

**The use of clinical audit in farm animal
veterinary practice in the UK**

KATIE WAINE BVSc MRCVS

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Abstract

Clinical audit was adopted from the medical profession in the late 1990s and is now widely discussed as a quality improvement tool in veterinary medicine. It is suggested by the Royal College of Veterinary Surgeons as a method to improve the care provided to veterinary patients and many opinion pieces offering advice have been published. However, there is no evidence to support its use in farm animal veterinary practice and no understanding of how it is currently used among farm animal practitioners. This PhD thesis aimed to determine if and how clinical audit can be used efficiently and effectively in farm animal veterinary practice in the United Kingdom (UK).

A review of the literature found that the translation of clinical audit from human to veterinary medicine had resulted in confusing and conflicting advice for practitioners working with all species. The definition of clinical audit seemed unclear, advice on how to conduct the process differed between authors and the relationship with evidence and guidelines was ambitious. Very few publications were based on research evidence and most centred on expert opinion. There was also no information on how clinical audit was used or understood by farm animal practitioners. A cross-sectional study to collect experiences and attitudes of farm animal veterinary surgeons in the UK towards clinical audit was conducted using a nationwide survey. Despite the emphasis put on the process, the survey revealed that many veterinary surgeons had never heard of clinical audit, or never been involved in clinical audit in farm animal practice. The participants' knowledge of clinical audit varied widely, supporting the findings of the literature review that clarification of the process was required.

A case-series using qualitative data gathering methods and analysis, including a nominal group technique (Priority Setting Partnership approach) and thematic analysis, was carried out with three farm animal veterinary practices in the UK. Prospective and retrospective clinical audits were implemented in the practices using a clearly defined framework and detailed feedback was

collected on the process through a number of routes. Attempting clinical audit in the three practices highlighted many challenges to conducting clinical audit in farm animal veterinary practice. This included the difficulty of differentiating between research and clinical audit, the logistics of data collection on farm, the limitations to conducting retrospective audits in farm practice, and the time taken for the process. A number of benefits of the process were also appreciated. The practitioners found clinical audit to be an interesting exercise that increased communication within the practice and improved knowledge on how procedures were conducted.

Protocols and guidelines are a suggested component of clinical audit but little information was found about their veterinary application in the literature review. To investigate the use of protocols and guidelines in farm animal practice a survey-based case study using structured interviews and a questionnaire was completed examining the understanding of, and attitudes towards, a surgical protocol used by veterinary surgeons within a practice. The case study found that guidance can have a place in practice, but highlighted that it should always allow for clinical findings in each case to be considered and acted on appropriately. Suggestions were made that checking all staff follow a guideline may not be the most beneficial way to conduct clinical audit.

Following the work of this thesis, the definition of clinical audit and suggestions for its use in the veterinary setting have been simplified and defined. Discussions about the suitability of clinical guidelines and protocols and how each relate to clinical audit have been started and may provide a baseline for future research. Recommendations for farm animal practitioners wishing to conduct clinical audit in practice have been produced with an emphasis on attempting the process for the first time. This thesis has modified the process of clinical audit to ensure that it is accessible and practicable for veterinary surgeons wishing to improve the quality of care delivered in practice.

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Ethical consideration

Ethical applications were submitted for each part of this project. All received ethical approval from the ethics research committee at the School of Veterinary Medicine and Science at the University of Nottingham.

Abbreviations

BCVA: British Cattle Veterinary Association

bTB: Bovine Tuberculosis

BVA: British Veterinary Association

BVD: Bovine Viral Diarrhoea

CASC: Clinical Audit Support Centre

CASP: Critical Appraisal Skills Programme

CEVM: Centre for Evidence-based Veterinary Medicine

CIDR: Controlled Internal Drug Release

CL: Corpus Luteum

COD: Cystic Ovarian Disease

CPD: Continued Professional Development

DBR: Diploma in Bovine Reproduction

EBM: Evidence-based Medicine

EVM: Evidence-based Veterinary Medicine

FC: Follicular Cyst

GMC: General Medical Council

GnRH: Gonadotropin-releasing Hormone

GP: General Practitioner

hCG: Human Chorionic Gonadotropin

HHVRS: Herd Health Visit Record Sheet

HQIP: Healthcare Quality Improvement Partnership

ID: Identification

JLA: James Lind Alliance

LDA: Left Displaced Abomasum

MSc: Master of Science

NICE: National Institute for Health and Care Excellence

NHS: National Health Service

NSB: Not Seen Bulling

PhD: Doctor of Philosophy

PD: Pregnancy Diagnosis

PMS: Practice Management Systems

PNC: Post-natal Check

PRID: Progesterone Releasing Intra-vaginal Device

PSP: Priority Setting Partnership

PSM: Priority Setting Meeting

QI: Quality Improvement

RCGP: Royal College of General Practitioners

RCVS: Royal College of Veterinary Surgeons

RFV: Routine Fertility Visit

SPVS: Society of Practising Veterinary Surgeons

SVMS: School of Veterinary Medicine and Science

SVS: Sheep Veterinary Society

UHB: University Hospitals Bristol

UK: United Kingdom

Terminology

Throughout this thesis the term 'veterinary surgeon(s)' has been shortened to 'vet(s)'. This has been done to reflect the colloquial use of the word in the UK.

Veterinary medicines

A number of veterinary medicines were mentioned by the practitioners over the course of this study. The trade names have been used in the text. Further details are listed below:

Betamox (Amoxicillin) 150mg/ml Suspension for Injection, Norbrook Laboratories

Chorulon® (Chorionic Gonadotrophin) 1500 iu Powder and solvent for solution for injection, MSD Animal Health

CIDR® (Progesterone) 1.38 g Vaginal Delivery System for Cattle, Zoetis UK Limited

Cyclix (Cloprostenol Sodium) 250 microgram/ml solution for Injection, Virbac Limited

Draxxin® (Tulathromycin) 100 mg/ml Solution for Injection, Zoetis UK Limited

Estrumate® (Cloprostenol Sodium) 250 µg/ml Solution for Injection, MSD Animal Health

Metacam® (Meloxicam) 20 mg/ml solution for injection for cattle, pigs and horses, Boehringer Ingelheim

Metricure® (Cephapirin) 500 mg Intrauterine suspension, MSD Animal Health

Micotil™ (Tilmicosin) 300mg/ml Solution for Injection, Elanco Animal Health

Naxcel® (Ceftiofur) 200 mg/ml Suspension for Injection for Cattle, Zoetis UK Limited

PRID® Delta (Progesterone) 1.55g Vaginal Delivery System for Cattle, Ceva Animal Health Ltd

Receptal® (Buserelin) 0.004 mg/ml Solution for Injection, MSD Animal Health

Tylan™ 200 (Tylosin Phosphate) 200mg/ml Solution for Injection, Elanco
Animal Health

Veterelin (Buserelin) 0.004 mg/ml Solution for Injection for Cattle,
Laboratorios Calier, SA

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Chapter 1 Literature Review

Clinical audit has been used as a quality improvement tool in medicine for many years (Jackson et al, 2013). This literature review will draw on the experiences of the medical profession to focus on the evolution of clinical audit in veterinary practice. Current use of clinical audit in farm animal practice and supporting resources available for veterinary surgeons will also be explored.

1.1 Introduction to clinical audit

1.1.1 What is clinical audit?

Clinical audit is widely used by the National Health Service (NHS) in the United Kingdom (UK) as a quality improvement tool to monitor and improve the standard of clinical care provided to patients (Healthcare Quality Improvement Partnership, 2010). The Oxford online dictionary currently defines audit as a '*systematic review or assessment of something*' (Oxford University Press, 2016). In the NHS, clinical audit is defined by the National Institute for Health and Care Excellence (NICE) as "*a quality improvement process that seeks to improve patient care and outcomes through systematic review of care and the implementation of change*" (Healthcare Quality Improvement Partnership, 2009). In the medical profession this is often done by measuring the services provided against evidence-based standards, or guidelines (Univeristy Hospitals Bristol, 2009c; Healthcare Quality improvement Partnership, 2015d; National Institute for Health and Care Excellence, 2016). Clinical audit is often presented as a cyclical process (Figure 1). The main stages include preparation, measuring performance against pre-determined standards, making changes and re-audit.

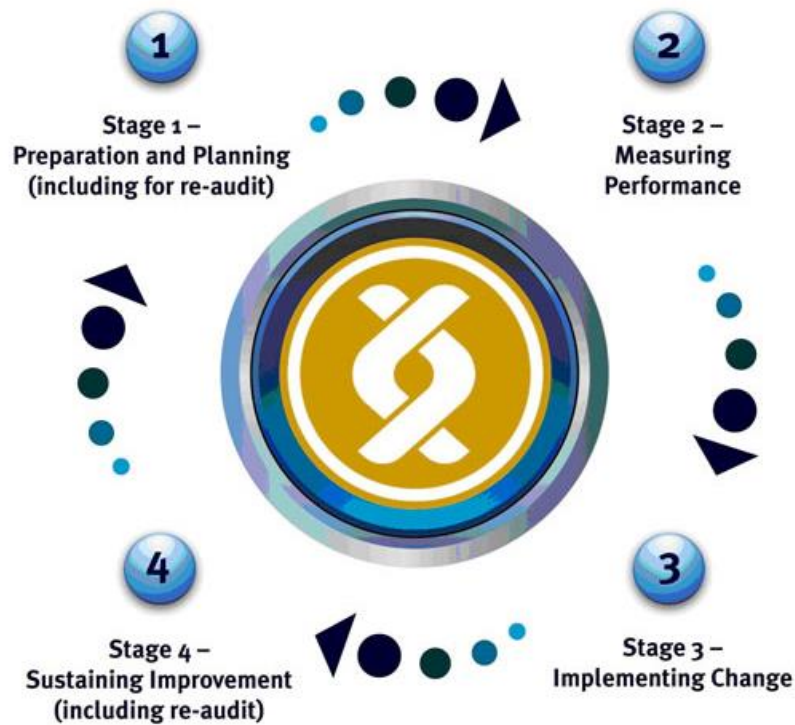


Figure 1 The medical clinical audit cycle (Healthcare Quality Improvement Partnership, 2015d)

The definition of clinical audit in the veterinary setting is less clear. Clinical audit was first mentioned in the veterinary literature by Mosedale (1998) where it was introduced as a tool to “*assess, evaluate and improve patient care in a systematic way*”. Five years later, Viner (2003) proposed the following definition of clinical audit based on a questionnaire and interview study where the majority of respondents suggested that they understood the concept of clinical audit well:

“Clinical Auditing is a quality improvement process in clinical practice that seeks to establish protocols for dealing with particular problems, based on documented evidence when it is available, monitoring the effectiveness of these protocols once they have been put into effect, and modifying them as appropriate. It should be an ongoing upwards spiral of appraisal and improvement”

Wide dissemination and understanding of the use of clinical audit among the profession before 2003 based on two publications (Mosedale, 1998; Rayment, 2002) and an editorial (Rossdale and Mair, 2000) seems unlikely. The Viner (2003) study was also conducted well before the launch of the RCVS Practice

Standards Scheme (PSS), which has since been one of the main drivers for practitioners to conduct clinical audit. Participants in the Viner (2003) survey were provided with a definition of clinical audit prior to being asked if they understood the concept, and this may have influenced how informed they felt about the topic. The suggestion that clinical audit should involve creating evidence-based protocols may have been taken from the medical profession (Rossdale, 2000), but the step adds yet another complicated dimension to the clinical audit process. The reason behind the creation of the Viner (2003) definition which diverges away from the simpler definition of clinical audit suggested by Mosedale (1998) is not clear. It also does not sit closely to the definition used by NICE at the time: *"A quality improvement process that seeks to improve patient care and outcomes through systematic review of care against explicit criteria and the implementation of change. Aspects of the structure, processes and outcomes of care are selected and systematically evaluated against specific criteria. Where indicated, changes are implemented at an individual, team or service level and further monitoring is used to confirm improvement in healthcare delivery"* (National Institute for Clinical Excellence, 2002). The Viner (2003) definition was then updated following research conducted by Viner (2006) to:

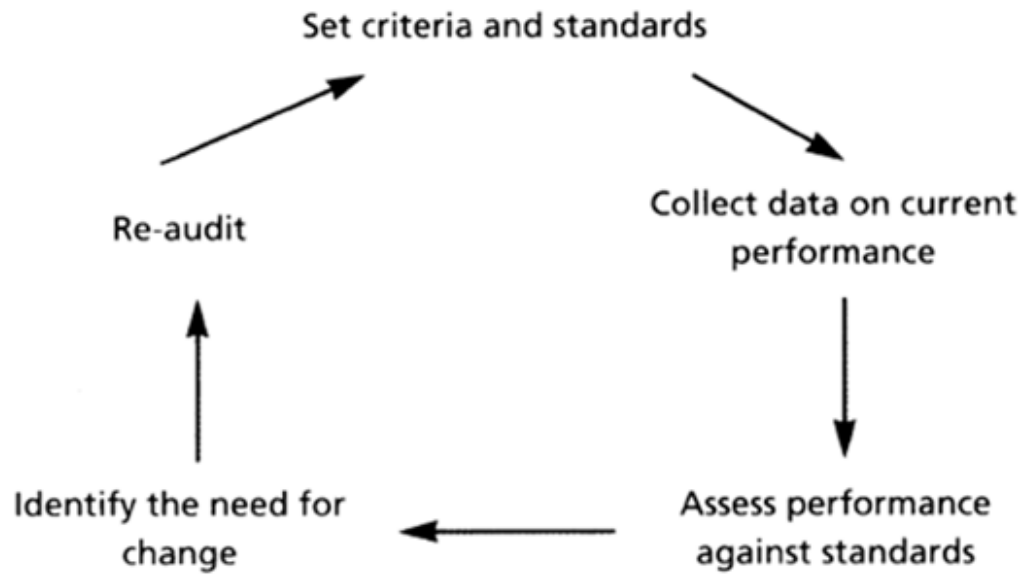
"The Clinical Audit Cycle is a quality improvement process in clinical practice that seeks to establish guidelines for dealing with particular problems, based on documented evidence when it is available, measuring the effectiveness of these guidelines once they have been put into effect, and modifying them as appropriate. It should be an ongoing upwards spiral of appraisal and improvement."

Viner (2003 and 2006) is the only previous primary research conducted on the use of clinical audit in the veterinary setting with the remainder of the literature being based on expert opinion, but the conclusions and definitions drawn have not resulted in a user-friendly quality improvement tool suitable for use in practice. Definitions suggested subsequently by other authors have ranged between the Mosedale (1998) definition of assessing and improving

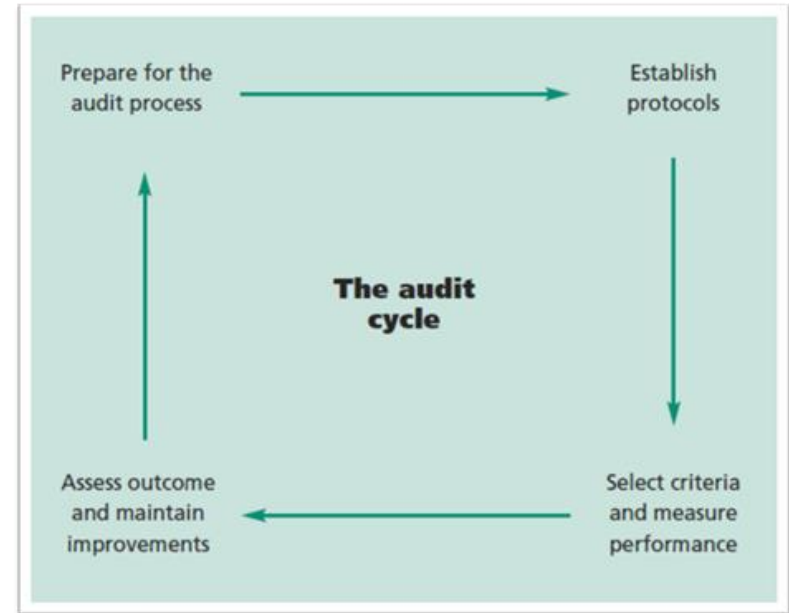
patient care and the Viner (2003 and 2006) definition of creating guidelines and auditing against them, with descriptions of defining and measuring against standards and criteria included by some (Mair, 2006; Gosall, 2008; Dunn 2012; Rose et al, 2016). The articles published on veterinary clinical audit give little acknowledgement to preceding articles, and each published clinical audit cycle appears to have been created with barely any recognition of those created before. This creates a confusing picture for the reader who may be wishing to conduct clinical audit. It also suggests that different individuals talking about or advocating clinical audit in practice may not all be discussing the same thing.

The work by Viner (2003 and 2006), along with the subsequent publications in the veterinary literature, have had significant impact on the awareness of clinical audit within the veterinary profession. Clinical audit is now part of the RCVS Code of Professional Conduct, the RCVS Practice Standards Scheme guidance, the RCVS Certificate in Advanced Veterinary Practice and the undergraduate veterinary curriculum. Despite the importance this places on the process, guidance on how to conduct clinical audit is not clear or user-friendly and much of this stems from a confusing definition.

At its most basic level, clinical audit is the collection of clinical information with the aim of monitoring and improving the quality of clinical care being delivered by the veterinary team (Mosedale, 1998; Viner, 2009; Rose et al., 2016a). Greater benefits are gained if the process is performed as a cycle, where continued monitoring, changes and improvements are made (Mosedale, 1998; Viner, 2005a; Mair, 2009; Viner, 2009; Bullivant and Corbett-Nolan, 2010; Dunn, 2012). Some examples of clinical audit cycles that have been published in the veterinary literature are shown in Figure 2.



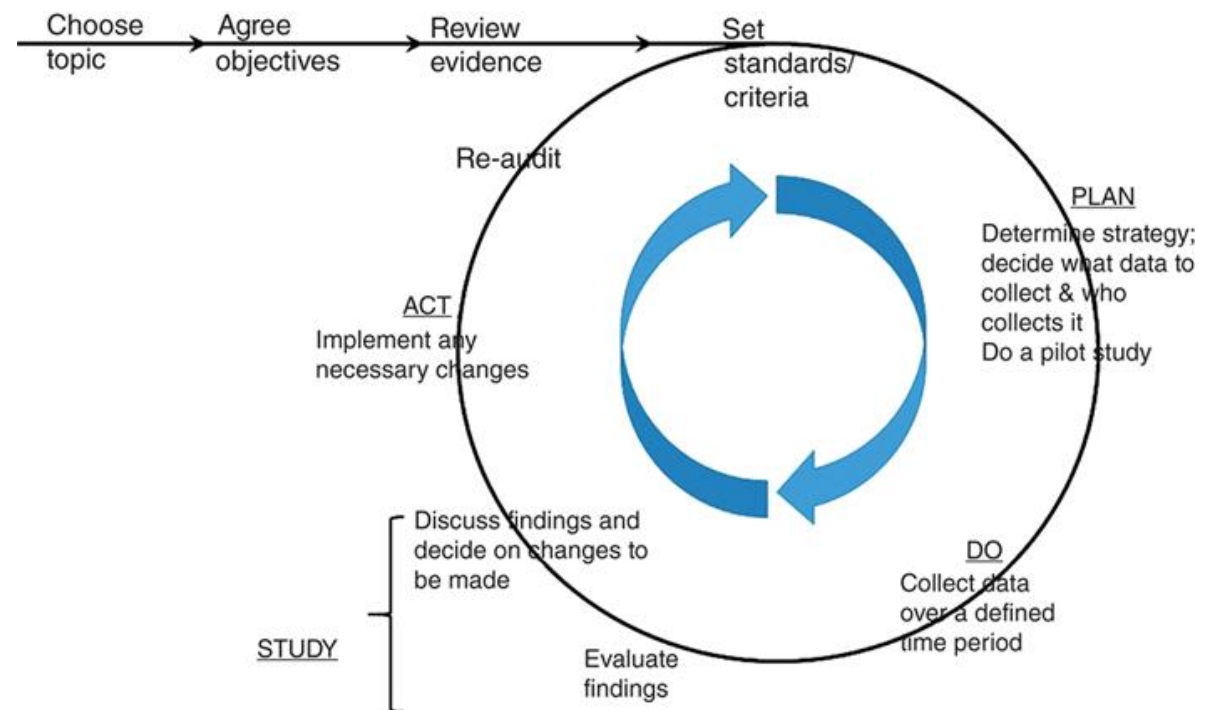
Mosedale (1998)



Viner (2005)



Dunn (2012)



Dugdale (2016)

Figure 2 Examples of clinical audit cycle schematics published in the veterinary literature

Stages of the clinical audit process as demonstrated by schematics of the audit cycle vary greatly in the veterinary literature and are summarised in Table 1. Some of the cycles depict that clinical audit should be based on standards derived from an evidence-base (Dugdale, 2016), some suggest that clinical audit explicitly involves comparing clinical practice to pre-existing 'gold standards' (Dunn, 2012) while others suggest that due to the lack of pre-existing standards in the veterinary profession, the process should be about creating guidelines to then audit against (Viner, 2009). These specific requirements suggested by veterinary authors may be the stumbling blocks of veterinary clinical audit. Often there are no published standards or gold standards, and creating guidelines is another entity in itself that practitioners need to understand, have time to create and the inclination to want to use. Not all cycles suggest assessing against a standard and this may be due to the lack of evidence-based standards available that relate to first opinion veterinary practice (Mair and White, 2008; Mair, 2009; Wylie, 2015). The re-audit stage is also a crucial part of the process where progress made after setting new goals and implementing changes can be assessed (Mosedale, 1998; Rayment, 2002; Dugdale, 2016). Viner (2006) and Dugdale (2016) compare clinical audit to Kolb's experiential learning cycle (Figure 3; Kolb, 1984).

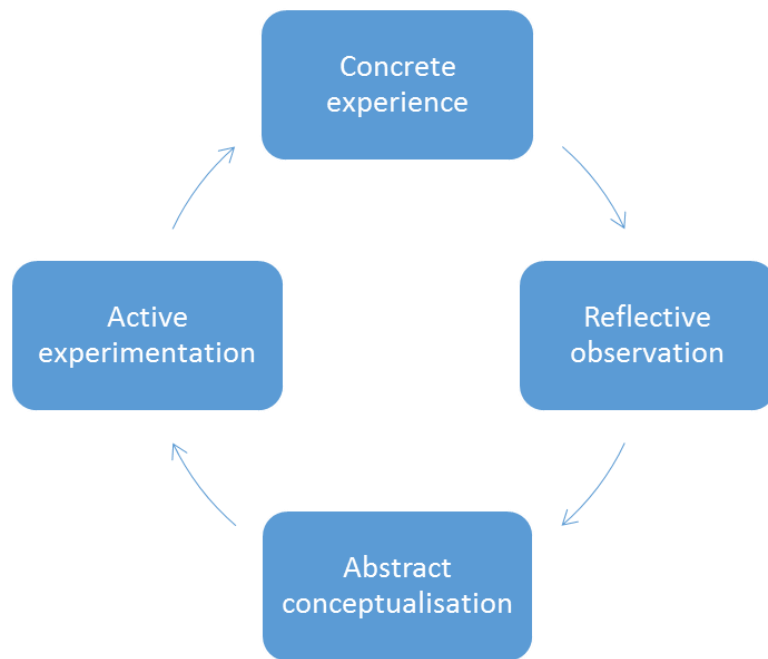


Figure 3 Kolb's experiential learning cycle (Kolb, 1984)

Dugdale (2016) and Rose et al (2016b) suggest clinical audit has a PDSA (Plan, Do, Study, Act) approach. In medicine, clinical audit and PDSA are however considered as two separate types of quality improvement (Healthcare Quality Improvement Partnership, 2015d). In the veterinary profession, the acronym PDSA may be confused with the charity organisation. Conducting clinical audit as a cycle allows continued assessment and improvement, as with Kolb's learning cycle and PDSA where reflection and behaviour change leads to improvement (Kolb, 1984; Rose et al., 2016b). If changes are not implemented as a result of audit then no improvements will be made, and by definition this may then not be considered clinical audit (Auplish, 1997). In some circumstances the first round of data collection may reveal that the service is operating at a level deemed appropriate, or at a level that reaches pre-determined standards. A re-audit may not then be needed at that stage, but the audit should be repeated in the future to ensure the continued quality of the service. A conscious pause in a clinical audit because services are deemed satisfactory is different to a clinical audit that fails to complete. The number of clinical audits successfully completed in the NHS is relatively low compared to the number of clinical audits initiated (Greenwood et al., 1997; Garg et al., 2012; Hillman and Roueche, 2012). Cited reasons for failure to complete an

audit include lack of time and support, and the movement of junior doctors on to other rotations (Garg et al., 2012; Johnston, 2000; Cai et al., 2009; Hillman and Roueche, 2011). These clinical audits may therefore be too complicated, involve the collection of too much data or are planned over too long a time period.

Mair (2009) suggests that a lack of evidence-based standards can limit the ability to conduct clinical audit. The amount of improvement may be difficult to measure if it is not clear what is 'best'. However, there could be a large scope for improvement just by discussing procedures and different approaches by individuals, even when the 'gold standard' is unknown. Where evidence-based standards are not available in medical clinical audit, critically reviewing clinical practice among peers can bring benefits compared with not discussing practice at all (Morrell and Harvey, 1999).

Table 1 Stages of the clinical audit process, as depicted in published schematics of the clinical audit cycle by various authors in the veterinary literature (Waine and Brennan 2015)

Publication	Prepare for audit	Define a standard	Set criteria	Create protocols or guidelines	Pilot the clinical audit	Collect the data	Measure performance	Assess current practice against the standard	Analyse the data/assess outcome	Make changes	Re-audit
Mosedale (1998)		✓	✓			✓		✓		✓	✓
Rayment (2002)	✓				✓	✓			✓	✓	✓
Mair (2006)		✓						✓	✓	✓	
Godsall (2008)	✓		✓			✓				✓	
Mair (2009)	✓	✓							✓	✓	
Viner (2005, 2009, 2010, 2012)	✓		✓	✓			✓		✓		
Dunn (2012)	✓	✓				✓		✓		✓	
Dugdale (2016)	✓	✓	✓		✓	✓			✓	✓	✓

1.1.1.1 Audit, service evaluation and clinical audit

Rose et al. (2016b) suggest an important distinction between 'audit' and 'clinical audit'. An 'audit' can be likened to a simple survey of practice, similar to 'service evaluation' used within the NHS (NHS, 2014b; Rose et al., 2016b). A simple 'audit' assesses the technique, procedure or outcome and the findings are discussed, but no changes are made. If there is no intention to make changes for improvement this can limit the ability to generate continuous advancement. A topic might be chosen for 'clinical audit' but if the results of the first round of data collection prove satisfactory, the process may finish at the 'audit of clinical practice' stage i.e. not progress to changes being made or a re-audit taking place. The alternative, 'clinical audit' should create a continuous improvement cycle; it aims to recognise areas of improvement, incorporate changes to practice and re-assess through a re-audit at a later date to ensure the changes have been effective (Viner, 2009; Dunn 2012). Confusion may arise between the two due to the common approach of shortening 'clinical audit' to audit.

1.1.2 Why should veterinary surgeons use clinical audit in practice?

The Royal College of Veterinary Surgeons (RCVS) suggest through the Code of Professional Conduct that veterinary surgeons conduct clinical audit as a part of their clinical practice (Royal College of Veterinary Surgeons, 2016).

Mandatory clinical audit is required in specific circumstances such as the placement of second microchips or in centres conducting transplant surgery (Royal College of Veterinary Surgeons, 2016). Veterinary practices are required to conduct clinical audit to meet the Core Standards of the RCVS Practice Standards Scheme, with further emphasis placed on the process to achieve award points for the Clinical Governance Module (Royal College of Veterinary Surgeons, 2015). Much of the existing literature therefore emphasises the usefulness of clinical audit in relation to clinical governance (Mosedale, 1998; Rayment, 2002; Viner, 2005b; Godsall, 2008; Viner, 2009;

Dunn and Dunn 2012). However, further benefits of clinical audit to veterinary practice have also been recognised.

Clinical audit is central to patient care (Mair and White, 2005). It can be used to assess the quality of care being provided by a practice and as a tool to improve overall patient safety (Oxtoby, 2014). Individuals may use clinical audit to monitor how well they perform as a clinician, and to improve personal processes and outcomes. Clinical audit may highlight areas that need further training or Continued Professional Development (CPD), as well as itself counting towards the RCVS CPD requirement (Moore and Klingborg, 2003). It can also be used to highlight areas where good practice is being undertaken. Clinical audit allows practices to gather information on clinical activities. It may be used as defence in litigation cases, and as a part of defensive medicine (Mosedale, 1998; Dunn 2012). Clinical performance can be compared with other veterinary surgeons and practices through benchmarking and the results of clinical audit can be used to demonstrate how efficient certain clinical services are (Society of Practising Veterinary Surgeons/Professional Development Foundation, 2005; Mair and White, 2008; Rose et al., 2016b). Viner (2009) also suggests that clinical audit can increase the confidence of the public in the veterinary profession as well as being used as a tool to increase the income of the practice. Clinical audit is an effective way of incorporating evidence-based veterinary medicine in to practice and can be used to demonstrate the benefits of certain procedures or treatments, as well as highlighting areas that require further research (Viner, 2009; Warman, 2014; Skeptvet, 2015). It can also facilitate the improvement of clinical standards in an evidence-based way (Dunn, 2012).

