed copies of the poster with instructions for them to be displayed. The poster had been reduced down in size from A0 to A4, rendering them barely legible. Copies had been put up in the laboratory and inside a cupboard in the second consulting room. The main consulting room—where the majority of appointments took place and the dispensary was located—did not have a copy. Tucked in these out-of-the-way locations, I did not witness the poster being referred to in the course of busy everyday life over the 12 weeks I spent at the clinic.

At the third clinic, the full-size poster had been completed and displayed in the main corridor behind the consulting rooms. It was situated on the wall above the scales that were frequently used to weigh dogs, for example, to calculate the dose of medicines they required. When I asked Jon, one of the full-time salaried veterinarians about the poster, he laughed, 'Do you know what? I've never noticed it!'. A second version of the poster had been completed by the separate organisation that provided out-of-hours veterinary care at the clinic and was displayed in their office for use by their discrete workforce: two forms of 'appropriate' antimicrobial use co-existing and enacted within the same clinic building.

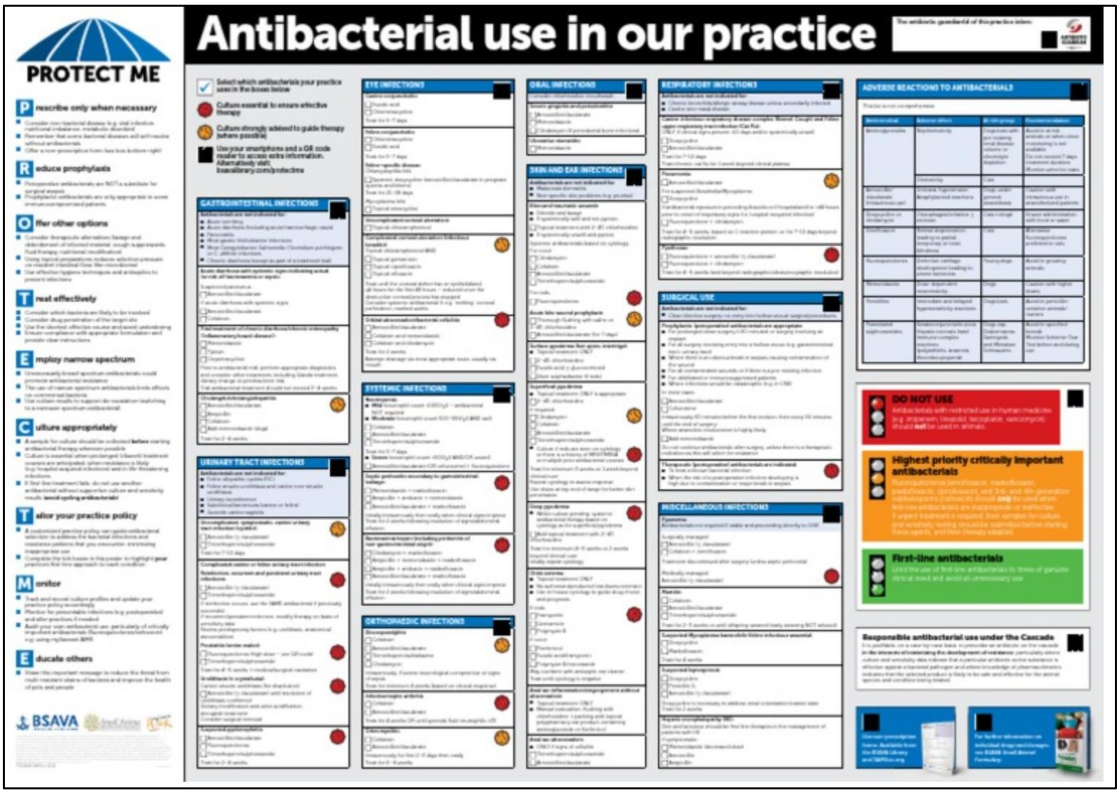


Figure 9.3: The PROTECT-ME Poster (original is A0 size) (BSAVA., 2018).

In 2009, BVA launched its eight-point plan for responsible use in practice (Anonymous, 2009a). It targeted both livestock and companion animal veterinarians and advised: working with clients to avoid the need for antimicrobials; avoiding inappropriate use; choosing the right drug for the right bug; monitoring antimicrobial sensitivity; minimising prophylactic use; minimising perioperative use; recording and justifying deviations from protocols; and reporting suspected failures to the VMD (a DEFRA executive agency responsible for protecting animal health, public health, and the environment and promoting animal welfare by assuring the safety, quality, and efficacy of veterinary medicines). In 2017, the poster was relaunched as a seven-point plan, with items regarding prophylactic and perioperative use combined, and it was subsequently reformatted in 2019 (Figure 9.4) (Anonymous, 2019a).

PROTECT, PROTECT-ME, and the BVA plan—initiatives arising from within the veterinary profession—allow 'space' for front-line veterinarians to exercise their professional judgment. When the contents of the BVA plan are considered, the wording offers flexibility regarding interpretation, echoing the local tailoring offered by PROTECT/PROTECT-ME. For example, under avoiding inappropriate use, the BVA plan advises to restrict antimicrobial use to ill or at-risk animals. What level of risk requires action is left open.

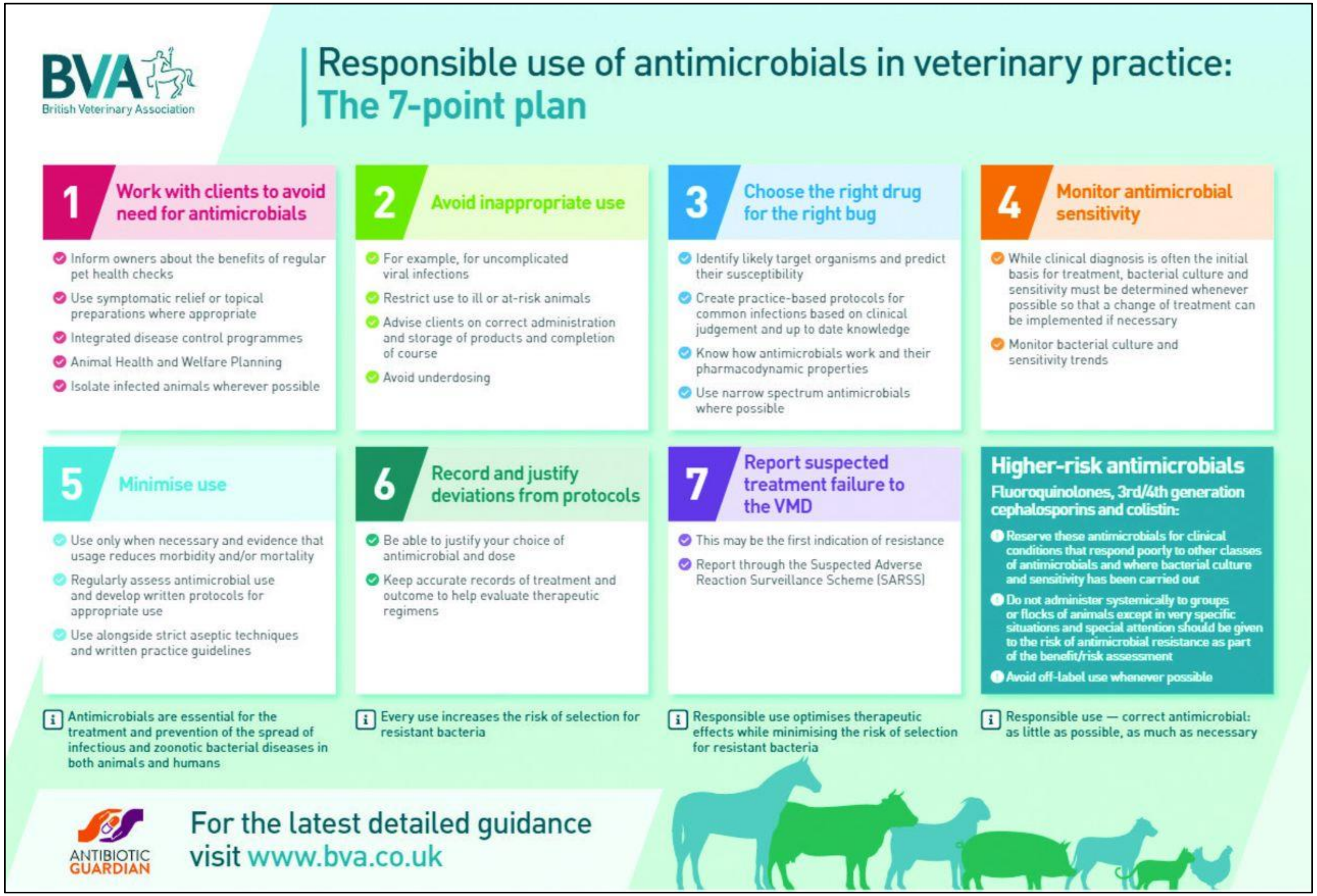


Figure 9.4: The British Veterinary Association's, 'Responsible use of antimicrobials in veterinary practice: the seven-point plan' (Anonymous, 2019a).

Previous research has identified that levels of risk acceptable to individual veterinarians varies: in their Categorical Principal Component Analysis of survey data investigating veterinarian demographics, attitudes, working environment, and antimicrobial use, Hopman et al. (2019a) identified that 'risk avoidance' was negatively associated with veterinarians working part-time and in urban clinics. Risk avoidance practices also vary within individual veterinarians: when interviewed, fieldwork participant Helen described her varying approach to managing canine diarrhoea:

'I'm not very consistent. Sometimes, when I'm feeling good, I'll wait and go through the whole process [of faecal assays] and sometimes I'll be more proactive and just give them antibiotics.'

Helen, salaried veterinarian, clinic one

In this quote, she uses good to mean resilient and thus it hints at how the working environment—including interactions with owners—may influence how much additional burden or risk caused by not supplying antimicrobials, a veterinarian feels able to shoulder. This includes negotiations regarding diagnostic tests, their additional cost, and coping with the risk of complications, e.g. secondary infection.

In the UK, the livestock sector has seen substantial reductions in antimicrobial use (UK-VARSS., 2019). This success has been ascribed to target levels of reduced antimicrobial use being set by stakeholders—including veterinarians—working within the sector (RUMA., 2019), avoiding the need for external 'policing' (Buller et al., 2015). This desire to manage the 'problem' of inappropriate antimicrobial use whilst also protecting professional veterinary autonomy can also be seen in these companion animal sector initiatives.

I now consider the national stewardship initiatives targeting companion animal owners. This chapter focuses on the 'Trust your Vet' campaign that was officially launched in April 2018 (Figure 9.5)**.** It is a collaboration between the BVA, DEFRA, the VMD, and the BSAVA. Its launch was timed to coincide with National Pet Month—a charity initiative with industry funding—seeking to promote 'responsible' pet ownership (Anonymous, 2020c). To publicise the campaign a news story was published on the UK's government website, *'Trust Your Vet on antibiotic treatment'* (DEFRA, 2018) and a letter from the Chief Veterinary Officer, *'Encouraging responsible antibiotic use by pet owners'*, was printed in the *Veterinary Record* (Middlemiss, 2018). A printed copy of the poster was included in copies of the journal sent to BVA members for their display at their clinic workplaces.

The 'Trust your Vet' campaign followed earlier initiatives: In 2013, a leaflet 'Antibiotics—Your Role as a Pet Owner' (Figure 9.6) was introduced into companion animal veterinary clinics. It was produced by the BVA with content derived from material produced by the FVA, echoing the sharing and translating of human antimicrobial stewardship materials between European countries (Jeppesen Kragh and Strudsholm, 2019). In 2017, a One Health poster targeting human patients and animal owners entitled 'Are you Antibiotic Aware?' (Figure 9.7) was launched (Wensley, 2017). The poster—a collaboration between veterinary and medical organisations and government departments—emphasizes the commonalities of stewardship messaging for patients in human and veterinary healthcare systems. Like the most recent version of the BVA's seven-point plan (Figure 9.4), it bears the logo of the Antibiotic Guardian scheme—a campaign that utilises public pledges and the power of social norms in a bid to influence antimicrobial use across human and veterinary medicine in the UK (Will, 2020). When the 'Trust your Vet' initiative is compared to earlier materials, the central positioning of the need for: i) companion animal owners to be trusting, and ii) a reduction in efforts to educate them about 'appropriate' antimicrobial use becomes apparent. I reflect upon these changes in the following sections.

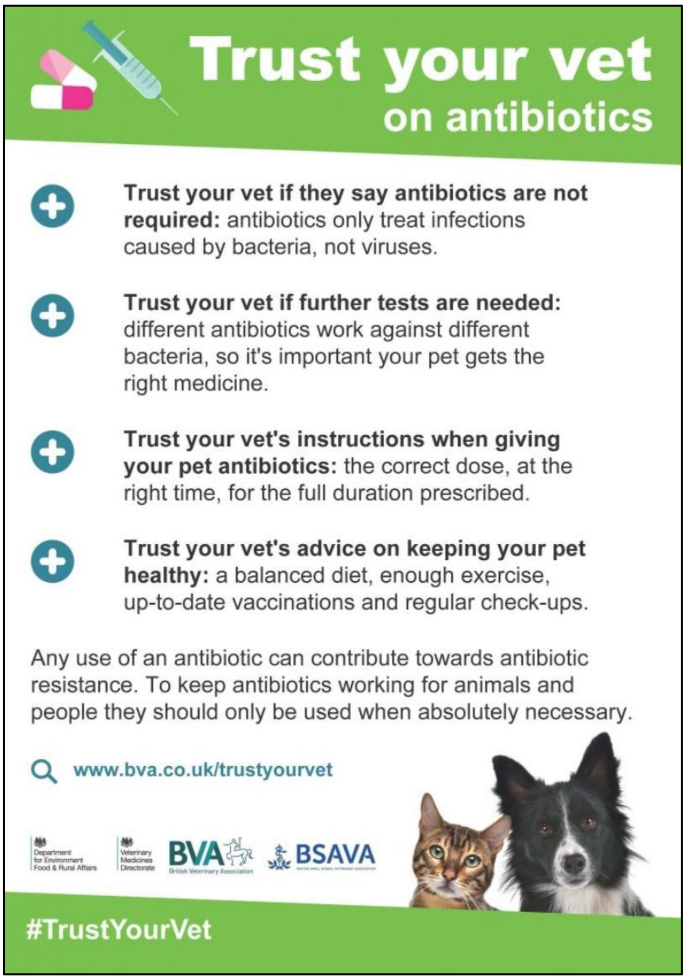


Figure 9.5: The 'Trust your Vet' poster.

BVA
British Veterinary Association

Antibiotics – your role as a pet owner

BVA client leaflet Number 5 • November 2013

Antibiotic resistance in pets is becoming a greater challenge, much like it is in humans. Antibiotic resistance is when the bacteria causing an infection are not affected by the antibiotic, making it ineffective as treatment.

Antibiotics are not always the answer

Not every infectious disease needs antibiotic treatment (for example, viral infections). Don't demand antibiotics if your vet says that your pet does not need them.

Antibiotics are lifesaving drugs

Antibiotics are vital to treat and prevent disease in animals and humans. But the risk that the organism causing the disease will develop resistance to them increases every time they are used. To make sure antibiotics stay effective now and in the future, they must be strictly controlled and used only when really necessary and with caution.

Keep your animal healthy

A healthy animal is better equipped to fight off infections. Do your best to keep your pet healthy by feeding it food with a high nutritional value, providing a healthy lifestyle, having it vaccinated regularly and taking it to your vet for an examination each year. If your pet gets sick, go to your vet immediately.

Do not try to treat your pet yourself

Do not share antibiotics between pets or re-use tablets that were prescribed for an earlier illness. They may not be appropriate for your pet's current condition, or they may be toxic for certain animals, out of date or contaminated. Never give human medicines to your pet as they could be dangerous and ineffective.

Diagnostic tests might be needed

Your vet may need to carry out a laboratory test to find out whether treatment with antibiotics is really necessary and, if so, which antibiotic will work best. Your vet will then be able to prescribe the right antibiotic for the right bacteria. Older antibiotics, such as penicillin, are often as effective as modern antibiotics.

Follow the dosage instructions

Make sure that you give your pet all the recommended doses of an antibiotic as prescribed by your vet, even if your pet seems better after a few doses. This helps cure the current infection and will also help to keep the bacteria from discovering new ways of being resistant to the antibiotic.

Top tip

People's hands are the most common way of spreading germs. Although these germs can be harmless they may also cause diseases such as stomach bugs and bacteria that are resistant to antibiotics such as MRSA and MRSP between animals and people. Make sure you wash your hands properly.

Talk to your vet

If you have worries or questions about antibiotic resistance, you should discuss these with your vet. Your vet is an expert and will be your best advisor. Try to build up a good relationship with your vet so you can work together to keep your pet healthy and happy.

Glossary

Antibiotics: drugs that kill disease-causing agents such as bacteria. They are not effective against viruses.

MRSA: meticillin-resistant staphylococcus aureus. These highly resistant bacteria are typically found in human hospitals but can also cause infection in animals.

MRSP: meticillin-resistant staphylococcus pseudintermedius. These highly resistant bacteria typically cause infections in animals but, on rare occasions, have caused human infection.

About the BVA

The BVA is the national representative body for the UK veterinary profession. We support our members to fulfil their roles for the benefit of animals and the public.

This is one of a series of leaflets for animal owners produced by the BVA, you can find more at **www.bva.co.uk/public**

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Figure 9.6: The British Veterinary Association's 2013 leaflet for owners regarding antibiotic use.

Figure 9.7: The collaborative One Health poster targeting patients and companion animal owners launched in 2017 (Wensley, 2017).

9.2. Trust: an avenue by which to alter antimicrobial use?

In this section, in light of the 'Trust your Vet' campaign, I describe the construct of 'trust' and its potential as a mechanism by which to alter antimicrobial use. Trust is a widely used and diffuse concept: Jack Barbalet (2019), who writes from a contemporary sociological perspective, describes it as, 'interpersonal relations of support and cooperation' (Barbalet, 2019, p. 11). In human healthcare, trust has been explained as, ‘the belief that a doctor is working in the patient's best interests’ (Rolfe et al., 2014, p. 3).

Best interests can be problematic to define regarding antimicrobial use. As described in Chapter 4, veterinarians face dilemmas regarding the imperative to treat the poorly patient in front of them whilst protecting public health and the health of future generations from the loss of therapeutic efficacy due to antimicrobial resistance. This dilemma is an example of the ‘tragedy of the commons’ whereby the interests of the population as a whole are harmed by individuals acting to maximise their own personal benefits (Tonkin-Crine et al., 2015). This ‘weighing-up’ of societal harm versus individual benefits is made harder given that many of the consequences of antimicrobial use in companion animals—especially with respect to antimicrobial resistance in human populations—remaining unclear (Jensen et al., 2019). This is partly due to the lack of routine antimicrobial resistance monitoring and surveillance in companion animals (UK-VARSS., 2019). Therefore, calls for antimicrobial stewardship rely on evoking imagined futures, rather than data-driven accounts; what Chandler (2019) describes as sentinel rather than actuarial approaches. The context of the UK companion animal veterinary sector exacerbates this uncertainty as limited diagnostic testing results in the prevalence and nature of antimicrobial resistance being relatively poorly characterised within companion animal populations.

In terms of ‘Trust your Vet’, typically the trust giver—i.e. the companion animal owner—is rendered dependent due to their lack of knowledge regarding future outcomes and what is for the best (Barbalet, 2019). However, in the case of antimicrobial use in companion animals, veterinarians may also struggle to answer, ‘What are the public health risks of using this course of antimicrobials?’. Furthermore, the relatively recent advent of veterinary work protecting the ‘private goods’ of companion animals has led some to question whether the veterinarian’s traditionally strong role in protecting public health—for example, via their food safety work—has become disconnected (Hueston, 2016).

In human healthcare, trust has been found to be positively associated with patient satisfaction and adherence to treatment (Rolfe et al., 2014), both of which have relevance to antimicrobial stewardship efforts. Improved satisfaction would help prevent ‘shopping around’ and loss of business if antimicrobials are withheld. Improved treatment compliance would reduce the risk of treatment failure and recurrence of disease, as well as reducing the occurrence of antimicrobial resistance. In terms of interventions, a systematic review did not identify any studies evaluating the effectiveness of education campaigns urging healthcare consumers to be more trusting (Rolfe et al., 2014). With regards to antimicrobial use, a cross-sectional survey found that interpersonal trust was associated with a self-reported willingness to limit personal antimicrobial use (Robertson et al., 2018). However, it is unclear how hypothetical self-reported behaviours reflect complex, enacted practices. In primary care, almost nine out of ten of UK adults surveyed trusted their general practitioner to determine the need for antimicrobials (McNulty et al., 2016).

There has been limited research into trust in the companion animal veterinary sector. A quarter of a sample of Icelandic and Norwegian owners reported they no longer trusted their veterinarians to do what would be best for their dog (Lund et al., 2009). In terms of antimicrobial use, UK 'experts' believe a trusting relationship is important in enabling owners to accept advice, particularly that antimicrobials are not needed (Currie et al., 2018). I was unable to locate any statistics in the existing scientific literature regarding the public's trust in UK companion animal veterinarians regarding antimicrobial use. Nevertheless, drawing on recent insights from the efforts to understand public responses to climate change initiatives, social values—including trust—have been proposed as a target by which to alter antimicrobial use in livestock (Redding et al., 2020).

9.3. A retreat from educating?

The information contained by the 'Trust your Vet' poster' is a distillation of that included in the 2013 leaflet: there has been a reduction in the number of instructions covered from eight to five. Two of the dropped directives involve 'at-home' practices—handwashing and not treating your companion animal with leftover veterinary or human medicines. This perhaps acts to centralise the position of the consulting room—and the veterinarian—in protecting antimicrobials and preventing antimicrobial resistance. The recommendation to talk to your veterinarian and ask questions has also been discontinued with, instead, owners being told to follow the instructions provided by their veterinarian. Linked to this, in Section 9.6 I reflect upon how the crisis of antimicrobial resistance is positioned as requiring a return of more paternalistic forms of healthcare.

The 'Trust your Vet' poster (Figure 9.5) provides less supporting information under each heading than the earlier initiatives (Figure 9.6; Figure 9.7). In her analysis of major UK public health campaigns regarding antimicrobial use and resistance, Will (2020) reported how behavioural economics—in which citizens are 'nudged' into changing their behaviour via non-reflective forms of thought, such as 'following the herd' (Thaler and Sunstein, 2009)—are increasingly deployed, mirroring the popularity of these approaches in broader public health (Roberto and Kawachi, 2015). Will partly attributes this move as a response to campaign evaluations revealing that members of the public with better knowledge did not always act in the predicted—more 'appropriate'—manner, opining that, 'it seem[s] too difficult to talk to people about the likely mechanisms of antimicrobial resistance, to relate to the complexity of people's experience of infections, or to discuss collective stakes in the spread of resistance' (Will, 2020, p. 17). Through her analysis, Will develops the concept of 'a shrug'—a strategic retreat from engaging with the public in this regard (Will, 2020). We can see the shift towards encouraging unreflective action, the 'shrug', in the companion animal veterinary sector, too, via the instruction to 'Trust your Vet'.

9.4. Glossing over money

Compared to the earlier iterations, an area where less detail is provided by 'Trust your Vet' is the reasoning behind the instruction to complete the antimicrobial course. As the 2013 leaflet explains, it, 'helps cure the current infection and will also help keep bacteria from discovering new ways of being resistant to the antibiotic' (BVA., 2013a). The inclusion of this information might be helpful given the suspicion amongst companion animal owners that veterinarian actions are influenced by the profit from medicines sales (Smith et al., 2018).

Companion animal owners are instructed to 'Trust your vet if further tests are needed' (Figure 9.1); however, there is no mention of the additional costs that will be incurred. Multiple studies have identified cost as a major barrier to increased use of diagnostic testing (see Section 2.2.8). However, this initiative does not address—or mention—this barrier. In Chapter 6, I used the theoretical lens of 'dirty work' (Hughes, 1971) to reflect upon why the financial aspects of veterinary work are rarely discussed, and the 'Trust your Vet' provides a further illustration of this. Talking openly about the cost of the diagnostic testing—or the profit made by veterinarians on antimicrobial sales—might improve the perceived 'trustworthiness' of veterinarians by owners and facilitate 'easier' consultations. For one person to trust another, both need to believe that the other is reliable, and that neither will act to contravene the other's interests (Barbalet, 2019).

9.5. The 'work' of 'Trust your Vet'

In the following sections, I take the 'Trust your Vet' campaign as my object of study and consider the work it does between actors at the interface of antimicrobial use in the different spaces of the veterinary clinic. To facilitate my endeavours, I view the 'Trust your Vet' initiative through the lens of being a boundary object (Star and Griesemer, 1989) between social worlds. Such entities adapt to the needs of actors belonging to different communities and, although their meaning is plastic and deployed for different ends, they maintain sufficient coherence to enable a shared meaning to be formed.

Through this analysis, and in the sections below, I consider how ‘Trust your Vet’ might be interpreted as shoring up the social standing of the veterinary profession and making companion animal owners ‘responsible’ via its antimicrobial stewardship efforts. I also report the unintended effects that ‘Trust your Vet’ may have as it moves through spaces of care, diagnosis, and owner interaction within the clinic. This by presenting a vision of veterinary care in which i) no variation in antimicrobial use exists between professionals; ii) a definitive diagnosis is always possible; and iii) the scientific evidence base is well developed and unchanging. Rather than making entanglements with companion animal owners easier, these may act to make the lives of front-line veterinarians more difficult.

9.5.1. Shoring up professional standing

In Chapter 4, I described current conditions that make undertaking companion animal veterinary work challenging. These include the increasing use of ‘Dr Google’ (BVA., 2019a), a perceived lack of respect and recognition from the public (Robinson et al., 2020), and an increasing ‘complaint culture’ (Kernot, 2018). Together, these act to weaken the social standing of veterinarians and their ‘expert’ knowledge. Viewed in this context, the ‘Trust your Vet’ campaign could be seen as an attempt to shore up the status of companion animal veterinarians.

Antimicrobial stewardship initiatives can represent a challenge to the power of professional groups with the ability to prescribe antimicrobials. For example, when launching their responsible antimicrobial use guidelines, the BSAVA described how, ‘antibacterial resistance is a politically important topic and there are those who wish to restrict veterinary use of certain antibacterial products, which could have significant implications for animal health and welfare. It is therefore essential that veterinary surgeons are seen to be using antibacterials responsibly’ (BSAVA., 2018). Echoing this sentiment, an interview study with UK companion animal veterinarians found their key motivator for enacting antimicrobial stewardship was defending their professional authority and knowledge, rather than the protection of antimicrobial therapeutic efficacy (Cartelet et al., 2018). In France, Fortané (2019) observed how livestock veterinarians have mobilised to reframe their profession so that they are seen as protectors of public health—and antimicrobials—rather than as a threat due to their antimicrobial misuse. These findings reflect how antimicrobials are powerful social actors and therefore efforts to limit their use become political projects.

When reflecting on power in modern healthcare, philosopher and political theorist Grimen (2009) writes, 'analyses of trust that neglect power are naïve' (Grimen, 2009, p. 17). The 'Trust your Vet' campaign positions veterinarians in a central role not only when deciding whether antimicrobials and/or diagnostic testing are required, but also in promoting health. As such, it offers an opportunity by which to reassert the veterinary profession's expert scientific knowledge, their power to (not) grant access to pharmaceuticals, and their role as protectors of antimicrobials. One might reflect on the absence of a 'please' from the campaign's slogan: this is not a request to a healthcare consumer exercising the logic of choice, that Mol (2008) argues underpins much of Western healthcare. Barbalet (2019) notes that any relationship based on trust involves vulnerability on the part of the trust giver, who cooperates despite the absence of a known concrete future outcome. Could urging companion animal owners to be more trusting be also interpreted as asking them to make themselves more vulnerable in veterinarian–owner encounters, thus helping veterinarians to reassert their professional authority?

In Chapter 4, I situated companion animal veterinarians and owners within a context of precarity. Trust has been positioned as being important in maintaining social order in these precarious times even though, under these conditions, being trusting becomes a precarious activity in itself (Barbalet, 2019). Therefore, we are no longer expected to blindly trust those in positions of power such as medical or veterinary professionals (Ward, 2018). Although trust in these groups remains high, evidence suggests it is declining due to post-modern perspectives that render knowledge as, 'always provisional and contingent on context and power' (Rolfe et al., 2014, p. 4). By invoking the need to trust, perhaps the 'Trust your Vet' campaign is harking back to the golden days of veterinary work, when professionals such as James Herriot were respected members of the community.

Unlike the earlier 'Antibiotics—Your Role as a Pet Owner' (Figure 9.6), 'Trust your Vet' does not encourage owners to ask questions of their veterinarian. When interviewed regarding their antimicrobial decision making, UK companion animal veterinarians sometimes described their relationships with owners as adversarial, particularly when they felt their knowledge and authority were being challenged (Cartelet et al., 2018). Through no longer encouraging questioning, 'Trust your Vet' might be interpreted as seeking to lessen this mechanism via which veterinarians feel their power is being threatened and their expert status undermined.

The BVA is one of the authors of the 'Trust your Vet' campaign and has an ongoing interest in the perceived trustworthiness of veterinarians. As part of its activities, BVA champions the veterinary profession, with its website describing how, 'Vets are exceptional professionals and one of the most trusted professions in the UK' (BVA., 2019d). This statement is derived from a 2015 opinion poll they commissioned along with the RCVS (Anonymous, 2015). Over 2,000 adults (both companion animal owners and non-owners) were asked their views about their satisfaction and trust of different professional groups (Figure 9.8). At the time, John Blackwell, the then-BVA president commented, 'Vets are particularly concerned, and sometimes worried, about how their clients—and wider society—perceive them. So it is particularly heartening to learn that the general public holds the profession in such high regard in relation to trust . . . Vets should be proud to be part of one of the most trusted professions in Britain' (Anonymous, 2015, p. 563). This exercise reveals a wider interest of the BVA in demonstrating the trustworthiness of veterinarians—beyond their use of antimicrobials—with the choice of the comparative professions included in the survey shedding light on their projected societal standing (Figure 9.8). Participating in antimicrobial stewardship schemes offers another avenue through which the BVA can promote the trustworthiness of veterinarians. Echoing the findings presented in Chapter 6, where the pharmaceutical sector moulded antimicrobial stewardship messaging to meet their organisational goals, this case illustrates how the 'Trust your Vet' initiative provides another avenue through which the BVA can promote the veterinary profession.

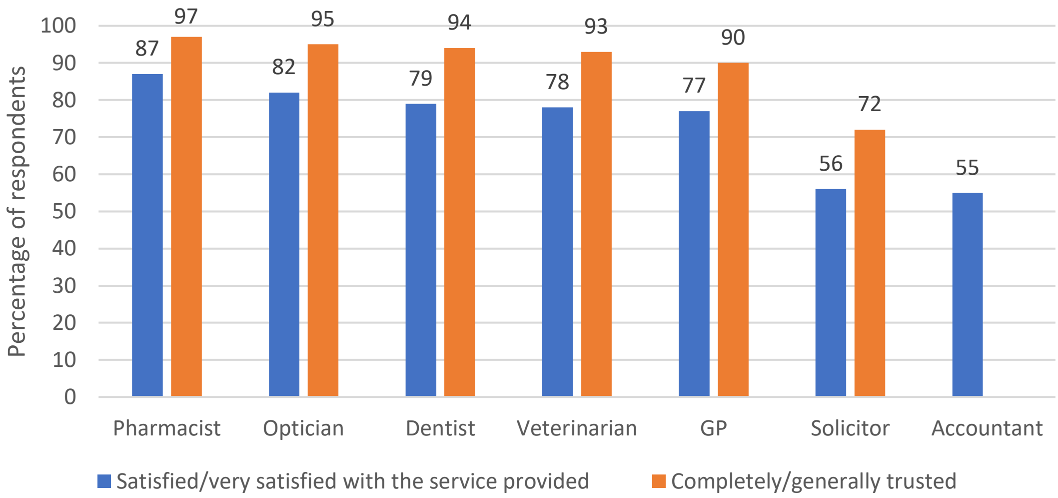

Figure 9.8: Selected results of the BVA commissioned opinion poll of the UK general public (n = 2,002) regarding their satisfaction and trust in professionals (Anonymous, 2015).
[GP: General Practitioner; No trust data available for accountants].

9.5.2. Making owners 'responsible'

In the UK, antimicrobials are prescription-only medicines in both human and veterinary sectors. Therefore, one might expect efforts to influence their 'appropriate' use to focus on the healthcare and veterinary professionals able to prescribe them. However, in both sectors, consumer desire for antimicrobials and the pressure placed on prescribers is widely cited and, as a consequence, it becomes necessary to 'educate' the demanding publics regarding 'appropriate' antimicrobial use (Will, 2020).

As described earlier, the launch of the 'Trust your Vet' was accompanied by a governmental press release and a letter from the Chief Veterinary Officer. The collective message of these supporting materials is that companion animal owners are responsible for driving the misuse of antimicrobials. The governmental press release quotes a BVA survey saying that, 'Almost 90% of vets said clients came to appointments with an expectation they will provide antibiotics for their pets' (DEFRA, 2018). Perhaps in order to show support for the pressures that veterinarians face, rather than asking companion animal owners themselves what their expectations were, this statistic was derived from veterinarians' opinions. In her letter to veterinarians, the Chief Veterinary Officer explains, 'We know pet owners usually turn up to the vets with high expectations of receiving antibiotics as a treatment for their ill pets with little knowledge of the problems it can cause if it is not the correct course of treatment' (Middlemiss, 2018). Thus, veterinarians are positioned as central in assessing public levels of ignorance regarding antimicrobial 'appropriate' use and resistance. As Will (2020) writes in her analysis of antimicrobial stewardship schemes, 'Identifying ignorance in others is a way of claiming status for experts' (Will, 2020, p. 2).

One might also consider ideas of ignorance from the perspective of those involved in developing the 'Trust your Vet' campaign. Based on the US licensing of the antimicrobial Ketak, a brand of telithromycin, McGoey (2012) coined the term 'strategic ignorance' to describe how ignorance can sometimes be a powerful and productive asset for individuals and institutions. Possibly, by foregrounding the role of owners, organisations involved in the 'Trust your Vet' campaign are able to overlook other potential drivers of antimicrobial use, the tackling of which may be seen to threaten their authority or that of their members.

My ethnographic findings build on previous research in suggesting that the 'expectation' for antimicrobials is rarely articulated by owners. In Chapter 6, I described the infrastructural arrangements that result in the orientation of veterinary system around the provision of medicines and products. I propose that, on the ground, the circulating discourse of owners expecting antimicrobials is more diffuse and not limited to this class of pharmaceutical. I suggest that the orientation of the companion animal veterinary 'system' both leads owners to anticipate receiving a medicine or product and veterinarians to pre-empt the articulation of these demands. It is uncertain whether a poster targeting owners is sufficient to re-orientate this system of providing care.

During fieldwork, an oft-heard sentiment from veterinarians and support staff was that they did this—emotionally and physically draining—work for their companion animal patients, in spite of their owners. Elizabeth Armitage-Chan (2019) studied early career veterinarians and observed the ways in which their diagnosis-focused identity, fostered at university, came up against on-the-ground obstacles that prevented their deployment of extensive diagnostics and treatments. Typically, these barriers were linked to companion owners, who were positioned as the enemy, preventing them from achieving their academically orientated goals. The sharing of this sentiment between colleagues validated the 'pet owner as the enemy' framing and provide a temporary feeling of workplace satisfaction. Armitage-Chan goes on to note, 'Contextualising this observation within the veterinary media revealed a pervasive "client as enemy" rhetoric. Traditional and social media articles within the public domain frequently depicted clients as failing to understand the needs of the veterinarian' (Armitage-Chan, 2019, p. 7). When viewed through this lens, the 'Trust your Vet' initiative could be another avenue through which to frame the companion animal owners as difficult and problematic to work with.

Beyond the companion animal sector, making consumers responsible for inappropriate antimicrobial use has also been observed in human healthcare (Chandler, 2019). Lupton (1995) has previously described the process of *responsibilisation* in which individuals are held responsible for their health, a re-positioning that shifts responsibility away from the state. More recently, Lohm et al. (2020) reported the entanglement of healthcare consumers in the contrary expectations of being responsible for their antimicrobial use and, at the same time, to trust healthcare professionals to make antimicrobial decisions on their behalf. Jensen et al. (2019) described the expectation for consumers to demonstrate self-restraint by not asking for antimicrobials—and instead place their trust in healthcare professional—in terms of Foucault's concept of 'governmentality'. This is the means by which modern states exert their power on citizens in diffuse ways (i.e. we are governed mentally) rather than being physically disciplined into obedience (McHoul and Grace, 2015). Placing the onus on individual owners to be responsible and regulate their companion animal's antimicrobial consumption is another facet of governmentality.

The rhetoric of being a 'responsible' companion animal-owning citizen has been mobilised widely, beyond the topic of antimicrobial use, e.g. through ensuring your dog is sterilised to prevent unwanted offspring and vaccinated to prevent the spread of disease (DogsTrust, 2016).

The Kennel Club runs 'The Good Citizen Dog Training Programme' (KC, 2020d), although it is unclear whether the 'good citizen' is the dog who has been rendered obedient through participation or its human owners. Uncollected dog faeces have been interpreted as a metonym for being 'uncivil' (Dergesa et al., 2012) and the trigger for civil dispute (Pemberton, 2017). Owners' perspectives on being responsible centre on meeting their dog's needs, driven by their deep emotional connection (Westgarth et al., 2019). For example, when in public, their priority is to protect their dog from harm whilst the needs of others are seen as of secondary importance (Westgarth et al., 2019). This finding might help us to understand the popularity with owners of prescribing antimicrobials 'just in case' (Dickson et al., 2019). In these more general discussions surrounding responsible dog ownership, there is no mention of 'appropriate' antimicrobial use. This relatively new imperative is yet to be incorporated into holistic interpretations of being responsible. This mirrors how the imperative to care for antimicrobials is yet to find a consolidated space within the veterinary clinic or within veterinary medicine as a discipline (Chapter 7).

9.5.3. In spaces of care

In the poster and news story accompanying the launch of 'Trust your Vet', the veterinary profession is presented as a cohesive, single entity united in the goal of protecting antimicrobials (DEFRA, 2018). However, in her letter to fellow veterinarians, the Chief Veterinary Officer wrote, 'We need solidarity across the profession; no vet must offer an easy route to access antibiotics where they are not justified' (Middlemiss, 2018, p. 410). Previous research identified that the fear of owners 'shopping around' to find a competing veterinarian who freely dispenses antimicrobials acts a barrier to veterinarians enacting antimicrobial stewardship (Chapter 2). Unlike the public-facing image presented by the 'Trust your Vet' campaign, variation in antimicrobial use between veterinarians is known to exist within the profession.

In Chapter 5, I explored variation in antimicrobial use using epidemiological methods. I found there was limited clustering of highest priority critically important antimicrobials at a clinic level suggesting that veterinarians do not automatically share ways of working with antimicrobials. Fieldwork revealed how the clinic was not the bounded unit portrayed by the statistical model. The extended opening hours and the rising numbers of veterinarians working part-time or as locums means that consulting duties and the care of ongoing cases are shared. Reflecting these conditions, perhaps the slogan of the campaign should more accurately read, 'Trust your Vet**s**'. By not doing so, the campaign could inadvertently reinforce expectations of outdated models of veterinary care in which continuity of care is the norm and owners are less likely to navigate a landscape of care provided by a team of veterinarians. In Chapter 7, I described the 'tricky' situations faced by front-line veterinarians when their colleagues' previous 'inappropriate' antimicrobial use influences owner expectations. By presenting the veterinary profession as a unified whole focused on protecting antimicrobial use, the 'Trust your Vet' campaign could unintentionally increase the pressure of front-line veterinarians when trying to explain the differences between their (appropriate) and their colleagues' (inappropriate) deployment of antimicrobials.

During my fieldwork, it was unusual for owners to challenge the proposed use of antimicrobials by their veterinarian in consultations; however, it did occasionally happen. The discouragement of owners from asking questions by the 'Trust your Vet' initiative might prevent this mechanism by which veterinarians are made to reconsider their prescribing habits. By muting the expression of owner concerns, could it act to reinforce the status quo and the circulating discourse of owners expecting antimicrobials? Human healthcare studies have suggested that 'blind trust' may prevent the asking of necessary and important questions, causing a decline in the quality of care (Rolfe et al., 2014).

9.5.4. In spaces of diagnosis

The 'Trust your Vet' campaign allows no room for uncertainty on the part of the veterinarian with regard to diagnosis. For example, the poster explains how illness will be definitely determinable as either viral or bacterial in origin. However, kennel cough (canine infectious respiratory disease complex) is a commonly seen disease that develops when a viral pathogen such as canine respiratory coronavirus or canine parainfluenza virus facilitates secondary infection caused by bacteria present in the upper respiratory tract (Singleton et al., 2019d). Traditionally, antimicrobials were used to treat kennel cough; however, guidelines now recommend that this only in cases where the clinical symptoms persist for over 10 days and/or the animal is systemically unwell (BSAVA., 2018). This condition illustrates how the divide between viral and bacterial infections—based on taxonomic classification—might not be reflected on the ground and in the respiratory tracts of dogs.

In Chapter 8, I described the unique challenges faced by companion animal veterinarians in reaching a firm diagnosis. By foregrounding diagnosis-orientated framings of veterinary care over relational, client-orientated care, the campaign might increase the pressures experienced by front-line veterinarians. One source of the poor wellbeing in early career veterinarians is thought to come from 'identity confusion' caused by the mismatch between veterinary work as presented at university—a scientific endeavour of disease diagnosis and treatment—and the messy reality of clinical uncertainty and ambiguity (Clarke and Knights, 2018). The 'Trust your

Vet' campaign, does not present this uncertainty; rather, it promotes veterinarians as definite information sources regarding diagnosis and antimicrobial use—an image that may be difficult to 'live up to'.