1.1.3 Types of clinical audit

Donabedian (1966) describes three main approaches to assessing medical care by examining structure, outcome and process. These approaches have been supported as appropriate for veterinary clinical audit use by various authors (Viner, 2009; Dugdale, 2016). Structure audits assess the facilities or equipment available, process audits consider how procedures or treatments

are carried out and outcome audits examine the expected outcomes of procedures or treatments (Hexter, 2013). Examples of outcome, process and structure clinical audits used in medicine are shown in Figure 4 (Hardman and Joughin, 1998). This demonstrates how different clinical audit topics can span more than one 'type' of clinical audit.

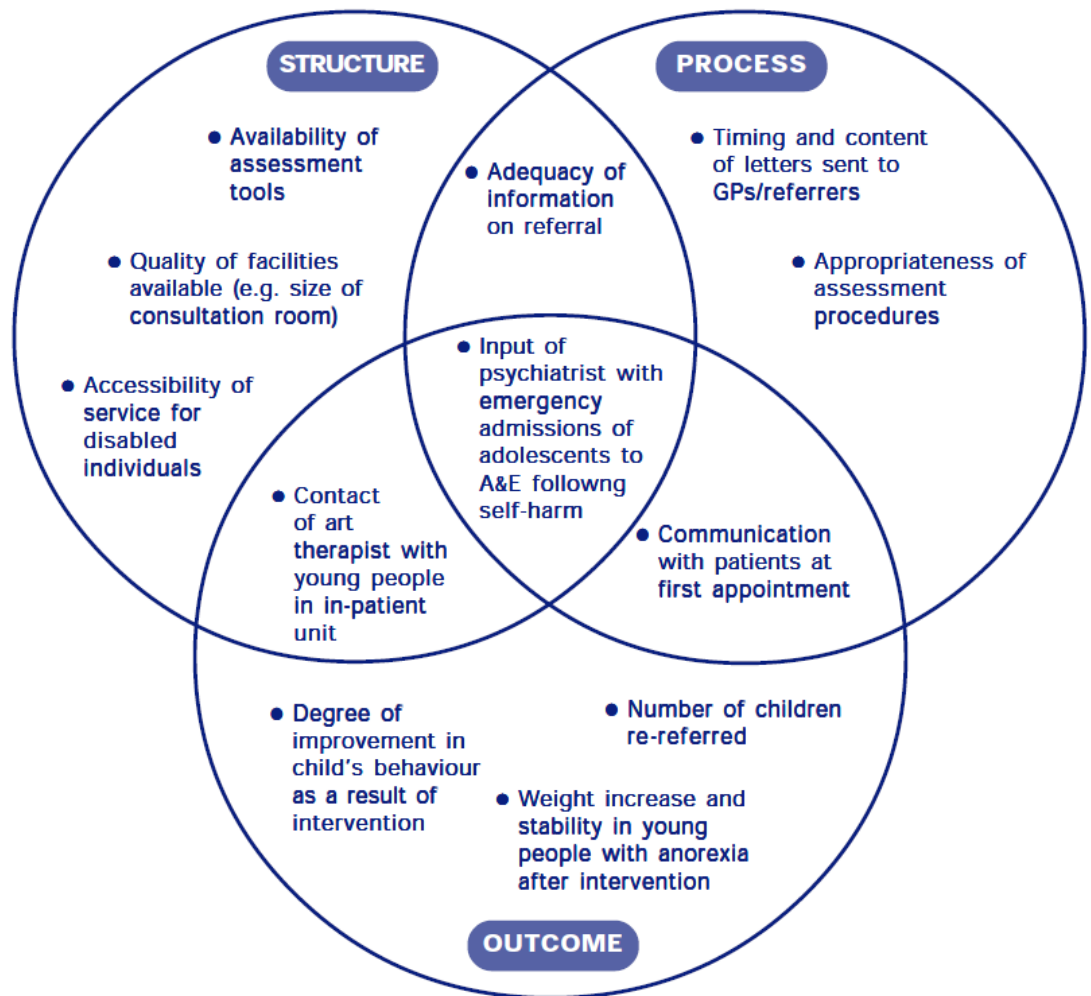


Figure 4 Examples of structure, process and outcome clinical audits in child and adolescent mental health services (Hardman and Joughin, 1998)

Another type of clinical audit is a significant or critical event audit, where good or bad events are discussed within the practice team (Royal College of Veterinary Surgeons Knowledge, 2016a). Significant event audits share similarities with Morbidity and Mortality (M&M) rounds with both involving the discussion of noteworthy cases. M & M rounds take place on a frequent occurrence and aim to improve patient safety by identifying errors and near

misses (Ludders et al., 2017). Significant event audits happen less frequently and focus on single events in more detail; these events may be positive or negative experiences where discussion aims to help to repeat them or prevent them happening again respectively.

1.1.3.1 Retrospective vs prospective clinical audit

Clinical audit can be performed retrospectively by examining data that already exists or prospectively by collecting information at the time the service is delivered (Copeland, 2005; University Hospitals Bristol, 2009d; Optimal Blood Use, 2013). Retrospective clinical audit relies on pre-existing data (University Hospitals Bristol, 2009d). This negates the impact of the Hawthorne Effect where staff may alter their behaviour when they know they are being observed (MacMillan, 1933; Optimal Blood Use, 2013; Haessler, 2014). However, if behaviour change leads to improvements, the Hawthorne Effect may be beneficial (MacMillan, 1933; Dunn, 2012; Haessler, 2014).

Prospective data collection allows for accurate, specific data to be recorded by clinical staff at the point of care (Copeland, 2005). When inadequate details exist for retrospective clinical audit, prospective data collection can be utilised and can yield more reliable and complete information (Optimal Blood Use, 2013). Existing examples of prospective veterinary clinical audit include those suggested by Mosedale (1998), Rose et al (2016a) and Woodmansey (2016). Whether data is collected prospectively or retrospectively, Mosedale (1998) highlights the importance of ensuring data collection is user-friendly to avoid the activity becoming tedious (Dunn, 2012). Retrospective clinical audit requires complete, accurate records of a good quality (Rose et al., 2016b). Viner (2006) implemented guidelines and ran prospective clinical audits, while comparing the findings with retrospective audits based on the 12 months prior. The findings from these clinical audits suggested very detailed clinical records were kept at the practice. The author of the Viner (2006) study was the Practice Principle in the practice in which the clinical audits were run and was aware of what information existed on the practice records. In-house codes had also been developed to be able to search and find cases easily. This

may not be so easily done in other practices. Morgan et al. (2012) describe a retrospective cow caesarean clinical audit where 30% of the existing records were found to lack information required for inclusion. Care must therefore be taken to ensure that retrospective clinical audit does not result in a review of how well clinical details are recorded, rather than how well clinical services are provided (University Hospitals Bristol, 2009d).

1.1.4 The difference between clinical audit and clinical research

Confusion between clinical audit and clinical research is well recognised in both the medical and veterinary professions (Smith, 1992; Lomax, 2003; Manning, 2003; Viner, 2009; Dunn, 2012; Wylie, 2015). Wylie (2015) suggests that the wrong terminology is often used by authors to describe research and clinical audit. For example, Elliston et al. (2012) is labelled as clinical audit but within the text the work is called a cohort study. The use of incorrect terminology can lead to difficulties for others searching the literature for the work (Wylie, 2015). In medicine, clinical research is concerned with finding the best way to do something, while clinical audit is about finding out if the best thing is being done (Smith, 1992). This description also fits veterinary research. Wylie (2015) agrees with this definition of clinical audit despite highlighting the relative paucity of veterinary evidence to create standards or guidelines. Burford (2013) suggests that due to the lack of evidence-based standards veterinary clinical audit considers if what is *being* done, *should* be done. Although evidence does not always exist to know exactly what should be being done, judgement and discussion can be used to decide what might be wrong (Morrell and Harvey, 1999).

Table 2 shows the main differences between clinical audit and clinical research (Wylie, 2015). Clinical research should answer a question and add new knowledge to the existing pool, whereas clinical audit should monitor or create knowledge about clinical practice allowing improvements to be made (Morrell and Harvey, 1999; Wylie, 2015). Morrell and Harvey (1999), Viner (2009) and Wylie (2015) suggest research is carried out over a large area and a long period of time, whereas clinical audit should be centred on local

applications. This is not always true for either research or clinical audit; large area, long duration research projects are not always possible in veterinary medicine, and clinical audits can be nationwide and conducted over a long period of time (VetsNow, 2013; Healthcare Quality Improvement Partnership, 2015f; Woodmansey, 2016). Mosedale (1998), Viner (2009) and Wylie (2015) agree that clinical audit should not require as rigorous statistical analysis as clinical research. This is important when clinical audit is attempted in practice by individuals who may not have had detailed statistics training. Wylie (2015) suggests that clinical research always requires ethical approval whereas, in agreement with Viner (2009), clinical audit usually does not.

Table 2 The difference between research and clinical audit (Wylie, 2015)

Differentiation	Research	Clinical audit
Definition	Attempts to create new knowledge regarding best practice	Creates knowledge of clinical practice and need for improvement
Aim	To generate or test hypotheses, identify or explore these	To answer whether a service reaches a predetermined standard
Scope	Usually large scale, over a long time period, one-off/discrete study	Usually small scale, shorter time period, but an ongoing/cyclical process
Measures	Clearly defined research questions, aims and objectives	Current clinical practice against evidence-based clinical guidelines or standards
Interventions	May involve a completely new treatment, or placebo	Choice remains that of clinician and patient
Routine care	May involve different treatments, samples or investigations	Does not affect normal treatment
Data collection	Usually involves collection of data additional to routine care	Usually involves analysis of existing data from patient notes
Randomisation	May use random sampling methods	Does not use randomisation
Allocation	May involve allocation of patients to intervention groups	No allocation or intervention
Statistical analysis	Often extensive	Often basic, descriptive
Replication	Results can be replicated	
Generalisability	Results need to be generalizable to a target population	Specific and local to one particular group
Next step	No mechanism to act on findings	Responsibility to act on findings via an action plan
Influence	Findings can have a wide influence on clinical practice	Findings usually only influence practice within the area evaluated
Ethical approval	Always requires ethical approval	Does not require ethical approval

Clinical audit and clinical research are however, very closely linked. Clinical research can provide the evidence needed when setting up and running clinical audit, and clinical audits can lead to the development of new research questions (Morrell and Harvey, 1999). Clinical audit can be researched, and research can be audited. Wylie (2015) suggests that research and clinical audit can overlap in practice.

1.2 Clinical Audit and Evidence-based Veterinary Medicine

1.2.1 What is Evidence-based Veterinary Medicine?

Evidence-based veterinary medicine (EVM) is a multifaceted approach to the management of veterinary patients; it considers the best available evidence alongside clinical expertise to make the best clinical decision (Doig, 2003; Holmes and Cockcroft, 2004; Schmidt, 2007; Brennan, 2014; Arlt, 2016; Centre for Evidence-based Veterinary Medicine, 2016). EVM involves searching the literature, critically evaluating the findings and then applying the appropriate evidence to a given clinical situation to improve care (Holmes and Cockcroft, 2004; Centre for Evidence-based Veterinary Medicine, 2016).

1.2.2 EVM and clinical audit

Clinical audit and EVM are strongly intertwined with current definitions suggesting that each one would fail to exist without the other (Auplish, 1997; Viner, 2006; Centre for Evidence-based Veterinary Medicine, 2016). Clinical audit has two main identities; it can be the fifth and final step of EVM and it also exists as a stand-alone quality improvement tool (Viner, 2009; Centre for Evidence-based Veterinary Medicine, 2016; Rose et al., 2016b). As the final step of EVM, clinical audit can be used to assess if any changes have made a difference to the outcome of patients. As a stand-alone concept clinical audit can be used to assess and improve current practice. It is a useful method for incorporating EVM principles into clinical practice by encouraging review of the literature, and review and improvement of clinical skills and knowledge (Rayment, 2002; Viner, 2005a; Mair, 2006; Dunn, 2012; Wylie, 2015).

Some authors suggest that clinical audit relies on the existence of good evidence, but good quality, relevant evidence does not always exist in veterinary medicine (Rayment, 2002; Viner, 2005a; Mair, 2006; Dunn, 2012; Wylie, 2015). The DREAM mnemonic (Distinct, Relevant, Evidence-based, Achievable and Measureable) has been suggested as a framework for designing clinical audit in both human and veterinary medicine (Morrell & Harvey, 1999; Viner, 2005). Medicine has a plethora of available evidence to base clinical audit on compared to veterinary medicine, where there is a lack of evidence relevant to first-opinion clinical practice. The requirement of evidence for clinical audit is desirable, but it cannot be essential for clinical audit in the veterinary setting. The evidence should be searched and consulted, but a lack of evidence should not preclude the conduct of clinical audit. There may also be some clinical audits where evidence is not necessary in any form, for example if auditing client waiting times (Mosedale, 1998).

As the final step of EVM, clinical audit may rely on evidence but this could take the form of expert opinion or published papers. When using audit in this way it assumes that the earlier steps of EVM (asking a question, finding the evidence, appraising the evidence and applying the results) have been conducted which in turn implies that some form of evidence was found. As a stand-alone quality improvement tool however, evidence is not a necessity for clinical audit.

1.3 Clinical audit from a governance perspective

A number of major failings in the services delivered by the NHS in the 1990s led to the call for a system that allowed healthcare organisations to monitor and improve the quality of care delivered to patients (Scully and Donaldson, 1998). This system, named clinical governance, was introduced on the 1st April 1999 as a statutory duty for all National Health Service bodies (Travaglia et al., 2011). It was defined by Scully and Donaldson (1998) as *“a system through which NHS organisations are accountable for continuously improving the quality of their services and safeguarding high standards of care by creating an environment in which excellence in clinical care will flourish”*. Clinical

governance is the main framework used by the NHS to maintain high standards of care by continuously improving the services provided to patients, and addressing areas of concern (Sally and Donaldson, 1998). In the veterinary profession in the UK, clinical governance is a part of the RCVS Code of Professional Conduct for Veterinary Surgeons and the RCVS Practice Standards Scheme (Royal College of Veterinary Surgeons, 2015; Royal College of Veterinary Surgeons, 2016). Although the requirement for audit through the PSS may have increased awareness and engagement with clinical audit, the 'tick-box' nature encouraged by the Scheme requirements may be a barrier to the process for practitioners.

There are seven pillars of clinical governance (Clinical Governance Support Team, 2007; Clinical Audit Group, 2007; University Hospitals Bristol, 2015; Hexter, 2013).

1. Clinical effectiveness

Clinical effectiveness looks at 'what works' in the health care that is delivered (PubMed Health, 2015). It can be measured by clinical audit.

2. Education, training and CPD

This is the encouragement of life-long learning to ensure that professional skills and knowledge remain up-to-date. Since 2003 the RCVS have required veterinary surgeons to undertake 35 hours of relevant CPD per year (Royal College of Veterinary Surgeons, 2016).

3. Use of information

This includes the correct use and storage of personal information of clients and colleagues according to the Data Protection Act 1998, as well as using the best available evidence when making clinical decisions (Viner, 2009).

4. Patient experience and involvement

Clients should be informed of the best available evidence to ensure they can make the best decisions for their animal. Feedback should be regularly sought from clients to ensure that services are continually monitored and improved (Viner, 2009).

5. Staffing and staff management

An open, no-blame culture should be created within the team to allow free expression of ideas, concerns or problems (University Hospitals Bristol, 2015).

6. Clinical audit

Clinical audit can be used as an effective tool to monitor and improve the clinical standards in a practice (Univeristy Hospitals Bristol, 2015). Many authors suggest this is a separate 'pillar' of clinical governance, despite the fact it is also incorporated under the pillar of clinical effectiveness (Clinical audit group, 2007; Viner, 2009).

7. Risk management

Significant event clinical audits, also known as critical event audits or morbidity and mortality audits, can be incorporated under the pillar of 'risk management' (Clinical audit group, 2007; Mosedale, 2014). Actions that can also be found under the same heading include complying with health and safety legislation, such as ensuring the correct disposal of clinical waste or observing the local radiation rules (Healthcare Quality Improvement Partnership, 2015c).

Clinical audit is an effective tool for measuring clinical effectiveness offered by health professionals; this is an essential component of clinical governance (Univeristy Hospitals Bristol, 2015). Viner (2009) defined clinical effectiveness as *"The application of the best available knowledge, derived from research, clinical experience and client-preferences, to achieve optimum processes and outcomes of care for patients"*. Clinical effectiveness assesses the extent to which evidence-based interventions have affected the outcomes of interest (Mair, 2009).

A major step forward in clinical governance achieved by the medical profession was the creation of the National Institute for Health and Care Excellence (NICE) guidelines, best practice guidelines based on systematic reviews and other synthesised research evidence produced by the Cochrane Collaboration (Natonal Insitute for Health and Care Excellence, 2014a). Many

of the clinical audits in the medical profession are carried out to monitor compliance in adherence to NICE guidelines (University Hospitals Bristol, 2009c). The Healthcare Quality Improvement Partnership (HQIP) supports clinical audit at a local level in the NHS in England and Wales, as well as managing the National Clinical Audit programme (Royal College of Nursing, 2015; Healthcare Quality Improvement Partnership, 2015f).

1.3.1 Quality Improvement

Quality improvement is a formal approach to analysing the care delivered by a practice and uses different methods to improve practice and staff performance (American Association of Family Physicians, 2016). Clinical governance is an overarching strategy that can be used for quality improvement (Campbell and Sweeney 2002). Equally, quality improvement tools can be used to meet clinical governance requirements (Healthcare Quality Improvement Partnership, 2015d). The emphasis in medicine is placed on using quality improvement methods for good governance, and clinical audit is just one of many tools that can be used (Healthcare Quality Improvement Partnership, 2015d). Performance benchmarking, process mapping, decision trees, guidelines, protocols and checklists are all ways in which the quality of care delivered can be improved (Healthcare Quality Improvement Partnership, 2015d). All techniques require a no-blame culture where staff are able to freely discuss clinical cases and procedures with colleagues (Healthcare Quality Improvement Partnership, 2015d). Each tool requires the recognition of a problem or the evaluation of practice, and should lead to change and improvement. Established in the medical profession, quality improvement tools in the veterinary sector are still relatively new. Of the tools listed above, clinical audit has had the most time and resources spent on it to date. Despite this, it is not clear yet if it is suitable for veterinary use.

1.4 Clinical audit in the medical profession

The process of improving patient care through observation and standard setting was pioneered by Florence Nightingale in the Crimean War in the 1850s (Morrell and Harvey, 1999). In a clinical setting with limited resources and challenges seen only in a battlefield, Florence Nightingale cut mortality rates of soldiers associated with hospital-acquired infections. This suggests that improving patient care should be possible in any clinical setting. Early reference to medical audit in American and Canadian medicine can be found as far back as 1910 (Jackson et al., 2013). From the very beginning clinical audit appears to have been a contentious tool in the improvement of medical care with advantages and disadvantages of the process recognised early on (Wolf, 1957). Some authors suggested clinical audit involved ‘controlling’ the profession or testing ‘how good’ doctors were (Mortrud, 1953; Smith, 1953), while some began to note its value in evaluating medical care delivered to patients (Lembcke, 1956).

Mandatory medical clinical audit in the UK was introduced in 1989 (Department of Health, 1989; Jackson et al., 2013). An NHS white paper was the first document to discuss the use of clinical audit in Britain, where growing demands on the medical profession required clearer accountability (Department of Health, 1989; Johnston et al., 2000b). A quality crisis emerged in the 1990s (Bevan, 2008). A number of scandals within the medical profession questioned the high esteem in which doctors were usually held as the profession was condemned for being unable to regulate itself (Abbasi, 1998; Bevan, 2008). Three significant cases led to a review by the UK government of its health care services: the Rodney Ledward case, a consultant gynaecologist in south-east Kent who performed unnecessary and inappropriate procedures on at least 418 women; the Bristol Royal Infirmary case, where there was a high death rate among babies undergoing cardiac surgery; and the case of Harold Shipman, a general practitioner doctor convicted for murdering 15 of his patients (Kennedy, 2001; Anon, 1998; Bevan, 2008). After these events clinical audit was further utilised to try to

ensure that the NHS was providing a safe and efficient health care system. Through national or local clinical audit, attempts were made to ensure a continued improvement in the standards of care provided by medical services (Rayment, 2002). The regulatory body of the medical profession, the General Medical Council (GMC), now require through Domain 2 of Good Medical Practice (2013) that all doctors take part in clinical audit (Glew et al., 2014; General Medical Council, 2015). This is supported by the representative body of general practitioners, the Royal College of General Practitioners (RCGP). The RCGP revalidate doctors every five years, and it is expected within this time that individuals will have completed at least one cycle of a quality improvement project, such as clinical audit (Caesar, 2016). Clinical audit can also be used to meet revalidation requirements for nurses (Rashid et al., 2016).

The NHS appears to be a leading authority on clinical audit, but the tool is also used around the world (Siddiqi and Newell, 2009; Yorston and Wormald, 2010). Jackson et al. (2013) extensively describes the use of clinical audit in America where it appears to have originated. Although the literature is UK centred today, clinical audit has been discussed in Ireland, France, New Zealand, India, Africa and South America with the tool modified depending on available resources (Smits et al., 2002; Siddiqi and Newell, 2009; Jackson et al., 2013).

In the UK medical profession, clinical audit was set up and funded by the Government in the 1990s (Viner, 2009). Delivered through the NHS, the resources were readily available for the initiative to be picked up, developed and carried out in practice (National Health Service, 1998). All hospitals had to be a part of it, and there were many resources available to ensure that it could be done efficiently. In some cases there were incentives to record cases for clinical audit such as the increase in GP income based on their performance (Viner and Jenner, 2005). Within the NHS, clinical audit is conducted by a number of people including all types of Health Care Professionals across many NHS settings, as well as individuals working in

dedicated clinical audit and quality improvement departments. Hidden and overt clinical audit costs are incurred; Lock (2000) estimated that clinical audit cost the NHS in Scotland £36.3m per year, with staff time accounting for 80% of the cost.

In the UK, it is often the responsibility of junior doctors to undertake clinical audit (John et al., 2004). Junior doctors are asked to complete a clinical audit in their foundation years (Benjamin, 2008). The doctors may choose a topic based on a problem they have observed on a ward. It may be an area of special interest, it may be a clinical audit that was started by somebody else or a topic due a re-audit (Tasker and Thomson, 2012). Usually clinical audits are based on areas of high cost, caseload or risk. A topic may also be chosen based on a national clinical audit. Clinical audits can take place on a local or national scale (National Health Service, 2014a). Although some studies show that local clinical audits are more effective at improving patient care than national clinical audits, many national clinical audits are conducted within the NHS (Clinical Audit Support Centre, 2015; Healthcare Quality Improvement Partnership, 2015f). The National Clinical Audit Programme is a system managed by the Healthcare Quality Improvement Partnership that allows the standard of healthcare in certain specialities to be compared against accepted standards. Medical, surgical and mental health care clinical audits comprise the more than 30 clinical audits that are part of the programme (Healthcare Quality Improvement Partnership, 2015f). The clinical audits vary in their purpose and implementation. The National Diabetes Audit examines data on over 2 million patients with diabetes in England and Wales (Healthcare Quality Improvement Partnership, 2013b). The clinical audit collates all local data on diabetic patients to allow analysis and benchmarking to take place on a national level (Healthcare Quality Improvement Partnership, 2015f). The National Emergency Laparotomy Audit combines structure, process and outcome data from nearly 200 health care providers in England and Wales treating patients having emergency bowel surgery. This clinical audit was funded by NHS England and the Welsh government (Royal College of

Anaesthetists, 2015). The National Ophthalmology Audit is being used to collate a large amount of information on cataract surgery in order to update the standards of care for England and Wales (Healthcare Quality Improvement Partnership, 2015f). A number of resources exist on a local or national level to support the conduct of clinical audits, including the local hospital clinical audit team and national providers of support and training (University Hospitals Bristol, 2012; Health and Social Care Information Centre, 2015; Clinical Audit Support Centre, 2015). On completion, the clinical audit should be presented to the team involved and a full clinical audit report written up and submitted to the clinical audit department (University Hospitals Bristol, 2009a). As part of their clinical audit requirements, junior doctors are expected to produce a report when their clinical audit has been completed, although many clinical audits are not completed due to time constraints (Dixon, 2011).

The medical profession also regularly publish completed clinical audits and competitions held at medical conferences display the clinical audits that have recently been undertaken (Healthcare Quality Improvement Partnership, 2015e; clinicalaudits.com, 2015). A journal of clinical audits 'The Online Journal of Clinical Audits' exists as an interface for the publication and sharing of clinical audit reports (clinicalaudits.com, 2015). This was founded by NHS doctors who wished to share their experiences of clinical audit. The author guidelines describe a detailed audit structure (aims, audit standards, methods, results, discussion, conclusions, recommendations and references) and a document style guide. The authors and the lead consultant involved in the clinical audit are also recognised (clinicalaudits.com, 2016). HQIP, in partnership with the Clinical Audit Support Centre (CASC), also jointly run a competition to find the best clinical audit completed by a junior doctor (Healthcare Quality Improvement Partnership, 2015e).

1.4.1 Challenges and difficulties of using clinical audit in the medical profession

Despite the extensive resources put into clinical audit in the medical profession, it is far from perfect (Clinical Audit Support Centre, 2015b). Clinical

audit has been a 'pawn' in the health care provision game played between clinicians, management and the state (Jackson et al., 2013). The UK government wanted efficiency improved and expenditure cut within the NHS which at times conflicted with the ability to provide good quality patient care; Jackson et al. (2013) suggest that there has subsequently been an ongoing conflict between managerial and professional strategies since clinical audit was introduced into the UK health system.

In some circumstances although clinical audit may be conducted, it may not necessarily result in improvements in patient care. For example, Rodney Ledward was in charge of clinical audit in the hospital he worked in for seven years which delayed the discovery of his activities (Anon, 1998). Conducting clinical audit to meet clinical governance requirements may result in a box ticking exercise with little improvements in patient care. The ability of a clinical audit to improve patient care will depend on how and why the audit is conducted, who conducted the audit and whether findings were acted on and communicated to team members.

The Clinical Audit Support Centre (CASC) conduct an annual survey of medical personnel involved in clinical audit to gather views on the state of clinical audit. In 2015, 72% (106/147) of respondents thought that a maximum of 20% of clinical audits conducted resulted in cost saving, 70% (115/163) felt that the level of patient involvement in clinical audit was poor, and 22% (37/163) and 23% (37/159) respectively thought that local and national clinical audit had been reinvigorated over the last decade (Clinical Audit Support Centre, 2015b). A quarter of clinical audit professionals felt more negative about the process than they had in 2014. In surveys of the medical profession, junior doctors have stated that clinical audit cannot always be conducted in working hours and many clinical audits are not completed (John et al., 2004; Cai et al., 2009). Barriers to clinical audit have been highlighted as lack of resources, education and expertise (Glew et al., 2014). At the Clinical Audit Conference 2016, personnel involved in clinical audit were asked for their thoughts on the state of clinical audit. Comments collected by the CASC highlighted some of

the issues surrounding clinical audit in the NHS. These suggested that more help and support was needed, protected time to conduct clinical audits would be helpful and there were too many national clinical audits.

1.4.2 Lessons that can be learnt from the medical profession

The veterinary profession can learn from the barriers and difficulties highlighted by clinical audit in the medical profession. Where medical healthcare workers find that clinical audit takes too much time, lacks patient involvement and bring little cost saving to healthcare (Clinical Audit Support Centre, 2015b), veterinary audit needs to develop methods of clinical audit that don't take too much time, have adequate benefits and involve clients.

The NHS has teams of clinical audit staff and yet the completion rate of a clinical audit is very low (Cai et al., 2009). Despite the clinical audit teams that exist, emphasis is put on junior doctors to conduct clinical audits and often the junior doctors are unable to finish what they start (Glew et al., 2014). Widening the stakeholders may improve the completion rate of clinical audits. In the veterinary profession the skills and time of support staff including veterinary nurses, administrators and practice managers may help to spread the work load. Keeping clinical audit short and unambitious may also aid completion rates and increase the benefits from the process. Time should also be protected for staff so that they are able to conduct audit within working hours (Cai et al., 2009). The benefits of clinical audit must balance out the costs invested to make the whole process worthwhile. This may mean simplifying the process used in medicine to ensure it 'costs' less to the veterinary profession.