9.5.5. In spaces of communication with owners

In addition to handling diagnostic uncertainty, veterinarians are also faced with gaps in the scientific evidence regarding appropriate antimicrobial use (Chapter 6). A message in the 'Trust your Vet' and other public information campaigns is the importance of completing prescribed courses of antimicrobials. However, a narrative review published in the *BMJ* questioned the evidence base underlying this common instruction, instead arguing that the contribution to antimicrobial resistance was greater from treatment prescribed for longer than necessary compared to when it was stopped early (Llewelyn et al., 2017). The story was subsequently picked up by the lay press generating headlines like, 'You SHOULDN'T always take full course of antibiotics: Experts now say taking drugs after you feel well may encourage risk of superbugs', which appeared in the *Daily Mail* (Taylor, 2017). Organisations, including the British Society of Antimicrobial Chemotherapy and the Responsible Use of Medicines in Animals Alliance(RUMA), raised concerns that Llewelyn's efforts had caused more harm than good as, by undermining part of antibiotic stewardship messaging, members of the public would doubt and not adhere to other components (BSAC., 2017, RUMA, 2017). Such controversies contribute to the, 'fragmentation of expertise' undermining the authority of professions whose expertise is built upon the biomedical knowledge (Lohm et al., 2020, p. 5), causing mistrust amongst members of the public.

This case illustrates the difficulties of communicating messages about 'appropriate' antibiotic use to the public that inspire confidence and trust against a backdrop of developing and—sometimes scarce—evidence. This is particularly true for companion animals who, as a marginal group, are not a priority when it comes to funding antimicrobial resistance surveillance systems and research into antimicrobial use. As a result, many dimensions of appropriate antimicrobials use in this group, for example the correct course length, remain un(der) investigated (see Chapter 6). There is also the challenge of communicating changes in best practice or 'appropriate' antimicrobial use as the evidence base changes. For example, uncomplicated diarrhoea and kennel cough were traditionally treated with antimicrobials, although this is no longer the case (BSAVA., 2018). By positioning the veterinarian as the expert and as antimicrobial prescribing decisions as 'black or white', the 'Trust your Vet' campaign does not support front-line veterinarians in handling—or communicating—these uncertainties and limitations of scientific knowledge.

9.6. Antimicrobial resistance and the suspension of shared-decision making

In this section, I explore the framing of antimicrobial stewardship interventions and how they project visions of decision-making regarding antimicrobial use. The ‘Trust your Vet’ initiative adopts a paternalistic approach to nudge owners into not driving antimicrobial misuse. Antimicrobial stewardship campaigns in human healthcare have also instructed consumers to do what their healthcare professionals tell them. For example, a Public Health England campaign, launched in October 2017, tells patients to ‘Take Your Doctor’s Advice’ (Figure 9.9) (PHE, 2019).

Figure 9.9: An advert from Public Health England’s ‘Keep Antibiotics Working’ campaign (PHE, 2019).

One might consider, therefore, that the urgent problem of antimicrobial resistance is framed as requiring a return to more paternalistic models of healthcare in which healthcare professionals alone decide what is for the best. This is at odds with the general movement towards more collaborative modes of healthcare, in which power equalities are challenged, for example, via shared-decision making between healthcare consumers and professionals (NHS, 2020).

In paternalistic models of healthcare, the professional informs the patient of the treatment plan following history taking and a physical examination. Four assumptions underpinning such a model have been proposed (Table 9.3) and challenged with respect to antimicrobial use in human primary care (Butler et al., 2001). Through examination of 'Trust your Vet' in the preceding sections, one might view these underpinning principles as also problematic in the companion animal sector. This is due to the limited evidence base, the delivery of veterinary care via a largely private system, and the involvement of owners acting on behalf of their companion animals.

Table 9.3: Assumptions underpinning paternalistic models of decision-making in healthcare, adapted from Butler et al. (2001)

- A definitive best treatment exists with no uncertainty about this or the diagnosis.
- Healthcare professionals are aware of the best treatment and deploy them consistently; their decision making is not swayed by 'social factors'.
- Healthcare professionals are able to reliably to evaluate trade-offs (e.g. costs vs benefits) between different treatment plans when deciding.
- Healthcare professionals make decision solely based on concern for the welfare of their individual patient with no competing pressures from public health or business concerns.

At the other end of the spectrum is informed decision making in which the healthcare professional acts as a source of information to the consumer who acts as the decision maker (Charles et al., 1999). However, this has been problematised as overburdening patients and their carers, who might prefer to abdicate the responsibility of decision making to their healthcare professionals (Butler et al., 2001). Furthermore, it has been suggested that such informed approaches would cause antimicrobial prescribing rates to increase to meet consumer demand with the associated negative impact on public health (Butler et al., 2001).

9.6.1. Shared decision making

Mid-way between these models is shared decision-making approaches—in which professionals and consumers work together to explore treatment options, as well as their potential risks and benefits (Charles et al., 1999, Shaw et al., 2004). Core to this ideology is the positioning of the healthcare consumer at the heart of decision making, with advocates of this approach claiming it enables consumers to feel supported and empowered to make informed choices that they are engaged in and agree with (Charles et al., 1997). It is also posited to strengthen healthcare professional and consumer relationships (NHS, 2020).

Critics argue that the 'informed choice' is often, in fact, the option advocated by the healthcare professional and that shared decision making is a continuation—if re-shaped—form of patriarchal control. This is partly because the evidence available to inform decisions is based on a literature with limited healthcare consumer involvement; meanwhile, the 'evidence hierarchy' (Howick et al., 2011) gives little weight to the experiences of healthcare consumers (Greenhalgh et al., 2015). Furthermore, being less paternalistic is sometimes interpreted as the use of shared decision-making tools rather than challenging the structural power imbalances between healthcare professionals and consumers (Greenhalgh et al., 2015). Critics suggest that shared decision-making models portray healthcare consumers as unemotional, 'rational' individuals only interested in the effectiveness of treatments (Greenhalgh et al., 2015) and in reality—and in the context of the increasing culture of clinical audit and litigation—they cannot be relied upon as imagined (Lambert, 2006, Wirtz et al., 2006). Therefore, the so-called movement of patient-centred care—in which shared decision making sits—remains inherently professional centred (Wirtz et al., 2006). Despite these challenges, shared decision making is positioned as a key component of achieving 'modern', personalised healthcare (NHS, 2020).

9.6.2. Antimicrobial stewardship and shared decision making

The expectations of antimicrobial stewardship initiatives of compliant healthcare consumers sit awkwardly with ideas of reflexive healthcare consumers making informed choices in collaboration with healthcare professionals (Lohm et al., 2020). Why are aspirations for healthcare systems orientated around shared decision making suspended when seeking to intervene in antimicrobial use? Is the threat of antimicrobial resistance of such scale and urgency (Davies et al., 2013) that a return to paternalism is required under these emergency conditions? Can healthcare consumers not be trusted to understand what's at stake in order to make the 'right' choice—one that prioritises the long-term survival of humanity over their own immediate needs?

There is some evidence to suggest shared decision making alters antimicrobial use in human primary care settings. A Cochrane systematic review from Coxeter et al. (2015) evaluated interventions designed to encourage shared decision making by promoting 'better discussions' between healthcare professionals and consumers, and about the benefits and harms of treating acute respiratory infection with antibiotics. The interventions included communication skills training for healthcare staff and providing patients with structured information. The authors concluded that such strategies reduced antimicrobial prescribing in adults with acute respiratory infections attending primary care by almost 40% (Coxeter et al., 2015). Despite its apparent effectiveness, an observational study in Australian primary care found that shared decision making was rarely deployed in consultations about acute respiratory infections (Bakhit et al., 2018). The authors found that balanced conversations were more likely when decision aides were used. This suggests shared decision making might be an underutilised means by which to intervene in antibiotic prescribing in the companion animal veterinary sector.

9.7. Implications for care and antimicrobial stewardship

In this chapter, I reflected upon national antimicrobial stewardship initiatives targeting the UK companion animal veterinarian sector, informed by the critical discourse analysis of stewardship campaigns targeting UK human healthcare consumers undertaken by Will (2020). When the recent initiative 'Trust your Vet' is viewed as a boundary object (Star and Griesemer, 1989), the work it does to shore up the social standing of veterinarians became apparent. I considered how the initiative might operate within spaces of care, diagnosis, and client interactions, and concluded that, whilst well intentioned, it could inadvertently increase pressure on front-line veterinarians. I described how—by providing less supporting information—the poster could make veterinarians seem less trustworthy, for example, when advocating costly culture and sensitivity testing. The findings of this chapter regarding the retreat from providing information, the paternalistic framings, and the non-engagement with owners' emotional concerns could be strengthened by increasing the sample size and analysing stewardship campaign materials targeting companion animal owners from other countries beyond the UK.

There has been no formal, published evaluation of the 'Trust your Vet' campaign, its impact on antimicrobials use, or the pressure perceived by companion animal veterinarians to supply these medicines. Such an evaluation could provide valuable insight regarding the effectiveness of urging healthcare consumers to be more trusting of their healthcare professionals, its continuation in the companion animal veterinary sector, and whether it might be extended to human primary care. In the meantime, the effectiveness of such an approach remains unclear.

Based on sociological study of vaccine hesitancy, it has been proposed that trust needs to be earned based on reciprocal and meaningful engagement between healthcare consumers and professionals (Ward, 2018). Are there contextual conditions necessary to support the state of co-operation urged by the 'Trust your Vet' initiative? An interview study with parents of children with respiratory tract infections found that continuity of care was valued and the basis upon which a trusting relationship with their doctor was built (Brookes-Howell et al., 2014). In this environment, parents felt able to ask questions regarding treatment plans and accept decisions about antimicrobial (non-)deployment. In Chapter 6, I described how 'modern' staffing patterns means that veterinary care is often delivered by a team of professionals. Further consideration might be required about how to promote the conditions that foster productive, cooperative interactions between veterinarians and owners, beyond the provision of a poster.

Drawing on companion animal owner trust might not be a tool equally available to all veterinarians. Sociological studies indicate that we are more likely to trust someone if they look and act in line with our preconceptions (Ward, 2018). In Chapter 7, I described the disconnect between representations of the companion animal veterinary profession and the multitude of intersectional experiences and voices undertaking this work. Future efforts should consider how mobilising 'trust' might not be a tool equally available to all veterinarians, for example, those for whom English might not be their first language, or recent graduates. More representative images of the profession as a multinational, mostly female group in client-facing literature might begin to address the societal preconceptions of what a companion animal veterinarian is expected to 'be'.

Echoing recent antimicrobial stewardship initiatives in human healthcare (Will, 2020), the campaign does not engage with the emotions experienced by companion animal owners. As reported in the literature review (Chapter 2), qualitative research suggests that owners fear that veterinarians do not appreciate how poorly their companion animal is (Redding and Cole, 2019a), and anticipate unbearable guilt if the worse was to happen and their animal passed away (Dickson et al., 2019). The 'Trust your Vet' does not address these fears and this avenue could be explored by future information initiatives. For example, a leaflet might explain that, for most dogs, uncomplicated diarrhoea—although messy and smelly—will resolve in a few days without antimicrobials and is not something to be gravely concerned about. The leaflet could also provide self-care advice and signs to monitor in case of deterioration. The use of statistics derived from prognostic research into conservative management strategies could help owners better quantify the risks to their companion animal—i.e. X% of cases will resolve within 48 hours—and provide further reassurance.

I described how the 'Trust your Vet' initiative acts to shore up the social standing of companion animal veterinarians. In doing so, it positions companion animal owners as responsible for antimicrobial misuse. The technique of 'other-blaming' has also been identified in UK livestock veterinarians towards farmers (Golding et al., 2019). To overcome this barrier to antimicrobial stewardship, it has been proposed that efforts are required to collapse the 'us' and 'them' cognitive groups to reduce this 'psychological distancing' (Golding, 2020). Perhaps emphasizing the shared interest—and responsibility—of veterinarians and owners in animal health and welfare could help reduce the othering observed in the companion animal sector. Further reflection about the constructiveness and the pervasiveness of the framing of the 'problematic owner' within the companion animal veterinary sector is warranted: a thought-provoking experiment might be a parallel campaign of in which veterinarians are urged to 'Trust the Owner' alongside owners being told to 'Trust their Vet'.

Social scientists have problematised the dichotomies—such as 'inappropriate' versus 'appropriate'—deployed when talking about antimicrobial use (Denyer Willis and Chandler, 2018). For example, an interview study of healthcare consumers in Australia found the binary of compliant and non-compliant to be too blunt when describing their antimicrobial-seeking and taking practices (Lohm et al., 2020). Instead the authors call for stewardship messages that, 'accommodate better the reflexive risk management of diverse publics . . . It may be helpful to bring antimicrobial stewardship into closer connection with concepts of prescribing concordance, alliances and collaborations' (Lohm et al., 2020, p. 15). This lens could be used to strengthen the veterinarian–owner unit in future companion animal antimicrobial stewardship initiatives. In Chapter 6, I reported how the advertising campaign of a pharmaceutical company sought to exploit the perceived gap between veterinarian advice and owner behaviour to sell more injectable antimicrobials. Closing this gap by reinforcing the 'veterinarian–owner' unit would remove this avenue for promotional activities encouraging increased antimicrobial use. This could be facilitated by a better understanding of how owners engage with veterinarian instructions on how to administer medications to their companion animals (Wareham et al., 2019), a source of mistrust between veterinarians and owners.

Shared decision making could be a potential avenue by which to alter antimicrobial use, partly by mitigating the perceived pressure from owners. In doing so, it could help harmonise the veterinarian–owner unit described and begin to address the 'pervasive client as enemy rhetoric' observed by Armitage-Chan (2019). The adoption of more collaborative models of communication between livestock veterinarians and farmers has been proposed as a means by which to prompt behaviour change (Bard et al., 2017). More generally, the BVA advocates shared decision making by veterinarians and owners when choosing treatments (Everitt, 2012). Recently, the BVA and RVC initiative 'VetFutures' called for a paradigm shift away from paternalistic models of communication towards more collaborative approaches (VetFutures, 2015).

Patient-centred approaches, perhaps supported by shared decision-making tools, are yet to be investigated by stewardship schemes in the companion animal sector. Careful consideration is required regarding how this ideology might sit amidst prevailing attitudes and conditions of the UK companion animal veterinary sector, which aspires to the ideals of evidence-based medicine (Greenhalgh et al., 2015). For example, when interviewed in the course of this research, veterinarians acknowledged the importance of involving owners in the decision-making process but that this created time pressures within the consultation, a finding noted elsewhere (Everitt, 2011, Belshaw et al., 2018). Shared decision making may be problematic to implement in companion animal veterinary clinics working under business models of busy-ness (Chapter 6) in which care is delivered in time-limited consultations. Prescribing antimicrobials has been suggested as a 'quick fix' for overworked front-line clinical staff without the time to explain and decline such requests (Mateus et al., 2014, Hopman et al., 2018, Chandler, 2019). Perhaps the paternalistic models of care alluded to by public antimicrobial stewardship campaigns—such as 'Trust your Vet'—replace one quick fix (i.e. providing antimicrobials) with another (i.e. 'do what you're told').

I also described the difficulties faced by healthcare professionals in general—and companion animal veterinarians in particular—regarding communicating the uncertainties surrounding the consequences of using antimicrobials. In Chapter 6, I reported how the trans-biopolitics (Blue and Rock, 2011) at play resulted in the non-prioritisation of research into antimicrobial use in companion animals. Improved funding in companion animal surveillance and research, and reducing the gaps in the evidence base, would help front-line veterinarians in discussing the risks and benefits with companion animal owners. It would support the development of evidence-informed stewardship interventions and shared decision-making tools.

Chapter 10 Conclusion

10.0. Introduction

This thesis has focused on various aspects of the veterinarian, support staff, owner, and animal experience of antimicrobials in the UK companion animal veterinary sector. It has provided new insights into the ways and reasons that antimicrobials are used in the care of pet dogs. From a stewardship perspective—concerned with the preservation of antimicrobial therapeutic efficacy for future generations of humans and animals—the obvious next question is how to respond to these insights?

Here, I review the key findings from each of my chapters before exploring potential paths forward for stewardship. I present these in the form of recommendations, each of which builds on the insights of the results presented in this thesis together with existing literature on changing clinical practices and/or their context. In addition to providing insights that can be applied to tangible recommendations that could be piloted to alter antimicrobial use in companion animals, the approach and insights of this thesis also provide impetus for further lines of research. I summarise these in terms of implications for research on antimicrobial use, evaluations of interventions and social research in the veterinary sector. I conclude with some reflections on my PhD journey.

10.1. Summary of findings

As an introduction to the main results chapters, in **Chapter 4** I 'set the scene' by providing a sketch of the UK companion animal veterinary sector. I described how relying on international flows of veterinarians and belonging to a corporate group can help mitigate the financial challenges and workforce shortages that threaten the sustainability of veterinary clinics. I also situated companion animal veterinarians and owners within the societal context of 'precarity'.

In **Chapter 5**, I investigated the organisational context in which antimicrobials are used by UK companion animal veterinarians working in corporate groups. Based on a large VetCompass™ dataset, the study quantified the variation in the percentage of antimicrobial events comprising of HPCIAs between clinics and three different veterinary groups. It also identified that relative HPCIA utilisation was more strongly clustered within dogs than within clinics.

Chapter 6 drew upon ethnographic fieldwork and documentary analyses to render visible infrastructural arrangements that support current ways of caring with antimicrobials in the companion animal veterinary sector. I described the 'business model of busyness' and proposed that antimicrobial stewardship messaging—for example, discouraging prescribing 'just in case'—requires an inversion to a way of life orientated around the provision of medicines and products. I considered the role of the veterinary-industrial complex in shaping the evidence landscape drawn upon by veterinarians and proposed that evidence gaps enable the moulding of 'appropriate' antimicrobial use messaging to meet broader, pre-existing organisational goals.

Chapter 7 centred on daily life in the companion animal veterinary clinic and the enactment of multiple foci of care there. By considering the ordering of the social and material worlds, I explored how temporal and logistical constraints shaped the care provided. Within this context, I described the more-than-human entanglements of mammalian and microbial bodies necessary for delivering interspecies care and the possible tension with gold standard infection control procedures. I reflected upon how the relatively recent imperative to care for antimicrobials is yet to 'find a home' within an already full clinic life, and how the intangible threat of antimicrobial resistance is difficult to identify as a threat to 'cleanliness'. I also described the multiplicity of intersectional experiences of veterinarians and how this might influence antimicrobial use.

I turned my attention to caring for the companion animal in **Chapter 8,** and described some of the challenges of reaching a firm diagnosis, the starting point for many narratives of 'appropriate' antimicrobial use. I considered how the social demands placed on the phenotypic and genotypic forms of our canine companions has produced dogs for whom poor health and veterinary intervention has become normalised. I suggest that, rather than using antimicrobials as 'sticking plasters' for these broken bodies, a more radical re-evaluation of the anthropocentric demands we place on our canine companions and their health is required.

In **Chapter 9**, I considered existing UK companion animal stewardship initiatives using a critical discourse analysis approach. When the recent initiative 'Trust your Vet' was viewed as a boundary object (Star and Griesemer, 1989), the work it does to shore up the social standing of veterinarians became apparent. I considered how the initiative might operate within spaces of care, diagnosis, and client interactions, concluding that, whilst well intentioned, it could inadvertently increase pressure on front-line veterinarians. I also reflected upon how its paternalistic framing may come at the expense of other—more collaborative—modes of decision making within veterinary healthcare.

Taken together, these chapters illustrate that antimicrobial use is a bio-social practice that is produced by social, material, semiotic, and technical networks that extend beyond the individual actors—the veterinarians, the owners, the companion animals—entangled at the interface of their deployment. At a time when seeking One Health-informed solutions for tackling antimicrobial resistance are increasingly advocated (Robinson et al., 2016), these findings highlight the particular conditions that companion animal veterinarians work in as antimicrobial prescribers in the UK. Therefore caution—and empathy—are needed when comparing antimicrobial use and stewardship efforts between veterinary and human primary care systems. Whilst translocating stewardship interventions from one setting to another might be a tempting One Health solution, careful reflection and tailoring will be necessary to ensure such efforts are effective and do not have unintended consequences.

10.2. Strengths and limitations

The insights from this thesis illustrate the benefits of undertaking mixed-methods research for understanding complex problems. The epidemiological analysis—and consideration of the hierarchical model of care depicted of dogs nested in clinics nested in veterinary groups—was held in conversation with the ethnographic fieldwork. This two-way conversation helped to shape and strengthen the ideas reported in this thesis. Furthermore, the mixed-methods approach adopted facilitates the communication of the notions presented in this thesis to a range of audiences including policy makers, researchers and veterinarians.

The ethnographic approach of this study has facilitated the elucidation of enacted practices—rather than self-reported behaviours—rendering visible the animal–human–microbe knots necessary for the delivery of interspecies care and placing them in the context of wider ecologies and infrastructures. This thesis builds on the insight provided by earlier studies that have studied antimicrobials in isolation, separated from a praxis orientated around the provision of veterinary medicines and products. Previous research in this setting has also largely framed antimicrobial use as the result of an individual's behaviour. Throughout this study, I was committed to understanding the broader context in which veterinarians work and was the first to explicitly set out to explore daily life in clinics belonging to corporate veterinary groups. Along with the work of Clarke and Knights (2019), this research has demonstrated the feasibility of conducting ethnographic fieldwork in busy—and often cramped—UK companion animal veterinary clinics.

Due to the time constraints of a three-year doctoral programme, and the ambition to adopt a mixed-methods approach, limits had to be drawn in the scope of the project. For example, in order to ensure the feasibility of the epidemiological analyses, it was necessary to consider dogs only. Future studies could investigate antimicrobial use in another companion animal species adopting a similar hierarchical modelling approach. To save time, I reused a pre-existing dataset

(Buckland et al., 2016) that had already been cleaned. However, this use limited the variables available and the hypotheses that could be investigated. For example, there was no clinical or diagnostic testing data included to help understand the context in which antimicrobials were deployed. It also meant that the quantitative data were collected a few years prior to the qualitative data. Given the number of subsequent stewardship initiatives and increasing societal awareness of the need to use antimicrobials 'appropriately', it is unclear to what extent the patterns of use observed in 2012–2014 persist to this day. A valuable exercise would be to repeat the epidemiological study with a more contemporaneous dataset.

From the anonymised clinical data shared with VetCompass™, it was not possible to quantify the degree to which the use of HPCIAs was clustered at an individual veterinarian level. This would have been an interesting exercise given the prevailing discourse in the companion animal veterinary sector that antimicrobial use in a largely the result of the behaviour of individuals. Nor was the study able to consider the influence of owner characteristics. Future studies could quantitatively investigate these factors if databases were able to capture these attributes alongside clinical details and prescribing outcomes.

The ethnographic study comprised of spending around three months in each of three fieldwork sites. Whilst small sample sizes are common in anthropological work, in which depth of understanding is prioritised over generalisability of findings, there are nonetheless some limitations to the conclusions that can be drawn from this sample. For example, each of my fieldwork clinics were suggested by their corporate group head office and may not be typical of their other clinics or their ways of working with antimicrobials. However, the amount of time spent 'in the field' meant I was able to generate a finely grained, in-depth analysis in these specific sites that could extend and enhance accounts from previous interview-based research. The arrival of COVID-19 meant it was not feasible to undertake follow-up visits to discuss the nascent findings with my fieldwork participants or to discuss how staff turnover had altered antimicrobial use following my placement with them. In the future, I hope to revisit my fieldwork sites and the head office of the corporate groups to share my research findings or, if not possible, to send a feedback report with a thank-you letter.

Only one of my three ethnographic fieldwork sites was included in my quantitative analyses of antimicrobial use; the second site had not yet been set up in 2012–2014, whilst the corporate group of the third had not yet joined VetCompass™. At the clinic for which I had quantitative data, it is unlikely that antimicrobial usage patterns persist to this day given that no veterinarians from this time continue to work there. Therefore, I was not able to follow my initial plan of tying up my ethnographic observations with the quantitative estimates of prescribing—were they high, average, or low users of antimicrobials? However, I did observe—and was able to reflect upon—variation of ways in working with antimicrobials within my fieldwork clinics in real time, which was important in informing my analysis.

In my methods chapter, I described how my non-veterinarian background offered a fresh set of eyes on a topic traditionally studied by veterinarian researchers. However, a limitation of my lack of veterinary background and clinical expertise was that I felt unqualified to judge whether antimicrobials were being used 'appropriately' or not. Therefore, in this thesis, I have steered away from describing clinical cases to instead focus on the context in which companion animal veterinarians work. By doing so, I hope I have turned this possible limitation into a strength by offering new insights that might otherwise be obscured, to better understand antimicrobial use in these clinic settings.

As my fieldwork was predominately clinic based, I have concentrated my attention on the enactment of care by the cast of more-than-human actors there. This has meant that the role of owners in providing companion animal care has been somewhat overshadowed. Future anthropological studies could consider how companion animals are cared for in non-clinical settings such as dog grooming parlours, doggy day care, and, most importantly, the home. Taking seriously owners and their lay understanding of the canine multiple will help the development of a more holistic understanding of caring for companion animals and their role in supporting 'appropriate' antimicrobial use.

The contribution this thesis can make to the One Health debate is limited through its empirical study of antibiotic use in only one domain, with no primary data collected in human healthcare or environmental settings. However, it does add to the development of the One Health concept, in particular its interest in connectivity and a concern with the flows of things that extends beyond its historical focus on diseases. For example, by working in multispecies dimensions to articulate ideas of care as they move between domains, it stretches our thinking of One Health approaches. It adds to the conversation by thinking through the translocation of stewardship interventions from one setting to another. Echoing changes seen in the veterinary sector, increasing number of GP surgeries are joining together to deliver care within the UK NHS, sometimes through a private company owned overseas (Iacobucci, 2021). Therefore, the companion animal veterinary sector may offer an increasingly relevant UK model of how 'appropriate' antimicrobial use is constructed in a primary health care system of corporate clinics that strive to treat patients as consumers rather than the more public health-type approaches classically associated with the NHS.

10.3. Recommendations for practice

In this section, I collate the recommendations for antimicrobial stewardship proposed in preceding chapters. The novel mixed-methods approach and use of social theory has enabled me to extend the options proposed beyond the usual education campaigns. Whilst derived from the study of clinics belonging to corporate veterinary groups, many of these recommendations could be applied to independent clinics as well.

10.3.1. Changing antimicrobial pricing and decoupling dispensing from prescribing

Antimicrobial pricing influences patterns of use in the UK companion animal veterinary sector. The hierarchical model reported in **Chapter 5** revealed the odds of an antimicrobial event comprising of a relatively costly HPCIA were greater in low-weight breeds in which smaller—less expensive—doses are indicated. Meanwhile the case study in **Chapter 6** demonstrated how the pharmaceutical sector adjusts pricing to alter the relative attractiveness of antimicrobials. Stewardship initiatives could learn from—and invert—such marketing approaches to shift antimicrobial use away from HPCIAs. For example, in Scotland and Wales, minimum pricing per alcohol unit has been introduced to protect human health (Woodhouse, 2020). A minimum price could be applied to a HPCIA dispensing event to discourage their use in smaller dog breeds and cats.

In **Chapter 6**, I opened the 'black box' of veterinarians profiting from antimicrobial sales, a unique situation for antimicrobial prescribers in the UK. In **Chapter 9**, I reflected upon the possible tension between this and companion animal owners being urged to 'Trust your Vet' on antimicrobial use. One approach to address this possible conflict of interest would be to remove the ability of veterinarians to both prescribe and dispense antimicrobials. However, there is opposition to this move within the UK veterinary profession (Anonymous, 2011b). Decoupling has been achieved in Nordic countries and the business models of companion animal veterinary clinics have been adjusted. These models could be investigated to understand how they function and if they could be applied in the UK, perhaps using multi-sited ethnographic approaches. The rise of the multinational corporate veterinary groups—for example IVC Evidensia (IVC-Evidensia, 2019)—that operate in countries with and without decoupling could facilitate sharing information between veterinary clinics about how this is possible. In **Chapter 7**, I noted the absence of a high-level antimicrobial stewardship champion in the UK companion animal veterinary sector. Such an actor—free from other commitments and interests—could help drive the stewardship agenda and initiate some of the trickier conversations around possibly reducing/removing the profit made on antimicrobial sales.

Ultimately, the decoupling of prescription and dispensing in UK companion animal veterinary clinics may be deemed as too great a threat to animal welfare—if it delays the onset of emergency treatment—and the financial sustainability of clinics in these precarious times (**Chapter 4**). Another option could be to remove antimicrobial sales from contributing towards clinic or veterinarian turnover targets, with the targets revised downwards accordingly. Such interventions would be relatively easy to implement and evaluate, and extend the existing evidence base of interventions considered (**Chapter 2**). A null finding—that these changes do not alter antimicrobial use—could provide valuable evidence to reassure owners that veterinarians are 'trustworthy', an area of concern for the BVA (**Chapter 9**). Alternatively, if antimicrobial prescribing was found to change, this would help put these types of structural interventions 'on the table' for consideration by professional and governmental organisations.

A further option to alter antimicrobial use would be to introduce legislation implementing restrictions on the use of certain antimicrobials. For example, the use of HPCIAs could be restricted to cases where culture and sensitivity testing have been deployed. Any such limitations would need careful planning evaluation to ensure that companion animal health and welfare are not compromised (**Chapter 8**). In the Netherlands, in consultations with owners, companion animal veterinarians are now able to 'blame' recent legislation when not providing HPCIAs without a culture and sensitivity test (Hopman et al., 2018). In this way, they are able to externalise the justification for antimicrobial (non-)use in a way that excuses themselves from being 'difficult' and does not blame the companion animal owner. This might be one way to 'sell' such an intervention that is contested by organisations representing veterinary professionals, although it has been largely discussed from a livestock sector perspective (Anonymous, 2012).

10.3.2. Resisting pressure for a 'quick fix'

In **Chapter 6**, I described how companion animal veterinary clinics were orientated around the business model of busy-ness in which greater activity—for example, increased medicines sales—are financially rewarded. Within this system, the day of the consulting veterinarian is broken into ten- or fifteen-minute appointment slots accessible to owners through the payment of consultation fees. In **Chapter 8**, I reported the interspecies challenges of reaching a diagnosis, especially when faced with companion animals resistant to being examined and owners unwilling or unable to pay for additional diagnostic testing. Longer consultations could reduce the pressure placed on companion animal veterinarians as they try to complete history taking, companion animal examination, diagnostic testing, engaging with the companion animal owner, and enacting a treatment plan. Time pressures have also been singled out as a key barrier to antimicrobial stewardship in the companion animal sector by preventing veterinarians from explaining why antimicrobials should be withheld (Eastmure et al., 2019a). Meanwhile, in **Chapter 9**, I suggested that shared decision making might be a possible avenue to support antimicrobial stewardship through veterinarians and owners working collaboratively. However, such conversations and decision making are time consuming (Everitt, 2011). An obvious solution would be to lengthen the durations of consultations but, in reality, it is unclear how this reduced veterinarian productivity would be compensated for under current business models. Cost/benefit analyses could help model the potential impacts. Drawing from the 'slow medicine' movement (Attena, 2019) may help guide a thought experiment in which a 'slower' form of veterinary medicine is imagined.

In **Chapter 6**, I wrote about how the current fees systems places companion animal veterinarians under pressure to 'get things sorted' at the first consultation. This is compounded by busy owners finding it difficult to get time off of work to take their companion animal to the veterinarian. If employers were required to allow their employees time away from work to attend the clinic, for example, to attend a follow-up consultation, this could alleviate some of this pressure. It might also make the translocation of the human healthcare stewardship intervention of a delayed antimicrobial prescription less problematic. Such a prescription is left at clinic reception and, if their companion animal's condition has not improved within a couple of days, the owner returns to collect it.

10.3.3. Benchmarking antimicrobial use

Benchmarking and clinical audit have been promoted as tools by which to prompt healthcare professionals to alter their antimicrobial prescribing habits, partly by utilising peer pressure (Walker et al., 2019). However, to date, there has been limited uptake of such techniques within the companion animal veterinary sector. In **Chapter 5**, I demonstrated that the percentage of antimicrobial events comprising of HPCIAs produced a skewed distribution when measured at a clinic level. Stewardship efforts could be focused on establishments located in the 'long tail', echoing initiatives in the livestock sector (Bos et al., 2015). However, careful attention should be paid to the selection of any future benchmarking metric: for example, the one used in this study only considers relative usage of antimicrobials rather than absolute levels. The introduction of any benchmarking metric should be closely monitored to ensure that 'inappropriate' antimicrobial use does not mould into another form, an unintended consequence known as the ‘balloon effect’, in which the volume of antimicrobial use remains the same but it is ‘squeezed’ into other classes of antimicrobials (Jensen, 2019).

In **Chapter 7**, the challenges of incorporating stewardship activities—such as auditing and benchmarking antimicrobial use—were reflected upon. Due to existing business models, it was difficult to prioritise these activities over income-generating activities, especially when improved stewardship might lead to reduced medicine sales. Whilst the provision of free benchmarking tools such as SAVSNET-AMR (Radford et al., 2017) remove some of the barriers, questions regarding how to make these part of the ‘everyday’ remain.

One possible option to encourage stewardship activities would be to include mandatory antimicrobial prescribing auditing and/or benchmarking at a clinic level within the Practice Accreditation Scheme run by the RCVS (RCVS, 2020d). Around half of UK veterinary clinics are accredited via this voluntary scheme that requires the demonstration of responsible antimicrobial use, typically through the production of local policies and/or treatment protocols (Burke et al., 2017) . A recent multivariable mixed effects logistic regression model of UK veterinary clinics found that accreditation was associated with the reduced odds of systematic antimicrobial use (OR: 0.79, 95% CI: 0.68–0.92) (Singleton et al., 2020). However, the cross-sectional nature of these data means they are unable to confirm a possible causal link between accreditation and antimicrobial use. In the future, efforts could be made to evaluate the impact of undergoing accreditation—either via existing standards or perhaps through an enhanced form that requires clinical audit—perhaps drawing on before and after study designs. Efforts to support the increased uptake of accreditation could also be considered.

Clinical audit and benchmarking results could be made publicly available: as a sector, companion animal veterinary medicine has avoided much of the surveillance that the human medicine and livestock sectors undergo (Jensen et al., 2019). However, there is little public interest or appetite for the reduction of antimicrobial use in companion animals unlike in livestock production (YouGov, 2020). Whilst of little public interest, publishing benchmarking data may mobilise peer pressure and scrutiny from within the veterinary profession. Careful consideration would be necessary to ensure that benchmarking or auditing activities were conducted in a supportive way that does not exacerbate the stressful conditions under which companion animal veterinarians already work. A compromise towards this might be to encourage ’in-house’ benchmarking activities between veterinarians or between the clinics belonging to the same corporate group, the head office of which might be able to take on some of the associated workload. Some corporate groups have recently produced in-house antimicrobial stewardship materials for distribution at their clinics including posters, owner leaflets, and supporting benchmarking activities (Anonymous, 2019b).

Chapter 8 illustrated the role antimicrobials have in alleviating canine ill health caused by anthropogenic activities. When seeking to optimise antimicrobial use in companion animals, consideration needs to be taken to ensure they are still accessible for treating those animals in need. Part of this could be through the clinic monitoring and auditing of adverse outcomes in cases were antimicrobials were withheld.

10.3.4. Supporting veterinarians

Existing initiatives targeting companion animal veterinarians have focused on encouraging the production of clinic-level policies based on locally adapted templates (Battersby, 2011, BSAVA., 2018). However, the clinic was found not to be the bounded, stand-alone unit as seen historically. There was an ever-changing cast of veterinarians, such as night and locum staff, whose 'membership' of the clinic team was less strong than permanent staff working there in the day. Their overlooking by existing stewardship efforts contributes to the erasure of the multiplicity of voices and experiences of those undertaking companion animal veterinary work (**Chapter 7**). For example, the traditional forum of information dissemination is the clinic meeting; however, veterinarians combining working part time with caring for their families may be excluded from these in a way not encountered by full time veterinarians. Further consideration therefore is required regarding how best to reach these veterinarians, who may work across several clinics, each of which may have their own 'appropriate' use policies. Unlike independent clinics, corporate groups could set group-wide policies to prevent variation between sites. However, the findings from **Chapter 7** suggest that careful thought is required to ensure local buy-in, especially amongst senior veterinarians who value their professional autonomy. Furthermore, the organisational 'culture' was found to differ between veterinary groups during fieldwork and therefore what might work in one company may be less effective in another.

Relying on clinic level policies regarding 'appropriate' antimicrobial use can be problematic for veterinarians working across several clinics or for those who do not feel properly part of the clinic team, for example, veterinarians providing maternity cover. Possible solutions could be to incorporate mandatory antimicrobial stewardship training in clinic induction processes, the CPD individual veterinarians are required to undertake in order to remain on the professional register (RCVS, 2020c) or to achieve advanced practitioner status (RCVS, 2020a). Linking antimicrobial stewardship and professional status would be a symbolic gesture that emphasizes the role of the veterinarian as a protector of antimicrobials. At the moment, the choice of CPD topics is left to the discretion of veterinarians who might be influenced by their personal interests or keen to learn new techniques that could attract additional clients to the clinic. Mandatory antimicrobial stewardship training would promote an activity that is difficult to prioritise under existing business models. Consideration would be needed, however, to ensure that veterinarians were engaged with this process and that it did not become a 'tick-box' exercise with minimal impact on antimicrobial use.

In **Chapter 7**, I described how companion animal veterinarians took on the informal role of the clinic antimicrobial champion. This model of stewardship relies on having enthusiastic individuals who are comfortable challenging and cajoling their colleagues. Further thought is required about how best to support these individuals within the intersectional space of the clinic. For example, developing a network of like-minded individuals—within and between clinics—could offer more social support and a means by which to share information and experiences about 'what works', perhaps hosted by the regional groups of the BSAVA. Spreading the burden of this work across more shoulders would make this model of antimicrobial stewardship more sustainable and less vulnerable to staff turnover. Improved identification and support of local antimicrobial champions to prioritise systematic action has been proposed in the UK human healthcare system (Eastmure et al., 2019a). Adopting a One Health approach and sharing insight between settings could be a valuable exercise in strengthening the antimicrobial champion model.

Many stewardship campaigns seek to promote the 'appropriate' use of antimicrobials. However, the empirical work presented in **Chapters 6 and 7** demonstrates that notions and practices of 'appropriateness' are negotiated between actors, shifting between contexts and over time. These flexible definitions arise from more than the evolving clinical evidence base regarding what constitutes best practice in terms of veterinary care. Whilst this plays a role, this thesis has illustrated how a host of other personal, social, economic and technical factors interact to shape antibiotic deployment. These insights suggest that designers of future antimicrobial stewardship initiatives might need to engage with multiple understandings of 'appropriate' use and how these interact with ideas of clinical judgement and professional autonomy.

In **Chapter 6**, I reported the influence of the veterinary-industrial complex in setting 'appropriate' levels of medicines and products use. Based on my own attempts to track down the 'scientific' evidence on which advertising claims are based, I propose that references should be given in full and, in the case of grey literature, the full text made available on the company's website. The setting up of a publicly accessible, compulsory register of veterinary clinical trials would also support transparency (Goldacre, 2013). It would facilitate the identification of the full evidence base and reduce publication bias via which trials with null findings are less likely to be published, skewing the information that veterinarians use to make decisions (Wareham et al., 2017). Within the veterinary literature—for example, the widely read *Veterinary Record*—the boundary between advertising, press releases, and news stories can be difficult to distinguish. Clear labelling of articles about veterinary products based on press releases or sponsored by pharmaceutical companies would support front-line veterinarians in appraising this 'evidence', especially if its quality assessed using the levels of evidence appraisal system used in evidence-based (veterinary) medicine (Howick et al., 2011) was reported alongside.

Chapters 8 and **9** described how there is little acknowledgement of cases in which a firm diagnosis is not possible and the provision of antimicrobials helps to form a safety net against future consequences. This mismatch between representations of veterinary medicine and its enactment could place additional pressure on front-line veterinarians, especially those who have recently graduated. Future work could consider strategies to support veterinarians handling diagnostic uncertainty—and the use of antimicrobials as a diagnostic tool (Hardefeldt et al., 2018b)—amidst a backdrop of antimicrobial stewardship.

In **Chapter 8**, rather than trying to separate the biological and the social influences on canine health, I drew on the work of Lock (1993) to consider how the broken bodies of our canine companions are bio-socially produced. Previous research has identified how newly qualified veterinarians struggle to translate the 'pure' form of veterinary medicine they were taught with the messy realities of everyday practice. Including the work of social scientists such as Lock in undergraduate veterinary teaching curricula could help students to better understand how animal health—and therefore the medicine they will practise—is socially, as well as biologically, constructed.

10.3.5. Making antimicrobial resistance tangible

In **Chapter 7**, I reported how, in a setting where productivity is valued, it is hard to prioritise stewardship activities whose benefits are intangible and nebulous. Current business models do not 'naturally' allow space for such public health activities. As alluded to earlier, finding ways to support a temporal and spatial home for antimicrobial stewardship activities will sustain its uptake in everyday clinic life.

Efforts to make local patterns of antimicrobial resistance more 'knowable' to veterinarians may help it become a more tangible risk that requires action. For example, tailored monthly emails based on the IDEXX Pet Resist website (IDEXX, 2020) could be circulated by clinic management to veterinarians informing them of local patterns of resistance. The wider uptake of the screening of clinic premises could also be encouraged to provide additional insight regarding veterinary care acquired infections. From a commercial perspective, being able to demonstrate your clinic is free from resistant microbes could act as a 'selling point' and contribute to improving or consolidating your business reputation. Conversely, knowledge that such microbes are present would be commercially sensitive and could lead to the loss of clientele. Careful consideration should be given about how to support clinic owners and staff whose premises screen positive, not only in terms of microbial management but also for reputation management. A further note of caution—a better understanding of local patterns of antimicrobial resistance could lead to (possibly) false reassurance: if local levels are found to be low this could act to discourage changes to existing 'inappropriate' patterns of prescribing.