1.5 Clinical audit in the veterinary profession

Viner and Jenner (2005) suggest that whilst it is possible to learn from the medical application of clinical audit, it should be appreciated that the veterinary practice setting differs and the principles may not be directly applicable. Although emphasis is put on clinical audit by the governing professional body, there is no external funding for veterinary practices to

conduct clinical audit and little guidance on how it can be efficiently done in practice. First opinion veterinary practice is profoundly different to general practice in medicine (Viner and Jenner, 2005); referral practices differ from first opinion practices, and it can be appreciated that farm animal veterinary practice is different again from small animal and equine veterinary practice.

1.5.1 Using standards in veterinary clinical audit

Many publications, both medical and veterinary, mention 'standards' when describing how to conduct clinical audit. The Oxford online dictionary definition of 'standard' is:

A level of quality or attainment (Oxford University Press, 2015) E.g. *'The practice provides a high standard of veterinary services to its farmers'* OR

A required or agreed level of quality or attainment (Oxford University Press (2015) E.g. *'The practice met the strict standards outlined in the Practice Standards Scheme to achieve General Practice status.'*

The former definition is more subjective. Forming an opinion on the standards of one thing compared to another may vary depending on an individual's previous experience. A service considered to be of high standard to one person may be considered of poor standard to another individual. The latter definition provides a more objective level of quality where a service or thing meets a pre-defined level.

When considering 'standards' as a level of quality, it should be possible to assume (due to the RCVS oath) that all veterinary surgeons aim to offer high standards of care to their patients. In reality, standards of care provided by a practice might range from sub-optimal to excellent; here clinical audit can be used to assess the clinical 'standards' and ultimately improve them.

Some authors of papers on clinical audit advocate defining a 'standard' as more like the second definition above - a required level of quality. This particular use of the word 'standard' relates to a more complicated concept. The NHS often uses the NICE guidelines to audit against, and these guidelines

act as 'standards' in this context (University Hospitals Bristol, 2009c). Where this is not possible, the hierarchy of evidence is scaled down and standards are agreed based on the best available evidence; this may be personal opinion and experience if no evidence exists (University Hospitals Bristol, 2009c; Tasker and Thomson, 2012). The equivalent evidence-based guidelines are very scarce in veterinary medicine due to a relative lack of available evidence to create them and resources to collate them. There are also few results on studies collected from first opinion practice that can act as 'standards', which makes this type of scenario difficult to execute. Dunn (2012) stated that the main downfall of the veterinary profession was the lack of monitored standards and that veterinary surgeons should be relying on local clinical audits to bring benefits to clinical practice. Some authors suggest setting standards at a local practice level to audit against (Rayment, 2002; Burford et al., 2014) and this may be appropriate in some instances, but the standards chosen may be somewhat arbitrary if little is known about the baseline level. Another way of identifying a standard for a practice is to run an initial round of audit (known as a service evaluation in the NHS (National Health Service, 2014b)) and use this as a future standard to audit against (Burford et al., 2014).

The NICE guidelines used by the NHS in many cases are recommendations based on the best available evidence such as systematic reviews and randomised controlled trials (National Institute for Health and Care Excellence, 2014b). They advise on how people with specific conditions should be cared for by healthcare providers. Viner (2009) suggests that the veterinary clinical audit process should involve the establishment of guidelines to audit against. The development of evidence-based veterinary clinical guidelines is a challenging and detailed process, often involving the creation of the evidence initially and may be difficult for busy veterinary surgeons in practice to do. The NICE guidelines can take 18-24 months to develop, involves multiple stakeholders and personnel and carries the associated costs (National Institute for Health and Care Excellence, 2009). Despite this extensive process, the

guideline may still not be applicable to each individual patient or case (Greenhalgh, 2010).

1.5.2 National veterinary clinical audits

National clinical audits are less common in the veterinary profession. The providers of veterinary care in the UK are a mix of individual independent and individual corporate businesses, so collating data between businesses may be more difficult. However, national corporate practices are becoming more common with the advent of companies such as VetsNow, Vets4Pets and Companion Care, which may make nationwide clinical audits more possible. The XL Vets group have conducted a clinical audit on cattle caesarean sections where data has been collected from 49 member practices in the UK, although the full results of this are still to be released (Woodmansey, 2016). Local clinical audits may be easier to conduct for some, but they are also an option for all practices whether part of a national group or not. Both local and national medical clinical audits have been shown to have advantages and disadvantages and these should be taken into consideration before commencing a clinical audit of either type in veterinary practice (Absi, 2013; Tantrige, 2014).

1.5.3 The cost of veterinary clinical audit

The cost of clinical audit to veterinary practice has not been widely discussed in the veterinary literature, although Viner (2006) found that clinical audit could lead to increased income for the practice when audit highlighted areas where improving patient care meant an increase in workload for the practice. There are no financial incentives or funding for veterinary practices to conduct clinical audit and this may be a potential barrier to the process. Practitioners may expect clinical audit to be costly due to the perception that it is a complicated process. In a similar way it has been suggested that human hospitals in low-income countries, who have no funding for quality improvement, have been reluctant to use valuable resources for clinical audit (Siddiqi and Newell, 2009). However, in medicine it has been shown that the best value for money has the potential to be achieved through the use of

quality improvement tools (Smits et al., 2002). Financial restrictions may not need to be an issue in veterinary practice; Siddiqi and Newell (2009) suggests that innovation and improvement can often arise from resource constraints. Quality improvement can also be basic and can work in unfamiliar places if the correct training and support is given (Siddiqi and Newell, 2009).

1.5.4 Guidance for conducting clinical audit in veterinary practice

The RCVS Code of Professional Conduct for Veterinary Surgeons directs veterinary surgeons to www.vetaudit.co.uk for more information on how to carry out clinical audit in practice (Royal College of Veterinary Surgeons, 2016). This website, created by the Society of Practising Veterinary Surgeons (SPVS) Masters group in 2005, aimed to support the veterinary practitioner wishing to undertake clinical audit (Society for Practising Veterinary Surgeons/Professional Development Foundation, 2005). The website, last updated in 2006, is out of date. The black and white text and lack of pictures does not appear inviting or user friendly, the site is difficult to navigate and aimed primarily at small animal clinicians. There is an extensive benchmarking project on post-neutering complication of dogs and cats presented that appears to be successful. However, the site does not provide any information for the practitioner wishing to conduct a simple clinical audit in practice. Although the group aimed to create guidelines for carrying out clinical audit, these do not appear to have been made available on the website. Intentions for the website may have been good, but the link from the Code of Conduct may now be detrimental to getting practitioners enthused about undertaking clinical audit.

RCVS Knowledge, the charitable arm of the RCVS, launched a clinical audit toolkit in 2015 (Royal College of Veterinary Surgeons Knowledge, 2016a). Here clinical audit is defined as *“A way for practices to find out where their services are doing well and where improvements can be made. It is a process of assessing, evaluating and improving procedures for each stage of care, diagnosis and intervention”*. The toolkit guides practitioners on how to set up a clinical audit for the first time. It highlights the need for systems to be in

place within the practice before a clinical audit can be successful, as well as the benefits that clinical audit can bring by demonstrating to the public that care being provided is safe and effective. Although suggesting otherwise in the introductory material, the toolkit states establishing protocols as one of the main steps of clinical audit. It also advises that results should be compared to standards from the literature, or benchmarked against other practices; information that is not currently widely available. The clinical audit toolkit also includes details on clinical governance, potentially causing confusion between the two. This confusing guide for the veterinary profession on what clinical audit is, how it fits with clinical governance, and how to carry it out in practice may stem from the general confusion that surrounds the concept of clinical audit within the veterinary profession.

There are many documents found on the internet via the search engine Google, advising how to complete effective clinical audits in the medical field which can be applicable to veterinary practice if they do not rely on the existence of guidelines (Healthcare Quality Improvement Partnership, 2013a; National Health Service, 2014a; Healthcare Quality Improvement Partnership, 2015a). There are many opinion based guidance articles available on clinical audit to the veterinary profession, but many are not peer-reviewed and a cost is often required to access them (Mosedale, 1998; Rayment, 2002; Viner, 2009; Viner, 2010; Dunn and Dunn, 2012; Dunn, 2012). The first veterinary clinical article published (Mosedale, 1998) provides a simple, user-friendly guide to conducting clinical audit that is still applicable today. However, the suggested reliance of clinical audit on evidence, protocols and guidelines in more recent articles has caused some confusion when attempting to conduct clinical audit in practice (Viner, 2009; Dunn, 2012; Wylie, 2015).

1.5.5 The current use of clinical audit in the veterinary profession and attitudes towards it

Despite the emphasis placed on clinical audit in veterinary practice, little information exists as to the extent to which it is used and understood. Viner (2003) collected some opinions towards clinical audit in veterinary practice.

This study used eight interviews and a questionnaire distributed through the Veterinary Times but it did not review if and how clinical audit was being used in practice. Viner (2003) found that 58% of the 904 veterinary surgeons who participated in the questionnaire, and all eight veterinary surgeons interviewed, considered clinical audit to be a practical tool for use in veterinary practice. The questionnaire had a fair response rate with a spread between small, farm and equine practitioners that reflected the profession but the responses from farm animal veterinary surgeons were not specifically discussed. Fifty-eight percent of respondents felt they understood the concept of clinical audit well, but a definition of clinical audit was provided at the beginning of the questionnaire. Eighteen percent of respondents stated that they reviewed their current clinical performance against internal or external standards while 80% agreed it was highly desirable to encourage clinical audit in practice (Viner, 2003).

All eight interviewees felt that they understood clinical audit well; four measured their own performance against internal or external standards and all participants agreed that clinical audit should be encouraged in practice (Viner, 2003). The results from these interviews are unlikely to be usefully representative of the veterinary profession in 2016 as it had a small sample size with a geographical, gender, age and positional bias (seven out of the eight vets were based in the South-East of England; five of the interviewees were male, six of the veterinary surgeons were over the age of 41 and five out of eight of the vets were sole owners or partners in the business). The author considered that the characteristics of these individuals represented the demographics of veterinary surgeons that 'over saw' clinical audit at the time, but it is unlikely that these eight individuals represent the general population of UK farm animal veterinary surgeons in 2016. It is also unknown which individuals in farm animal practice tend to 'over see' clinical audit.

Viner (2006) asked vets, nurses and practice managers a small number of opinion questions in pre- and post-audit interviews, including if they thought clinical audit would involve a large amount of work. The participants felt more

strongly that clinical audit would take extra work after the clinical audits had been conducted in practice but they also felt their understanding of clinical audit had improved after conducting the process. A questionnaire sent to veterinary surgeons who had attended a SPVS Clinical Audit Roadshow found that 8% (9/118) of the participants were conducting clinical audits in practice while 38% (45/118) had started to introduce the concept to their practices (Viner, 2006). Confusion between clinical audit and research, trying to achieve too much, picking a topic with a low caseload, not allowing enough time and poor communication were all highlighted as common pitfalls with the audit process (Viner, 2006). Clinical audit is mentioned on some veterinary practice's websites and found in newsletters, suggesting that there may be a fair spread of use of the tool in the profession (Newark Vets, 2016, Jackson Vets, 2016). However, there have been no further studies seeking the opinions or experiences of veterinary surgeons in relation to clinical audit since Viner (2006), so it is unknown if and how it is currently used by practitioners.

Mair and White (2008) suggested there was little evidence that clinical audit was used in veterinary medicine outside of the UK, although Moore and Klingborg (2003) had published an article discussing clinical audit from California in 2003. In 2016 two articles on clinical audit were published in Canada (Rose et al., 2016a; Rose et al., 2016b). There were blogs on the topic from America (SkeptVet, 2016), articles discussing how it can be further incorporated into veterinary medicine in Australia and New Zealand and a website offered participation in worldwide surgical clinical audits (Veterinary Laparoscopy, 2016). This literature from countries outside the UK all describe clinical audit in a similar light and discuss how it can, and needs to be, further incorporated into the profession.

1.5.6 The publication of clinical audits

There are very few (16 companion animal and two farm animal) published veterinary clinical audits in the veterinary literature (Morgan et al., 2012; Tisdall and Barrett, 2013; Rose et al., 2016b). Some published clinical audits

have been mislabelled and would be considered research (Elliston et al., 2012; Proot and Corr, 2013; Wylie, 2015). Some published clinical audits don't mention 'clinical audit' in their title so are difficult to find (Morgan et al., 2012). Mislabelling makes it very difficult for practitioners to see what kinds of clinical audits have been completed by others, and the results that they have found (Wylie, 2015). Viner (2006) carried out clinical audits as part of his doctoral thesis, but published the findings only in review articles. With a lack of published standards in the veterinary profession, published clinical audit results, even on a local level, would greatly increase the available 'standards' to veterinary practices.

The use of statistical tests in clinical audit is not a requirement, although where significant or large scale changes are to be made statistics can provide reassurance that the right decisions are being made. Dugdale (2016) and Rose et al. (2016a) recommend that only descriptive statistics are required, but many existing published clinical audits include the use of extensive statistical tests. This may suggest to others that statistical tests are a requirement of clinical audit. Rose et al. (2016a) used software that included R and Prism to analyse the data; although the version of R used was free (which overcomes the barrier of cost) the version of Prism was commercial. Use of this software requires a certain amount of knowledge and skill that cannot be assumed to be held by all individuals wishing to conduct clinical audit. Reporting guidelines, journals or journal editors may request the inclusion of rigorous statistical testing on published data, which may be why authors feel the need to perform such tests. Dugdale (2016) recommends that the SQUIRE 2.0 Guidelines (<http://www.squire-statement.org/index.cfm?fuseaction=Page.ViewPage&PageID=471>) are followed when publishing clinical audits; these also suggest using qualitative and quantitative statistical analysis. Requesting statistical analysis for clinical audits to be published may further the confusion between research and clinical audit. Rose et al. (2016a) describe a simple clinical audit measuring post-operative hypothermia in dogs, but the clinical audit description is

complicated by the traditional research paper lay-out. The initial data collection and re-audit are described as two separate clinical audits, with results comparing each individual finding in each audit. Extensive statistical tests are also used to describe the results and the discussion describes their findings as 'supporting' existing research rather than comparing to it.

University Hospitals Bristol (2009b) questions the publication of clinical audits where the aim is to share the results rather than the methodology, and suggest that this may make the work research rather than clinical audit.

1.6 Clinical audit in farm animal practice

When the literature was searched for 'farm animal clinical audit' only two examples were found yet farm animal veterinary surgeons and practices are under the same RCVS requirements as small animal and equine practice, where far more literature on clinical audit exists. Both examples were short conference presentation abstracts published in Cattle Practice, one in 2012 and the other in 2013 (Morgan et al., 2012; Tisdall and Barrett, 2013). Morgan et al. (2012) described a clinical audit looking at caesarean sections in cattle, while Tisdall and Barrett (2013) explained the development of a medicines audit tool. Little can be taken from these abstracts on how best to run clinical audit in farm practice as they are short, and little is discussed on the logistics of how each clinical audit was conducted. Although the regulations stipulate that farm animal veterinary surgeons should be carrying out clinical audit, there is little guidance and support available, and information on how they might do this effectively in practice has to be translated from small animal or equine advice. There is no information on how clinical audit is currently being used in farm animal practice on a national scale.

1.7 The process of clinical audit

1.7.1 Choosing a topic to audit

Any subject can be audited and one of the first steps of clinical audit preparation is to choose the topic (Mosedale, 1998). Focus should be put on just one or two areas of clinical work to avoid creating too big a task for the

clinical audit team (Viner, 2005a). Valuable resources such as time and effort are required to run a successful clinical audit so it is beneficial if all staff members engage with the process and have an interest in the topic (Mosedale, 1998). Greatest compliance with clinical audit is achieved if all members of staff are involved in the process (Mosedale, 1998). In medicine, clinical audit topics are chosen based on high risk, high cost or high caseload scenarios, or alternatively on national guidelines or national clinical audits (Benjamin, 2008). Individual clinicians in the NHS therefore may not be able to choose their own topic to audit where it is being conducted based on national suggestions (Lyon et al., 2013). When a topic does need to be chosen, the process has been recognised as being overwhelming due to the huge variety of clinical activities medical professionals undertake in one day (Lyon et al., 2013). Figure 5 shows local guidance that exists in the NHS to provide assistance with this first stage of clinical audit (Lyon et al., 2013).

	Yes	Maybe	Don't know	No
Is the topic High Risk?	☐	☐	☐	☐
Is the topic High Volume?	☐	☐	☐	☐
Is the topic High Cost?	☐	☐	☐	☐
Is there wide variation in practice?	☐	☐	☐	☐
Is there local concern about practice?	☐	☐	☐	☐
Are Standards / Guidelines available?	☐	☐	☐	☐
Is the topic important locally?	☐	☐	☐	☐
Is the topic important nationally?	☐	☐	☐	☐
Can practice be changed?	☐	☐	☐	☐

Figure 5 A tool used for practitioners for prioritising clinical audit topics in the NHS (Lyon et al., 2013)

Viner (2009) suggests following Morrell and Harvey's (1999) DREAM mnemonic and a small checklist exists as part of the 'Is my audit a good audit' document that can be found at www.vetaudit.co.uk. However, these recommendations have been based on medical clinical audit and may not necessarily be relevant to veterinary clinical audit. For example, the 'E' in DREAM stands for Evidence-based, and although every attempt should be made to ensure any existing evidence is considered in veterinary clinical audit, in many cases there may be little evidence available (McIlwraith, 2000; Viner, 2006; Mair, 2006; Mair and White, 2008; Mair, 2009).

The topic chosen to audit should be one where improvements can be made; a topic with the most potential for improvement is likely to involve higher risk, a higher caseload, a higher cost to the practice or client, or the existence of a wide variation in current practice (Lyon et al., 2013). Through a questionnaire Viner (2006) found that veterinary surgeons held more positive views about the clinical audit process if they were actively involved in selecting the clinical audit topic.

1.7.1.1 Consensus methods for choosing a topic

A variety of consensus methods can be used to aid decision making in clinical practice (Jones and Hunter, 1995). The use of these methods allows many of the common disadvantages of group decision making, such as one individual dominating the discussion, to be overcome (Jones and Hunter, 1995).

Consensus methods aim to reach an agreement for the topic discussed, as well as agreement within a group.

In 2004 the James Lind Alliance (JLA) was formed in partnership with the National Health Service (James Lind Alliance, 2016). The JLA use a nominal group technique with clinicians, patients and carers to discover which clinical topics these groups think should be prioritised for further research.

Previously, topics receiving research grants were not necessarily those that were deemed important areas for investigation by clinicians and their patients (James Lind Alliance, 2016). Through Priority Setting Partnership (PSP) meetings facilitated by the JLA, research bodies now have the opportunity to see what is important to these affected groups of people, therefore allowing the funding of relevant future research (James Lind Alliance, 2013). The JLA have not yet selected topics for clinical audit, but the nominal group technique may be suitable for prioritising clinical audit subjects too. The Priority Setting Partnerships consist of clinicians, carers and patients and are facilitated by the JLA representatives to finalise a top 10 list of prioritised research questions (Cowan and Oliver, 2013). All participants must have an equal say and have time to explain why a treatment uncertainty is important to them. During the PSP meetings, members of the JLA act as facilitators to

guide the meeting and support the representatives. These JLA members ensure that the whole process is fair and transparent; doing so in a neutral and impartial manner (Cowan and Oliver, 2013). The JLA methodology has previously been adapted for use in the prioritisation of veterinary research topics (Anon, 2015). There is no literature discussing its use as an aid for choosing topics to audit in veterinary practice before.

1.7.2 Practicalities of conducting clinical audit

In order for clinical audit to run effectively it is important to understand some of the facilitators and barriers to the process. Johnston et al. (2000) reviewed the literature to assess the facilitators and barriers to conducting medical clinical audit. Perceived barriers to effective clinical audit included lack of time to complete the process, lack of resources, communication problems within the team, clinical aspects too difficult to audit, problems with setting standards, lack of motivation, lack of support staff and a gap between theory and practice (Johnston et al., 2000). Perceived facilitators included the introduction of a clinical audit team, an individual clinical audit enthusiast within the team, good information systems, good team work, available time and money, support, regular meetings and working in a teaching hospital or large practice (Johnston et al., 2000).

1.8 Protocols and guidelines

1.8.1 Protocols and guidelines as a part of clinical audit

The most recent clinical audit guidance available in 2016 suggests that *“clinical audit works best in protocol-based clinical practice”* (Evidence Based Veterinary Medicine Network, 2016). The use of protocols in clinical audit appears to originate from Rossdale (2000) through personal communication with a medical doctor. A part of the questionnaire from Viner (2003) focussed on clinical audit where participants were provided with the following definition:

*“Clinical auditing is a form of quality control in clinical practice that seeks to establish **protocols** for dealing with particular problems, based on*

*documented evidence when it is available, and then monitoring the effectiveness of these **protocols** once they have been put into effect”*

On analysing the results of this questionnaire Viner (2003) reported that approximately 50% of the 904 participants did not have any protocols in their practices which was suggested as the first step of clinical audit. This is perhaps not surprising considering there were no previous veterinary clinical audit definitions that suggested creating protocols was part of the clinical audit cycle (Mosedale, 1998; McIlwraith, 2000; Rayment, 2002; Moore and Klingborg, 2003). All eight of the veterinary surgeons that were interviewed as a part of the project indicated that they used protocols for clinical procedures. As a result of this study Viner (2003) claimed that most practices did have evidence-based protocols. Viner (2003) considered the NICE definition of clinical audit and created a new definition for veterinary clinical audit:

*“Clinical Auditing is a quality improvement process in clinical practice that seeks to **establish protocols** for dealing with particular problems, based on documented evidence when it is available, monitoring the effectiveness of these **protocols** once they have been put into effect, and modifying them as appropriate. It should be an ongoing upwards spiral of appraisal and improvement.”*

Evidence-based veterinary medicine was in its infancy in 2003. There were very few resources available to practitioners on how to search and use any evidence appropriately and the concept had not yet been introduced into the veterinary undergraduate curriculum (Schmidt, 2007). The common use of evidence-based protocols in clinical practice at that time therefore seems unlikely. In 2016 a lack of evidence to create protocols or guidelines is still a common problem recognised when attempting clinical audit in practice (Rose et al., 2016b). The number of interviews conducted by Viner (2003) was small with participants personally chosen by the author. In the same study, the questionnaire participants were provided with a definition of clinical audit that had not been seen elsewhere in the literature. Viner (2006) modified the clinical audit definition to make it more user-friendly after suggestions that

the word 'protocol' was considered to be too prescriptive and inflexible. The word 'protocol' was therefore replaced by the word 'guideline':

*"Clinical Auditing is a quality improvement process in clinical practice that seeks to establish **guidelines** for dealing with particular problems, based on documented evidence when it is available, measuring the effectiveness of these **guidelines** once they have been put into effect, and modifying them as appropriate. It should be an ongoing upwards spiral of appraisal and improvement"*

The Viner (2003) and subsequently Viner (2006) definition of clinical audit, the replacement of 'protocols' with 'guidelines' and the assumption that evidence-based protocols have been widely used in veterinary practice for over a decade, does not appear to have a strong evidence base. This is important as much of the work that has followed has based clinical audit on the requirement for guidelines or protocols (either published guidelines or those created locally by practitioners) as a standard to audit against, which may be unrealistic in veterinary practice (Dunn, 2012; Royal College of Veterinary Surgeons Knowledge, 2016a). The development of evidence-based veterinary clinical guidelines of publication standard is a challenging and detailed process, often involving the creation of the evidence initially. Some published veterinary guidelines that have been developed in a systematic way do exist, but not as many as are found in medicine (Wapenaar, 2011; Fletcher et al., 2012; International Society of Feline Medicine, 2015; American Animal Hospital Association, 2016). Creating 'local' guidelines relies on practitioners to search the literature and find the evidence (if it exists) or agree on a consensus. The former may be difficult for busy veterinary surgeons in practice to do and the latter may encourage the introduction of error into practice depending on expertise available. The main recognised limitation of the guidelines used in medicine is that they may be wrong; they may be out of date, may not consider multi-morbidities, are not as sophisticated as an experienced practitioner making similar decisions and may be irrelevant where emotional and practical decisions are required (Greenhalgh et al.,

2014). Guidelines can often represent imperfect knowledge (Elwyn et al., 2016). The evidence they are based on may be lacking or misleading, and experts may make recommendations not suitable for use in practice (Woolfe et al 1999). Auditing against guidelines may therefore result in unfair assessment of the quality of care delivered (Woolf et al., 1999).

1.8.2 Terminology

To use evidence-based clinical protocols or guidelines as a part of clinical audit in veterinary practice is further confused by the definition of both.

Greenhalgh (2010) and Swinglehurst (2005) suggest there is a distinction between protocols and guidelines in medicine. Protocols are a rigid set of instructions, for use usually by more inexperienced staff members where there is a known outcome (Swinglehurst, 2005). Guidelines assist with clinical decision making. They are developed based on the best available evidence through a systematic process (Swinglehurst, 2005; Field and Lohr, 1990).

In veterinary medicine both terms appear to be used to describe a similar entity – a set of guidance that individuals may or may not choose to follow to varying degrees. In existing farm animal literature, protocols and guidelines tend to relate to courses of treatment or to diagnostic procedures (Darwash, 1997; Heuwieser, 1999; Dee et al., 2000; Decaluwé et al., 2014; Smith, 2015; Viora, 2015;). They vary between suggested treatment and management strategies to evidence based, expert consulted treatment plans (Gomez, 2014; Wapenaar, 2011). There are also a number of guidelines that relate to the responsible use of medicines in production animals (Taylor, 2010; Responsible Use of Medicines in Agriculture, 2016). Some authors consider protocols to be more rigid and instructional than a guideline, which may be seen as more flexible and advisory (Viner, 2009; Wapenaar, 2011). In other situations, the terms seem to be used variably. Bell (2016) discusses the treatment of lameness in dairy cows in a blog entitled ‘treatment protocols’ and yet there is no mention of protocols within the blog which describes the treatment of a number of cases. Protocols imply a known outcome and therefore a defined

course of action, and treatments often have to differ depending on clinical findings. However, a treatment 'protocol' rather than a 'guideline' may be the correct term where the action and outcomes are defined and known such as the treatment of lame cows on one farm, by one vet or within one practice. 'Protocol' suggests a greater degree of adherence is required, compared to the label of 'guideline'. The correct term should therefore be used in the correct scenario, and this will differ depending on location, personnel, resources and clinical aims; one man's protocol may be another man's guideline. Some authors appear to use the terms interchangeably. For example, Rees (2016) takes the guidelines developed by Wapenaar (2011) and presents them as a protocol, and IDEXX (2015) has a list of protocols which are individually labelled as guidelines.

Other authors appear to use other terms to describe similar tools for example standardised operating procedures (Rao et al., 2011), best practice recommendations (Hanel et al., 2016), care pathways (Woolfe et al 1999) and consensus proposals (Bhatti et al., 2015) . Multiple terminologies used may make it difficult for practitioners to find and use the tools appropriately as it is not easy to differentiate between each term. Oxtoby and Mossop (2016) suggests an umbrella label 'standardised methods of treatment' to cover the range of terminology so far discussed and this will also be used throughout this thesis.

1.8.3 Guidelines and protocols in medicine

The National Institute for Health and Care Excellence (NICE) was founded in 1999 with a remit to ensure the most clinically and cost effective drugs and treatments were available to patients through the NHS (National Institute for Health and Care Excellence, 2016b). The NICE guidelines were created to improve the quality of care delivered to patients (Woolfe et al 1999). By 2016 NICE had an established worldwide reputation for creating and maintaining evidence-based advice and guidelines that allow for the delivery of cost effective and evidence-based care to be delivered by the NHS; over 1,500 pieces of NICE guidance existed on all aspects of human health care (National

Intitute for Health and Care Excellence, 2016b). Although clinical guidelines can bring many potential benefits to clinical practice (Woolf et al., 1999; Greenhalgh, 2010), Elwyn et al. (2016) highlight the realities of delivering patient care in a medical setting where clinical guidelines are considered.

1.8.4 Guidelines and protocols in veterinary medicine

In contrast to the medical profession in the UK where guidelines are created predominantly by one organisation based on the highest quality evidence, veterinary guidelines and protocols are sporadic, vary in quality and are created by a number of different organisations or individuals. There is no one place to go to find all relevant protocols and guidelines. Some protocols or guidelines are validated and based on evidence (Boller and Fletcher, 2012; International Society of Feline Medicine, 2015; Barnard et al., 2016) while others appear to be a general consensus of opinion (Warman and Harvey, 2007). Some publications compare the outcomes seen with different protocols (Bourel et al., 2013). Some guidelines represent the advice of industry partners attempting to encourage good practice or setting out steps needed to meet certain requirements (Horserace Betting Levy Board, 2016). As defined by Swinglehurst (2005), 'systematically developed' refers to both the fact that guidelines should be produced on systematic review of the evidence and that they are developed in a systematic way. These two points may make the creation of guidelines challenging in the veterinary profession; evidence is limited and there is little to indicate guidance should be followed when creating guidelines, as practitioners are encouraged to create guidelines to audit against.