Ethnographic methods enabled me to study the everyday, easily overlooked acts of care undertaken in the clinic. For example, cleaning is largely undertaken by a low-paid, female workforce in a space centred around anthropocentric and masculine bodies. Additional consideration should be given to promoting and acknowledging this low-paid—but high-value—work when it comes to safely managing microbes within the clinic. In doing so, it could help to begin to address the gendering of clinic hierarchies.

10.3.6. Veterinarian–owner interactions

In **Chapter 6,** I described how veterinarians deflected the perceived pressure to prescribe antimicrobials by substituting these with other products in their treatment plans. These non-antimicrobial alternatives prevented owners from leaving 'empty handed' and also helped veterinarians to mitigate the risk of a decline in health of the companion animal. This strategy could be encouraged for use by other veterinarians, particularly if the non-antimicrobial alternative products are demonstrated to be efficacious. Future research could identify clinical scenarios where non-antimicrobial alternatives would be welcomed by front-line companion veterinarians, perhaps drawing on Delphi consensus building methods. This would help inform the development of future products.

In **Chapter 9**, I described how the 'Trust your Vet' initiative positions companion animal owners as responsible for antimicrobial misuse. Further reflection about the constructiveness and the pervasiveness of the framing of the 'problematic owner' within the companion animal veterinary sector is warranted: a thought-provoking experiment might be a parallel campaign in which veterinarians are urged to 'Trust the Owner'. Bridging the gap of the 'us and them' framing—perhaps through a shared interest in animal health and welfare—could pave the way for shared decision-making tools regarding antimicrobial use. Evidence from human primary care suggests that such tools reduce the perceived pressure to prescribe and increase healthcare consumer satisfaction (Coxeter et al., 2015).

In **Chapter 2,** I reported how qualitative research suggests that owners fear that veterinarians do not appreciate how unwell their companion animal is, anticipating their own unbearable guilt if the worse was to happen (Dickson et al., 2019, Redding and Cole, 2019a). Meanwhile in **Chapter 9**, I describe how existing stewardship campaigns do not engage with such concerns. Future information initiatives could seek to engage with these emotions and how they influence expectations of veterinary care. For example, a leaflet might explain that, for most dogs, uncomplicated diarrhoea will resolve in a few days and is not something to cause grave concern. Such a leaflet could also provide self-care advice and signs to monitor in case of deterioration.

Table 10.1 summarises the recommendations for practice arising from this thesis.

Table 10.1: Recommendations for practice (interventions are in **bold**, potential cautions are in *italics*)

Antimicrobial pricing and sales
• Learn from—and invert—**pharmaceutical marketing approaches** to alter antimicrobial demand.
• Consider a **minimum price** per highest priority critically important antimicrobial dispensing event to deter 'over use' in smaller animals. • Explore introducing **legal restrictions** on antimicrobial prescription and use, for example, no use of HPCIAs without culture and sensitivity testing. *Reducing the accessibility of antimicrobials may harm animal health and welfare.*
• Remove antimicrobials from contributing towards clinic/veterinarian **turnover targets.** *May impact salaried and senior veterinarians differently, complicating workplace dynamics.*
• Investigate **decoupling** by studying the business models of veterinary clinics abroad in which prescribing and dispensing have been decoupled. *Careful modelling of the impact on clinic profitability and veterinarians' salaries arising from any changes is required.*
• Appoint a high-level **antimicrobial stewardship champion** to review options for changes to antimicrobial provision in the companion animal veterinary sector.
Resisting pressure for a 'quick fix'
• Imagine what **'slower' form of veterinary medicine** might look like. *Any increase in consultations duration/loss of veterinarian productivity will impact current business models* • Map out how a **delayed antimicrobial prescription system** might be integrated into current work flows. *Reducing the accessibility of antimicrobials may harm animal health and welfare.*
• Encourage employers to **allow employees time away from work** to attend the veterinary clinic with their companion animal.
Benchmarking and auditing
• Reflect on how to support the uptake of **benchmarking tools** such as the existing, free SAVSNET-AMR. *Careful attention to the selection of any benchmarking metric to avoid unintended impacts on prescribing (for example, switching to other classes of antimicrobials or medicines) is required.*
• **Corporate groups head office** could shoulder some of the auditing/benchmarking workload *Any performance review activities need to be handled sensitively so as not exacerbate workplace stress.*
• Consider inclusion of antimicrobial benchmarking within the **RCVS practice accreditation scheme**.
• **Audit cases where antimicrobials were withheld** (including adverse outcomes) to provide evidence both to researchers and on-the-ground veterinarians regarding animal health and welfare

Supporting veterinarians
• Reflect on how to reach veterinarians who work part-time, locums or provide out-of-hours care, perhaps by incorporating **mandatory antimicrobial stewardship training in the Continuing Professional Development requirements.** *Veterinarians may not engage with a 'tick box' exercise, resulting in minimal impact on antimicrobial use.*
• Corporate groups could set **organisation-wide policies** to reduce variation in best practice between sites helping veterinarians who work across multiple clinics. *The culture between corporates groups varies and a 'one-size-fits-all' approach may not work.* *Top-down approaches may be interpreted as a challenge to professional autonomy.* *Preventing the exclusion of independent clinics from stewardship initiatives requires consideration.*
• Develop a **network of antimicrobial champions** to provide peer support and to share information about 'what works'. *The model of clinic champions is vulnerable to staff turnover.*
• Clearly label articles about veterinary products based on press releases and, when making advertising claims, make the references cited easily accessible to support veterinarians making evidence-based prescribing decisions. *There may be limited appetite for this due to the advertising revenues paid by pharmaceutical companies to publishers of veterinary journals.*
• Set-up a publicly accessible **veterinary clinical trials register** to reduce publication bias. *This would require financial investment to set up and maintain, backed up by legislation.*
• Consider strategies to support veterinarians and owners in handling **diagnostic uncertainty** against a backdrop of antimicrobial stewardship. *Publicly acknowledging diagnostic uncertainty exists may be difficult for veterinarians and the professional organisations representing them.*
Making antimicrobial resistance tangible
• Find ways to include antimicrobial stewardship activities finding a temporal and spatial home in everyday clinic life.
• Distribute tailored monthly emails based on the IDEXX Pet Resist could enable **characterisation of local antimicrobial resistance** patterns and inform the selection of antimicrobials. • Wider uptake of the screening of clinic premises and/or staff would foster a better understanding of the aetiology veterinary care acquired resistant infections. *If local levels of antimicrobial resistance are found to be low this could act to discourage changes to existing 'inappropriate' patterns of prescribing.* *Clinic owners and staff whose premises screen positive may need support in terms of microbial and reputation management.*
• Acknowledge **the role of cleaning and infection control practices** in the safe management of microbes.
Veterinarian–owner interactions
• Identify clinical scenarios where front-line companion veterinarians would welcome **non-antimicrobial alternatives** via Delphi consensus building methods.
• Investigate **shared decision-making tools** regarding antimicrobial use. • Engage with **owners' emotional concerns** perhaps via leaflets to reassure them about the outcomes of common—rarely fatal—conditions. *Paper tools cannot replace high-quality, verbal communication with owners in consultations.*

10.4. Recommendations for research

In this section I collate the themes arising from my findings that point to a need for further research into the following areas: strengthening the biomedical evidence base; evaluation of stewardship interventions; and additional social science research.

10.4.1. Strengthening the biomedical evidence base on 'appropriate' use

A fundamental obstacle in supporting companion animal veterinarians to use antimicrobials 'appropriately' is the incomplete evidence base regarding what constitutes 'appropriate'. As reported in **Chapter 6**, there has been limited investment into biomedical veterinary research investigating when antimicrobials should be deployed (or withheld), which class should be used, and for how long in companion animals. Instead existing guidelines draw from both expert opinion and scientific literature and, to a lesser extent, evidence from human medicine when evidence from the veterinary setting is unavailable. Strengthening the evidence base would enable more robust 'appropriate' use guidelines to be developed; those that are less easily dismissed by veterinarians drawing upon their own empirical evidence. It would also help to resist efforts to mould 'appropriate' antimicrobial use messaging by the pharmaceutical sector.

The companion animal veterinary sector relies on research sponsored by the private pharmaceutical sector which has resulted in an evidence base orientated around their organisational needs (**Chapter 6**). This has meant fewer trials with placebo or delayed prescribing arms, areas of interest when seeking to alter antimicrobial use. Across human and veterinary medicine, the antimicrobial development 'pipeline' has relied on private funding leading to a paucity of new antimicrobials entering the market (O'Neill, 2016). Recently, new funding models have been proposed to foster antimicrobial development (Singer et al., 2020). Similar collaborative approaches could be mobilised to fund research in order to strengthen the evidence base regarding antimicrobial use in companion animals.

In the course of this project, I met several veterinarians undertaking research of this nature in their 'spare' time with minimal funding. Echoing the local antimicrobial stewardship champions, this model of research is vulnerable to other competing priorities and relies on the goodwill and appropriate skills of highly motivated individuals 'going the extra mile'. Properly funding this research and the establishment of specialist veterinary clinical trials units at universities—mirroring their human health equivalents—could offer a more resilient model and the aggregation of technical skills necessary to generate this type of evidence outside of the private sector.

Unlike healthcare professionals, veterinarians provide care for multiple species. In the UK, their prescribing decisions are dictated by the 'Cascade principle' in which they are legally required to use a veterinary medicinal product authorised for use in that species, for a specific condition, and route of administration (VMD, 2019). However, if one is not available—and an animal is at risk of unacceptable suffering—an unlicensed medicine can be used, for example, one authorised for use in that condition but in another species or in humans, as long as owners provide informed consent and are made aware of potential adverse reactions. In some companion animal species—such as rabbits—there are few licensed antimicrobials and these might be HPCIAs. In 2014, the VMD issued clarification that, on a case-by-case basis, antimicrobials can be prescribed 'on cascade' due to concerns about antimicrobial resistance (Eckford, 2014). In reality, this generates additional work for veterinarians as they explain to owners the cascade principle and how they have assessed the risks of antimicrobial resistance to be greater than the risks posed to the companion animal's health by using an off-licence antimicrobial. Given that time pressures within consultations have been cited as a key barrier to enacting antimicrobial stewardship in the companion animals (Eastmure et al., 2019a), it seems doubtful that such processes will be undertaken, with, instead, the authorised antimicrobial being used. Improving the evidence base by undertaking clinical trials to generate the necessary evidence would enable the licensing of antimicrobials in more species and across more conditions. This would help overcome these mixed messages given by the cascade system based and the classification of antimicrobials based on their contribution to antimicrobial resistance. Furthermore, as described in **Chapter 6**, the licensing of an injectable, medium-duration antimicrobial agent that is not a HPCIA would be welcomed by companion animal veterinarians, especially for use in cats.

Priority setting partnerships—informed by the methods of the James Lind Alliance (Partridge and Scadding, 2004)—could help to ensure that the most pressing public health knowledge gaps regarding antimicrobial use in companion animals are addressed first. For example, considerable uncertainty remains regarding the optimum duration of antimicrobial courses for common conditions such as canine UTIs (**Chapter 6**). It is suggested that the currently recommended course durations are unnecessarily long. Pinpointing the optimal duration could be a low-hanging fruit by which to reduce the volume of antimicrobial exposure in companion animals. Such strategies could help reduce antimicrobial use in the short term, whilst longer term efforts reflect upon how to support companion animal veterinarians in situations where antimicrobials are not required. These might require structural changes to a system orientated around the provision of veterinary products and medicines.

In **Chapter 9**, I also described the difficulties faced by healthcare professionals in general—and companion animal veterinarians in particular—regarding communicating the uncertainties surrounding the consequences of using antimicrobials. Improved funding and reducing the gaps in the evidence base would help front-line veterinarians in discussing the risks and benefits with companion animal owners. A frequently cited concern of veterinarians is the risk of owners not following the instructions they have been given regarding administering antimicrobials to their companion animal and the necessity of completing the course (**Chapters 2** and **6**). However, a recent systematic review of the factors affecting owner compliance with pharmaceutical treatment recommendations identified a scant and poor-quality evidence base in this area (Wareham et al., 2019). A better understanding of owners' practices at home would support veterinarians in handling these risks when prescribing antimicrobials.

10.4.2. Careful evaluation of stewardship interventions

Much of the existing research literature, as described in **Chapter 2**, frames the provision of information through education or guidelines as a central step in achieving 'appropriate' antimicrobial use in companion animals. However, a recent systematic review identified a limited, low-quality evidence base in this regard and called for international comparisons to assess the implementation and effectiveness of guidelines (Ekiri et al., 2019). The European Network for Optimization of Veterinary Antimicrobial Treatment (ENOVAT), funded by the EU was launched in November 2019. It aims to optimize veterinary antimicrobial use with emphasis on the development of animal specific—including companion animals—and disease-specific antimicrobial treatment guidelines and the refinement of diagnostic procedures (ENOVAT, 2020). Within the UK, the implementation of future updates to the BSAVA stewardship activities could be introduced in a phased manner to enable evaluation of their impact through a stepped wedged approach (Hopman et al., 2019c).

In **Chapter 5**, I utilised a dataset derived from electronic health records to investigate antimicrobial use. Using a dataset from 2012–2014, I found limited clustering of HPCIA use at a clinic level. This analysis could be repeated using a more contemporary dataset to see if this finding has changed following the introduction of the PROTECT-ME guidance that included a locally adaptable clinic 'appropriate' antimicrobial use template (Allerton, 2018). Two UK-based surveillance systems—VetCompass™ (RVC) and SAVSNET (Liverpool University)—have been used to describe and monitor trends in antimicrobial use patterns (Buckland et al., 2016, Singleton et al., 2017). These systems could be utilised to evaluate the impact of interventions in the future either through randomised or natural experiment designs (Croker et al., 2019). They could be used to identify clinics or groups who are 'super' responders or, conversely, non-responders to interventions that could be targeted for further investigation drawing on the contextualised, nuanced understanding offered by social science informed studies to explain why.

In **Chapter 7**, I described the intersectional experiences of delivering veterinary care. Recognising that veterinarians have differing motivations and foci of care can help inform the design of antimicrobial stewardship interventions and their evaluation. To date, evaluations have focused on assessing the impact on antimicrobial use patterns (Weese, 2006, Bager et al., 2017, Sarrazin et al., 2017, Hopman et al., 2019c). Meanwhile research has identified that concerns about harming animal welfare and the fear of owners 'shopping around' act as barriers to enacting antimicrobial stewardship (**Chapter 2**). Robust evaluation of unintended consequences—such as complications, follow-up consultation rates, and even mortality—have not been provided. Furthermore, producing evidence and materials that make the 'business case' for altering antimicrobial use is also an under-investigated avenue. If evaluation reveals that such activities do threaten clinic sustainability—for example, through reduced medicines sales—then an open discussion is needed about who should 'foot the bill' of using antimicrobials appropriately.

My ethnographic finding presented in **Chapters 6** and **7** illustrated the challenges of incorporating antimicrobial stewardship activities into already full, hectic days in the veterinary clinic. Recently published evaluations of companion animal antimicrobial schemes studied interventions that were complex, multi-stranded, and resource-intensive (Hopman et al., 2019c). Due to their design, it is unclear which of the strands triggered the changes observed in antimicrobial prescribing. Future trials should seek to identify the minimal level of effective intervention—perhaps by employing trial designs with multiple arms—to help ensure transferability and sustainability in the 'real world' outside of trial conditions.

In **Chapter 9**, I suggested an evaluation of the 'Trust your Vet' initiative could provide valuable insight about the effectiveness of this approach and whether it might be extended to other settings. Given the interest of professional bodies in ensuring veterinarians are trusted societal figures, research could also be conducted into the contextual conditions required to foster productive, cooperative interactions between veterinarians and owners, extending beyond the provision of a poster.

10.4.3. Further social science research in veterinary medicine

The thesis contributes to the nascent—but growing—field of social science studies of veterinary medicine. By drawing upon material semiotic approaches, multispecies interests and critical engagements with health, this research has been able to adopt a distinct vantage point from previous research in antimicrobial use in companion animals. In allowing for multiple, messy realities, studying natureculture, and an interest in relational engagements, it has demonstrated the value of adopting fresh—theoretically rich—perspectives when studying veterinary healthcare. Here, I describe the questions emerging from this thesis, and the work of others, that necessitate further social theory informed veterinary research. Together, they share an interest in the consideration of broader structural and contextual factors that shape veterinary healthcare.

In **Chapter 1**, I reported the absence of historical accounts describing antimicrobial use in the companion animal sector, whose history, in general, remains understudied (Bonnaud and Fortané, 2020). Historical analyses of the discovery of antimicrobials, and their subsequent introduction and regulation in farming and human healthcare have been fruitful endeavours (Bud, 2007, Podolsky, 2015, Kirchhelle, 2018), as has the consideration of their historical role in the veterinary care of livestock (Woods, 2019). Equivalent studies in the companion animal sector would be a welcome addition.

Hobson-West and Jutel (2020) suggested future sociological studies could help to inform responses to the challenges facing the contemporary companion animal veterinary, as summarised in **Chapter 4**. They propose investigating the impact of the Internet on the power balance between veterinarians and owners, for example, during the process of diagnosis. Similarly, further empirical research could examine the role of the Internet in shaping owner expectations for antimicrobials and subsequent veterinarian–owner encounters.

In my recommendations for practice, I suggested comparing companion animal veterinary clinic business models in countries with, and without, decoupling of prescribing and dispensing. In their review of the social science literature on the veterinary profession, Bonnaud and Fortané (2020) identified a paucity of such comparative studies and also of those that examine the operation of the veterinary businesses and the animal health market. Such empirical studies would build on the ideas presented in this thesis and better understand the broader context in which antimicrobials are used. For example, following approaches could be deployed to better understand the global veterinary pharmaceutical market and the international journeys made by antimicrobials from their manufacture, distribution, dispensing to, and consumption by companion animals.

Linked to a better understanding of animal health markets, Hobson-West and Jutel (2020) have called for more research into the role played by commercial drivers encircling veterinary diagnosis. For example, they highlighted the need to better understand the disease awareness campaigns operated by industry players—who stand to benefit from sales of veterinary medicines for animal treatment. This has resonance with my efforts in **Chapter 6** tracing the production of evidence regarding 'appropriate' antimicrobial use by the pharmaceutical industry, and calls for a better understanding of the political economy of veterinary medicines use (Brown and Nading, 2019).

In **Chapter 8**, I challenged the idea of dog breeds as being 'natural' categories by describing their bio-social production. Rather than breed-related health problems being inevitable, the production of these 'broken bodies'—and their associated intensified veterinary care requirements—are the result of the anthropocentric demands we place on our canine companions. Studying antimicrobial use in these dogs overlooks the upstream determinants of poor canine health. Further social sciences research is needed to untangle the complex problem of societal demands for forms of dog with compromised health.

Multispecies entanglements can be both health promoting and health harming, with effects extending beyond the human actors that have been the focus of much of the interest to date (Wolf, 2015). Rock (2017) has argued that the 'public' in 'public health' should be extended to include more-than-human beings and their interests and, therefore, socio-ecological theory—or One Health-type approaches—should be drawn upon in health promotion activities. One such avenue could be the entangled problem of anthropogenic canine ill health, antimicrobial use, and resistance relevant to human and canine health.

Social scientists have problematised the dichotomies—such as 'inappropriate' versus 'appropriate', or 'compliant' versus 'non-compliant'—deployed when talking about antimicrobial use (Denyer Willis and Chandler, 2018, Lohm et al., 2020). These are frequently used in the companion animal veterinary sector. Future social theory informed work could consider how stewardship messaging might be reframed around concepts of alliance and collaboration (Lohm et al., 2020). This work could also help to identify means by which to strengthen the veterinarian–owner unit, thus reducing the perceived pressure to prescribe in which veterinarians blame owners, and owners blame veterinarians (Smith et al., 2018).

In **Chapter 7**, I described the gendering of the imperative to care for antimicrobials through the delegation of antimicrobial stewardship work to recently qualified, female veterinarians. While the rise of women in veterinary roles has been remarked upon widely (Irvine and Vermilya, 2010, Begeny and Ryan, 2018, Tindell et al., 2020), I am unaware of this particular finding being reported in other veterinary literature or discussed more generally. Reflecting upon the gendering of stewardship work has implications for other healthcare settings beyond the companion animal veterinary sector and warrants further attention. Such work could also explore the tensions between the medical and veterinary professions—with their male gendering (Knights and Clarke, 2019)—and the delegation of the majority of child and companion animal care to women (Lohm et al., 2020). For example, a recent Public Health England antimicrobial information campaign targeted women aged 20 to 45 years old as, 'they tend to have primary responsibility for family health' (PHE, 2019). I propose that gender-informed social theory can help us better understand the hierarchies and tensions at play in the antimicrobial stewardship arena (Figure 10.1).

Figure 10.1: Cartoon from taken from the social life of AMR series, a cartoon series based on a social science AMR research programme led by Professor Alex Broom (Broom, 2019), reproduced with permission.

10.5. Endings and beginnings

And so, this thesis—and my PhD journey—draws to a close. Over the last three years or so, when explaining my project—both professional and socially—a typical response would be 'Oh, studying pets? What fun!' Mostly, it was fun—and interesting—and I am very grateful to all those who supported me along the way.

However, studying antimicrobial use in this marginal group is more than just fun, and more than just an academic novelty. Notwithstanding implications for human health, understanding antimicrobial use in companion animals has value in and of itself—to inform efforts to optimise such medicines' use and prevent the potential of prevent antimicrobial resistance from becoming the problem of the magnitude seen in human healthcare. Furthermore, I have found companion animals are 'good to think with' when seeking to understand the complex bio-social practices surrounding the uses of antimicrobials in society. Hopefully, this thesis has gone some way to illustrate these practical applications emergent of careful mixed methods research.

Finally, I acknowledge how fortunate I was that COVID-I9 appeared in the final year of my project and not as my fieldwork got underway 12 months earlier. Within veterinary clinics, the arrival of COVID-19 has upturned business models of busy-ness and ways of caring within constraints, necessitating their urgent revision. When writing up during lockdown, my thoughts often wandered back to my fieldwork sites and the clinic teams attempting to deliver care there under these new conditions. I wonder about the sustainability of existing models of bio-economic life at UK companion animal veterinary clinics in the face—and wake of—this virus and what forms of business, care, and multispecies possibilities will emerge, both in terms of antimicrobial use and beyond.

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Appendices

Appendix 1 Interview Topic Guide

Understanding Antibiotic Use in Pets, Version 1, 19th October 2018

Introduction

- Thank interviewee.
- Describe the study and confirm participant agrees with the use of the digital recorder.
- Reassure them data will be treated confidentially and any quotes will be anonymised.
- Informed consent.

The following should act as prompts only to guide the conversation. The researcher should follow a flexible approach.

Background

- How did you come to work here?
- Can you tell me about the veterinary practice?
- What laboratory/ diagnostic technologies does the practice have access to?

Antibiotic Resistance

- What do you understand by the term antibiotic resistance?
- What do you understand by antibiotic stewardship or guardianship?
- Do you think antibiotic use in pets plays a role in the global problem of antibiotic resistance?

Guidelines/ Policies

- Does the practice have any in house guidelines regarding antibiotics use/selection?
- Do you use/are you aware of any other guidelines or policies?
- How relevant are they to your everyday practice?
- Do you use any other information sources?
- Do you have any unanswered questions about antibiotic use?

In the clinic

- Do pet owners often seek antibiotics? How do you manage these requests?
- Do you use culture and sensitivity testing often?

Finishing off

- Is there anything else you would like to say about antibiotic use in pets?
- Thank you

General probes/prompt:

- Could you tell me a bit more about that?
- What do you mean by . . . ?
- How did you find that experience?
- How did that make you feel?
- (Use of adjectives)—why/what was it you found e.g. scary…

Appendix 2 Participant Information Sheets / Informed Consent Form: Clinic staff observations

London School of Hygiene and Tropical Medicine •
15-17 Tavistock Place •Kings Cross •London •
WC1H 9SH• www.lshtm.ac.uk

Understanding Antibiotic Use in Pets

Observation of Veterinary Consultations: Staff Information Sheet

We would like to invite you to take part in our research study. This information sheet explains why the research is being conducted and what it will involve if you choose to take part. Please read it carefully before making a decision. Feel free to talk to others about the study if you wish. Please ask us if there is anything that is not clear or if you would like more information.

1. What is the purpose of this study?

The aim of this study is to explore how we use antibiotics to care for our pets. Antibiotic use in companion animal care is coming under increasing scrutiny. Although there is lots of talk by policy makers about "appropriate antibiotic use" and "antimicrobial resistance", there is a very limited understanding about how these phenomena are encountered by frontline veterinary staff and pet owners.

Existing research into antibiotic use in pets has largely been based on interviews or self-reported data – e.g. what people say they do - rather than observing what they actually do. Furthermore, the views and experiences of veterinary support staff and pet owners have been overlooked. Previous studies have focused on the moment of prescribing – not considering the broader context. Our study seeks to address these knowledge gaps.

By better understanding how antibiotics are used, we can help design interventions to support the use of antibiotics in appropriate cases, helping to keep these medicines effective for longer.

2. Why have I been invited?

You have been invited to participate because your work is linked to companion animal care. We hope to observe many aspects of such care including veterinary consultations, inpatient care, reception and administrative duties. These can be related and unrelated to antibiotics.

In addition to conducting observations, we are also interviewing vets, support staff and pet owners whose dogs have recently been prescribed antibiotics.

3. Do I have to take part?

No – it is entirely optional. If you agree to take part you are free to withdraw from the study at any time, without giving a reason.

4. What will happen to me if I take part?

Before the observations start at your workplace, the researcher - Alice - will answer any questions you may have and ask you to complete a consent form. Observations will only be conducted if all those present have agreed to be observed. Alice will then sit in on your work, listening to conversations and watching what happens. She may take some notes and occasionally ask questions to check she understands what is happening.

5. What are the possible benefits or disadvantages of taking part?

Your participation in the study poses no major physical or psychological risk. There is no direct benefit to you from taking part, but you will be helping to inform the design of future schemes to protect pets from antibiotic resistance.

6. Are there any expenses and payments?

Unfortunately, we are unable to offer participants reimbursement for their time.

Staff Observations Participant Information Sheet, Version 1, dated 19 October 2018
Research Ethics Committee Reference Number: 16126

LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

7. What will happen to information collected about me?

The research team has a duty of confidentiality to you as a research participant. The information from your vet consultation will be coded with a study number so you cannot be identified from it. Your personal details (on the consent form) will be kept in a different safe place to the other study information and will be destroyed within 10 years of the end of the study.

We will keep all the data we collect for 10 years after the end of the study in line with London School of Hygiene and Tropical Medicine policy. All data will be kept securely according to the Data Protection Act 1998. Information will only be accessible to the study team at London School of Hygiene and Tropical Medicine and the Royal Veterinary College. Responsible members of London School of Hygiene and Tropical Medicine may be given access to data for monitoring and/or audit of the study to ensure we are compiling with regulations.

8. Use of quotations

The researchers may use some direct quotations in publications. No individuals will be identifiable from the quotations.

9. What will happen if I don't want to carry on with the study?

If you decide you no longer wish to participate in the study, please tell the researcher (see section 15 for contact details). You can withdraw at any time and you do not need to give a reason. If your consultation has already been observed, we will ask whether you would like this information to be included or withdrawn from the study.

10. What if there are any problems?

Given the nature of this study, it is highly unlikely that you will suffer harm by taking part. However, London School of Hygiene and Tropical Medicine has arrangements in place to provide for harm arising from participation in the study.

11. Complaints statement

If you have a concern about any aspect of this study, you should ask to speak to the researcher who will do her best to answer your questions. If you wish to complain about any aspect of the way in which you have been approached or treated during the course of this study, you should contact the senior investigator Dr Clare Chandler, (clare.chandler@lshtm.ac.uk, 020 7299 4709) or the London School of Hygiene and Tropical Medicine Research Governance and Integrity Office (RGIO) (020 72927 2626, rgio@lshtm.ac.uk).

12. What will happen to the results of the research study?

The results of the study will be reported at conferences and published in peer-reviewed journals and lay publications. We will also provide a newsletter updating study participants on our findings.

13. Who is organising and funding the research?

The research is being conducted by London School of Hygiene and Tropical Medicine who are working with the Royal Veterinary College. It is financially supported by Antibiotics Research UK and a Bloomsbury Colleges PhD Studentship.

14. Who has reviewed the study?

This study has been reviewed by an independent group of people, called a Research Ethics Committee to help protect your safety, rights, wellbeing and dignity. This study has been reviewed and given a favourable opinion by the Research Ethics Committee of London School of Hygiene and Tropical Medicine.

15. Further information and contact details

Please contact: Alice Tompson

✉ London School of Hygiene & Tropical Medicine, 15-17 Tavistock Place, Kings Cross, London WC1H 9SH

☎ 07870 211490 alice.tompson@lshtm.ac.uk

Thank you for taking the time to read this information sheet

London School of Hygiene and Tropical Medicine •
15-17 Tavistock Place •Kings Cross •London •
WC1H 9SH• www.lshtm.ac.uk

Lead Researcher: Dr Clare Chandler

Understanding Antibiotic Use in Pets
Observation Consent Form – Staff

		Please initial each box
1.	I confirm that I have read and understand the information sheet Version 1, dated 19 October 2018 for the above study.	
2.	I have had the opportunity to consider the information, ask questions and have these answered satisfactorily.	
3.	I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my legal rights being affected.	
4.	I understand that direct quotations may be included in the study results but I will not be identified.	
5.	I understand that data collected during the study may be looked at by authorised individuals from London School of Hygiene and Tropical Medicine and the Royal Veterinary College where it is relevant to my taking part in this research. I give permission for these individuals to have access to my data.	
6.	I agree to take part in the above study.	

Name of participant (please print)	Date	Signature
Name of person taking consent (please print)	Date	Signature

Participant ID Number

COPIES FOR RESEARCH TEAM & FOR PARTICIPANT

Staff Observation Consent Form, Version 1, 19 October 2018 Study REC Reference: 16126

Appendix 3 Participant Information Sheets / Informed Consent forms: Veterinarian interviews

LONDON SCHOOL of HYGIENE &TROPICAL MEDICINE

London School of Hygiene and Tropical Medicine • 15-17 Tavistock Place •Kings Cross •London • WC1H 9SH• www.lshtm.ac.uk

Understanding Antibiotic Use in Pets: Staff Interviews
Research Study Information Sheet

We would like to invite you to take part in our research study. This information sheet explains why the research is being conducted and what it will involve if you choose to take part. Please read it carefully before making a decision. Feel free to talk to others about the study if you wish. Please ask us if there is anything that is not clear or if you would like more information.

1. What is the purpose of this study?
The aim of this study is to explore how we use antibiotics to care for our pets.

Antibiotic use in companion animal care is coming under increasing scrutiny. Although there is lots of talk by policy makers about "appropriate antibiotic use" and "antimicrobial resistance", there is a very limited understanding about how these phenomena are encountered by frontline veterinary staff and pet owners.

By better understanding how antibiotics are used, we can help design interventions to support the use of antibiotics in appropriate cases, helping to keep these medicines effective for longer.

2. Why have I been invited?
You have been invited to participate because you work at site involved in companion animal care. We hope to conduct up to 30 such interviews. We are unable to interview anyone who is aged less than 18 years old.

In addition to vets and support staff, we will also interview pet owners as part of the study. We will also spend time observing pet care in vet practices too.

3. Do I have to take part?
No – it is entirely optional. If you agree to take part you are free to withdraw from the study at any time, without giving a reason.

4. What will happen to me if I take part?
Participation will involve an interview that takes place at work at a convenient time. Before the interview starts, the researcher – Alice - will explain the study, answer any questions and ask you to complete a consent form. The interview will then last about 45 minutes and, with your permission, will be recorded. You will be asked about your views and experiences of local antibiotic use, infection control and antibiotic resistance in both in- and out- patient small animal care.

5. What are the possible benefits or disadvantages of taking part?
Your participation in the study poses no major physical or psychological risk. There is no direct benefit to you from taking part, but you will be helping to inform the design of future schemes to protect pets from antibiotic resistant infections.

6. Are there any expenses and payments?
Unfortunately, we are unable to offer participants reimbursement for their time.

7. What will happen to information collected about me?

The research team has a duty of confidentiality to you as a research participant. The information you provide will be coded with a study number so you cannot be identified from it. Your personal details will be kept in a different safe place to the other study information and will be destroyed within 10 years of the end of the study.

We will keep digital copies of the interviews but not identify you by name on the recording. We will keep all the data we collect, including the recordings, for 10 years after the end of the study in line with London School of Hygiene and Tropical Medicine policy. All data will be kept securely according to the Data Protection Act 1998. Information will only be accessible to the study team in London. Responsible members of London School of Hygiene and Tropical Medicine may be given access to data for monitoring and/or audit of the study to ensure we are compiling with regulations.

8. Use of quotations

The researchers may use some direct quotations in the publications. In the case of participants with less common and potentially identifiable roles there may be limits to their ensuring anonymity. The study consent form provides the option for their direct quotes not to be used in study outputs.

9. What will happen if I don't want to carry on with the study?

If you decide you no longer wish to participate in the study, you can phone, write to or e-mail the research team (see section 15 for contact details). You can withdraw at any time and you do not need to give a reason. If you have already been interviewed, we will ask whether you would like this information to be included or withdrawn from the study.

10. What if there are any problems?

Given the nature of this study, it is highly unlikely that you will suffer harm by taking part. However, London School of Hygiene and Tropical Medicine has arrangements in place to provide for harm arising from participation in the study for which the School is Research Sponsor.

11. Complaints statement

If you have a concern about any aspect of this study, you should ask to speak to the researcher who will do her best to answer your questions.

If you wish to complain about any aspect of the way in which you have been approached or treated during the course of this study, you should contact the senior investigator Dr Clare Chandler, (clare.chandler@lshtm.ac.uk, 020 7299 4709) or the London School of Hygiene and Tropical Medicine Research Governance and Integrity Office (RGIO) (020 72927 2626, rgio@lshtm.ac.uk).

12. What will happen to the results of the research study?

The results of the study will be reported at conferences and published in peer-reviewed journals and lay publications. We will also provide a newsletter updating study participants on our findings.

13. Who is organising and funding the research?

The research is being conducted by London School of Hygiene and Tropical Medicine who are working with the Royal Veterinary College. It is financially supported by Antibiotics Research UK.

14. Who has reviewed the study?

This study has been reviewed by an independent group of people, called a Research Ethics Committee to help protect your safety, rights, wellbeing and dignity. This study has been reviewed and given a favourable opinion by the Research Ethics Committee of London School of Hygiene and Tropical Medicine.

15. Further information and contact details

Please contact Alice Tompson

✉ London School of Hygiene & Tropical Medicine, 15-17 Tavistock Place, Kings Cross, London WC1H 9SH

☎ 07870 211490 alice.tompson@lshtm.ac.uk

Thank you for taking the time to read this information sheet

London School of Hygiene and Tropical Medicine • 15-17 Tavistock Place •Kings Cross •London • WC1H 9SH• www.lshtm.ac.uk

Lead Researcher: Dr Clare Chandler

Participant ID Number:

Understanding Antibiotic Use in Pets
Interview Consent Form – Staff

Please initial each box

1. I confirm that I have read and understand the information sheet Version 1, dated 19 October 2018 for the above study. ☐
2. I have had the opportunity to consider the information, ask questions and have these answered satisfactorily. ☐
3. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my legal rights being affected. ☐
4. I agree to take part in the interview and agree to it being audiotaped. ☐
5. I understand that direct quotations may be included in the study results but I will not be identified. ☐
6. I understand that data collected during the study may be looked at by authorised individuals from London School of Hygiene and Tropical Medicine and the Royal Veterinary College where it is relevant to my taking part in this research. I give permission for these individuals to have access to my data. ☐
7. I understand that an anonymised transcript of my interview may be shared via a public data repository or by sharing directly with other researchers, and that I will not be identifiable from this transcript ☐
8. I agree to take part in the above study. ☐

Name of participant (please print)	Date	Signature
Name of person taking consent (please print)	Date	Signature

COPIES FOR RESEARCH TEAM & FOR PARTICIPANT

Staff Interview Consent Form, Version 1, 19 October 2018   Study REC Reference: 16126

Appendix 4 Participant Information Sheets / Informed Consent forms: Companion animal owner observations

London School of Hygiene and Tropical Medicine •
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Understanding Antibiotic Use in Pets
Observation of Veterinary Consultations: Pet Owner Information Sheet

We would like to invite you to take part in our research study. This information sheet explains why the research is being conducted and what it will involve if you choose to take part. Please read it carefully before making a decision. Feel free to talk to others about the study if you wish. Please ask us if there is anything that is not clear or if you would like more information.

1. What is the purpose of this study?

The aim of this study is to explore how we use antibiotics to care for our pets. Antibiotics are medicines used to treat infections in both humans and animals. Their widespread use in recent years has meant that they are becoming less effective and led to the emergence of "superbugs". These are strains of bacteria that have developed resistance to many types of antibiotics. Antibiotic resistant infections caused by superbugs are a major threat to health.

By better understanding how antibiotics are used, we can help design interventions to support the use of antibiotics in appropriate cases, helping to keep these medicines effective for longer.

2. Why have I been invited?

You have been invited to participate because your pet has an appointment at [Name of Veterinary Practice] who are taking in our research. We hope to observe consultations for a range of conditions in which antibiotics are and are not used.

In addition to observing veterinary consultations, we are also interviewing pet owners whose dogs have recently been prescribed antibiotics. If you would like to find out more about being interviewed please contact us – our details are in section 15.

3. Do I have to take part?

No – it is entirely optional. If you agree to take part you are free to withdraw from the study at any time, without giving a reason. Your decision to participate or not will not affect the veterinary care your dog receives.

4. What will happen to me if I take part?

Before the consultation starts, the researcher - Alice - will answer any questions you may have and ask you to complete a consent form. Alice will then sit in on you and your pet's appointment with the vet. She will listen to the conversation and watch what happens. She may take some notes.

5. What are the possible benefits or disadvantages of taking part?

Your participation in the study poses no major physical or psychological risk. There is no direct benefit to you from taking part, but you will be helping to inform the design of future schemes to protect pets from superbugs.

6. Are there any expenses and payments?

Unfortunately, we are unable to offer participants reimbursement for their time.

7. What will happen to information collected about me?

The research team has a duty of confidentiality to you as a research participant. The information from your vet consultation will be coded with a study number so you cannot be identified from it. Your personal details (on the consent form) will be kept in a different safe place to the other study information and will be destroyed within 10 years of the end of the study.

We will keep all the data we collect for 10 years after the end of the study in line with London School of Hygiene and Tropical Medicine policy. All data will be kept securely according to the Data Protection Act 1998. Information will only be accessible to the study team at London School of Hygiene and Tropical Medicine and the Royal Veterinary College. Responsible members of London School of Hygiene and Tropical Medicine may be given access to data for monitoring and/or audit of the study to ensure we are compiling with regulations.

8. Use of quotations
The researchers may use some direct quotations in publications. No individuals will be identifiable from them.

9. What will happen if I don't want to carry on with the study?
If you decide you no longer wish to participate in the study, you can phone, write to or e-mail the research team (see section 15 for contact details). You can withdraw at any time and you do not need to give a reason. If your consultation has already been observed, we will ask whether you would like this information to be included or withdrawn from the study.

10. What if there are any problems?
Given the nature of this study, it is highly unlikely that you will suffer harm by taking part. However, London School of Hygiene and Tropical Medicine has arrangements in place to provide for harm arising from participation in the study.

11. Complaints statement
If you have a concern about any aspect of this study, you should ask to speak to the researcher who will do her best to answer your questions. If you wish to complain about any aspect of the way in which you have been approached or treated during the course of this study, you should contact the senior investigator Dr Clare Chandler, (clare.chandler@lshtm.ac.uk, 020 7299 4709) or the London School of Hygiene and Tropical Medicine Research Governance and Integrity Office (RGIO) (020 72927 2626, rgio@lshtm.ac.uk).

12. What will happen to the results of the research study?
The results of the study will be reported at conferences and published in peer-reviewed journals and lay publications. We will also provide a newsletter updating study participants on our findings.

13. Who is organising and funding the research?
The research is being conducted by London School of Hygiene and Tropical Medicine who are working with the Royal Veterinary College. It is financially supported by Antibiotics Research UK and a Bloomsbury Colleges PhD studentship.

14. Who has reviewed the study?
This study has been reviewed by an independent group of people, called a Research Ethics Committee to help protect your safety, rights, wellbeing and dignity. This study has been reviewed and given a favourable opinion by the Research Ethics Committee of London School of Hygiene and Tropical Medicine.