1.8.5 Adherence to protocols and guidelines

The degree to which protocols or guidelines should be adhered to is unclear and varied, with the legal implications of non-adherence unknown in many cases in the veterinary profession. The national tuberculin testing protocol for the Single Intradermal Comparative Cervical Tuberculin (SICCT) test for Bovine TB in the UK is a nationally governed protocol and should be strictly adhered to to ensure the best results of the diagnostic test (Animal and Plant Health

Agency, 2016). Non-adherence to this protocol can lead to disciplinary action against the veterinary surgeon by the Animal and Plant Health Agency or the RCVS. It is, however, unclear what the consequences are of non-adherence to local protocols or guidelines. In the medical profession, legal implications of guideline or protocol use has been laid out and guidelines have been used in legal cases for and against the defence of a practitioner (Tingle, 2002; Samanta et al., 2003).

1.8.6 Challenges of using protocols and guidelines

According to the definitions by Greenhalgh (2010) and Swinglehurst (2005) above, guidelines should '*not force clinicians to abandon common sense*' when making clinical decisions about a patient (Greenhalgh, 2010). However, a number of limitations have been recognised when using guidelines within the NHS (Elwyn et al., 2016). Guidelines can be time consuming and inconvenient to use in practice (Woolf et al., 1999). Guidelines do not consider risks, benefits or degrees of uncertainty (McGee, 2015). They assume a situation where all outcomes are known and where rational, linear decisions need to be made (Elwyn et al., 2016). This is often not reality – many patients have co-morbidities and may already be on a range of medication. For this reason the medical profession are now entering a post-guideline era and developing tools that can deal with more complicated clinical scenarios (Elwyn et al., 2016).

The RCVS however advocate the use and revision of evidence-based clinical guidelines and protocols, suggesting discussions on them be a part of clinical effectiveness (Royal College of Veterinary Surgeons, 2015). Viner (2003) suggests creating protocols and guidelines within a practice. The creation of clinical guidelines requires a specific methodology that incorporates evidence-based medicine with consensus recommendations by a panel of experts (McGee, 2015); NICE have a 240 page manual detailing how to create a clinical guideline (Jackson and Feder, 1998; National Institute for Health and Care Excellence, 2014a). Wapenaar (2011), Freeman and Curtis (2015) and Elwyn et al. (2016) all clearly highlight the extensive process that is involved in creating

an evidence-based guideline – likely to be an unpractical task for busy veterinary surgeons in practice. In veterinary practice, many different factors must be taken into consideration when making a clinical decision as resources, situations and desired outcomes may all differ for the same clinical condition seen in different patients. Viner (2006) suggests that veterinary surgeons do not like to be ‘told what to do’ and therefore the suggestion of following a guideline must be handled carefully within a practice team.

1.9 Summary of the clinical audit literature

Clinical audit has been extensively used in the medical profession as a quality improvement tool. It has developed over a century and changed to suit the ever developing environment of health quality care. Despite the longevity of the tool, there are still a number of challenges and barriers to its use that the veterinary profession can learn from.

In comparison, clinical audit in the veterinary setting is fairly new. The concept has been taken from medicine and directly applied to veterinary medicine, where resources and evidence are not the same or as well developed. This has led to confusing advice around what clinical audit is in the veterinary setting, and how it should be conducted. Emphasis has been placed on the use of protocols and guidelines within veterinary practice, with no evidence to support if and how they may be suitable for use in veterinary practice. Confusion now exists around the definitions of clinical audit and how to conduct one, and there is no evidence to show if and how the concept is actually being used in practice. For such emphasis to be placed on the process being conducted, more needs to be understood about the implications of its use in practice.

Clinical audit is here to stay. It is another tool that enables the veterinary profession to remain self-regulated. As something that veterinary surgeons are required to do, the process needs to be user friendly, time resourceful and low-cost.

1.10 Aims of the project

The aim of this project is to determine if and how clinical audit can be conducted efficiently and effectively in farm animal veterinary practice.

The methods of practice engagement, topic prioritisation, clinical data collection, knowledge transfer and change management will be adapted from the medical profession and incorporated into this study. The study will investigate the facilitators and challenges of carrying out clinical audit in farm animal practice and will assess how the clinical audit process can be completed in a useful and effective way, as part of clinical governance and otherwise. The ultimate aim is to produce guidance for farm animal veterinary surgeons wishing to conduct clinical audit in practice.

To achieve the aims above, a number of objectives will be met. The research flow diagram below (Figure 6) shows which chapter will meet each objective.

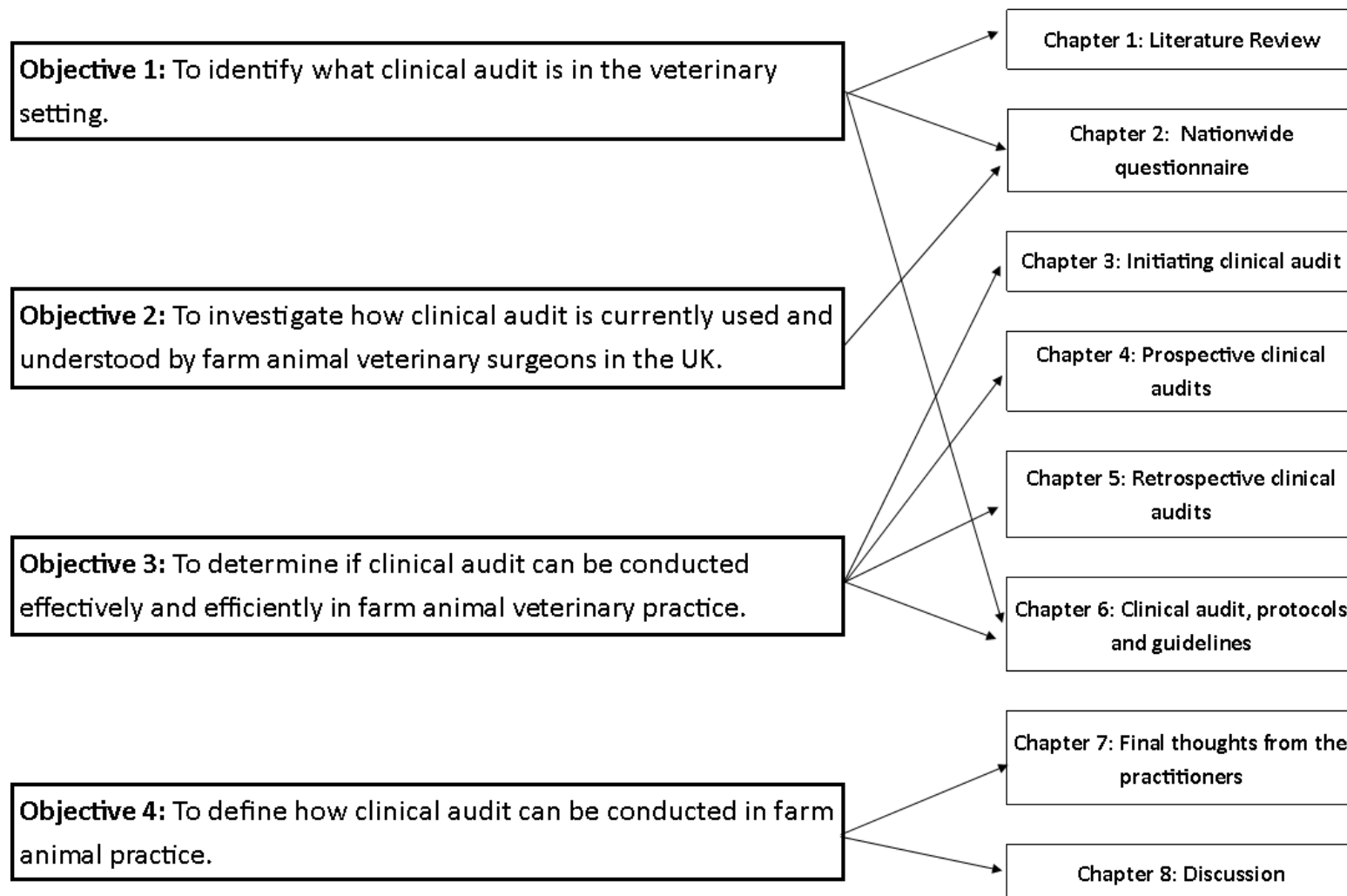


Figure 6 Research flow diagram

1.11 Thesis structure

This thesis consists of a study evaluating the current use of clinical audit in farm animal practice (Chapter 2), attempts to conduct clinical audit in practice with associated facilitators and barriers (Chapters 3, 4 and 5), further investigation into the use of a surgical protocol in a farm animal practice (Chapter 6), final thoughts from the practitioners that worked on the project (Chapter 7) and a final discussion evaluating the findings and suggesting how to conduct clinical audit in farm animal practice (Chapter 8).

Chapter 2

This describes a study investigating how veterinary surgeons who undertake farm animal clinical work currently conduct clinical audit in practice. A questionnaire was distributed to collect experiences and attitudes of veterinary surgeons in the UK towards the quality improvement tool.

Chapter 3

This is the first of three chapters describing work where clinical audits were conducted in three farm animal veterinary practices in the UK. This chapter focuses on initiating clinical audit; an amended JLA Priority Setting Partnership Meeting format was used to select a topic to audit. Opinions, attitudes and the practicalities of conducting clinical audit in practice at a local level were also investigated via questionnaire and discussion.

Chapter 4

This examines the feasibility of conducting clinical audit in farm animal practice where data are collected prospectively. It also discusses the potential challenges and benefits of the process.

Chapter 5

This chapter investigates the feasibility of conducting retrospective clinical audit in farm animal practice.

Chapter 6

The relationship between clinical audit, protocols and guidelines has been discussed in the literature review; this chapter examines the understanding of, and attitudes towards a surgical protocol used in a farm animal practice. Benefits and challenges of following a protocol or guideline, and opinions on their use in practice was also investigated.

Chapter 7

This chapter collects final thoughts and opinions from the practitioners in the three practices on the clinical audits conducted and the overall project.

Chapter 8

This brings together the findings from all the previous chapters to suggest if and how clinical audit may be conducted successfully in farm animal veterinary practice.

Parts of this chapter have been published in:

WAINE, K. and BRENNAN, M. (2015) Clinical audit in veterinary practice: theory v reality. *In Practice* 37: pp.545-549.

Chapter 2 Experiences and attitudes towards clinical audit of veterinary surgeons undertaking farm animal clinical work in the UK

2.1 Introduction

No previous studies have investigated the extent to which clinical audit is utilised in farm animal veterinary practice in the UK, despite the increasing emphasis put on the process (Royal College of Veterinary Surgeons, 2015; Royal College of Veterinary Surgeons, 2016). In contrast to the veterinary profession, many studies have been conducted in the medical profession to gather opinions and experiences of clinical audit with the first collection of opinions recorded in 1952 (Sereda and Hanson, 1952; Gabbay et al., 1990; Grol and Wensing, 1995; Millard, 1996; Newman and Pyne, 1996; Shortell et al., 1998). Grol and Wensing (1995) suggested that the introduction of quality improvement methods did not necessarily result in implementation by general practitioners. Black and Thompson (1993) focussed on the concerns of doctors surrounding clinical audit as it was felt that the improvement of negative factors was most important in developing better clinical audit implementation methods.

Johnston et al. (2000) suggested that the attitudes of the professionals using clinical audit needed to be taken into consideration for the process to be beneficial. For clinical audit regulation and guidance to be successfully set and implemented in farm animal veterinary medicine, it is therefore important that the current use and understanding of the concept by farm animal veterinary surgeons is considered.

The aim of this study was to gather attitudes towards, and experiences of, clinical audit from a wide range of veterinary surgeons undertaking farm animal work in the UK.

2.2 Methods

A cross-sectional study of farm animal veterinary surgeons in the UK was conducted through distribution of an online questionnaire to survey their opinions about clinical audit. The questionnaire (Appendix 1) was developed in SurveyMonkey

(https://www.surveymonkey.com/r/farm_animal_clinical_audit). Although many medical studies have used interviews to collect opinions (Black and Thompson, 1993; Grol and Wensing, 1995; Millard, 1996), it was felt that an online questionnaire would collect the most responses across the target population over the period of time available in this study.

2.2.1 Population of interest

The target population was RCVS registered veterinary surgeons that worked in farm animal veterinary practice or undertook farm animal clinical work in the UK. The sampling frame used for the study was membership of the British Cattle Veterinary Association (BCVA) and the Sheep Veterinary Society (SVS), practices registered as carrying out clinical work for sheep and cattle on the RCVS 'Find a Vet' website, visitors to the CEVM website and users of Facebook and Twitter.

2.2.2 Questionnaire structure

A single data collection mode was used; the questionnaire was created on SurveyMonkey (SurveyMonkey Inc, Palo Alto, California, USA; www.surveymonkey.com) and distributed electronically. The questionnaire consisted of four main sections. Section one asked for background information about the respondents. The second section asked questions relating to current knowledge of, and past education on, clinical audit. Section three contained questions which determined the experience the respondent already had of clinical audit, either as a participant in a clinical audit set up by another individual and/or as an individual that had set up a clinical audit themselves. The fourth section asked questions eliciting respondents' current

attitudes towards clinical audit. A definition of clinical audit was given at the beginning of section three.

A mixture of open questions, closed questions, multiple choice and opinion questions requiring a response on a Likert Scale were used. Three of the opinion questions were based on questions used in pre and post audit interviews by Viner (2006). Other questions were based on work by Viner (2003). Skip logic (a function that allows the respondent to skip to a future question based on the answer choice they selected) was used throughout the questionnaire to avoid participants responding to questions not applicable to them (SurveyMonkey 2016). Questions with skip logic required an absolute answer while all other questions were optional.

2.2.3 Questionnaire development and distribution

The questionnaire was constructed and sent to members of the CEVM at the University of Nottingham School of Veterinary Medicine & Science to be pretested. Five responses were received and the questions were altered accordingly based on the comments of the pre-testers. The questionnaire was then piloted with nine practising farm animal veterinary surgeons (three of whom were based at the University of Nottingham) and the questions were altered based on their feedback.

The questionnaire was distributed in five different ways:

1. The RCVS 'Find a Vet' website advanced search (<http://findavet.rcvs.org.uk/find-a-vet/advanced-search/>) was used to find email addresses for veterinary practices listed as providing veterinary services for sheep and cattle. The search found 842 practices. Practices that did not have email addresses, practices already working with the CEVM on clinical audit research and practices whose email address suggested they did not provide farm animal services (for example dogsandcats@avetpractice.com) were removed from the list, resulting in 567 relevant email addresses. An email asking for help from farm animal veterinary surgeons was sent to these 567

email addresses as blind carbon copy. The email asked for the link to be forwarded on to any vets in the practice that undertook farm animal work. The email was sent to the RCVS 'Find a vet' list of practices on Wednesday 29th July 2015, with a reminder four weeks and six weeks later.

2. An email containing the survey link was sent by the Sheep Veterinary Society (SVS) to its members. The questionnaire was distributed to the SVS email list on Monday 27th July 2015.
3. A website and QR code link to the questionnaire was included in the BCVA newsletter. This was posted to members in paper format, sent electronically by email and available as a PDF on the BCVA website. The link to the questionnaire was included in the July 2015 edition of the BCVA newsletter and was posted on the BCVA website from Monday 27th July 2015.
4. The questionnaire was distributed via social media, specifically Facebook and Twitter. Distribution on social media continued sporadically during the two month period.
5. A link to the questionnaire was also available on the CEVM website for the time the survey was open.

The questionnaire was closed on Wednesday 23rd September 2015.

2.2.3.1 Incentives

Respondents completing the questionnaire were offered the chance to enter a prize draw to win £50 worth of vouchers for a store of their choice. They were also given the opportunity to enter their email address to receive a summary of the results from the study.

2.2.4 Data management and analysis

Responses received from SurveyMonkey were downloaded into a Microsoft Excel V.14.0.6 file (2010 Microsoft Corporation). The dataset was managed in Microsoft Excel and tables and graphs were also created using this software. The results were analysed using qualitative and quantitative methods. Pearson's Chi-squared tests in Microsoft Excel were used to assess correlation

between whether the participants undertook clinical audit compared with the respondents' age, clinical audit education, work pattern and caseload. A Person's Chi-squared test was also used to determine if there was a difference in undergraduate education provision between veterinary surgeons qualifying pre and post 2010. Statistical significance was set at $P < 0.05$.

The questions with free text answer boxes were included in an attempt to find the opinions of the individuals about their prior experiences, what was important to them about the clinical audit process and to gather advice that may be passed on to other vets attempting clinical audit for the first time. The answers to the free text questions were analysed using inductive thematic analysis within Microsoft Excel. Thematic analysis is a foundation method of qualitative analysis (Braun and Clarke, 2006). The principles of the Phases of Thematic Analysis were used for the thematic analysis of the data and for each free text question a thematic 'map' was created (Bowling, 2009). General important themes were identified from the comments and example quotes are shown to support these.

2.2.5 Data protection and anonymity

Questionnaire respondents were advised that all personal data would be kept confidential, with any email addresses entered for the prize draw or for receiving results of the study being separated from the questionnaire responses before analysis.

2.3 Results

Three hundred and thirty-two responses to the questionnaire were received over eight weeks. Not all respondents chose to answer every question. Figure 7 shows the number of responses to each of the 29 questions of the questionnaire. Some questions had skip logic applied; depending on response, some participants were directed to the next question applicable to them. Question 10 asked if the participants had ever been involved in clinical audit in any species. If the participants entered 'No' or 'Don't know' they were directed to question 27. Question 15 asked if respondents had set up or

participated in clinical audit in farm animal practice. Those who indicated participation only were directed to question 21. Question 16-21 was therefore only asked to those who had set-up their own clinical audit(s). Question 27 asked for attitudes towards clinical audit and this question was asked to all participants. Question 29 asked how the participant had received the questionnaire.

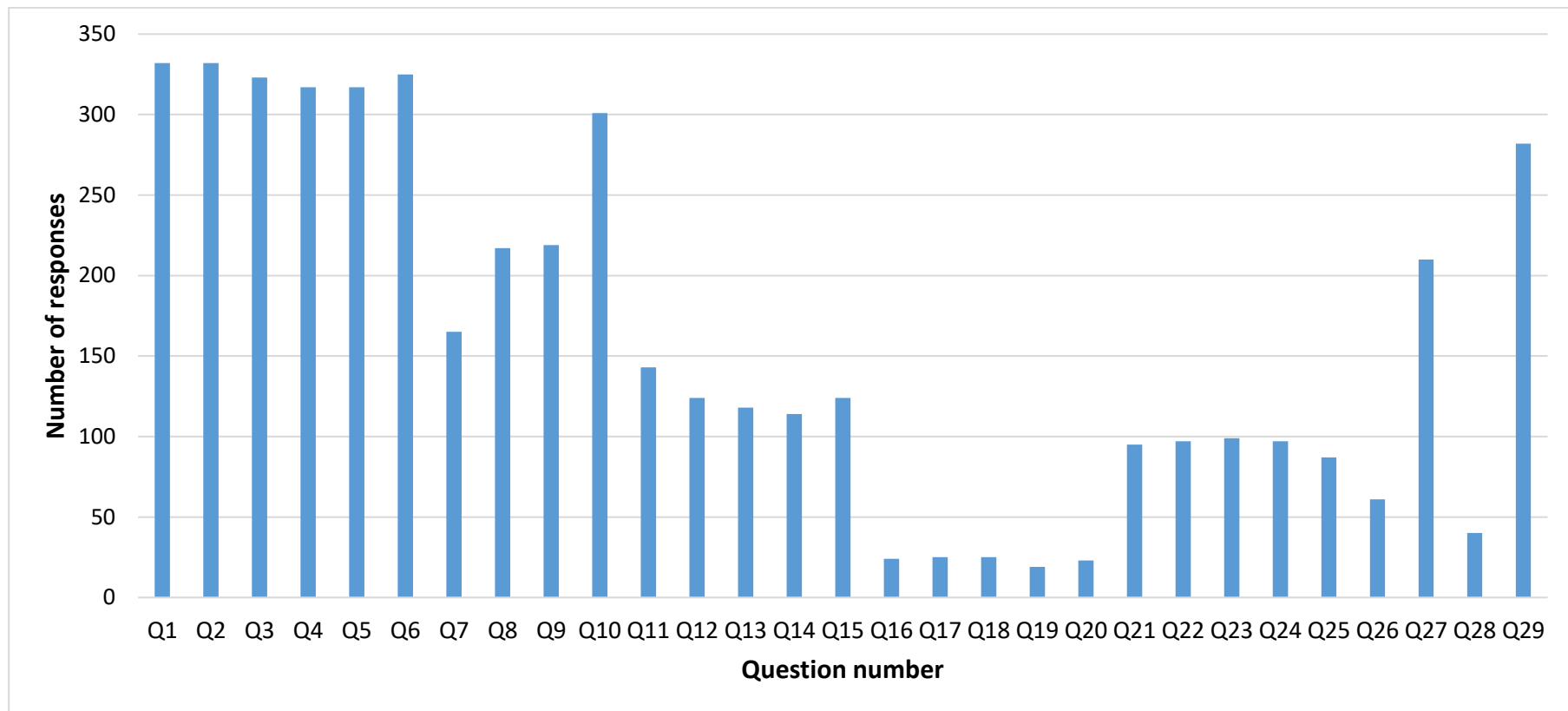


Figure 7 The number of responses to each question in the questionnaire [Q1= question 1]

The majority of the respondents stated that they received the link to the survey via the email sent to the RCVS 'Find a Vet' practice list (210/282; 74%), 26 participants received the link via Facebook (26/282; 9%), 20 through the BCVA (20/282; 7%), 11 through the SVS (11/282; 4%), and two via Twitter (2/282; 1%). Thirteen respondents (13/282; 5%) received the link to the survey via more than one source.

2.3.1 Background information about the participants

Forty-five percent (148/332) of the veterinary surgeons that participated carried out solely farm animal clinical work while 54% (180/332) undertook a mixed clinical caseload (the other 1% ticked 'other'). One hundred of the veterinary surgeons undertaking a mixed case load saw small animal, equine and farm animal cases (100/180; 56%); 44 saw small animal and farm animal cases (44/180; 24%) and 36 saw equine and farm animal cases (36/180; 20%). The majority of the respondents worked in clinical practice full time (296/323; 92%). Year of graduation of the participants is shown in Figure 8 and ranged from 1975-2015, with 155 (49%; 155/317) classified as 'recent graduates' by the British Veterinary Association (less than 8 years qualified) (British Veterinary Association, 2014).

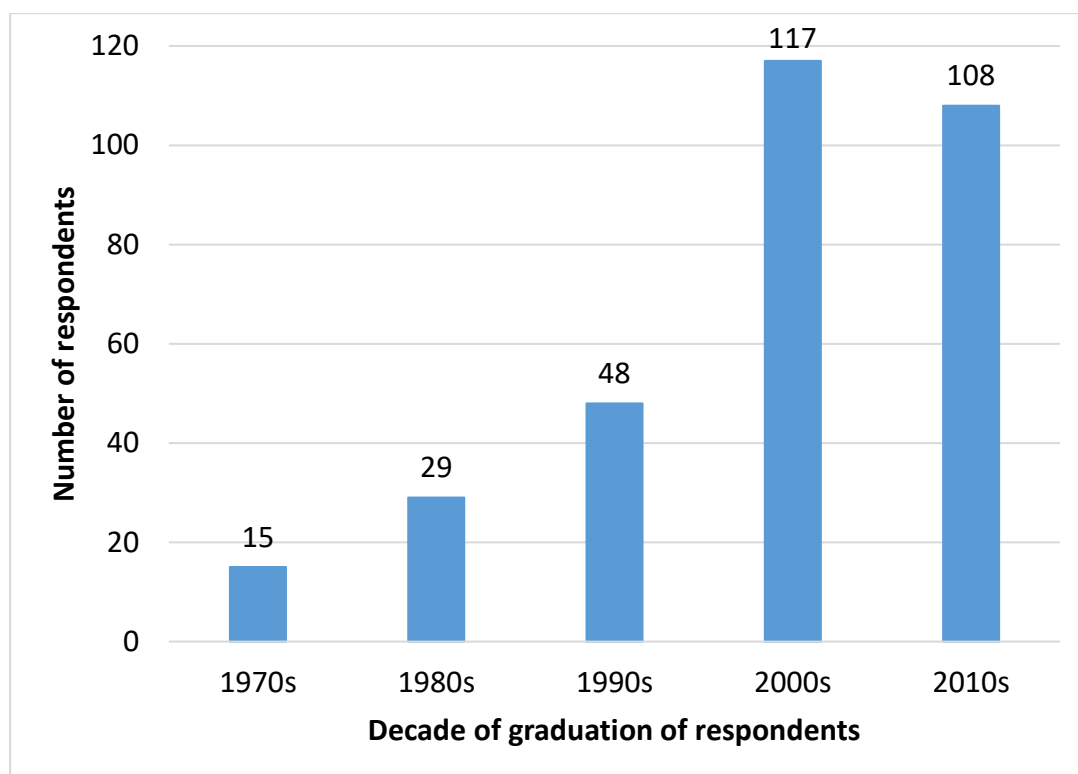


Figure 8 Bar chart showing the decade of graduation of the veterinary respondents to the survey on clinical audit

2.3.2 Current knowledge of, and past education on, clinical audit

A large proportion (237/325; 73%) of respondents had heard of clinical audit previously, whilst 79/325 (24%) had not, and 9/325 were unsure if they had (3%).

In total, 219 veterinary surgeons provided a definition of clinical audit. The majority of the respondents used the words 'assess', 'review', 'evaluate', 'analyse', 'appraise' or 'monitor' in the definition they provided; *"to review cases and their results"*, *"examining practices and related data to determine success rates and evaluate performance"*, *"analyse and assess successes and failures in clinical treatment of cases/situations"* and *"...also assess and appraise treatment regimes..."*. Some respondents suggested clinical audit involved reviewing the outcomes of different procedures to find the best technique or treatment; *"assessment and evaluation of clinical practices – i.e., gathering information on what is done and reviewing this information to try to find best practices"*. Many definitions suggested clinical audit involved looking at current clinical procedures or outcomes and improving them for the future;

“monitoring clinical outcomes of actions/treatments in different situations to assess success/failure & hence modify future actions/treatments” and “measuring the outcomes of a treatment process such that we have evidence to influence the choice of treatment decision in future cases”. Some definitions mentioned best practice (*“an assessment of one’s clinical skills to check they are still up to date and offering ‘best practice’”*), monitoring against a standard (*“reviewing procedures and practices against ‘best practice’ standards”*), quality control (*“quality control”*) and criteria (*“assessment and subsequent review following changes of specific clinical criteria”*). One respondent defined clinical audit as retrospective (*“a retrospective assessment of a situation/ clinical area”*), one as peer review (*“OTHER VETERINARIANS CHECKING WORK PERFORMED TO SEE IF OF ACCEPTABLE STANDARD- peer review if you like”*) and one as benchmarking (*“System for monitoring clinical performance within practice and possible benchmarking or a feedback system”*). Three negative definitions were recorded such as *“being checked up on by a third party”, “having my work investigated”* and *“caseload accounting”*. Five definitions mentioned creating protocols (*“a system where for example morbidity/mortality is recorded, data assessed, outcomes discussed and where necessary changes in procedures and protocols established”*), reviewing protocols (*“a critical review of treatment protocols”*), referencing protocols (*“referencing protocols and procedures to ensure that they are best practice and in line with the current advice based on peer reviewed studies”*), checking if protocols work (*“checking if the protocols you follow are correct and work”*) and that clinical audit itself is a protocol (*“a structured quality assurance protocol that aims to improve patient care and clinical”*). Two respondents indicated that they were not sure of the definition (*“unsure”*) and some respondents were likely to have used the search engine Google to find the definition (three definitions written down exactly matched the definition that can be found when Google is searched for ‘What is clinical audit?’ for example *“a quality improvement process that seeks to improve patient care and outcomes”*).

Less than one fifth (31/165; 19%) of the veterinary surgeons had received training on clinical audit at veterinary school, while twenty-two percent (47/217) had undertaken postgraduate training on the subject (Table 3). Significantly more veterinary surgeons who had graduated after 2010 had received undergraduate training on clinical audit compared to clinicians graduating in previous decades ($P<0.001$).

Table 3 The proportion of respondents who nominated that they had had received undergraduate and/or postgraduate training on clinical audit by decade of graduation

Decade of graduation	Undergraduate education				Postgraduate education			
	n =	Yes	No	Don't know	n =	Yes	No	Don't know
1970s	9	0 (0%)	9 (100%)	0 (0%)	10	1 (10%)	9 (90%)	0 (0%)
1980s	15	0 (0%)	15 (100%)	0 (0%)	20	4 (20%)	15 (75%)	1 (5%)
1990s	29	1 (3%)	27 (94%)	1 (3%)	34	4 (12%)	29 (85%)	1 (3%)
2000s	55	2 (4%)	50 (91%)	3 (5%)	80	20 (25%)	59 (74%)	1 (1%)
2010s	51	20 (39%)	26 (51%)	5 (10%)	65	18 (28%)	45 (69%)	2 (3%)

[NB Data is included here for participants that provided year of graduation AND answered the questions on undergraduate (n=159) and/or postgraduate (n= 209) training]

2.3.3 Experience of clinical audit

Forty-nine percent of respondents (148/301) had not carried out clinical audit in any species, while ten individuals (10/301; 3%) did not know if they had or not. The remaining 48% (143/301) indicated that they had previously been involved in clinical audit in any species.

Participants who had received postgraduate training in clinical audit were significantly more likely to have conducted audit in any species than those who had not ($P < 0.05$). Working pattern (full or part time), caseload (farm animal vs mixed) and year of graduation had no significant association with whether respondents had or had not previously conducted clinical audit in any species. One hundred and twenty-six respondents indicated that they had previously been involved in clinical audit specifically in farm animal veterinary practice.

2.3.3.1 Most recent clinical audit

One hundred and twenty-four participants indicated the reason for the most recent clinical audit conducted in their practice; 58 people gave more than one reason to the closed question. The most common reason for conducting the most recent clinical audit amongst participants was to gather information

on what happens in the practice (86/184), while 41 veterinary surgeons had conducted the clinical audit to meet RCVS PSS requirements (Figure 9).

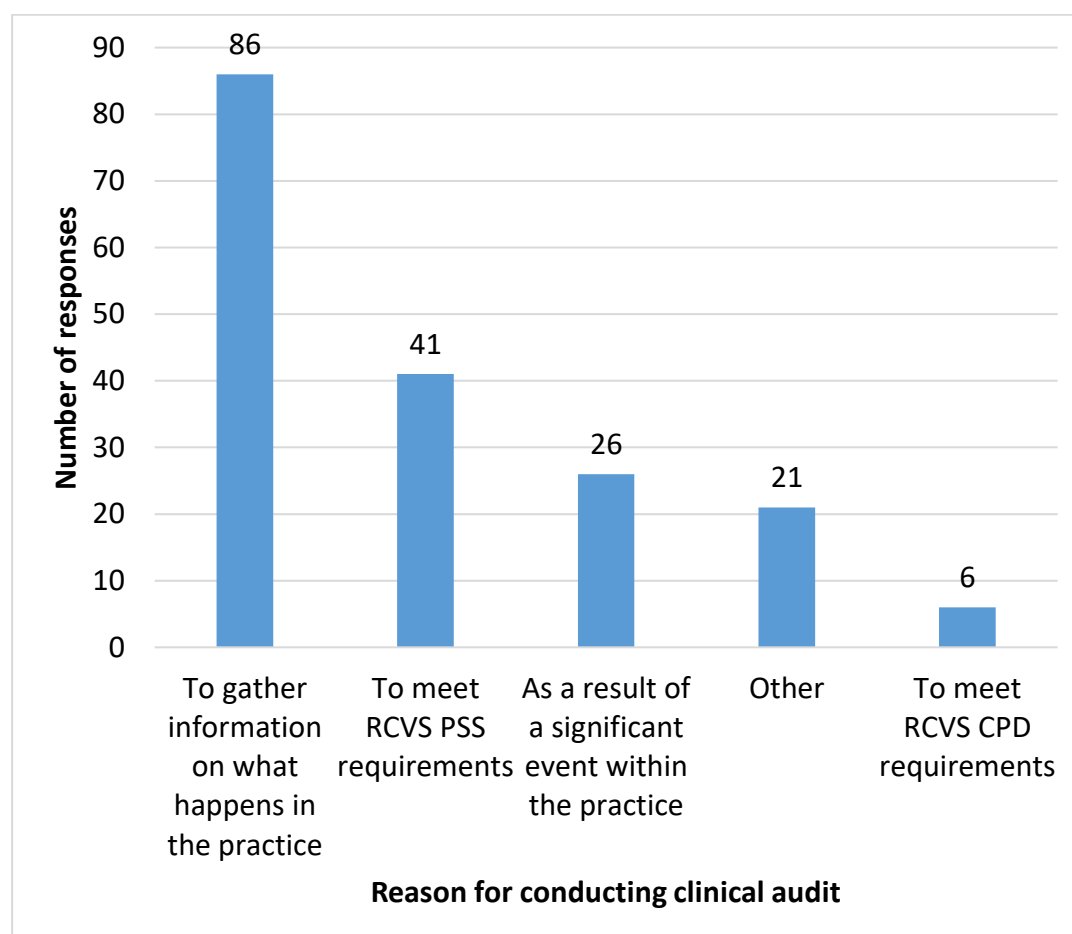


Figure 9 Reasons given by the respondents as to why their most recent clinical audit was conducted. RCVS = Royal College of Veterinary Surgeons, PSS = Practice Standards Scheme, CPD = Continued Professional Development

Figure 10 shows the topics of the most recently conducted clinical audits. Seventy-eight percent (79/101) of the topics were surgical with the majority of these focussing on caesarean sections (61/79; 77%).

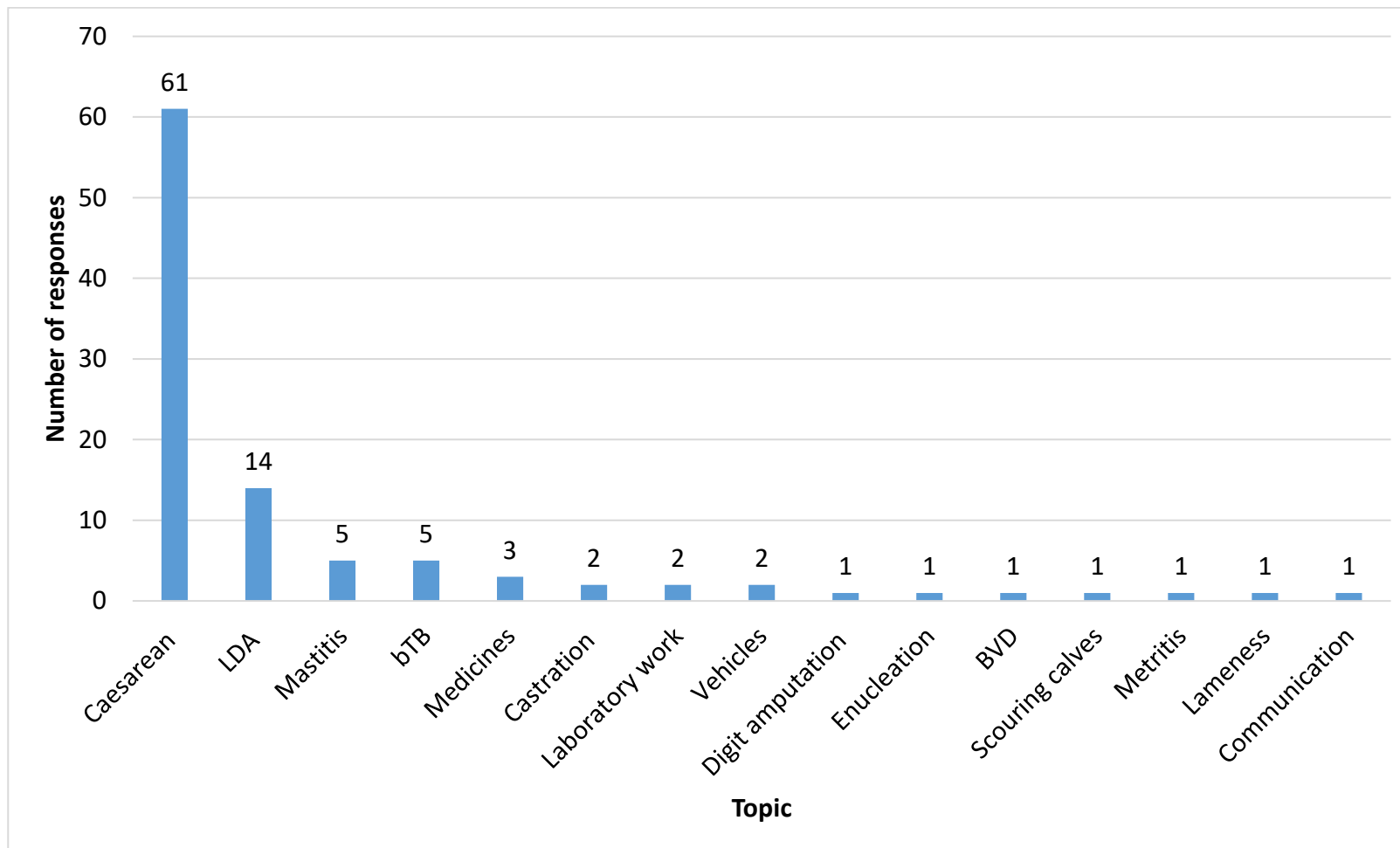


Figure 10 The topic of the most recent clinical audit conducted by the respondents to the questionnaire

[LDA = Left displaced abomasum, BVD = Bovine Viral Diarrhoea, bTB = Bovine Tuberculosis]

A free text box was provided for the respondents to explain why these topics had been chosen; the main themes are shown in Table 4. Many of the respondents indicated that the topic had been chosen so that they could assess what was currently being done within their own practice. Some people said they were unsure why as they had not chosen the topic themselves and a few vets responded that the topic had been chosen because it was considered easy to do or because data would be easy to collect.

Table 4 Reasons why the respondents chose their most recent clinical audit topic

(n = 114, some respondents gave >1 answer)

Theme	Example quote
To assess what we currently do (28)	<i>"to assess outcomes"</i>
Topic not chosen by respondent (17)	<i>"not chosen by me"</i>
Easy topic (12)	<i>"relatively easy to do"</i>
Good caseload (11)	<i>"we treat a lot"</i>
To standardise our approach (9)	<i>"wanted to standardise and find best practice"</i>
In response to unexpected outcomes (9)	<i>"unexpected outcomes"</i>
To improve our services (9)	<i>"help identify areas that can be improved"</i>

2.3.3.2 Experience of co-ordinating a clinical audit

Twenty-five respondents indicated that they had set up and run their own clinical audits in farm animal practice. Eight (8/23; 35%) of the individuals who had set up clinical audits before had received training at a post-graduate level (compared to 47/217; 22% for the whole population) while two (2/23; 8%) had received training during their undergraduate degree (compared to 31/165; 19% for the whole population). Twenty-three of the 25 respondents worked full time in clinical work, while the remaining two were employed part time. Nearly half of respondents stated they had completed all of the clinical audits that they had set up (11/ 25; 44%) while over half (14/25; 56%) stated

they had started but not finished at least one clinical audit at the time of the survey. One respondent had set up and completed more than ten clinical audits.

Thirty-five responses were received from 25 participants asked about the standards used in their most recent clinical audit (the respondents could tick all that applied). When using standards as part of their clinical audit, nine participants had used standards found in the literature, nine had used pre-existing local standards such as protocols or guidelines and nine had used standards created within the practice for the purpose of the clinical audit. Four veterinary surgeons had used standards gained after running the first round of audit, and four veterinary surgeons had not used any standards.

Five overarching themes emerged from 19 comments of advice veterinary surgeons would give others who were setting up and running clinical audit for the first time (Table 5). Many respondents stressed the importance of good preparation for a clinical audit. This advice ranged from defining the outcomes, aims and purpose, choosing an easy topic, setting a clear time limit on data collection and ensuring literature was accessible, read and searched for 'gold standards'. Communication appeared as a main theme; *"communicate well"*, *"ensure participation from all stakeholders"* and *"involve all vets"* while one participant thought that if communication within the practice was already good enough then clinical audit would not be necessary. Comments about data collection systems (*"needs to be simple and easy to gather the information"*), IT software (*"learn how to use excel"*) and the importance of recording accurate and complete data (*"collect ear numbers etc so that you can get full data"* and *"relies on vets recording data accurately"*) were mentioned. One respondent thought it was important that data analysis should be detailed, while another suggested that data detail was not important. Motivational advice included *"it is well worth it"*, *"do it....you might surprise yourself"* and *"make sure once you start it that you finish it"*. Some participants recorded comments of negative clinical audit experience, these included; *"be prepared for arguments"*, *"it is not easy, difficult to get records*

and to get busy people to participate” and “participation of staff ebbs over time”.

Table 5 Advice that veterinary surgeons who have set up and run clinical audit would give to other veterinary surgeons wishing to set up clinical audit (Number of participants).

Theme	Subtheme	Example quote
Clinical audit Preparation (6)	Defining aims, purpose and outcomes	<i>"Have a specific aim that you want to achieve with clinical audit (e.g. unified practice policy on LDA correction technique), and make sure everyone involved understands and agrees with that aim before commencing audit"</i>
	Choosing the topic	<i>"Research the topic and case prior to discussion"</i>
	Setting a time limit	<i>"Include a specified time period"</i>
	Literature	<i>"Read the literature, try to decide if there is a 'gold standard' treatment or method for the procedure/condition, or if there are any methods/treatments that are no longer appropriate" and "Gain access to a full reference library, many articles necessary for determining best practice are not freely available. Learn how to review published literature effectively, often papers misinterpret the evidence they present, often favourably!"</i>
Communication (4)	Importance of good communication	<i>"...involve as many stakeholders within the audit as possible and communicate well as to the purpose of the audit..."</i>
	Existing communication	<i>"If you communicate with staff and clients you should not need one, its common sense and unnecessary!"</i>
Data (6)	Collection methods	<i>"Threaten anybody who doesn't fill the form, collect ear numbers etc. so that you can get full data!"</i>
	Detail	<i>"...relies on vets recording data accurately..."</i>
	Software systems	<i>"Learn how to use excel spreadsheets"</i>
Motivational tips (3)	For individuals	<i>"Do it - you might surprise yourself"</i>
	For the team	<i>"...it is well worth it"</i>
Negative clinical audit experiences (3)	Participation	<i>"Be prepared for arguments"</i>
	Resources	<i>"It is not easy, and difficult to get records and get busy people to participate"</i>

2.3.3.3 Experience of participating in clinical audit

Ninety-five respondents had participated in, but never set up and run their own clinical audits in farm animal practice. Nine of the respondents who had set up clinical audit, had also participated in clinical audits set up by somebody else. The respondents had participated in mostly one-two and up to more than ten clinical audits (Figure 11).

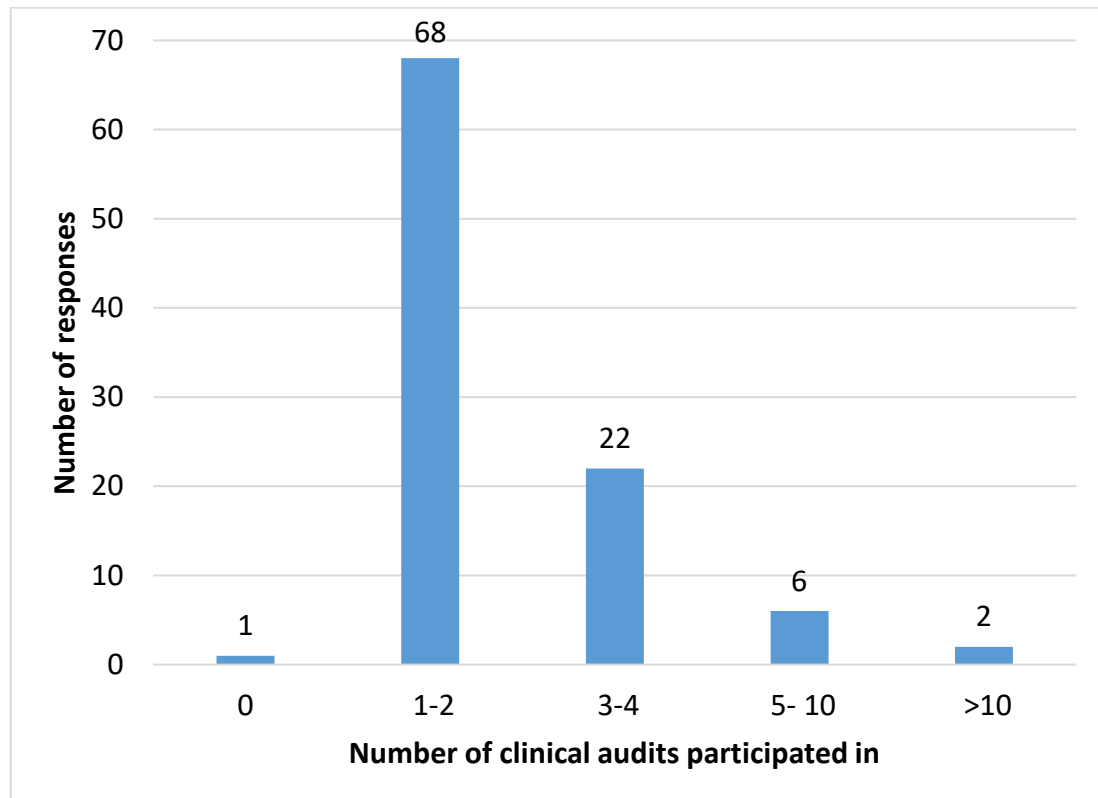


Figure 11 The number of clinical audits the respondents had participated in that had been set up and run by somebody else

How well informed the participants felt they were kept during their most recent clinical audit is shown in Figure 12. The majority of the respondents to this question were happy that they were kept well informed about the clinical audit that they were participating in. A larger percentage felt well informed about the initial stages of clinical audit (80/97; 83%, and 86/99; 87%, felt well informed about the initial aims and progress respectively) compared to a smaller amount of people who felt well informed about the progress and final results (69/97; 71%, and 55/87; 63%, respectively).

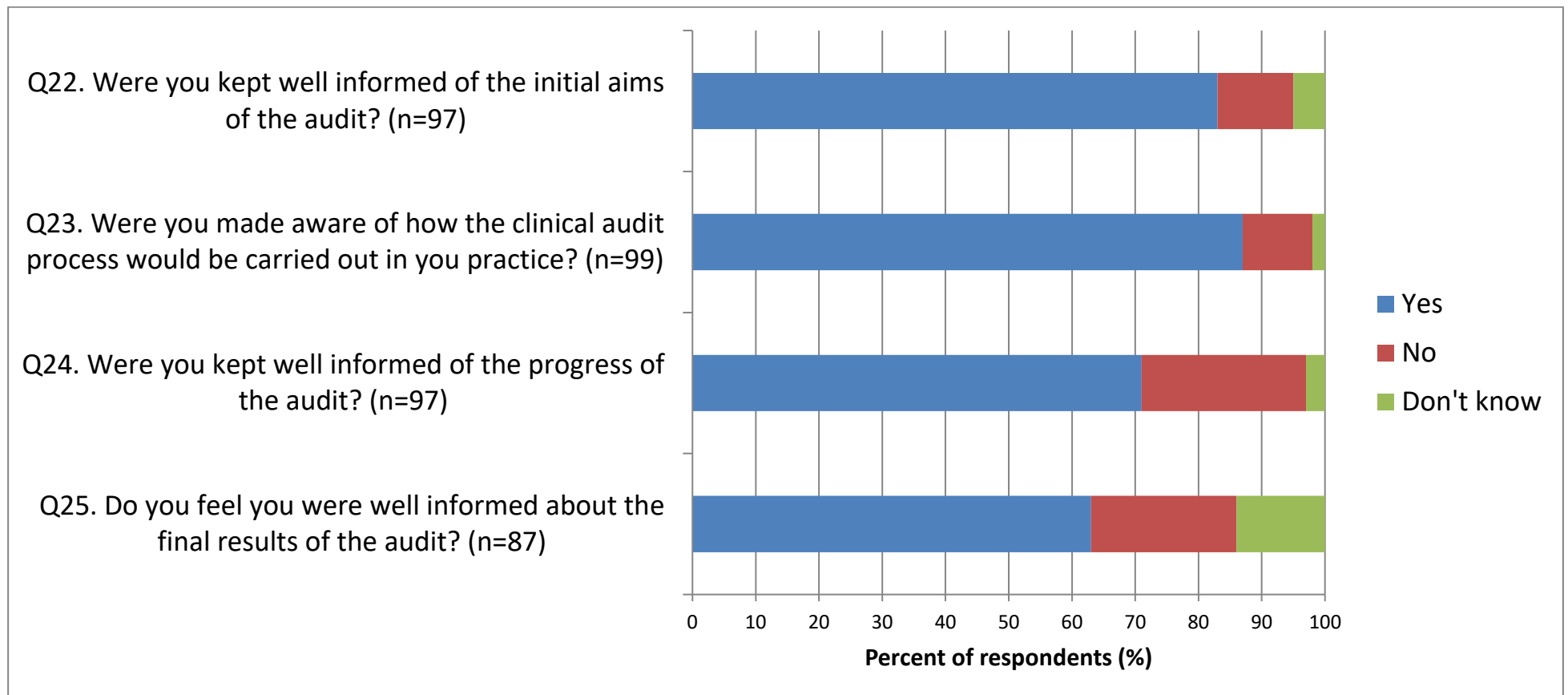


Figure 12 How well informed the participants felt they were kept when considering the most recent clinical audit conducted in their practice

The overarching themes and subthemes that emerged from the 61 comments of advice that respondents would give to other vets who were participating in clinical audits can be seen in Table 6. Many of the respondents mentioned the importance of good communication in their comments. This included clear communication of initial aims, ongoing progress and results of the clinical audit, as well as circulating information and holding meetings to ensure all clinical audit members stay informed and felt involved in the process. The respondents advised to *“ensure all involved are aware of key areas, information gathering and results”* and to *“communicate regularly and effectively with all members of the team”*. Individual and team participation was highlighted as important parts of the clinical audit process by some of the participants. The main messages here were to *“get involved”* and *“ask questions”* so that the individual can get the most out of the clinical audit on a personal level. Few individuals highlighted clinical audit as a learning opportunity *“take as much information on board from it that you can but do not be ashamed by "underperformance" due to day to day constraints. There is a big difference between pencil pushing gold standard and actually being in the field”*. Infrequently motivational comments were noted. Some veterinary surgeons suggested others should do it and get involved, and that the hard work was worth the effort with much to learn about yourself and others. Many of the comments mentioned the clinical audit data, this included how it was collected and handled as well as the overall quality of the information. Some of the vets highlighted the need for easy and fast data collection methods with concise questions. Many of the vets discussed the need for accurate data that should be recorded in a timely way. Here the importance of including all data relating to a clinical audit topic was also stressed; *“Record all relevant cases, even those that you think might have a poor outcome!”*, *“don't choose cases for submission plenty to learn from it, nothing to fear”* and *“give honest and full details”*. Some participants selected time as an important factor when undertaking clinical audit. Preparation for clinical audit was suggested by many as an area that needs great consideration before starting the process. A simple, realistic and well organised clinical audit with defined

targets and some background research on the topic were highlighted as important factors in a successful clinical audit. Infrequent responses suggested that *“getting someone enthusiastic and who knows what they are doing to run it”* and *“keeping good records”* would aid the process.

Table 6 Advice from veterinary surgeons who have participated in clinical audit for veterinary surgeons who are about to participate in a clinical audit set up by somebody else (Number of responses).

Theme	Subtheme	Example quote
Communication (21)	Audit purpose	<i>“Ensure you understand the aims of the clinical audit, and exactly what data needs to be collected”</i>
	Audit process	<i>“Communication of progress and results essential” and “Constant communication is essential and results need to be made readily available”</i>
Participation (8)	Individual	<i>“Get involved early to make sure outcomes are agreed”</i>
Motivation (5)	Improving standards	<i>“Use results to improve what you do”</i>
	Personal	<i>“Do it....”</i>
Data (16)	Quality	<i>“That the info gathered will help direct future policy, avoid litigation, improve standard of treatment - therefore answer as truthfully as possible” and “Give accurate answers and feedback - positive and negative”</i>
	Collection	<i>“Make time and make the questions easy and fast...”</i>
Clinical audit process (13)	Time	<i>“It takes time to do so make sure it has been thought through”</i>
	Preparation	<i>“getting someone enthusiastic and who knows what they are doing to run it”</i>

2.3.4 Attitudes towards clinical audit

Attitudes towards clinical audit appeared to be generally positive in all respondents to the questions (Figure 13). Ninety-four percent (196/209) agreed that clinical audit improves clinical standards in veterinary practice, 86% (180/210) thought it aided their own professional development and 77% (161/210) thought the process was interesting. There was slightly less agreement over the statement that clinical audit improved job satisfaction, with 33% (70/210) neither agreeing nor disagreeing, and 82% (173/210) of participants considering the process to be time consuming.

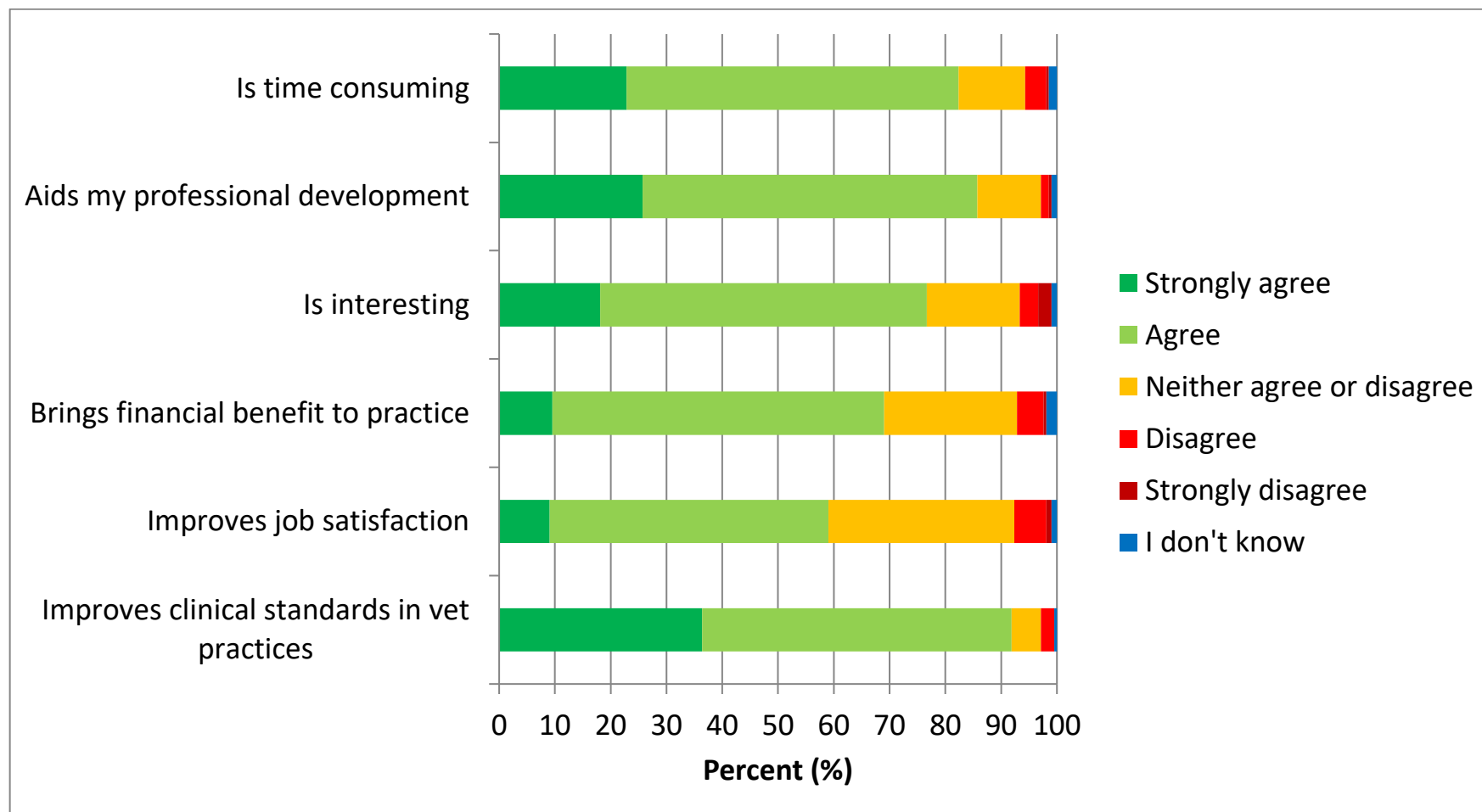


Figure 13 Attitudes towards clinical audit of veterinary surgeons that had heard of clinical audit before (n=210)

Figure 14 shows that similar trends of attitudes are held between people who have and have not been involved in clinical audit, although those that have been involved in clinical audit appear to consider it more interesting (88% of those involved compared to 61% of those not involved). The participants who had not, or did not know if they had or not, participated in clinical audit previously held more uncertainty on the topic and answered 'I don't know' more often than those respondents who had previously been involved in clinical audit.