15. Further information and contact details
Please contact: Alice Tompson

✉ London School of Hygiene & Tropical Medicine, 15-17 Tavistock Place, Kings Cross, London WC1H 9SH

☎ 07870 211490 alice.tompson@lshtm.ac.uk

Thank you for taking the time to read this information sheet

Pet Owner Observation Participant Information Sheet, Version 1, dated 19 October 2018
Research Ethics Committee Reference Number: 16126

London School of Hygiene and Tropical Medicine •
15-17 Tavistock Place •Kings Cross •London •
WC1H 9SH• www.lshtm.ac.uk

Lead Researcher: Dr Clare Chandler

Understanding Antibiotic Use in Pets
Observation Consent Form – Pet Owners

Please initial each box

1. I confirm that I have read and understand the information sheet Version 1, dated 19 October 2018 for the above study. ☐
2. I have had the opportunity to consider the information, ask questions and have these answered satisfactorily. ☐
3. I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason, without my pet's veterinary care or my legal rights being affected. ☐
4. I understand that direct quotations may be included in the study results but I will not be identified. ☐
5. I understand that data collected during the study may be looked at by authorised individuals from London School of Hygiene and Tropical Medicine and the Royal Veterinary College where it is relevant to my taking part in this research. I give permission for these individuals to have access to my data. ☐
6. I agree to take part in the above study. ☐

Name of participant (please print)	Date	Signature
Name of person taking consent (please print)	Date	Signature

Participant ID Number ______

COPIES FOR RESEARCH TEAM & FOR PARTICIPANT

Appendix 5 *Preventative Veterinary Medicine* paper

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Contents lists available at ScienceDirect

Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed

What drives antimicrobial prescribing for companion animals? A mixed-methods study of UK veterinary clinics

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ABSTRACT

Antimicrobial use in companion animals is a largely overlooked contributor to the complex problem of antimicrobial resistance. Humans and companion animals share living spaces and some classes of antimicrobials, including those categorised as Highest Priority Critically Important Antimicrobials (HPCIAs). Veterinary guidelines recommend that these agents are not used as routine first line treatment and their frequent deployment could offer a surrogate measure of 'inappropriate' antimicrobial use. Anthropological methods provide a complementary means to understand how medicines use makes sense 'on-the-ground' and situated in the broader social context.

This mixed-methods study sought to investigate antimicrobial use in companion animals whilst considering the organisational context in which increasing numbers of veterinarians work. Its aims were to i) to epidemiologically analyse the variation in the percentage of antimicrobial events comprising of HPCIAs in companion animal dogs attending UK clinics belonging to large veterinary groups and, ii) to analyse how the organisational structure of companion animal practice influences antimicrobial use, based on insight gained from anthropological fieldwork.

A VetCompass^{TM} dataset composed of 468,665 antimicrobial dispensing events in 240,998 dogs from June 2012 to June 2014 was analysed. A hierarchical model for HPCIA usage was built using a backwards elimination approach with clinic and dog identity numbers included as random effects, whilst veterinary group, age quartile, breed and clinic region were included as fixed effects. The largest odds ratio of an antimicrobial event comprising of a HPCIA by veterinary group was 7.34 (95% confidence interval 5.14 – 10.49), compared to the lowest group ($p < 0.001$). Intraclass correlation was more strongly clustered at dog (0.710, 95% confidence interval 0.701 - 0.719) than clinic level (0.089, 95% confidence interval 0.076 -0.104). This suggests that veterinarians working in the same clinic do not automatically share ways of working with antimicrobials. Fieldwork revealed how the structure of the companion animal veterinary sector was more fluid than that depicted in the statistical model, and identified opportunities and challenges regarding altering antimicrobial use. These findings were organised into the following themes: *"Highest priority what?"*; *"He's just not himself"*; *"Oh no – here comes the antibiotics police"*; *"We're like ships that pass in the night"*; and *"There's not enough hours in the day"*.

This rigorous mixed-methods study demonstrates the importance of working across disciplinary silos when tackling the complex problem of antimicrobial resistance. The findings can help inform the design of sustainable stewardship schemes for the companion animal veterinary sector.

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1. Introduction

Antimicrobial resistance is recognised as a key threat to global health and the global economy (O'Neill, 2016). However, major initiatives seeking to tackle this complex problem have largely overlooked antimicrobial use in companion animals (UK Government, 2013; O'Neill, 2016). This is despite humans and companion animals sharing classes of antimicrobials and living spaces, circumstances that could drive the development and spread of antimicrobial resistance relevant to human health (Pomba et al., 2017). Therefore, it is important to include companion animal veterinary care within antimicrobial stewardship activities.

The term antimicrobial stewardship is used to describe a range of approaches and interventions seeking to 'optimize' antimicrobial use (Dyar et al., 2017). It originated in human healthcare but is now applied in broader One Health contexts. In companion animal veterinary medicine, it has been interpreted as schemes to encourage the responsible use of antimicrobials by decreasing prescription rates without increasing negative patient outcomes (Allerton, 2018). The World Health Organisation (WHO) focuses stewardship efforts on antimicrobials with the strongest evidence of transmission of resistant microbes or resistance genes from animal sources to humans (World Health Organisation, 2019). These medicines, designated by the WHO as Highest Priority Critically Important Antimicrobials (HPCIAs), include third and fourth generation cephalosporins, fluoroquinolones and macrolides, which are all also available for use by companion animal veterinarians (National Office of Animal Health, 2019).

Epidemiological programmes such as VetCompass™ (O'Neill, 2013) and Small Animal Veterinary Surveillance Network (SAVSNET) (Radford et al., 2010) collate anonymised electronic patient records (EPRs) from primary-care veterinary clinics and enable the quantification of antimicrobial use in the wider companion animal population (Buckland et al., 2016; Singleton et al., 2017). In the United Kingdom (UK), antimicrobials are routinely prescribed for companion animals: over a two-year period, 25.2% of dogs and 20.6% of cats attending a veterinary clinic were given at least one antimicrobial treatment, with HPCIAs accounting for around five percent of antimicrobial prescribing events in dogs (Buckland et al., 2016). Unlike the livestock sector (O'Neill, 2016; Veterinary Medicines Directorate, 2019), there are no published target levels for appropriate antimicrobial use in companion animals; however, professional bodies such as the British Veterinary Association (2015) and the British Small Animal Veterinary Association (2018) advise that HPCIAs should not be routinely used as first line treatment. Variation in the use of HPCIAs could act as a surrogate measure for 'appropriate' antimicrobial use with a low proportion of HPCIA events amongst antimicrobial events presumed to be following this advice. This could offer potential opportunities to benchmark companion animal veterinary clinics in the future.

In addition to companion animal and veterinarian characteristics (Radford et al., 2011; Hughes et al., 2012), veterinary organisational structure has been associated with antimicrobial use. For example, the proportion of companion animals receiving antimicrobials varies approximately twofold between UK practices (Radford et al., 2011). Singleton and colleagues (2017) investigated longitudinal changes in HPCIA utilisation in veterinary consultations via a model that included practice (a single veterinary business) and premises (branches that form a practice) as random effects. They identified similar amount of variance at practice (0.225) and premise level (0.175) but did not explore the impact of belonging to different large veterinary groups. Across the UK companion animal veterinary sector, there has been increasing corporatisation in recent years with approximately half of all UK practices now belonging to large groups (Wedderburn, 2017). Understanding the context in which a growing number of companion animal veterinarians work may provide insights into where best to focus effective antimicrobial stewardship interventions. For example, identifying the organisational level at which antimicrobial use is most tightly clustered could indicate the most effective leverage point at which to intervene to change prescribing habits.

The social sciences are recognised to play a crucial role in understanding antimicrobial utilisation (Chandler et al., 2016). Often cast as 'irrational' and 'inappropriate', the methods and theories of anthropology offer a means by which to ask, *"what makes common sense here, and why?"* in order to develop situated accounts of antimicrobial use (Denyer Willis and Chandler, 2018). The cornerstone of anthropological methods is ethnography, involving participant observation to study enacted practice – both conscious and subconscious. Such an approach can provide additional insights to extend existing understandings of antimicrobial use, especially in companion animals, which has mostly relied on surveys that can only describe self-reported behaviour (Will, 2018). Ethnographic studies have been promoted in One Health for their ability to explicate the messy complexities of everyday lives whilst situating them in their broader political, economic, historical and social contexts (Wolf, 2015). This is crucial for a deeper understanding of the wider influences on antimicrobial use, beyond the moment of prescribing. Furthermore, anthropological approaches can address calls for the exploration of issues of power, professional identity and reputation with respect to veterinary prescribing of antimicrobials that, to date, remain under-scrutinised (Wood, 2016).

This mixed-methods study harnesses the complementary strengths of epidemiology and anthropology. This enables the painting of a more complete picture of antimicrobial use in companion animals, one that is, *"greater than the sum of the parts"* (O'Cathain et al., 2010). The goal of this research is to help inform the design of antimicrobial stewardship efforts in the companion animal veterinary sector. Therefore, the aims of this study are i) to epidemiologically analyse the variation in the percentage of antimicrobial events comprising of HPCIAs in companion animal dogs attending clinics belonging to large veterinary groups and, ii) to analyse how the organisational structure of companion animal veterinary medicine influences antimicrobial use, based on insight gained from anthropological fieldwork.

2. Materials and methods

2.1. Epidemiological study

2.1.1. Design

A VetCompass™ dataset spanning June 2012 to June 2014 inclusive that had previously been used to quantify UK antimicrobial use (Buckland et al., 2016) was analysed. Due to the time constraints of this PhD project, the study population was limited to dogs, the most common UK companion animal species (O'Neill, 2013). The percentage of antimicrobial dispensing events comprising of HPCIAs was selected as the outcome measure, given the interest in these agents (Veterinary Medicines Directorate, 2019). In addition to the previously applied inclusion and exclusion criteria (Buckland et al., 2016), only data from corporate veterinary groups with over thirty clinics were retained (Fig. 1). Supplementary material 1 describes the full study inclusion and exclusion criteria.

2.1.2. Data cleaning and processing

Buckland et al.'s (2016) definition of an antimicrobial agent and application to the dataset were re-used (Supplementary material 1). In brief, these were medicines that destroy or inhibit the growth of bacterial microorganisms and authorised for systemic use. Additional HPCIA coding based on the WHO's definition (2019) was added. As per Buckland et al.'s approach, an antimicrobial event was defined as an independent record (line) in the treatment data field of the EPR-derived dataset and, consequently, multiple events could arise from a single consultation or across multiple visits.

The variable 'any HPCIA' was generated and coded as positive for all antimicrobial events linked to a unique dog identity number if one or more of these events comprised of an HPCIA. Dog age was calculated as

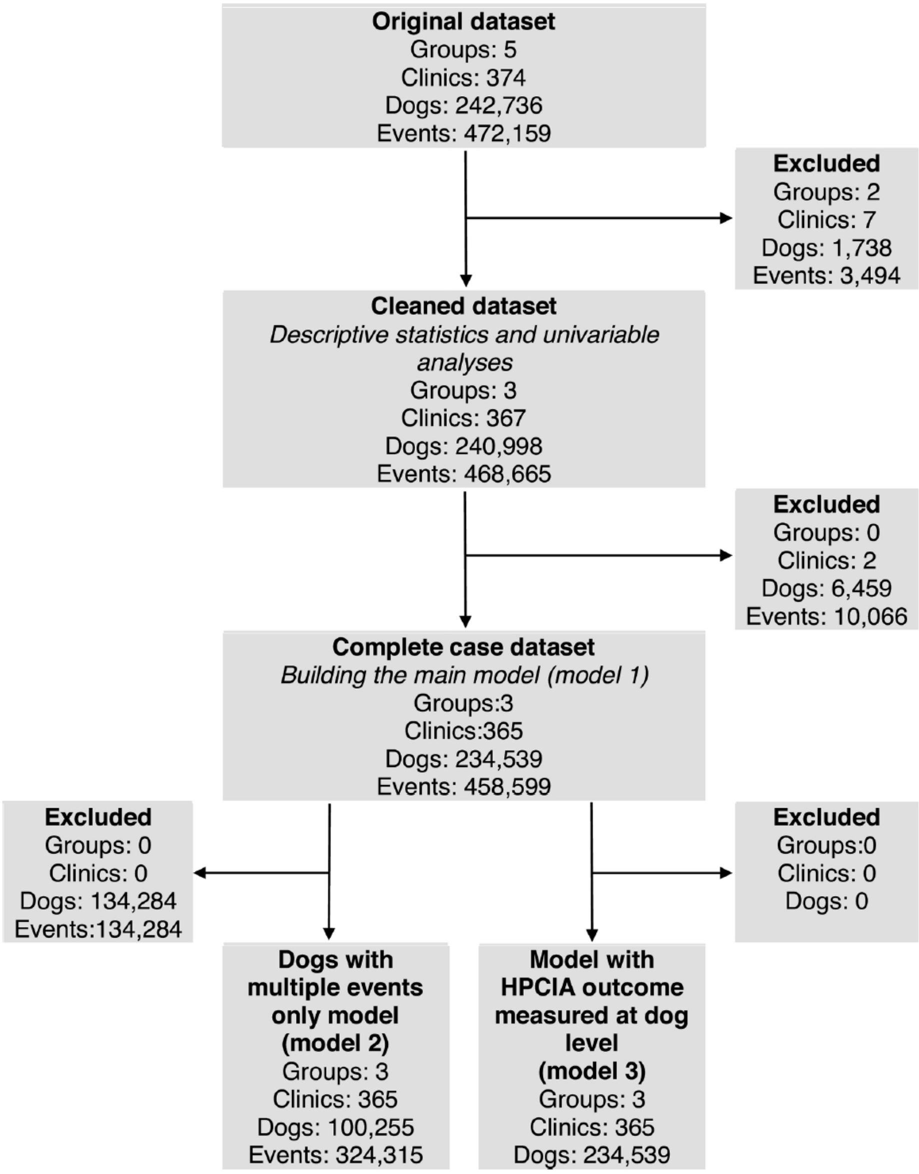

Fig. 1. The flow of data through the VetCompass^{TM} epidemiological study including the hierarchical models

the period between the birth date and the antimicrobial dispensing date; ages < 0 or > 24 years were coded as missing. Age was grouped a priori into quartiles to allow for non-linearity of effects and to facilitate interpretation. Dog sex was coded as male, female or missing. The 20 most prevalent dog breeds in the dataset were taken as categories, the remaining pure breeds were pooled together ('other purebreds') as were 'cross breeds'. The clinic postcode was used to derive its region in the UK.

2.1.3. *Descriptive and univariable analyses*

Counts and percentages were calculated for each categorical variable (dog sex, breed, clinic region). Dog age was summarised for each quartile using median and interquartile range (IQR) after reviewing its distribution. The Pearson chi-square test and the Mann Whitney U test, as appropriate, checked for differences between the sample characteristics of each veterinary group (Kirkwood and Sterne, 2003).

The total and average (mean, median) number of antimicrobial events and HPCIA events per dog were calculated. From the total number of antimicrobials events, the continuous outcome measure of the percentage of events compromising of HPCIAs was calculated at dog, clinic and veterinary group levels along with 95% confidence intervals (95% CIs). The distribution of the percentage of HPCIA events at a clinic level was plotted graphically. The composition of HPCIA events by veterinary group was investigated using percentages and 95% CIs.

2.1.4. Hierarchical modelling

A multilevel logistic regression model was built for the binary outcome of whether an antimicrobial event comprised of a HPCIA (yes versus no) using complete cases (antimicrobial events with full data on dog identification number, dog age, dog sex, dog breed, clinic identification number, clinic region, veterinary group identification number) in the dataset. This was with the aim of investigating the clustering of HPCIA use within dogs, clinics and veterinary groups. Data at individual veterinarian level were not available. Dog identity number and clinic identity number were added as random effects whilst veterinary group was included as a fixed effect. Clinic and animal identities were included as random effects due to the large number of individual identities at both levels and where the interest was in adjusting for clustering at these levels rather evaluating individual animal or clinic differences. A screening criterion of a univariable p-value < 0.25 was applied when considering the inclusion of additional fixed effects (dog age, sex, breed, clinic region) (Hosmer and Lemeshow, 2004).

Model development used a manual backwards stepwise elimination approach. Models without dog identity number, clinic identity number or veterinary group were not considered as this would have prevented the investigation of HPCIA use at these levels. Likelihood ratio tests were used to compare the performance of the new, smaller model to the original. The estimated coefficients of the remaining variables were compared to those from the full model with all variables included to check there was no sizable change in their magnitude (Hosmer and Lemeshow, 2004). Pair-wise interaction effects between age quartile and percentage of HPCIA events in each veterinary group were evaluated. However limited computational power prevented the inclusion of an interaction term in the hierarchical modelling.

Model performance was assessed using Receiver Operator Curve (ROC) statistics and Hosmer Lemeshow residuals (Hosmer and Lemeshow, 2004; Statalist, 2017). Odd Ratios (ORs) and 95% CIs were calculated for each fixed effect variable. The intraclass correlation coefficients (ICCs) at a dog and clinic level were calculated to assess the clustering of HPCIA use, that is the correlation among observations within the same cluster (Dohoo et al., 2003).

Due to the imbalanced structure of the dataset with most dogs having a single antimicrobial event, the analyses were re-run i) in the same model using a dataset limited to dogs with multiple antimicrobial events only (model 2) and ii) a model with a binary outcome of whether a dog received any HPCIA (model 3) (Fig. 1). The ICCs and performance of these models were compared to the main model (model 1) to assess the robustness of the estimates produced.

Data analyses were conducted in Stata 16 (StataCorp, Texas, USA) and statistical significance was set at the 5% level. These analyses were covered by the VetCompass™ research ethics approval from the Royal Veterinary College's Ethics and Welfare Committee (SR2018-1652).

2.2. Anthropological study

2.2.1. Data collection

Fieldwork was undertaken by the lead author (AT) over nine months in 2019 at three UK companion animal clinic sites belonging to different large veterinary groups (two commercial and one charitable). The extended nature of placements enabled the researcher to become embedded in the clinic teams who became less conscious of being 'studied'. All aspects of daily clinic life were observed including consultations, surgical procedures, administrative and reception duties. The researcher's non-veterinary background facilitated a 'fresh pair of eyes' (an 'etic' view) on taken-for-granted situations, illuminating the unwritten rules surrounding companion animal veterinary work that become self-evident from an 'emic' view (Russell Bernard, 1995). Within these observation periods, informal interviews were undertaken with veterinarians, support staff and owners to clarify arising issues. Detailed field notes describing relations, language, metaphors, and sense-making between those actors at the interface of antimicrobial use were made with attention paid to both verbal and non-verbal gestures. Additional written data sources included clinic and veterinary group policies and media articles from the mainstream and veterinary press. Semi-structured interviews were also conducted with veterinarians working at fieldwork clinics. These followed a topic guide (Supplementary material 2) but with flexibility to follow up issues raised by interviewees. The formal interviews were audio-recorded and transcribed.

2.2.2. Data analyses

The software NVivo 12 (QSR International Pty Ltd, USA) was used to organise the qualitative data and facilitate thematic coding. Initial, low level codes situated in the data – such as the activity being undertaken or topic being discussed - were developed into more abstract themes (Ziebland and McPherson, 2006). Analysis involved comparing clinics to draw out similarities and differences. Moving to a new physical space - and shifting between emic (insider) and etic (outsider) perspectives - rendered visible the enacted 'common sense' and supporting infrastructures (Chandler, 2019) in each location. Analyses were conducted by the first author and interim findings were discussed amongst the multidisciplinary research team.

The empirical fieldwork data was considered in response to - and building on - the existing theoretical literature. Anthropologists emphasise that researchers always operate from a particular theoretical position that informs the inflection of the research: It shapes the lines of inquiry, what is tuned into in conversations, what captures the fieldworker's gaze during observations and what is deemed noteworthy. The theoretical orientation informing this study arises from the research in anthropology and science and technology studies, influenced by the ontological turn in the social sciences, which moves from distinctions of 'nature' and 'culture' to understanding 'naturecultures' (Haraway, 2003). Anthropologists strive to 'take seriously' their interlocutors and give voice to traditionally marginalised or overlooked groups. As such, this study sought to move beyond blaming veterinarians for being irrational users of antimicrobials and beyond blaming owners for demanding antimicrobials. Instead this project wanted to understand antimicrobial prescribing as an emergent and contingent practice that is enacted under particular economic, social and material conditions (Reynolds Whyte et al., 2002). It was informed by sensory accounts of multispecies encounters (for example Kirksey and Helmreich, 2010) and material semiotic approaches that have previously been used to study care in veterinary work (Law, 2010).

All study participants gave informed consent. The anthropological study was approved by the research ethics committee of London School of Hygiene and Tropical Medicine (16126).

3. Results

3.1. Epidemiological study

3.1.1. Descriptive results

The cleaned dataset contained 468,665 antimicrobial events across 240,998 dogs with 294,016 (62.7%) of these events arising from veterinary group C (Table 1). Of the total antimicrobial events, 29,984 comprised of HPCIAs (6.4%, 95% CI: 6.3; 6.5%): this percentage differed between veterinary groups ranging from 4.9 % (95% CI: 4.8; 5.0) in group B to 15.6% (95% CI: 15.2%; 16.1%) in group A ($p < 0.001$). However, the canine and clinic characteristics of antimicrobial events also varied between veterinary groups (Supplementary material 3), potentially confounding this univariable finding although this is

Table 1
The distribution of antimicrobial and HPCIA events by veterinary group in a VetCompass™ UK dataset from 2012 -2014. Distribution is reported in total and at a clinic level (No.: Number; HPCIA: Highest priority critical important antimicrobial; CI: confidence interval; IQR: interquartile range)

Vet. Group	No. dogs (%)	No. antimicrobial events (%)	No. HPCIA events (%)	Percentage of antimicrobial events comprising of HPCIAs (95% CI)	No. clinics (%)	Median clinic percentage of antimicrobial events comprising of HPCIAs (IQR)
A	12,565 (5.2)	25,909 (5.5)	4,044 (13.5)	15.6 (15.2;16.1)	90 (24.5)	13.8 (10.9;19.9)
B	83,754 (34.8)	148,740 (31.7)	7,280 (24.3)	4.9 (4.8;5.0)	117 (31.9)	3.7 (2.1;6.1)
C	144,679 (60.0)	294,016 (62.7)	18,660 (62.2)	6.3 (6.3;6.4)	160 (43.6)	5.3 (3.6;7.7)
Total	240,998 (100.0)	468,665 (100.0)	29,984 (100.0)	6.4 (6.3;6.5)	367 (100.0)	5.9 (3.4;10.4)

accounted for in subsequent multivariable analyses.