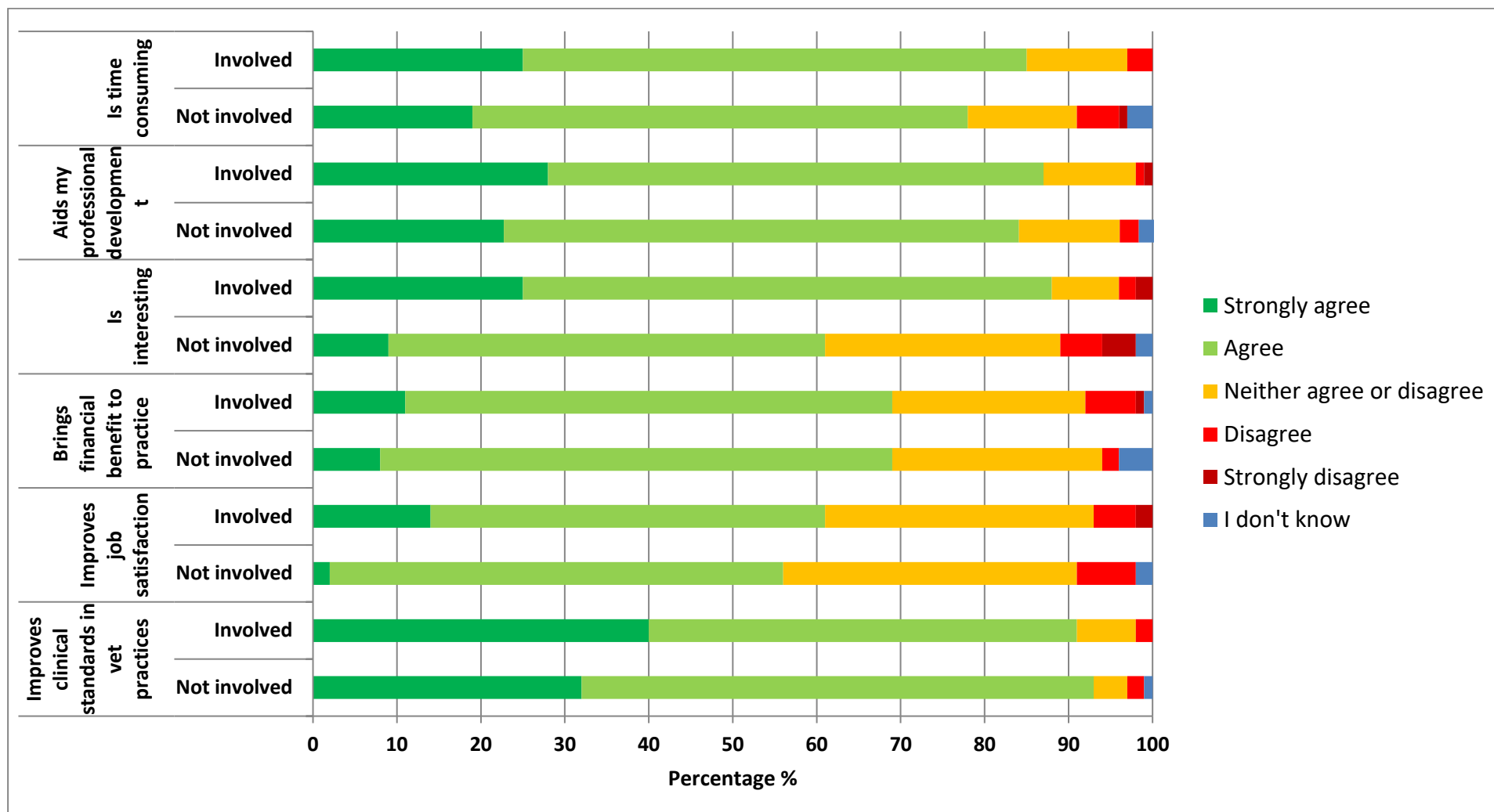


Figure 14 Attitudes towards clinical audit of veterinary surgeons who had heard of and been involved in clinical audit previously (n=122) compared to those who had heard of clinical audit but had not or did not know if they had been involved in clinical audit before (n = 88)

2.3.5 Final comments

Question 28 asked for any further comments that the participants might have about clinical audit in farm animal practice. Twenty-six comments were provided and the main themes and sub-themes are shown in Table 7. The respondents used this opportunity to suggest a number of barriers to the clinical audit process. Time appeared to be an important factor when conducting clinical audit and there is a suggestion that protected time is required for the process to take place *“Time is needed for the audit process”*. The responses suggested that creating protocols in practice was challenging (*“audit leads to protocol, and devising protocols that enhance clinical care whilst not restricting the practitioner is very challenging”*), that potential improvement would vary with the outcomes that were measured (*“clinical audit may improve or may not improve standards in veterinary practice, it depends on how the outcomes are measured”*) and that communicating the results of a clinical audit outside of the practice was difficult (*“It is an interesting exercise but difficult to communicate externally”*). A number of benefits were also listed such as the process being fun and interesting to do, particularly useful for new graduates and useful to improve efficiency within practices; *“Handled properly can be fun, part of CPD, and teach everyone something”*, *“I think as a new graduate clinical audit could be very valuable to assess both your own performance, and gather information from other practitioners to learn and improve”* and *“much of on-farm practice is solo vet charge with no objective criticism unless discussed informally back at the practice. Objective criticism of clinical procedures/outcomes should improve efficiency and learning”*.

Table 7 Final comments from the participants of the questionnaire on clinical audit.

CA = Clinical audit, CPD = Continued Professional Development

Theme	Subtheme	Example quote
Clinical audit resources (7)	Time	<i>"Having been involved with clinical audit, I feel it's a really worthwhile task but does require the time to do it"</i>
	Protocols	<i>"Audit leads to protocol, and devising protocols that enhance clinical care whilst not restricting the practitioner is very challenging"</i>
Benefits of clinical audit (9)	Clinical standards	<i>"CA may improve or may not improve standards in veterinary practice"</i>
	CPD	<i>"but handled properly can be fun, part of CPD, and teach everyone something"</i>
	New graduates	<i>"I think as a new graduate clinical audit could be very valuable to assess both your own performance, and gather information from other practitioners to learn and improve"</i>
	Education	<i>"Much of on-farm practice is solo vet charge with no objective criticism unless discussed informally back at the practice. Objective criticism of clinical procedures/outcomes should improve efficiency and learning"</i>
Barriers to clinical audit (5)	Time	<i>"Would like to carry out a clinical audit but time constraints are the main barrier"</i>
	Defining cases or outcomes	<i>"...it depends on how the outcomes are measured. Success is a subjective word and needs defining!"</i>
	Topic	<i>"It is interesting depending on the topic being audited!"</i>
	Communicating results	<i>"It is an interesting exercise but difficult to communicate externally"</i>
	Education	<i>"more should be done at uni level to inform students" and "More teaching should be done at vet school".</i>
Motivators to clinical audit (4)	Personal	<i>"Gives a guide to your personal competence and success rates"</i>
	Benefits	<i>"but handled properly can be fun, part of CPD, and teach everyone something"</i>

2.4 Discussion

The aim of this study was to gather attitudes towards, and experiences of, clinical audit from a wide range of veterinary surgeons undertaking farm animal work in the UK. This study has found that there is substantial variation in the use and understanding of clinical audit in veterinary surgeons who undertake farm animal work in the UK, while attitudes towards the topic are generally positive.

The RCVS suggest that veterinary surgeons should undertake clinical audit in practice (Royal College of Veterinary Surgeons, 2015; Royal College of Veterinary Surgeons, 2016). No previous work exists to demonstrate if the concept is understood, how clinical audit is used in reality and if veterinary surgeons find the process a benefit or a hindrance to their clinical work. The results of this study may aid the development of clinical audit guidance, as well as informing future policy on the topic. In agreement with the medical situation observed by Grol and Wensing (1995), although the concept of clinical audit has been introduced to veterinary practice it appears that not all practitioners are implementing it. A good number of responses from veterinary surgeons who work in farm animal practice was received for this study, allowing it to extend the information gathered by Viner (2003). Responses were received from individuals across different age groups with a spread broadly similar to the age of the practising veterinary population as described by the RCVS; this reflects the higher proportion of individuals graduating in the last 8 years (Royal College of Veterinary Surgeons, 2014b).

Many of the respondents used synonyms of the word 'review' in their definition of clinical audit, suggesting that this is the main foundation of clinical audit. Some confusion seems to exist around the definition however, and it is proposed that this is due to the varied definitions currently present in the veterinary literature. Chapter 1 of this thesis highlighted the differing definitions of clinical audit appearing in the literature and may explain this confusion, and suggests that a simple definition of clinical audit itself may make the process more user-friendly in the future.

2.4.1 Experiences of clinical audit

A larger proportion of farm animal veterinary surgeons appear to be conducting clinical audit in practice in 2015 compared to the 18% of 904 practitioners that participated in the study by Viner (2003). However, just 4% (of 904) of the survey sample did not understand the concept of clinical audit in 2003 (Viner, 2003) but in 2015 24% (79/325) had not heard of the concept before. This may be because a definition was provided to participants by Viner (2003) before the participants had been asked for their understanding. In the current study a definition was not provided until the following section.

Response bias may also have played a part in these findings; individuals may feel inclined to provide an untrue answer when asked about something they should be doing as part of their professional responsibilities (Rogers, 2016). It may also have been affected by the individuals who chose to complete the questionnaire. The fact that almost a quarter of respondents had not heard of clinical audit before in 2015 suggests that this is an area that requires education opportunities.

Just under half of respondents had not carried out clinical audit in any species. Apart from previous postgraduate education, demographic characteristics of the individuals with no prior clinical audit experience or knowledge did not differ significantly from the overall population of respondents. It is not known if post-graduate education is a cause or effect for conducting clinical audit; individuals who had undertaken post-graduate clinical audit education may have done so because they were asked to or planned to conduct clinical audit, or they may have conducted clinical audit because they had attended a recent course.

Preparation has been highlighted in the literature as an important part of the clinical audit cycle (Rayment, 2002; Viner, 2005a; University Hospitals Bristol, 2009c; Health and Safety Executive, 2013). Having a knowledgeable individual in charge, planning how the clinical audit will be communicated between team members and setting aside protected time to dedicate to the clinical audit may all aid in its delivery. There also appears to be a demand for easy,

simple, quick and honest data collection over short periods to avoid 'audit fatigue' and maintain interest.

The reasons respondents conducted their most recent clinical audit demonstrates that clinical audit is carried out for motives beyond meeting the RCVS requirements. Many vets want to know what happens in their practices, what their own outcomes are and where services can be improved. 'What do we currently do?' may be a beneficial, simple and effective place for clinicians to start clinical audit where current standards do not exist and current practices are unknown. These findings support the other benefits for conducting clinical audit in practice as mentioned in Chapter 1.

Veterinary surgeons appear to have conducted clinical audit on a wide range of topics with surgical topics being the most popular in the most recent clinical audits conducted. These appear to have several advantages such as being well defined cases with good caseloads and clear outcomes. It should be noted that at the time the survey was conducted XL Vets was running a nationwide clinical audit of caesarean sections over 49 practices (Woodmansey, 2016). It is unknown how many of the survey participants worked in XL Vets practices.

The XL Vets clinical audit may also have had an impact on the overall results of the survey as the majority of people that had been part of a farm animal clinical audit cited caesarean section as the topic of their most recent audit. Had the XL Vets clinical audit not been taking place, the number of vets that had previously participated in clinical audit may have been greatly reduced.

2.4.2 Education

Despite clinical audit being mentioned in the RCVS Code of Conduct, the PSS, and recent presentations at CPD events and some publications, the results suggest that more needs to be done to reach vets in practice to advise them on the use of clinical audit. Post-2010 graduates were significantly more likely to have received education on clinical audit whilst at veterinary school. This may be because clinical audit was introduced into the curriculum at that time,

or these responses could have been influenced by recall bias, with more recent graduates more clearly remembering what they had been taught. The results suggest that postgraduate education exists but that it has been undertaken by relatively few practitioners. Although post-2010 graduates may have, and currently are, receiving undergraduate education on the topic, the results suggest that there is still a large knowledge gap in veterinary surgeons who graduated prior to 2010 who may require extra support with the process. The appreciation of this knowledge gap may help with the running of a clinical audit. New graduates may provide a source of clinical audit knowledge that can be shared with the practice. Alternatively, CPD courses on clinical audit may be beneficial for an individual who can then lead and share knowledge with the rest of the practice team. Many articles exist that may help teams setting up a clinical audit and these could be distributed (Mosedale, 1998; Viner, 2009; Dunn, 2012). Remembering that clinical audit itself counts towards CPD requirements is also important, as the time required to complete clinical audit is valuable but the process has many benefits.

2.4.3 Barriers and facilitators towards clinical audit

In agreement with Viner (2003), attitudes towards clinical audit are positive, and seemingly more positive than the attitudes held by our medical counterparts (Nettleton and Ireland, 2000; Cai et al., 2009). Cai et al. (2009) conducted a survey of junior doctors using a questionnaire and found that junior doctors often failed to complete clinical audits, that they were unsure of the definition of clinical audit and that team members needed to work together out of 'office hours' in order to conduct effective clinical audit. Some of these barriers have also been highlighted by veterinary surgeons in the current study.

Findings by others suggesting that the time needed to undertake clinical audit appears to be a common stumbling block in both the veterinary and medical professions are supported by the current study (Nettleton and Ireland, 2000; Viner, 2003; Cai et al., 2009). Farm animal practitioners may therefore require protected time in order to conduct the process effectively, or the involvement

of other team members may help to spread the workload. The majority of respondents felt well informed of the clinical audits that had been conducted within their practices. This was a positive finding as the importance of good communication for a successful clinical audit has been previously highlighted (Rayment, 2002; Viner, 2009).

2.5 Study limitations

This study has gathered some detailed information on the use of clinical audit in farm animal practice in the UK. However, there are a number of limitations associated with this study. It is unknown how many veterinary surgeons undertake farm animal clinical work in any form in the UK. Neilsen et al (2014) suggested approximately 30% of the practising population were treating production animals in some form in 2010 but some details in reaching this figure are unclear. The five years between the Neilsen study and the current study has seen a decline in the number of mixed and farm animal practices, so this may also have reduced the percentage. It is therefore not appropriate to try to predict how representative this data was of veterinary surgeons undertaking farm animal work in the UK in 2015 based on the suggested figure by Neilsen et al (2014). Additionally, it is unknown how many veterinary surgeons the questionnaire reached in total. These factors meant it was not possible to calculate a response rate.

Emails sent to addresses found via the 'Find a vet' website were sent to practice email addresses, and it was requested for them to be forwarded on to any veterinary surgeons who carried out farm animal clinical work. Emails may have never been read, may not have been forwarded on, or may have been sent to the individual veterinary surgeon's email addresses and never read. The most responses were however received through this email list compared to the other channels, which indicates this is an effective way of reaching vets in farm practice.

A number of biases should be considered when interpreting the results of this nationwide survey. There is an assumption that participants will provide

honest answers in their questionnaire responses (Streiner and Norman, 2008). Online surveys provide only an electronic connection between researcher and participant; this may have led to more honest responses being given as the participants had the option to remain anonymous, or it may have encouraged less honest responses (Rogers, 2016). It is suspected that not all responses provided were 100% honest as some definitions of clinical audit matched exactly the wording found when the clinical audit definition was searched for on Google. Some individuals may have wanted to be seen in a good light, while others may have wanted to complete the questionnaire in the shortest time possible and these factors may also have affected the responses provided (Streiner and Norman, 2008). However, a large proportion of respondents completed all of the questions in the questionnaire, which suggests that time was not an issue for respondents.

Recall bias may also have affected the quality of the results (Streiner and Norman, 2008). The study asked for information relating to the most recent clinical audit which could have happened at any point in the past. Selection bias is another factor to consider (Dohoo, 2014). The questionnaire was created and delivered electronically. Veterinary surgeons who do not use the internet or email, or who were not members of BCVA or the SVS will not have received this survey. It is also unknown how many of the 20,000 veterinary surgeons listed as practising with the RCVS (Royal College of Veterinary Surgeons, 2014b) undertake farm animal work; and although listed as 'practising', does not confirm they work in clinical practice. The study population did have a similar structure to the age of practising vets as recorded by the RCVS (Royal College of Veterinary Surgeons, 2014b) however, it is difficult say how well the target population has been represented by these results (Dohoo 2014).

This survey did not account for clinical audits that were still running at the time the participants completed the survey. Individuals may not have included them in their responses, or they may have been included and then counted towards, for example, the number of clinical audits not completed.

As there is no guidance on how to analyse short, free text answers to questions, a basic thematic analysis approach was used. Thematic analysis is a flexible method of analysis but it allows for a range of analytic interpretation; the analysis here was carried out by one individual and another individual may have interpreted the data in a different way (Braun and Clarke, 2006). However, the method can be used to provide a good description of a data set as well as allowing for a social interpretation of data and producing easily accessible results (Braun and Clarke 2006).

Some of the skip logic on two of the questions in the SurveyMonkey questionnaire was set up incorrectly. The four respondents who answered 'other' to question two asking for a description of their caseload were taken directly to question six. These individuals therefore could not respond to questions three (full time or part time work pattern), four (year of graduation) and five (year became a MRCVS). This was a small number of participants and is therefore unlikely to have altered the overall description of the characteristics of the study population. The respondents who answered 'no, they had not heard of clinical audit before' to question six were directed to question 27 at the beginning of the 'attitudes to clinical audit' page. This was an error as individuals who have indicated that they do not know about something, cannot then answer questions on that topic. A number of individuals pointed this out in their comments. These responses were therefore not included when the 'attitudes to clinical audit' were analysed as it was considered that if they had not heard of the concept, they would not be able to hold an opinion. This was only true for a minimal number of respondents.

The questionnaire was shared on social media and could have been completed by veterinary surgeons from other sectors, non-practising veterinary surgeons or any member of the public. The first question asked if the individual conducted clinical veterinary work in the UK, and there did not appear to be any adverse or unexpected responses in the free text boxes so it is assumed that this had a minimal effect on the results of the study.

A £50 voucher for a store of their choice was offered to a participant selected at random, if the participant chose to enter their email for the prize draw. Prize draws have been shown to increase completion rates of online surveys and reduce the number of incomplete questions in a survey (Bosnjak and Tuten, 2003). Certain people may be more attracted by monetary incentives (as monetary incentives have been shown to increase participation in surveys (Bentley and Thacker, 2004). It is not known to what extent the prize draw incentive may have affected the results in this survey.

2.6 Conclusion

This study highlights the range of understanding, experience and use of clinical audit by farm animal veterinary surgeons in UK practice in 2015. The results suggest that clinical audit is a quality improvement tool that can be used with success in the farm animal practice setting. For particular consideration is the potential knowledge gap on the subject in the current practising population of veterinary surgeons and the resultant need for more education, resources and support.

Chapter 3 Initiating clinical audit in three farm animal practices; Identification of clinical audit topics and factors affecting engagement

3.1 Introduction

Good preparation is required for a clinical audit to be successful (Rayment, 2002; Viner, 2005a). The first stage of clinical audit should include a consideration of resources required, the creation of a no-blame environment and identification of stakeholders and clinical audit team members (Mosedale, 1998; Rayment, 2002; Viner, 2009). Effective communication should be set up between team members, a topic to audit should be chosen and the literature should be searched (Rayment, 2002; Viner, 2005a). Clear aims and a defined time frame will aid the progress and success of clinical audit (Rayment, 2002). A clinical audit pilot will allow any problems to be detected before proceeding with data collection (Rayment, 2002; University Hospitals Bristol, 2009d; Optial Blood Use, 2013;). Good communication is key for an effective clinical audit (Absi, 2013). An initial meeting allows all stakeholders to be involved in the decision making from the beginning of the process and aids in the establishment of clear communication channels (Rayment, 2002). In Chapter 2 the farm animal veterinary surgeons surveyed agreed that these elements should be considered when preparing for clinical audit.

This chapter focuses on the initial stages of clinical audit. There were two main aims to this study:

1. To hold meetings within veterinary practices using an amended JLA Priority Setting Partnership Meeting format, to enable practitioners to select a topic to audit in a fair, shared and transparent way.
2. To gather the opinions and attitudes, via questionnaire and discussion, of practitioners at a local level towards the use of clinical audit in farm

practice in order to determine perceived barriers and facilitators to the process.

3.2 Methods

3.2.1 Participant recruitment

Three farm animal veterinary practices were approached by the Centre for Evidence-based Veterinary Medicine (CEVM) to run clinical audits in practice. For reasons of confidentiality, full details of the practices cannot be given. The practices are known as Practice 1, Practice 2 and Practice 3 throughout the thesis. The practices were a mixture of mixed and farm animal only practices from different geographical areas of the UK. The veterinary surgeons within the practices conducted either mixed species or farm animal only work. All veterinary surgeons undertaking farm animal work within each of the three practices agreed to be involved in the project. This included a mixture of senior and junior members of staff. Demographics about the participants were collected using questionnaires (discussed below).

3.2.1.1.1 Initial contact with the veterinary practices

The three practices were sent an information sheet informing them of the project outline for the study (Appendix 2). Contact was then made with all three veterinary practices by telephone. During the initial phone conversations the practices were informed of the main aims of the project. After these initial phone calls, email was used to arrange visits to each of the practices to facilitate the initial practice meetings. In line with the JLA protocol, these are known here on in as Priority Setting Partnership Meetings (PSMs).

3.2.2 Choosing a topic to audit

To enable shared decision making within the practices for a topic to audit to be chosen, the use of two consensus methods were considered; the Delphi process and the nominal group technique (Jones and Hunter, 1995).

3.2.2.1 Priority Setting Partnership Meetings

The aim of the PSMs was to find a topic that could be taken forward to audit. PSMs use an adapted nominal group technique method to reach agreement on a topic within a group of people. The topic was chosen by the practising vets, with facilitation of the discussion by the researchers.

3.2.2.1.1 Preparation prior to the PSMs

Practices were contacted by email prior to the meetings and were asked to email back topics that they might like to audit. These topics (Column 1 in Appendix 3, Appendix 4 and Appendix 5) were all collated by the researcher. The suggested topics were very broad, for example 'right-sided pings', 'common bovine eye problems' and 'digit amputation'. The Online Journal of Clinical Audits, a database of published human medicine clinical audits, was therefore consulted for some specific clinical audit ideas that could be run within the practices based around their broad suggested topics (clinicalaudits.com, 2015).

3.2.2.1.2 *The practice meetings*

A spreadsheet for each practice was created and presented at each practice meeting, providing the vets with more specific ideas of what the clinical audit could potentially focus on (Appendix 3, Appendix 4 and Appendix 5).

A PSM Plan was drawn up as a guide to follow during the meetings:

- Welcome and introductions (10 minutes)
 - Vet and practice questionnaires to be filled in
- Short presentation (20 minutes)
 - Introduction to the CEVM and researchers
 - Information about the study
 - Introduction to clinical audit
- Discuss topics submitted (30-45 minutes)
 - Discuss the ideas emailed in
 - Go through each topic and record specific areas of interest (aim for two specific areas per topic)
 - Write these specific areas on to the worksheet
- Dinner break
- Split into two groups (30-45 minutes)
 - Topics to be ranked in order of preference
- Break for cake
 - Compare lists and find the top three topics
- Choose the final topic to audit
 - Working as a single group, from the top three choose a final topic to audit
- Discuss methods of data collection (10 minutes)
- Discuss keeping in touch (10 minutes)
- Discuss anonymity (5-10 minutes)
- Any other business (10 minutes)
 - Answer any questions
- Next step (5-10 minutes)
 - What happens now?

The initial submitted ideas were discussed. When the majority of the team agreed, a topic would be discarded or saved for the next round. A final topic to audit was chosen by a final vote of a show of hands from the people

present. If at the end of the PSM the topic was not specific enough, it was refined through emails after the meeting.

Options for the data collection for the clinical audit, methods that could be used to keep in touch and the next steps of the project were discussed and agreed upon before the meetings were drawn to a close.

To allow the decision making process to be analysed thoroughly, the Priority Setting Meetings were recorded using two dictaphones. An email sent to the vets before the meetings took place advised the vets that the meetings would be recorded. A consent form was completed by all the vets present at the PSMs prior to the start of the recording. This explained that the information collected would be anonymous and treated confidentially, that the veterinary surgeons involved would not be identifiable in the completed work and that they had the right to 'opt out' and switch the dictaphones off at any point during the meetings. The consent form also highlighted that the raw data would only be accessible to researchers within the CEVM working on the project and that the veterinary surgeons could access their data at any point during the study.

3.2.2.1.3 Analysis of data from the meetings

All suggested clinical audit topics were initially collated in Microsoft Excel V.14.0.6 (2010 Microsoft Corporation), the topics that were discarded at each round of discussion were noted on paper and a record made of the final topics chosen. The discussions were recorded and transcribed and Microsoft Excel V.14.0.6 (2010 Microsoft Corporation) was then used to organise the data for themes to be identified.

3.2.3 Practicalities of, and thoughts on, conducting clinical audit

Two different questionnaires were completed within each practice before the PSMs started to gather some understanding of the practicalities of clinical audit. These questionnaires also collected demographics about the project participants.

3.2.3.1 Vet questionnaire

At the PSMs, before any discussion about clinical audit with the veterinary surgeons in the practices took place, all of the practitioners were asked to complete a vet questionnaire (Appendix 6). Non-attenders of these meetings were left copies of the questionnaire and were asked to post them back to the CEVM. The vet questionnaire had two main sections spread over two sides of A4; the first asking for details about the individual veterinary surgeon 'About you', and the second concerning clinical audit. There were 18 questions in total; seven in section one and eleven in section two. The questionnaire included a mixture of closed questions, open questions, multiple choice questions, and opinion questions requiring a response using a Likert Scale. Three of the opinion questions were based on questions used in pre and post clinical audit interviews by (Viner, 2006). Other questions were based on work by (Viner, 2003). Non-attenders of these meetings were left copies of the questionnaire and were asked to post them back to the CEVM.

3.2.3.2 Practice Questionnaire

A practice questionnaire (Appendix 7) was also completed at the PSM held at each practice. The aim was to acquire the basic background information about the practices such as the computer system used, the number of support staff, details about the practice's RCVS Practice Standards Scheme membership and the type of work carried out. One of the partners or directors at each of the practices was asked to complete the practice questionnaire. The practice questionnaire comprised of seven questions on one sheet of A4 paper. The questionnaire included open questions, multiple choice questions and dichotomous questions.

3.2.3.3 Piloting of both questionnaires

Both questionnaires were constructed and then sent to members of the CEVM to be pretested. Responses were received and the questions were altered accordingly. The questionnaires were then piloted by members of the University of Nottingham School of Veterinary Medicine & Science farm animal clinical staff prior to the PSMs.

3.2.3.4 Analysis of questionnaire data

Data from the questionnaires were entered into a Microsoft Excel V.14.0.6 (2010 Microsoft Corporation) spreadsheet for analysis. The data were checked against the original paper copies, cleaned and coded before descriptive analysis was conducted. To check accuracy, all 19 completed questionnaires were checked against the original paper copies after coding. Categorical data were described as whole numbers and percentages. Responses to the Likert scale were described as whole numbers and reported as percentages.

Responses to the free text questions were examined visually and grouped into categories according to topics raised by the individual veterinary surgeons. These are presented as themes with example quotes from the respondents.

3.3 Results

3.3.1 The participants involved in the project

The veterinary surgeons that conducted farm animal clinical work in each practice were not all able to attend the PSMs: four out of eight vets attended the PSM at Practice 1; four out of six at Practice 2 and six out of 9 in Practice 3. At least one veterinary surgeon had to leave each meeting at each practice to attend an emergency. Other reasons for non-attendance included clinicians being away on holiday or on CPD courses, while some were still consulting in a separate branch practice and others worked part time and were not working that day. The vets who did attend were a mixture of mixed and large animal vets ranging between recent graduates and partners of the business. All worked full time.

3.3.1.1 Practice details

All three practices were members of the RCVS Practice Standards Scheme at the General Practice level, and all charged for their work by time spent on the farm. Table 8 shows practice level detail collected via both the vet and the practice questionnaires. Practice details have been combined for reasons of confidentiality.

Table 8 Practice level data collected via both questionnaires.

*Mixed = Small Animal, Equine & Farm or Small Animal & Farm Animal or Farm Animal & Equine caseload, FA = Farm Animal only. ⁺A definition of 'support staff' was not given

Total number of vets undertaking farm animal work in the three practices	Caseload of vets [Mixed:FA*]	Number of vets working [Full time:Part time]	Veterinary surgeons year of graduation [Median (IQ range)]	Number of vets holding post graduate qualifications	No. of farm animal support staff within the three practices ⁺	How work was charged in all three practices	RCVS Practice Standards Scheme membership level in all three practices	Practice management software used
23	10:13	20:3	2004 (1995-2009)	8	21	On time	General	Robovet or RxWorks

3.3.1.2 Vet details

At the start of the study, a total of 23 vets undertook farm animal clinical work at the three practices. Of these, 20 vets filled in the vet questionnaire giving a response rate of 87% (20/23). Nineteen vet questionnaires were fully completed; one vet missed the second page of questions. Information such as year of graduation and vet school attended was gathered from the internet via the practice websites or the RCVS register for three veterinary surgeons that did not complete their questionnaire. The initial results spreadsheet therefore contained 23 records, four of which were incomplete. The nineteen fully completed records were used for the analysis for question nine onwards.

The 23 veterinary surgeons had been practising between one and 35 years, with a median year of graduation of 2004. Forty-eight percent (11/23) of the veterinary surgeons had graduated in the previous eight years and could therefore be classed as recent graduates (British Veterinary Association, 2014). Twenty percent of veterinary surgeons were undertaking mixed work, while 80% (16/20) were carrying out large animal (equine and farm, or farm only) duties. Eighty-five percent (17/20) of the veterinary surgeons held full time positions. Sixteen of the twenty (80%) vets held, or were enrolled in post-graduate qualifications including the RCVS Certificate in Advanced Veterinary Practice (Cert AVP), RCVS and European Diplomas and the Diploma in Bovine Reproduction (DBR) (Figure 15).

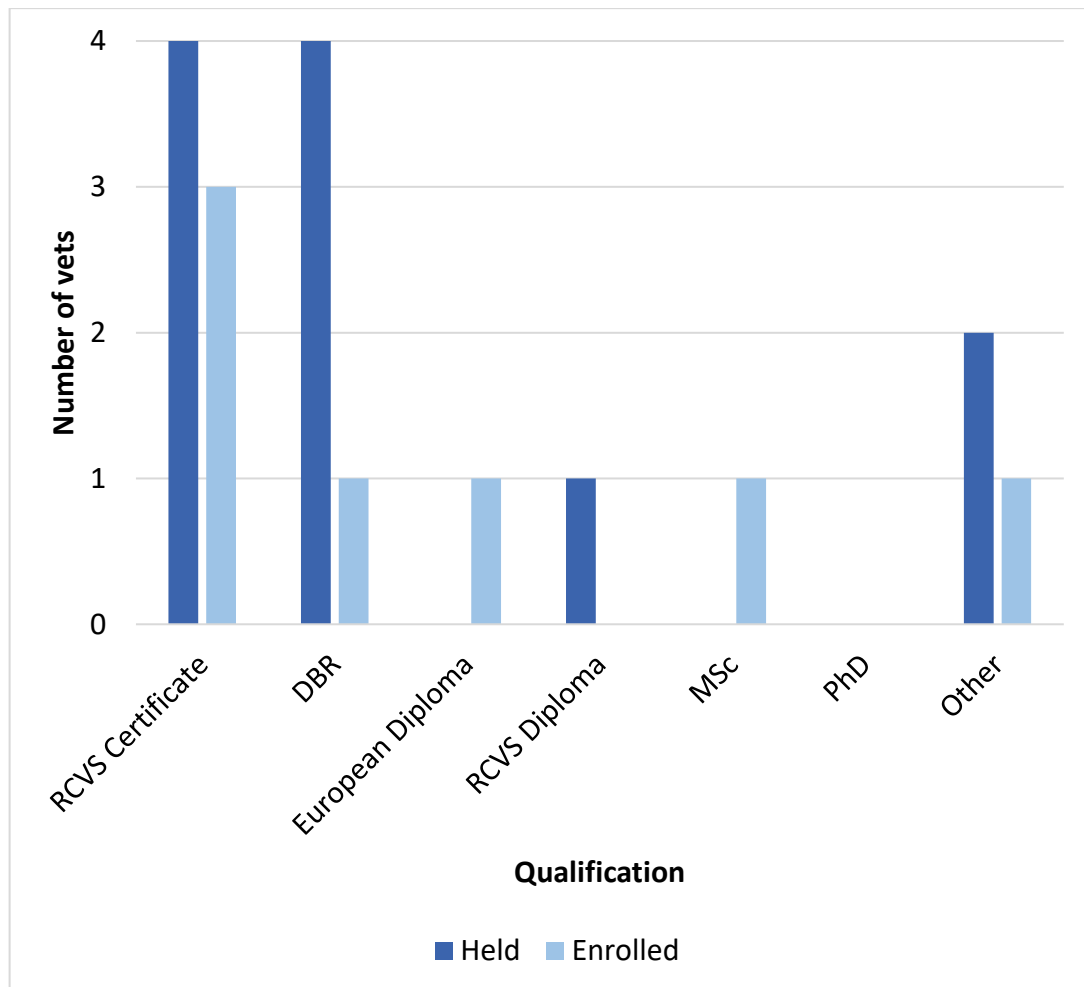


Figure 15 Number of veterinary surgeons enrolled on, or holding a post-graduate qualification in the three practices

DBR = Diploma in Bovine Reproduction, RCVS = Royal College of Veterinary Surgeons, MSc = Master's Degree, PhD = Doctor of Philosophy

3.3.2 Choosing a topic to audit

3.3.2.1 Priority setting meetings

It took between two to four months to arrange a date for the PSM with each practice. Time of year was an important consideration due to events such as holidays or calving season during spring time. Due to the smaller number of participants than expected at each of the meetings, the original meeting plan was amended, and the groups were not split into smaller groups. All discussions held at each of the three meetings included all of the participants present on the day.

3.3.2.1.1 Practice 1

Practice 1 initially submitted nine clinical audit topic ideas via email prior to the PSMs (Appendix 3). Metritis, endometritis, toxic *E.coli* mastitis and the use of tilmicosin at drying off were all dropped after the first round of discussion. Reasons included perceived low caseload, topic too complicated, farmer involvement with the condition or a lack of enthusiasm for the topic. Retained foetal membranes (RFMs), vet assisted calvings, ketosis therapies, Left Displaced Abomasum (LDA) correction methods and cystic ovarian disease (COD) were all discussed in more detail. Ketosis therapies were considered too complicated with challenges of case definition. Vet assisted calvings were considered too complicated due to the many different approaches to each case. A large amount of discussion took place around RFMs, but this was eventually discarded due to a low level of interest from the team and a concern that cases may not be presented for follow up. The two remaining topics (LDA correction methods and COD) had dominated the discussion from the beginning and were identified as the two favourite topic choices. A vote was taken from the veterinary surgeons present by a show of hands in the air and the final topic to audit was determined as cystic ovarian disease - what treatments were being used at first and follow up examinations. It took nearly three hours to reach this final decision on the choice of clinical audit topic.

As only half the members of the team had been present at the PSM and the decision making had aimed to incorporate the whole team, a second vote to refine the clinical audit question was conducted via email to allow all team members to vote. Four specific clinical audit choices were offered which were based on the two main areas of interest talked about during the PSM:

1. What treatment is given for COD at the first visit, and follow up visits, by vets in the practice?
2. What treatment is given at the first visit for COD? What are the reasons behind choosing these treatments?
3. What approaches are used for the treatment of LDAs, and why?
4. What approaches are used for the treatment of LDA, and does this affect longevity within the herd?

Half the team voted by email and option 1 (What treatment is given for COD at the first visit, and follow up visits, by vets in the practice?) was confirmed as the final topic to audit.

3.3.2.1.2 Practice 2

Practice 2 initially submitted eight topic ideas via email (Appendix 4). Fertility topics (metritis, endometritis, anoestrus and cystic ovaries) were rejected almost immediately as only two of the veterinary surgeons conducted frequent routine fertility visits and it felt best to choose a topic that all members of the team could be involved in. Bovine acidosis was dropped as it was considered too difficult to diagnose and confirm a case. Toxic *E.Coli* mastitis was rejected because it was thought that the case load would be too low and common bovine eye problems was not perceived to be as interesting as calf pneumonia.

It took 25 minutes for the practitioners to rule out all other topics and decide to focus on calf pneumonia and either treatment used, survival rates or the use of a pneumonia scoring system.

A link to a SurveyMonkey voting form was sent in an email after the PSM to all team members. Five choices for clinical audit were given:

1. Calf pneumonia treatment – The treatment used and why it is chosen
2. Accuracy of dosing - The number of calves weighed before a treatment is given for pneumonia
3. Accuracy of dosing - Weight estimates compared to weight as measured by a weigh tape, or scales
4. Outcome of calves treated for pneumonia – The number of calves still alive at four weeks post treatment
5. Use of a pneumonia scoring system – How clinical severity affects the choice of treatment

Half of the veterinary surgeons from the practice voted and all voted for option 4 (outcomes of calves treated for pneumonia – The number of calves still alive at four weeks post treatment).

3.3.2.1.3 *Practice 3*

Practice 3 initially suggested five topics to audit via email (Appendix 5). A large amount of discussion took place at the PSM around the topics with the discussion lasting approximately two hours.

All five topics were discussed in a varying amount of detail. Toxic mastitis was considered too difficult to audit compared to other topics and there was concern that the case load would be too low. A clinical audit of pre-weaned calf scour in calves admitted and treated at the surgery was thought not possible due to a small caseload. It was considered difficult to define cases for 'right-sided pings' and again, the caseload was considered too small. The caseload for digit amputations was also thought to be on the low side with success difficult to measure and difficulty drawing conclusions about cases.

Outcomes of LDA surgery had been a firm favourite from the beginning and was chosen as the final topic to audit. The clinical audit would specifically look at outcomes of surgery including survival rates, calving to conception and milk yields. The clinicians felt that the caseload would be fairly high. A farmer had also recently challenged them on their success rates so the practitioners felt it would be relevant to their clients. The veterinary surgeons also felt that they were fairly 'good' at LDAs but had never actually looked at any outcomes to confirm this. They also wanted to find out where their outcomes 'sat' compared to outcomes of laparoscopic surgery – a technique that would require significant time and economic investment should they wish to offer that service. This final topic was chosen through group discussion and rejection of all other topics.

3.3.2.1.4 *Practice results combined*

Practice 1 suggested nine topics, Practice 2 eight topics and Practice 3 five topics, giving a total of 22 with 16 different topics suggested overall. There were similarities between some of the topics suggested prior to the PSMs taking place (Figure 16). All three practices suggested toxic *E.coli* mastitis, and five of the same topics (LDAs, cystic ovaries, endometritis, metritis and toxic mastitis) were suggested by more than one practice. Many topics around reproductive issues were suggested.

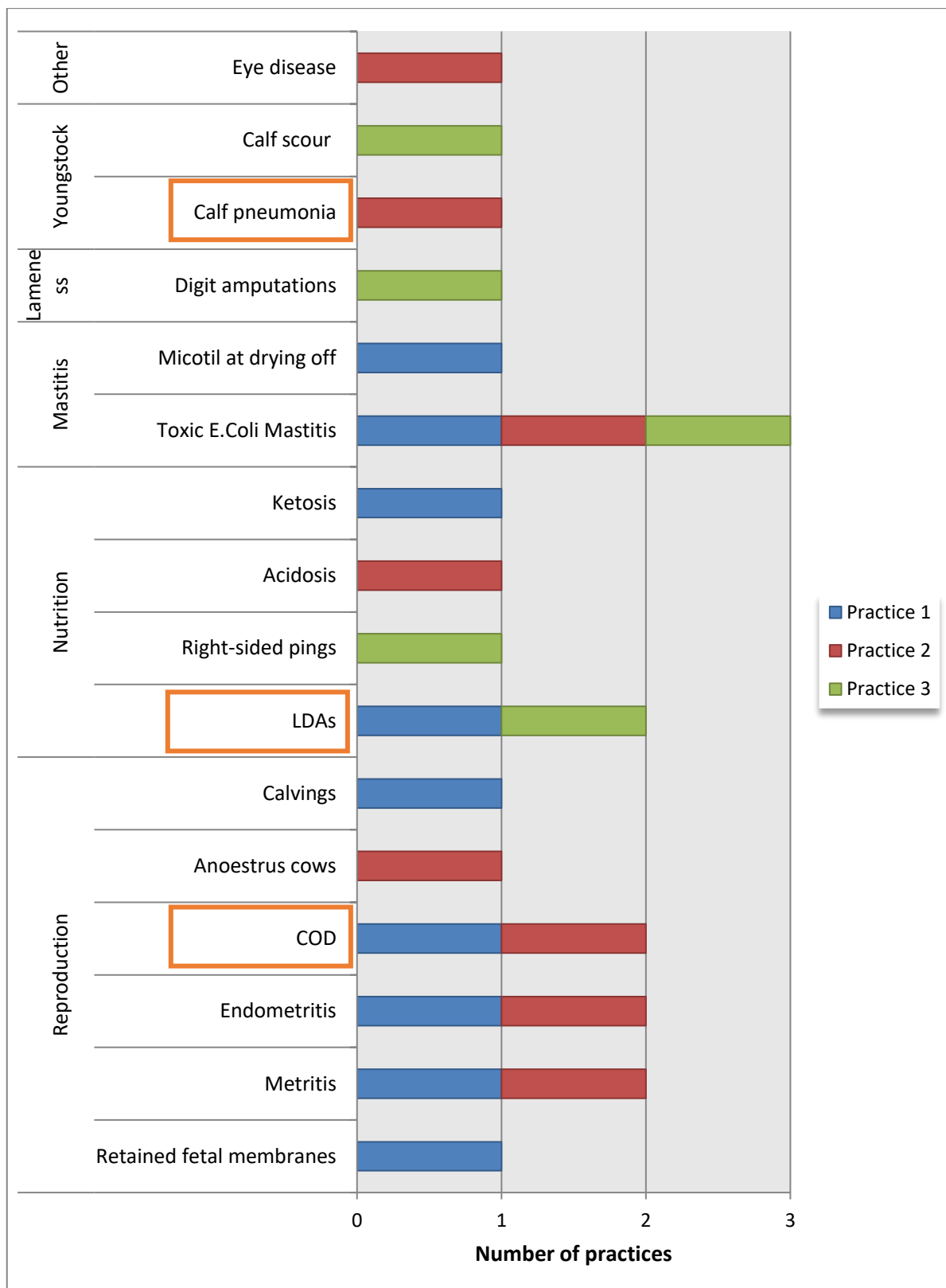


Figure 16 Clinical audit topics suggested by all three practices with final topics chosen highlighted in orange

COD = Cystic Ovarian Disease, LDAs = Left Displaced Abomasums

3.3.3 Practicalities of, and thoughts on, conducting clinical audit

3.3.3.1 Findings from the vet questionnaire

In the vet questionnaire 80% (16/20) of the vets stated that they had participated in clinical audit before, with one veterinary surgeon unsure if they had, or had not been involved with clinical audit previously. All of the veterinary surgeons (19/19) agreed or strongly agreed that clinical audit could improve clinical standards in farm animal veterinary practice, while 89% (17/19) agreed or strongly agreed that clinical audit could enhance job satisfaction. Seventy-four percent (14/19) thought that clinical audit could bring financial benefit to practices, 42% (8/19) thought that clinical audit took up a large amount of time and 63% (12/19) thought that clinical audit should be compulsory for all farm animal veterinary practices (Figure 17).

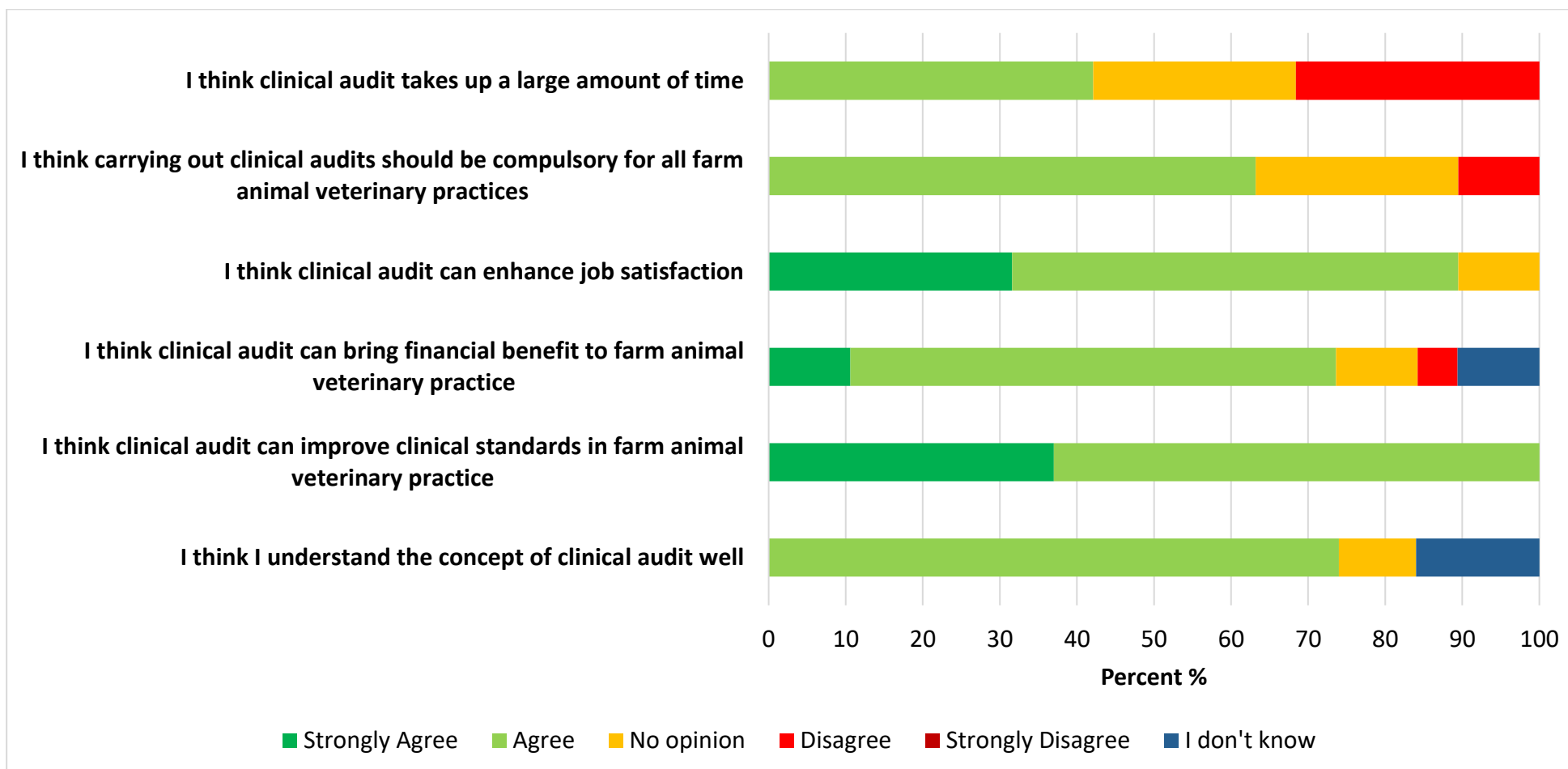


Figure 17 Level of agreement from practitioners on statements relating to clinical audit (n = 19)

Although fourteen out of the nineteen vets agreed that they understood the concept of clinical audit well, there were a variety of descriptions that were provided when asked to outline current understanding of clinical audit. Just over half (53%; 10/19) of the vets acknowledged that clinical audit involved assessing or measuring features of veterinary care, and the word 'outcomes' was mentioned in fifteen responses. Nine out of 19 responses suggested that clinical audit measured clinical performance, with six practitioners proposing that clinical audit specifically measured against published data, other groups or individuals, or pre-set protocols. No mentions were given to the clinical audit cycle. One veterinary surgeon specifically suggested that clinical audit was 'retrospective study', while three other veterinary surgeons mentioned protocols.

Overall there were more comments recorded for perceived difficulties of carrying out clinical audit in practice than there were for perceived facilitators. Some vets thought that the small diversity in the treatment options available for farm animals would make clinical audit fairly easy, and others thought that outcomes would be easy to measure (Table 9). Although the vets appear to have a generally positive view of clinical audit, many perceived difficulties were highlighted at this stage, such as time and accuracy of data recording.

Table 9 Aspects of carrying out clinical audit in farm practice considered to be easy or difficult by practitioners. Number of responders appears in brackets

Aspects of conducting clinical audit perceived to be easy by practitioners	Example quotes
Little diversity in treatments so easy to compare them (4)	<i>"There are various clinical conditions that have a similar approach/treatments so comparison/audit less complicated"</i>
Outcomes are easy to define and measure (4)	<i>"Certain outcomes such as alive or dead after a certain period of time"</i>
Agreeing to do the clinical audit (2)	<i>"Agreeing to do them"</i>
Case load (2)	<i>"Number of cases"</i>
Recording clinical findings (2)	<i>"Recording generally/normally easy - ticking boxes etc"</i>
Engagement of vets and farmers (1)	<i>"Engagement of vets, support staff and clients/farmers"</i>
Farm animal data easy to follow up (1)	<i>"Some farm animal data is easy to follow over protracted periods of time"</i>
Aspects of conducting clinical audit perceived to be difficult by practitioners	Example quotes
Time (8)	<i>"Finding time to record information when practice is busy"</i>
Accuracy and consistency of data recording by different individuals (6)	<i>"It would be difficult to standardise or categorise a lot of what we do..... We are also very dependent on farmer feedback which may not be accurate enough"</i>
Recording data in the farm environment (4)	<i>"Capturing data at the time on farm"</i>
Enthusiasm of vets and clients (4)	<i>"Getting everybody involved"</i>
Collecting follow up data (4)	<i>"Remembering to do follow-up paperwork"</i>
Specifying a diagnosis (2)	<i>"Specifying a diagnosis"</i>
Classifying levels of disease severity (1)	<i>"Some conditions such as pneumonia or metritis have different levels of severity therefore how do you weight the outcomes?"</i>
Collecting individual animal identification (1)	<i>"Individual animal identification"</i>
Case load (1)	<i>"Volume of cases"</i>

All respondents were asked for any further comments or concerns they might have about clinical audit. Two vets were concerned about making a diagnosis and what to do when cases did not 'fit the box' or when diagnoses were made but not confirmed. One vet stressed that clinical audit must be kept simple, so that busy vets can keep up to date with it while another noted that clinical audit is important, but needs to be pragmatic and beneficial. One veterinary surgeon included a notable closing comment on their questionnaire: *"Because farm vets work largely in 'splendid isolation' good things may not be passed on and bad things may never come to light. We probably need clinical audit in farm practice more than anything else"*

3.3.3.2 Thoughts from practitioners at the PSMs about conducting clinical audit in farm practice

Table 10 shows a summary of the issues that were discussed during the PSMs by the veterinary surgeons on conducting clinical audit in farm practice. Many themes were picked up from the vets while they were discussing which topics they would like to audit at the meetings held at the individual practices. These have been split into four broad overarching themes – thoughts about clinical audit relating to the vet, the farmer, the practice and the profession. Factors associated with the vet on a personal level are things the vets themselves may have to do in relation to clinical audit. At the practice level are factors that may have a potential impact on the practice, at the farm level are aspects of clinical audit that may affect the farmer and at the professional level are things that may be applicable to other members of the profession or the profession as a whole. The veterinary surgeons suggested that it may be good to look at outcomes that the farmers may be interested in, or find useful.

During the discussions, the practitioners raised a number of concerns about clinical audit. Firstly, choosing a topic that would be 'clean' or 'easy' to diagnose and deal with. Topics such as dystocia were considered too difficult to audit, and the vets felt that having a topic that could be easily diagnosed would be an advantage. There was also concern over auditing topics that had not definitively been diagnosed on farm; often vets treat farm animals based

on clinical signs and history alone, and it was felt that this would not be acceptable had this been a research project. It was therefore decided that when choosing a topic for clinical audit, a case would count for the clinical audit if the vet was treating the animal for that condition. For example, a ketotic cow would be included in a 'ketotic cow' clinical audit if the vet thought it was ketotic, and was treating it for ketosis, whether or not ketosis had been confirmed by further diagnostic tests. Many issues discussed focussed around the logistics of clinical audit – collecting ear tag numbers was considered a big barrier and there was concern over who would process the data.

The veterinary surgeons discussed many issues about how they would carry out clinical audit, how it would affect them in practice, who would carry out the clinical audit and the vets wanted an easy-to-complete data collection form. The vets felt that it was important that all of the vets were able to take part in the clinical audit and therefore a topic should be chosen that would involve everybody. There was also discussion over who would run the clinical audit and sort the data within the practice. Issues raised that specifically related to undertaking clinical audit in farm animal practice included ensuring that data collection books, if used, could survive the conditions on farm and ensuring that the process was as efficient as possible due to minimal time spent at the practice during the working day.

All three practices highlighted case load as an important factor when choosing a topic to audit. For many of the conditions discussed, the practitioners were unsure as to how many cases would be seen by the practice within a given time frame. There were some topics that they were sure they would see too few cases to audit, for example right displaced abomasums (RDAs), and others topics where they would almost see too many cases to audit, for examples cases of endometritis. Getting an overview on the number of cases seen was perceived to be one benefit of running a clinical audit.

Table 10 Themes arising from PSM meetings about conducting clinical audit collected during recordings of the discussion with vets from the three farm animal practices

Theme	Example quote
Vets – Personal level	
<u>Logistics of clinical audit</u> Choosing a 'clear', defined topic to audit Collecting and recording the data Who will be involved in the clinical audit Quality of data recorded <u>Understanding of the process and how it fits in with the bigger picture</u> Confusion between research and clinical audit Want a topic that is something that can be improved upon Need to be able to draw meaningful conclusions from the information collected <u>Benefits gained from doing it</u> Interesting to know what people do on a day-to-day basis, not in an ideal world Interesting to know why people do what they do	<i>"But then you have to have a case definition"</i> <i>"I always forget to write down the cow numbers"</i> <i>"A clinical condition we would all see"</i> <i>"If your data's absolute rubbish then your outcome's rubbish as well"</i> <i>"Yes, but then is that research is it?"</i> <i>"this would be of real benefit to us because it would fine tune the way we do things"</i> <i>"it's just getting useful information out of it"</i> <i>"I thought we basically all did the same anyway"</i> <i>"It would be interesting from my point of view to know why people make the decisions that they do"</i>
Practice level	
Unsure as to how many cases are seen by the practice in a given time period for a given condition Results could be used for marketing Don't want to choose something that may reflect badly on the practice	<i>"There's just not enough cases of it"</i> <i>"It would be good to say....and put it on all of our adverts"</i> <i>"it would be a PR disaster wouldn't it?!"</i>
Professional Level	
Auditing the use of off label/not licensed/illegal drugs Would like to be able to learn things from clinical audit that could then be presented back to the profession	<i>"They'll be using more off license stuff"</i> <i>"It would be useful to go back to the profession as a whole and say....."</i>
Farm/farmer level	
Problems with subjective assessments by farmers Can use data from Interherd or milk records Farm environment not ideal for data collection books	<i>"It was all a bit swollen at the bottom, but for him he was like "Oh, do you think that's a bit swollen?""</i> <i>"most milk recording farms will have that data easily enough"</i> <i>"And they'd be laminated...so they could be used on farm"</i>

3.4 Discussion

The questionnaires allowed the collection of prior experience, background information and thoughts on clinical audit from the practitioners involved in the project. This information provided a useful baseline to help facilitate the ongoing clinical audits discussed further in Chapters 4 and 5. The PSM format was unable to be rigidly followed due to the small number of veterinary surgeons able to attend each meeting; this did not however hinder the ability for a topic to be chosen for audit in a fair and transparent way.

3.4.1 Choosing a topic to audit

To enable shared decision making among the practitioners when choosing the topic to audit the use of two consensus methods was considered: the Delphi process and the Nominal Group Technique (Jones and Hunter, 1995). The Delphi process uses multiple stages of questionnaire completion by a group to reach a consensus (McMillan et al, 2016). Due to the amount of time required for this process and the reliance on multiple completed questionnaires by busy practitioners this was thought to be unsuitable. The nominal group technique can take place face-to-face with small groups of people and this method was deemed more appropriate for audit topic selection. The nominal group technique involves a period of quiet time where participants can generate their own ideas about specific questions, ideas are then shared in a round-robin style, there is then a period of group clarification to discuss the suggestions before a ranking phase starts (McMillan et al, 2016). The James Lind Alliance used a modified nominal group technique to allow groups of people to agree on a set number of topics. These Priority Setting Partnership meetings play an important role in human medicine for prioritising topics for research (Cowan and Oliver, 2013) and this concept has previously been adapted successfully for use in veterinary research (Anon, 2015). Due to the small number of practitioners present at each PSM, the adapted PSP protocol was however unable to be followed fully for choosing a topic to audit in this case. The full process of a classic nominal group technique is very time consuming with pre-meeting tasks and then 30 minutes given to each stage of

the decision making (McMillan et al, 2016). Veterinary surgeons are often very busy, and farm animal vets in particular spend a limited amount of time at the practice and among colleagues. Taking a few hours to choose a topic to audit may not be the best use of time for them. The JLA find that the PSP meetings allow individuals to all have an equal say. In some practices colleagues work very closely and a structured way of allowing people to speak may not be necessary. Clinical audit also varies from research; some clinical audits can be very short so spending a few hours choosing a topic for an audit that might be completed in an afternoon may not be time efficient. However, if a large scale clinical audit is planned, or an audit that will run over a long period of time, a more structured process that requires a large amount of time may be beneficial and conducive to a successful audit. How a topic is chosen for audit will depend on the practice culture and the type of clinical audit being planned. The modified nominal group technique has some benefits when used in appropriate situations.