The types of HPCIA used varied between veterinary groups. The higher percentage of HPCIA events in group A was largely composed of fluoroquinolone use which contributed 13.4% (95% CI: 12.9;13.8%) to the total antimicrobial events in this group; This compared to 4.5% (95% CI: 4.4; 4.7%) in group B and 4.2% (95% CI: 4.2; 4.3%) in group C. Group B – which had the lowest percentage of HPCIA events - had six uses of third generation cephalosporins (0.0% of antimicrobial events), suggesting they were not routinely stocked by clinics in this group. The corresponding results in groups A and C were 2.1% (95% CI: 2.0; 2.3%) and 1.9% (95% CI: 1.9; 2.0%) respectively. Macrolide use was low across all groups (n = 1,137 0.2% of antimicrobial events).

At a clinic level (n = 367), the median percentage of HPCIA events was 5.9 (IQR: 3.4 – 10.4%) with a range of 0.0% (10 clinics) to 69.9% (1 clinic). When plotted graphically, a positively (right handed) skewed distribution with a long tail was revealed (Fig. 2). The median number of antimicrobial events per dog was 2 (IQR: 1 - 4, range: 1 - 60), whilst the median number of HPCIA events was 0 (IQR: 0 - 0, range: 0 - 60).

3.2. Hierarchical modelling results

All variables met the univariable screening criterion for inclusion in the multivariable model building stage. At this point dog sex was not statistically significant and, therefore, the models comprised of clinic and dog as random effects, and corporate veterinary group, age quartile, breed and clinic region as fixed effects.

Table 2 reports the main model (model 1) results: The OR of an antimicrobial event comprising of a HPCIA was statistically significantly different between veterinary groups ($p < 0.001$) whilst and was positively associated with increasing quartiles of age. The nine breeds with the greatest OR of an HPCIA event were classified as 'small' (Kennel Club, no date). Compared to the South East, the OR of an event comprising of a HPCIA in Scotland was reduced (0.26, 95% CI: 0.14; 0.49) whilst the corresponding figure for an event at clinics in the north west was 0.47 (95% CI: 0.30; 0.73). In other regions, there was no statistically significantly difference.

The area under the ROC for the main model (model 1) was 0.983 (95% CI: 0.983; 0.984) and the Hosmer-Lemeshow test was non-significant ($p = 0.314$) suggesting an acceptable model fit. When dog identity number was removed as a random effect from the main model (model 1), the area under the ROC fell to 0.712 (95% CI: 0.709; 0.715, Hosmer-Lemeshow p-value 0.231) suggesting that the information contained with dog identity number variable makes a sizeable contribution to the model's performance.

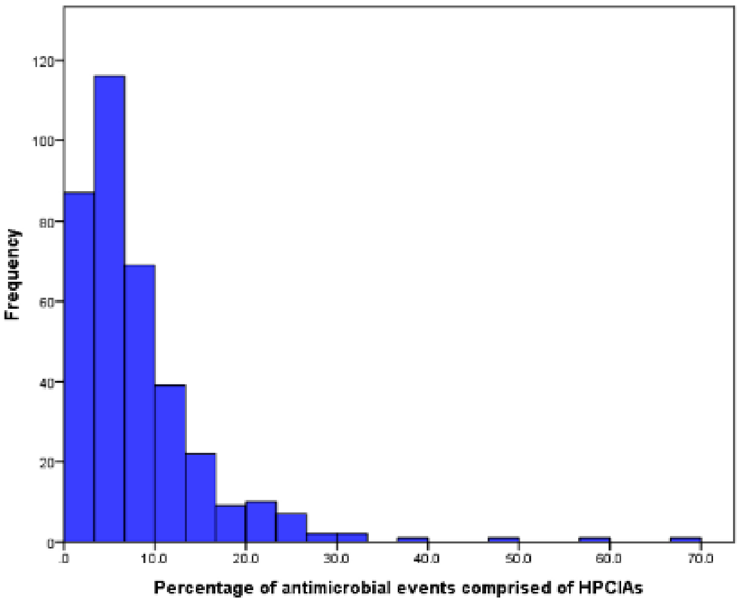

Fig. 2. The distribution of the percentage of antimicrobial events comprising of highest priority critically important antimicrobials by clinic (n = 367)

Table 2
The results of the main hierarchical model (model 1) investigating HPCIA events in a VetCompass™ UK dataset of antimicrobial events from 2012 -2014 (n = 458,599) (No.: Number; HPCIA: Highest priority critical important antimicrobial; CI: confidence interval)

Variable		No. (%)	Odds of HPCIA Exposure (95% CI)	p-value
Veterinary group	B	146,802 (32.0)	1.00	< 0.0001
	A	25,417 (5.5)	7.34 (5.14;10.49)	
	C	286,380 (62.4)	2.04 (1.56;2.70)	
Age quartile	< 1.5 years	113,060 (24.7)	1.00	< 0.0001
	1.5 to < 4.3 years	116,388 (25.4)	2.12 (1.97;2.29)	
	4.3 to < 8.2 years	113,029 (24.6)	2.95 (2.73;3.18)	
	8.2 years and over	116,122 (25.3)	5.02 (4.64;5.43)	
Breed	Crossbreed	94,069 (20.5)	1.00	< 0.0001
	Staffordshire bull terrier	27,753 (6.1)	0.74 (0.65;0.84)	
	Border collie	10,330 (2.3)	0.83 (0.68;1.01)	
	Rottweiler	5,947 (1.3)	0.95 (0.74;1.23)	
	Labrador retriever	35,097 (7.7)	0.96 (0.86;1.08)	
	German shepherd dog	14,686 (3.2)	1.03 (0.87;1.22)	
	Golden retriever	7,350 (1.6)	1.04 (0.84;1.30)	
	Springer spaniel	7,708 (1.7)	1.22 (0.98;1.51)	
	Jack Russell	22,303 (4.9)	1.28 (1.13;1.45)	
	English springer spaniel	6,228 (1.4)	1.39 (1.11;1.74)	
	Boxer	9,463 (2.1)	1.48 (1.22;1.79)	
	All other pure breeds	107,008 (23.3)	1.55 (1.43;1.68)	
	Border terrier	5,234 (1.1)	1.70 (1.34;2.15)	
	Cavalier King Charles spaniel	11,941 (2.6)	1.85 (1.57;2.18)	
	Cocker spaniel	19,289 (4.2)	1.98 (1.73;2.26)	
	Bichon fries	7,611 (1.7)	2.09 (1.72;2.54)	
	Lhasa apso	6,490 (1.4)	2.31 (1.89;2.84)	
	West highland terrier	18,115 (4.0)	2.47 (2.17;2.81)	
	Shih tzu	12,618 (2.8)	2.61 (2.24;3.03)	
	Yorkshire terrier	14,634 (3.2)	2.83 (2.47;3.23)	
	Pug	5,849 (1.3)	3.12 (2.52;3.86)	
	Chihuahua	8,836 (1.9)	3.31 (2.80;3.92)	
Clinic region	South East	78,224 (17.1)	1.00	0.0017
	Scotland	18,765 (4.1)	0.26 (0.14;0.49)	
	Northern Ireland	5,567 (1.2)	0.41 (0.17;1.01)	
	North West	45,192 (9.9)	0.47 (0.30;0.73)	
	North East	42,324 (9.2)	0.69 (0.41;1.14)	
	West Midlands	46,924 (10.2)	0.71 (0.45;1.11)	
	East Midlands	54,458 (11.9)	0.71 (0.45;1.11)	
	Greater London	41,402 (9.0)	0.74 (0.49;1.11)	
	East of England	65,092 (14.2)	0.80 (0.55;1.16)	
	South West	45,011 (9.8)	0.88 (0.59;1.40)	
	Channel Islands	926 (0.2)	0.98 (0.14;6.80)	
	Wales	14,714 (3.2)	1.02 (0.53;1.96)	

Comparison of the ICCs in the main model (model 1) suggests HPCIA use is more strongly clustered within a dog (0.710, 95% CI: 0.710; 0.719) than within a clinic (0.089, 95% CI: 0.076; 0.104). These estimates were broadly similar across the models 1 to 3 (Supplementary material 4). The removal of veterinary group identity number from the main model (model 1) increased the clinic level ICC only slightly to 0.118 (95% CI: 0.102; 0.136).

3.3. *Anthropological study*

The statistical model presents a representation of the companion animal veterinary work in which a dog attends a single veterinary clinic and that each clinic is a neatly bounded entity under the umbrella of a corporate veterinary group. Time in the field revealed more fluid structures which are described below. These are presented in an order to reflect the levels of the statistical model.

3.3.1. *"Highest priority what?"*

HPCIA – the quantitative outcome classification used in the statistical model - had little meaning 'on the ground'. For example, antimicrobials were organised in clinic based on their formulation type (tablet, injectable) rather than other categorisations. They were referred to by their brand names amongst staff, for instance there was awareness regarding the pressure to restrict use of Convenia (Zoetis), a third-generation cephalosporin. When outlining treatment plans to owners, it was unusual for veterinarians to present choices between different antimicrobials or describe their HPCIA status. More typically a yes/no option was proposed: 'antibiotics' were offered or, in some cases, suggestions were made that they should be withheld – at least initially – due to concerns about antimicrobial resistance. The reasoning behind the selection of the antimicrobial agent offered to pet owners was rarely articulated by the veterinarians.

3.3.2. *"He's just not himself"*

Whether a dog received antimicrobials was shaped by a complex interplay of canine and owner characteristics. Owners determined if - and when - their dog attended the veterinary clinic and therefore could potentially access antimicrobials. Some owners presented at the first sign of trouble whilst others had to make tricky decisions about when to seek help based on limited financial and time resources. The epidemiological modelling did not investigate this entanglement of biological and social factors.

Furthermore, these canine-owner knots also influenced prescribing decisions by veterinarians who assessed whether owner characteristics, such as frailty, mobility or financial hardship, may hamper antimicrobial administration or prevent return to the clinic in case of problems. Frontline veterinarians had to balance the immediate welfare needs of the animal in front of them with the less tangible risk of antimicrobial resistance. In such circumstances, the use of long-acting, injectable agents such as Convenia (Zoetis) given then and there 'made sense'.

3.3.3. *"Oh no – here comes the antibiotics police"*

Due to the anonymization of information available in VetCompass™, it was not possible to quantitatively investigate variation in HPCIA use at an individual veterinarian level. Observations revealed that this is important with several younger veterinarians taking on the role of local antimicrobials champion. They advised and, in some cases, cajoled their co-workers regarding more appropriate use. However, these champions revealed that they did not feel able to challenge all of their colleagues, in part due to their relative positions in the clinic hierarchy.

3.3.4. *"We're like ships that pass in the night"*

Modern ways of working challenge the notion of the veterinary clinic as a bounded unit with a stable workforce and shared practices. Shortages of qualified staff presented ongoing challenges in the fieldwork sites with rota gaps being filled by veterinarians from other clinics or locum staff. In some cases, out-of-hours work was contracted out to separate businesses. However, the flow of staff offered opportunities to share best practice between clinics.

Staffing patterns could pose issues in terms of continuity of care with pet owners no longer having a 'usual' veterinarian. For example, veterinarians were sometimes placed in awkward situations if pet owners had previously been seen by colleagues who had set a precedent by prescribing antimicrobials in conflict with guidelines.

3.3.5. *"There's not enough hours in the day"*

Belonging to a large veterinary group presented the potential to share some of the workload associated with antimicrobial stewardship. It was difficult for frontline veterinarians to personally carve out time to undertake such activities because clinical and revenue generating activities take priority under existing business models. At one fieldwork clinic, the corporate headquarters distributed template stewardship materials for completion; however, there was limited local capacity for this work in terms of time and personnel. In another group, a single 'top-down', business-wide policy regarding 'appropriate' use was introduced but there was muted buy-in at a clinic level. The level of clinic autonomy – for example deciding which drugs to stock – varied between veterinary groups whose organisational cultures differed.

4. Discussion

This study is the first to combine epidemiological and anthropological approaches to provide insights into antimicrobial use in the companion animal veterinary sector to help inform the design of sustainable stewardship interventions for this setting. Based on a large VetCompass™ dataset, the study quantified the variation in the percentage of antimicrobial events comprising of HPCIAs between clinics and three different veterinary groups. It also identified that relative HPCIA utilisation was more strongly clustered within dogs than within clinics. The anthropological fieldwork highlighted how the organisational structure of the companion animal veterinary sector was more fluid than that depicted in the statistical model, identifying opportunities and challenges when seeking to intervene regarding antimicrobial use. Table 3 provides a summary of the recommendations for antimicrobial stewardship schemes in companion animal veterinary practice arising from this study.

The main hierarchical model suggests that the cost influences antimicrobial choice: the odds of an antimicrobial event comprising of a relatively costly HPCIA were higher in low weight breeds in which smaller – less expensive - doses are indicated. In the future, a minimum price could be applied to a HPCIA dispensing event, deterring their use in smaller dog breeds. Recognising that companion animal veterinarians make decisions based on more than clinical factors alone is important when considering how to alter antimicrobial use. Previous research has used clinical vignettes to assess 'appropriate' antimicrobial utilisation (Barzelai and Whittem, 2017; Hardefeldt et al., 2017; Van Cleven et al., 2018). However, such methods overlook the day-to-day complexities faced by frontline veterinarians when making choices about antimicrobial use. The model also revealed that the odds of an antimicrobial event comprising of a HPCIA increased as dogs ages. This could be partially explained by the contraindication for fluoroquinolones in young dogs (BSAVA, 2018) or by longitudinal changes in the common conditions treatable using antimicrobials across a dog's life course.

Table 3
Recommendations for antimicrobial stewardship schemes in companion animal veterinary clinics

Tailor language to reflect target audiences.
Address the structural influences supporting antimicrobial use (for example their physical accessibility in clinic).
Provide tools to support vet-owner discussions regarding antimicrobials.
Make stewardship activities inclusive to all staff including those working part-time, as locums or hour-of-hours.
Support antimicrobial champions by strengthening the evidence base regarding clinical outcomes when adhering to prescribing guidelines.
Incorporate mandatory antimicrobial stewardship training in CPD requirements.
Encourage benchmarking by the provision of accessible benchmarking tools and services such as SAVSNET-AMR (Radford et al., 2017).

The quantitative study estimated that the odds of an antimicrobial event comprising a HPCIA was more tightly clustered at a dog level, perhaps reflecting their deployment in dogs with ongoing conditions. Less clustering was calculated at a clinic level suggesting that companion animal veterinarians working in the same clinic do not automatically share ways of working with antimicrobials. It was considered unlikely that within-clinic specialisation by veterinarians may have contributed to this limited within-clinic clustering, such that one clinician may be more likely to deal with dermatological conditions, for example, whilst another specialised in gastro-intestinal disorders. Within VetCompass the vast majority of work is primary care veterinary medicine with little internal referral and, as such, individual veterinarians are likely to treat the spectrum of conditions that present to a clinic. This limited clustering was echoed by the fieldwork finding that the 'clinic' was not found be the bounded, stable unit modelled in epidemiological studies as well as by work by Singleton et al (2017, supplementary material) where clinic premises explained little of the variance reported.

A limitation of this study is that the quantitative data was from 2012 to 2014and it is unclear to what extent these patterns of antimicrobial use persist. This study period was chosen due to the presence of a pre-existing, cleaned VetCompass dataset that facilitated the undertaking of this analysis. A UK-based SAVSNET study found the percentage of HPCIA events increased slightly between 2014 and 2016 (Singleton et al., 2017). Meanwhile, in the Netherlands, a statistically significant decrease in HPCIA use was measured between 2012 to 2014; however inter-clinic variation became more pronounced (Hopman et al., 2019a), perhaps suggesting differential uptake of antimicrobial stewardship messaging around HPCIA use. Subsequent to these quantitative data, the British Small Animal Veterinary Association (2018) introduced its UK stewardship campaign which included developing clinic level antimicrobial use policies. It will be interesting to assess whether the clinic level clustering of HPCIA use has subsequently changed.

From the anonymised clinical data shared with VetCompass™, it was not possible to quantify the clustering of HPCIA use at an individual veterinarian level or include the influence of owner characteristics. Future studies could quantitatively investigate these factors. However, time spent in clinic demonstrated that the decision to use an antimicrobial arose from complex interactions including those between the consulting veterinarian and the companion animal owner, highlighting the benefits of a mixed-methods approach. A previous qualitative study reported that veterinarians feel under pressure from owners to prescribe antimicrobials; however, owners reported that it was the veterinarians themselves who encouraged their use (Smith et al., 2018). Social scientists, meanwhile, have argued that focussing on who to blame overlooks the broader structural factors supporting the continued use of antimicrobials (Chandler, 2019). Future research should further investigate the entangled roles of these actors whilst considering the context in which they operate.

The percentage of antimicrobial dispensing events comprising of HPCIAs varied widely between veterinary groups largely due to variation in fluoroquinolone use. At a clinic level, a skewed distribution was observed. In the Dutch livestock sector, when defined daily antimicrobial dose per animal was plotted by farm a similarly skewed pattern was noted (Bos et al., 2015). The Netherlands Veterinary Medicines Authority used this as a basis to benchmark establishments and require that any above the 75th percentile – an arbitrary threshold – worked with their veterinarian to reduce their antimicrobial use. A similar approach could be adopted in the companion animal veterinary sector to tackle the 'long tail' of clinics using a higher proportion of HPCIAs. However, careful attention should be paid to the selection of any future benchmarking metric: for example, a clinic may have a high percentage of antimicrobial events comprising of HPCIAs despite a relatively small denominator (total antimicrobial events), thus masking a limited frequency of HPCIA events. Alternatively, veterinarians might be careful users of HPCIAs but frequently prescribe other antimicrobials. Future benchmarking could account for both absolute as well as relative usage of antimicrobials overall as well as HPCIAs.

On-the-ground, antimicrobial stewardship activities have to be fitted around existing, income generating workloads. Large veterinary groups may be able to shoulder some of this stewardship burden. However, the fieldwork indicates that careful reflection should be given to considering how best to ensure 'buy-in' by frontline veterinarians. Furthermore, the organisational culture of each veterinary group varied, suggesting an 'off-the-shelf' approach might have limited impact. Whilst recent graduates may be willing to act as local champions for appropriate antimicrobial use, consideration is required of how the hierarchies and gender roles at play in veterinary work (Knights and Clarke, 2019) may help or hinder these activities.

To date, there has been little published research evaluating the effectiveness of interventions seeking to alter antimicrobial use in the companion animal veterinary sector although several projects are underway. Two studies (Weese, 2006; Sarrazin et al., 2017) focused on the introduction of prescribing guidelines; however, the interpretation of their findings is hampered by methodological issues such as lack of contemporaneous control groups or, in the case Sarrazin et al. (2017), the short follow-up period. Targeting the behaviour of individuals - such as prescribers - is a popular stewardship approach but also one which often has limited impact as it fails to address broader contextual issues supporting the continued use of antimicrobials (Denyer Willis and Chandler, 2019). The current study provides valuable insight into these contextual issues that, to date, have be largely overlooked when seeking to optimise antimicrobial use in the companion animals.

A more recent trial (Hopman et al., 2019b) tested a multicomponent stewardship approach – which include benchmarking activities, social pledges, veterinarian education and owner information sheets. Total antimicrobial use was reduced by 15% although there was no statistically significant reduction in HPCIA use. Clinics were reimbursed for their involvement which required considerable veterinarian participation. If Hopman et al.'s intensive approach were to be rolled out more widely, the current study suggests that financial reimbursement or provision of veterinary staff to cover clinical duties could be crucial in supporting the completion of stewardship activities. Outside of a research context, it is unclear which commercial, professional, or governmental bodies would provide these.

To conclude, this rigorous mixed-methods study has provided fresh insights into antimicrobial use in the companion animal veterinary sector. In doing so, it demonstrates the strengths of working across traditional disciplinary silos to better understand and intervene in this area. By using both quantitative and qualitative approaches, it has enabled a deeper understanding of the organisational structure in which an increasing number of companion animal work and how this can influence antimicrobial use. These findings will help inform the design of sustainable stewardship interventions for this setting.

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Declaration of Competing Interest

The authors declare no conflicts of interest.

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Appendix A. Supplementary data

Supplementary material related to this article can be found, in the online version, at doi:https://doi.org/10.1016/j.prevetmed.2020.105117.

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