There were a number of points that can be taken from the PSM process to aid choosing a topic for audit within a veterinary team. There must be recognition that all individuals have an equal say in choosing the topic to audit. This becomes more important for clinical audits that will be conducted over a long period of time or that will involve a large amount of input from the audit team. Allowing each practitioner to have a share in the decision making is beneficial for clinical audit as all stakeholders should be involved from the beginning of the process (Viner, 2009). Members of a practice team vary in their interests, clinical experience and abilities, so achieving active involvement and engagement are crucial to ensuring success of the ensuing clinical audit.

The adapted PSM protocol was not fully followed or completed in any of the three practices, but holding a meeting had many benefits for initiating clinical audit. For veterinary practices that have an open environment with established, good team communication, holding a meeting may be a simple task. For practices where communication between team members is more

difficult, the presence of a facilitator may allow participants to have equal opportunities to speak (James Lind Alliance, 2016). The facilitator should oversee the group to ensure that individuals do not become overbearing. Individual personalities and positions within the team should also be considered; new graduates may not feel as comfortable to speak as a senior partner. In the meetings conducted here, the researchers found that keeping the discussion on the right track when it had started to diverge was not too challenging; but being external to the practices may have facilitated this. When holding a meeting the lay-out of the room is vital to encourage productive discussion within the group (James Lind Alliance, 2016). In all three meetings this was challenging as the room location was unknown until the meeting started and lay-out options were limited in all cases. Detailed consideration of lay-out is easier in a known environment, but in these cases lay-out limitations did not appear to effect discussion. This may have been because the environment was familiar to the participants.

Meeting to choose a topic to audit can have many other benefits for the individual vets and the practice as a whole, giving all members of the team time to communicate in person with each other. The PSMs stimulated discussion about recent research, what techniques and treatments the vets currently use, recent clinical cases, how many cases they see, what they should do more of and consideration of new diagnostic tests or surgical techniques. However, it was difficult to get all the practitioners in all three practices to the meetings because of on-call duties and other commitments; this could be a barrier to setting topics that everyone wants to audit and highlights the importance of effective communication between the team by other channels. Emails can be effective if practitioners have regular access and are technically competent, otherwise memos, posters or newsletters could be used to keep all stakeholders up to date (Anon, 2015).

The time taken to choose a topic to audit varied greatly between practices. This appeared to be affected by the number of people present at the meetings; more people resulted in more discussion overall. The detail in

which each potential topic was discussed appeared to depend on interest, experiences of recent cases, attendance of recent CPD on the subject and perceived complexity of how to define the topic.

3.4.1.1 Topics chosen for clinical audit

The topics chosen in the three practices were done so for a number of reasons; the practitioners wished to confirm perceived good outcomes, the team wanted a topic that everybody could be involved in; the practitioners were interested in the topic; the topic had a perceived high case load and the topic was considered 'easy' to define in practice. Viner (2005a) and Dunn (2012) suggest that all clinical audits should start with a perceived problem or an area where change is known to be required. However, benefits may be gained from auditing unknown or suspected successful areas. If processes or outcomes are unknown within a practice then encouragement and enthusiasm in the work delivered by a team can be gained by confirming problems do not exist and this may also boost interest in clinical audit. Performing clinical audit on areas of practice that are suspected or assumed to be successful may lead to confirmation of this which may also be encouraging for team members.

The seasonal nature of farm animal work can affect the caseload of certain conditions; busy seasons may yield a high number of cases to record, but it will also result in less time being available for the clinical audit administrative work. High caseloads however, may not be required for clinical audit; fewer cases may still lead to good discussions around a topic.

At the meetings all three practices generated good discussion around issues affecting the choice of clinical audit topics, enabling a single topic to be chosen fairly easily. The topics chosen in each practice were very different, although a number of similar topics were discussed between the practices in the process. Reproduction topics received a large amount of discussion due to the high case load and ease of monitoring outcomes by using milk recording data. Many dairy farms have fortnightly or monthly routine fertility visits,

usually performed by the same vet, and many farms milk record leading to a large amount of available data.

It is important that each practice chooses a topic to audit that is of interest to them, to ensure engagement in the process (Mosedale, 1998). It was thought that very simple topics could still be very useful, for example looking at the number of cows euthanased by the practice. If enough practices recorded these results the practice could see how they compare to other practices with a similar number of vets, farms and animal species. However, it was then pointed out that there may be factors outside of the practice's control that may affect the clinical audit – for example if a badly managed farm needed lots of animals euthanased despite the best efforts of the vets. This should not be a concern for clinical audit however, as many variables will effect various outcomes which can be taken in to consideration, but do not need to be justified or accounted for as in research.

During the discussions in all three practices it was evident that the veterinary surgeons were keen to find answers to clinical problems that they often encountered. This led to many clinical audit topic discussions developing into research topic discussions. In agreement with Viner (2009), the veterinary surgeons were drawn towards wanting to conduct practice based research rather than clinical audit. It is important that when choosing a clinical audit topic, it is a clinical audit that is decided upon, not a research project looking for an answer. The differences between clinical audit and research should always be taken into consideration (Viner, 2009; Wylie, 2015).

Prioritisation tools for choosing a topic to audit such as that suggested by Lyons (2013) could aid the selection of a topic. However, benefits may be brought about by auditing topics that have a low caseload, are low risk, low cost, have a similar approach in practice, have no existing associated concerns and are not important nationally. In agreement with Viner (2009) the DREAM mnemonic may be more appropriate to consider when choosing a topic to audit in veterinary practice. However, topics that are not distinct, evidence-based or measurable may still be worth auditing. Flexibility should therefore

be maintained when choosing a topic; allowing available resources and interests of the team to influence the topic being selected.

3.4.2 Practicalities of, and thoughts on, clinical audit

Similar themes were highlighted here as were highlighted during the survey conducted with a broader range of veterinarians (Chapter 2). The practitioners here seemed fairly positive about the ability of clinical audit to improve standards in veterinary practice, but in agreement with the survey respondents in Chapter 2, a large number of potential barriers and concerns were highlighted. Finding time to conduct clinical audit, choosing a topic that was 'easy' to define and diagnose and concerns relating to the logistics of data collection are issues that have been raised in both studies.

In the study conducted by Viner (2003) 80% of 904 vets surveyed agreed that it was highly desirable to encourage clinical audit in veterinary practice. The veterinary surgeons in the three practices in this study also held a very positive view on clinical audit, but also highlighted many factors that may make clinical audit difficult to carry out in practice. Mair and White (2008) conducted a study in 2008 where they surveyed the attitudes of equine veterinary surgeons to clinical audit. Similar to the findings here, they found that many (98%) of the veterinary surgeons thought that they understood clinical audit, yet when asked to define it were unable to give a complete definition. Given the huge variations in the definition of clinical audit that are present in the literature, each of the 19 veterinary surgeons did suggest a correct element of clinical audit. The main bulk of the understanding represented the measuring or assessment part of the process, and the important aspect of ensuring that vets were delivering the right treatment, or 'doing their best'. No responses included the description of the clinical audit cycle - a diagram that is depicted in much of the literature (Mosedale, 1998; Rayment, 2002; Viner, 2005a; Dunn, 2012). When carrying out clinical audit, the time involved in the process was highlighted as a concern by many practitioners in this study. For clinical audit to be successful the time involved,

either on farm or back at the practice must be kept to a minimum or practitioners must be given protected time to conduct it.

Veterinary surgeons must ensure that medicines administered to food producing animals are recorded in the keeper's records alongside the identification of the animal (United Kingdom Government, 2016). Although this information is always provided to the farmer, the veterinary surgeons admitted that they often do not record the animal identification in their own records. Although the collection of individual animal ID was seen as a barrier to clinical audit, it was also thought that it may encourage better practice as this was something that the vets felt they should be doing anyway.

The veterinary surgeons felt that this was very important that the farmers were kept happy throughout the whole clinical audit process. This may be through choosing a topic that they find interesting, choosing outcomes that may be of use to them or just by keeping the whole process hassle free. Practice 3 had recently had a farmer challenge them on the outcomes of LDA surgery and whether it was worth doing, so the vets thought that a clinical audit of LDAs may help with highlighting to their clients the good outcomes achieved by the practice.

On farm conditions and the logistics of a vet's working day on farm, in the car and in the practice all need to be taken into consideration when designing the methods for data collection.

3.4.3 PSM logistics

All PSMs were held in the evenings at the individual practice premises to try and get as many vets to attend as possible, starting at the end of the working day for all three practices. Not all vets were able to attend the meetings, and some attendees had to leave before the meetings came to an end. This highlights the difficulty of arranging meetings for farm animal veterinary surgeons, and this may also be true for veterinary surgeons in other sectors. For clinical audit to be effective, these barriers need to be overcome. Practice 1 historically had fortnightly practice meetings, which had gradually been

phased out as staff had often been too busy to attend. Practice 3 regularly held practice meetings, and found that this was a good time to discuss the clinical audit project. Although they may be difficult to fit into the working week, a practice meeting held regularly will improve communication between practitioners, and this therefore may facilitate the process of clinical audit. Other lines of communication should also be considered for keeping clinicians up to date about clinical audit projects.

3.5 Study limitations

Only three veterinary practices took part in this study so the findings here cannot be assumed to represent all farm animal practitioners working in the UK. The PSM meetings were recorded and facilitated by the researchers. This may have influenced what the practitioners were happy to discuss in the meetings if it made them feel uncomfortable (Gill et al., 2008). Junior and senior members of staff were present in the meetings; this may have had an effect on what either parties were willing to discuss and the findings may have been different had the two groups been separated.

3.6 Conclusion

All practitioners should have the opportunity to be involved in choosing the topic for clinical audit. Adapted prioritisation methods can have some advantages to choosing a topic in a fair and transparent way but this can be time consuming and less easily achieved with a small team. A meeting with team members that allows open communication so all stakeholders are able to have a say is an invaluable step in the process of clinical audit. Adequate time must be allowed and practitioners should feel comfortable to give their opinion. To develop and maintain team engagement in the initiation of clinical audit all staff must be involved from the beginning and kept informed throughout. There are a number of recognised barriers to clinical audit in veterinary practice and these need to be considered when attempting the process in practice. Open discussions about concerns of the process before starting may help to improve the overall success rate.

Chapter 4 Feasibility of conducting prospective clinical audit in farm animal practice

4.1 Introduction

Collecting information that can be analysed and subsequently improved upon is a key part of the clinical audit cycle (Rayment, 2002). Once a clinical audit topic has been chosen the necessary data can be identified, with care not to collect information excess to requirements (Mosedale, 1998). Data collection can be carried out prospectively or retrospectively, with the method chosen dependent on the availability and accessibility of data.

Clinical audit conducted in the medical profession may use data collected prospectively or retrospectively. Prospective data collection allows for clearly defined, more reliable and complete data to be collected compared to relying on pre-existing medical records as for retrospective clinical audit (Optimal Blood Use, 2013). Prospective clinical audit is required where sufficient data does not exist on the desired topic to audit (University Hospitals Bristol, 2009d). It can allow for better data accuracy and easier data analysis so the NHS suggest that these should make up the majority of clinical audits conducted in practice (Copeland, 2005).

Morgan et al. (2012) and Tisdall and Barrett (2013) describe retrospective farm animal clinical audits while Woodmansey (2016) reports on an on-going national prospective clinical audit in farm animal practice. A clear description of if, and how, prospective clinical audit can be conducted in farm animal practice in the UK however, does not exist.

This study aims to determine if prospective clinical audit can be conducted in farm animal practice in the UK. It will also highlight the potential challenges and benefits of the process.

4.2 Methods

This chapter discusses four clinical audits carried out in the three separate veterinary practices that were introduced in Chapter 3. Chapter 3 discussed

the way that the clinical audit topics were chosen and the initial discussions that were held in the practices.

4.2.1 Preparing for clinical audit

Additional points to those already discussed in Chapter 3 in relation to preparing for the clinical audits appear below.

4.2.1.1 Searching the literature

The literature was searched for any existing standards or evidence relating to the topics that had been chosen by the practices, and the processes or outcomes the clinical audits were focussing on. CAB abstracts and Medline were searched, as the combination of both provides the best coverage of veterinary related content (Grindlay et al., 2012). The literature search was conducted in CAB abstracts (1910-2014) and MEDLINE (1946-2014) through the OVID interface. A keyword and subject heading search was undertaken. Auto alerts were set up for all searches to ensure new relevant literature was included as the study progressed. Inclusion and exclusion criteria were applied to identify relevant papers (see results section specific to each practice for further details).

4.2.1.2 Data collection methods

At the initial meetings with the vets (Chapter 3), methods of data collection were discussed. A slide in the PowerPoint presentation suggested using online questionnaires, paper questionnaires and bound notebooks. These options were discussed along with any ideas raised by the practitioners, and a final decision was made as to how the information for the audit would be collected.

Once designed the data collection tools (further details to follow later in the chapter) were pretested by members of the CEVM and the University of Nottingham farm animal department. After appropriate changes had been made, the tool was sent to the practitioners to comment on. Responses were given to all feedback from the clinicians, and changes made before the data collection tools were finalised for the pilot clinical audit.

4.2.1.2.1 Farmer Consent

Each practice sent a letter to their clients to inform them that this study was taking place and that their farm's data may be used. If the farmers did not wish for their data to be used in the study they were asked to 'opt out' by contacting the respective practice or the researcher directly.

4.2.1.3 Clinical audit pilot

Each clinical audit was piloted within the individual practices to test the data collection methods and the clinical audit process. The length of time the pilot clinical audit was conducted for depended on the clinical audit topic. At the end of the pilot study basic results were shared with the practitioners, this included the number of cases collected on the number of farms, and the number of veterinary surgeons that had submitted cases. Feedback on how the data collection process had run was collected from the practitioners via email and changes were made to the tool and the clinical audit process as deemed necessary.

4.2.2 Data collection, data analysis and re-audit

Data were collected prospectively using booklets by the veterinary surgeons within the respective practices on their chosen topics for a pre-set period of time. The collected data was analysed and collated into a format for presentation to the vets in the practices. A second meeting was held at each individual practice and a Microsoft PowerPoint presentation of the first round of clinical audit was given. Here the findings of the first round of audit were discussed and the vets decided if they would like to make any changes to the way that they did things. A final meeting with the practitioners was held at the end of the research project (Chapter 7) and some of the results were also presented here.

4.2.3 Communication with the practice teams during the project

Email was used to communicate future plans, advise on changes or updates, send minutes and information from the meetings, collect votes for decision making, ask for opinions, promote discussion and as reminders for data

collection. A quarterly newsletter was created and sent out to all three practices involved in the project. The newsletter provided an update on how the work was progressing as well as conference and publication news.

Meetings were held at the beginning of the project (PSM), the end of the first round of audit (second meeting), and again at the end of the project (final meeting). Minutes from the meetings were sent to the practices within a few days and included a summary of the meeting and discussion, any supporting documents and the plan moving forward.

4.3 Results

4.3.1 Practice 1 – Cystic ovarian disease clinical audit

Three veterinary surgeons indicated on the vet questionnaire (Chapter 3) that they had not taken part in clinical audit before, while five indicated that they had previously undertaken clinical audit. Previously, the practice had attempted a retrospective clinical audit on LDA surgery, but found that the information often did not get collected as it involved asking farmers and veterinary surgeons to remember work that had been carried out up to six months previously.

4.3.1.1 Preparing for the clinical audit

One of the partners of the practice was the main contact for the duration of the project. All the veterinary surgeons had a practice email that they accessed regularly for work, so email was confirmed as a good way to stay in touch with the whole team.

4.3.1.1.1 *Choosing a topic*

At the Priority Setting Meeting the veterinary surgeons chose to audit the treatment of cystic ovarian disease. Recognition was given to the fact that practitioners were unable to definitely diagnose cystic ovarian disease as may be done in a research environment. It was decided that all cases of follicular cysts and luteal cysts were to be included in the clinical audit if these were what the practitioners treated as cysts.

4.3.1.1.2 Searching the literature

The literature search was conducted in March 2014. The search terms and inclusion/exclusion criteria used are shown in Appendix 8. The literature search identified 973 publications through CAB abstracts and 108 through MEDLINE. One hundred and twenty-eight publications remained after screening and were analysed for initial and follow up treatments of cystic ovarian disease. Many different treatments of cystic ovaries were described, but there was no study advising the 'best' treatment to use, and no guidelines or 'gold standard' examples were found.

4.3.1.1.3 Methods of data collection

The veterinary surgeons requested that collecting the necessary data should be quick, easy and straight forward. They thought that loose sheets of paper may get lost, and rejected the idea of an app on their mobile phone due to lack of smart phones and unreliable 3G internet provision. A paper data collection form in the form of a bound and laminated notebook, to be used for on farm data collection, and an online version (created on SurveyMonkey) for the information to be transferred onto back at the practice were agreed on as the data collection tools for the clinical audit.

Practice 1 had opted to do an outcome clinical audit, so easy follow up of each case was vital. The same data collection form was to be used for first and follow-up examinations; a tick box indicated whether the cow was being examined for the first time. The veterinary surgeons were advised that the data collection period may run for a maximum period of 12 months.

Feedback was received during pre-testing from 9 individuals, and the forms were altered accordingly. The data collection forms were then piloted by three members of the clinical farm animal staff at the School of Veterinary Medicine and Surgery (SVMS) at the University of Nottingham and changes made according to their suggestions. The paper forms were then pretested by the veterinary surgeons in the practices. Changes were made to the forms before both were finalised for use in the pilot clinical audit.

4.3.1.1.4 Clinical audit pilot

The clinical audit pilot data collection period ran from the 9th May 2014 to the 9th June 2014. Thirty-four cases were collected by three different veterinary surgeons on 12 different farms.

At the end of the pilot project a telephone conference was held with the veterinary surgeons on the 23rd June 2014 to discuss how it had gone. Three veterinary surgeons were able to phone in to the telephone conference. The practitioners were generally happy with the process and felt the paper data collection forms worked well on farm. An email was sent to all of the vets asking for any further feedback they had on the pilot clinical audit. Feedback included:

Vet A: "I think the booklet works well for quick recording allowing later upload via SurveyMonkey"

Vet B: "System seems to work fine. Paper recording followed by on-line versions essential. Farmers are fine with it. Just the follow ups are sometimes lost I think, possibly because they are served, don't know, would have to check."

One veterinary surgeon requested tick boxes for the data collection form to cut down on the amount of information that had to be written or typed, and thought this could be set up with the trade name of the drugs they regularly used for treatment. It was though acknowledged that this may make things confusing if the practice changed the products that they bought.

Changes to the data collection forms were agreed upon and the forms were then altered accordingly.

4.3.1.2 Data collection

The data collection for the first round of the clinical audit began on the 23rd June 2014 and finished on 31st March 2015. The SurveyMonkey version of the data collection form that was used for the clinical audit is shown in Appendix 9.

4.3.1.3 Analysing the data

The data were downloaded from SurveyMonkey into a Microsoft Excel V.14.0.6 (2010 Microsoft Corporation) spreadsheet for analysis. During the nine months of data collection (23rd June 2014 – 31st March 2015) 251 cases of cystic ovarian disease were seen by six veterinary surgeons on 27 different farms. The practitioners recorded 202 of these examinations as 'first examinations' and 49 as 'follow up' examinations.

The number of cases collected per month declined after the initial three months of data collection (Figure 18).

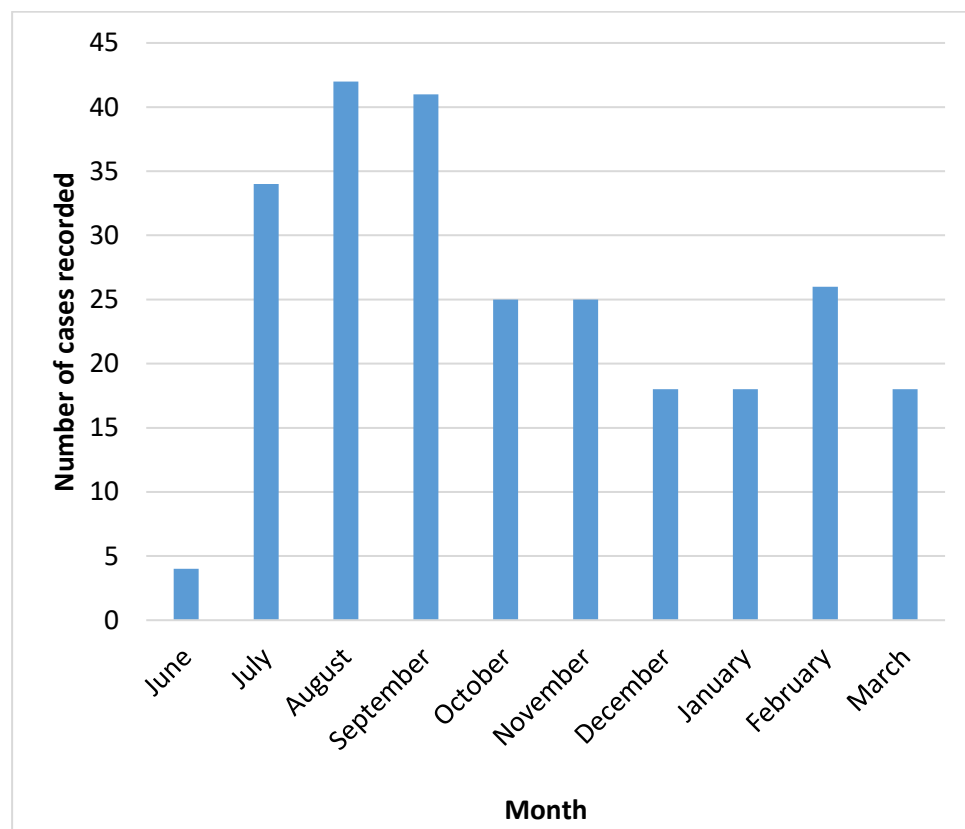


Figure 18 Number of cystic ovarian disease cases collected per month by the vets in Practice 1

There was variation in the number of cases collected per veterinary surgeon (Figure 19).

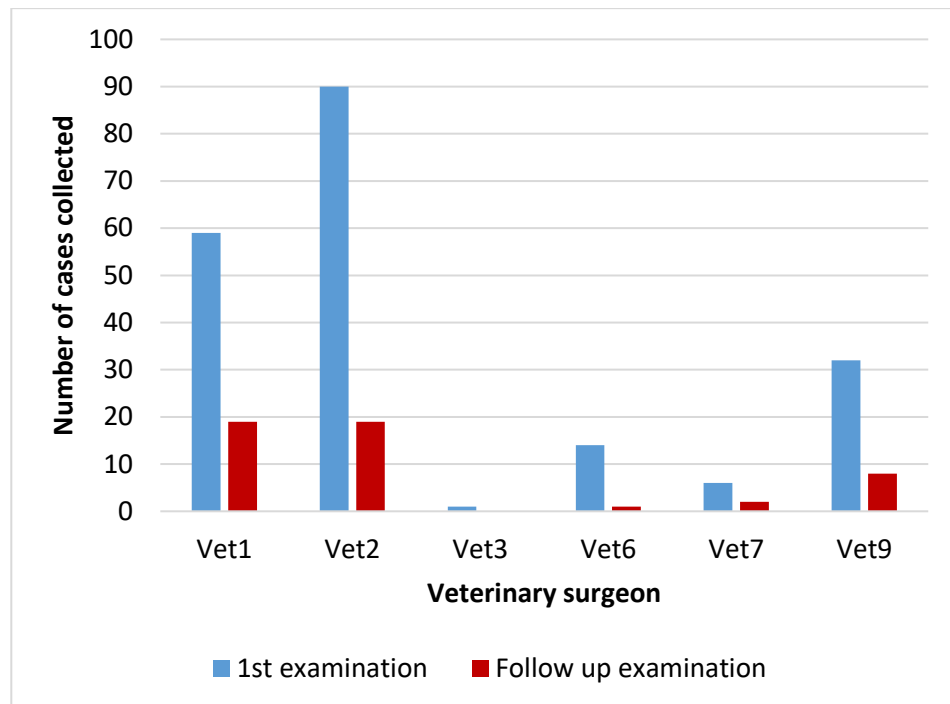


Figure 19 Number of first examination and follow-up examination cases collected by each veterinary surgeon in Practice 1

The number of cases re-examined was significantly less than the number of cows seen for a first examination. The proportion of follow-up examinations conducted also varied between farms (Figure 20).

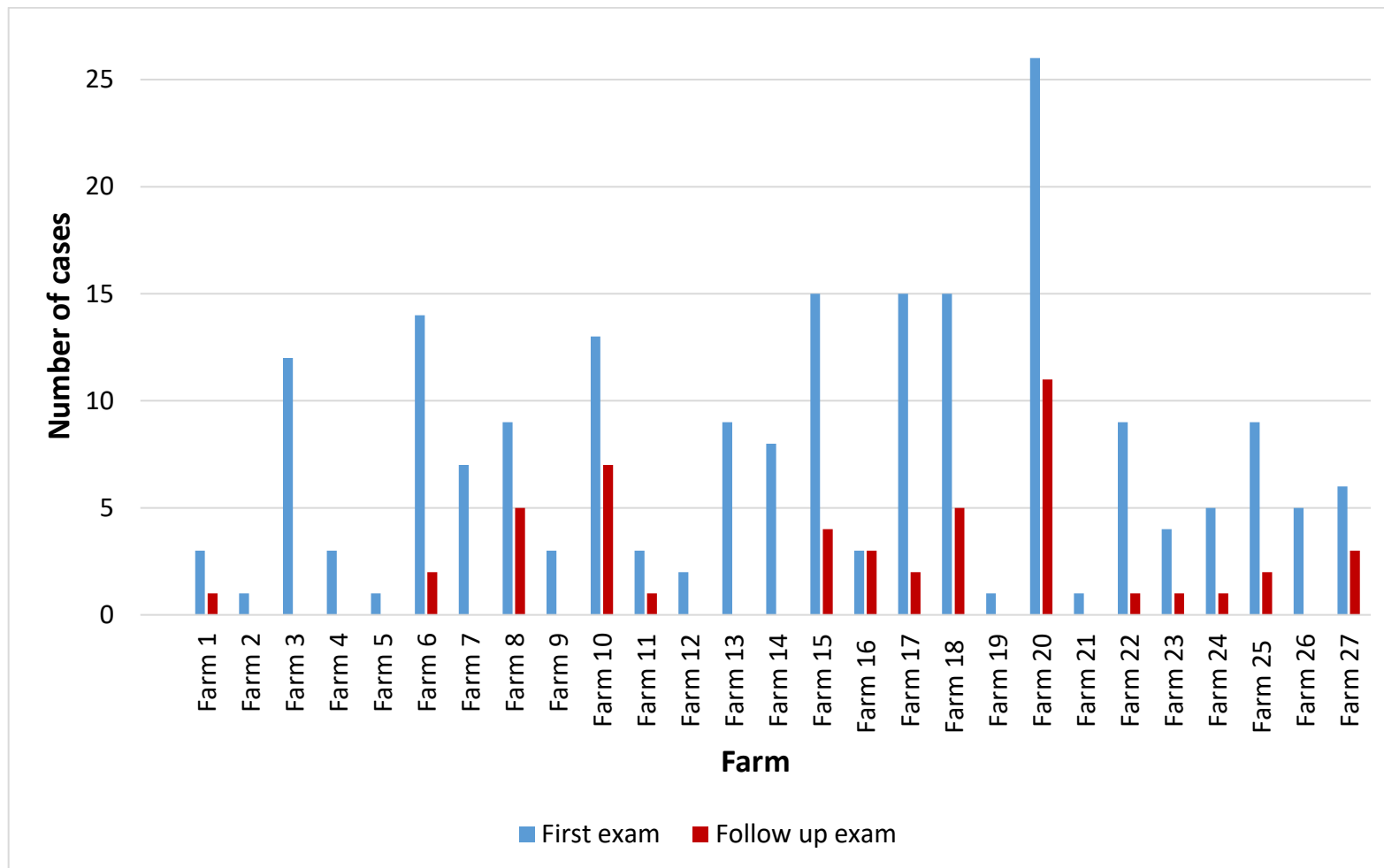


Figure 20 The number of first and follow-up examinations performed at each farm by veterinary surgeons in Practice 1

The diagnosis made at each first and follow-up examination is shown in Figure 21. Follicular cysts dominated the type of cystic ovarian disease diagnosed at each examination.

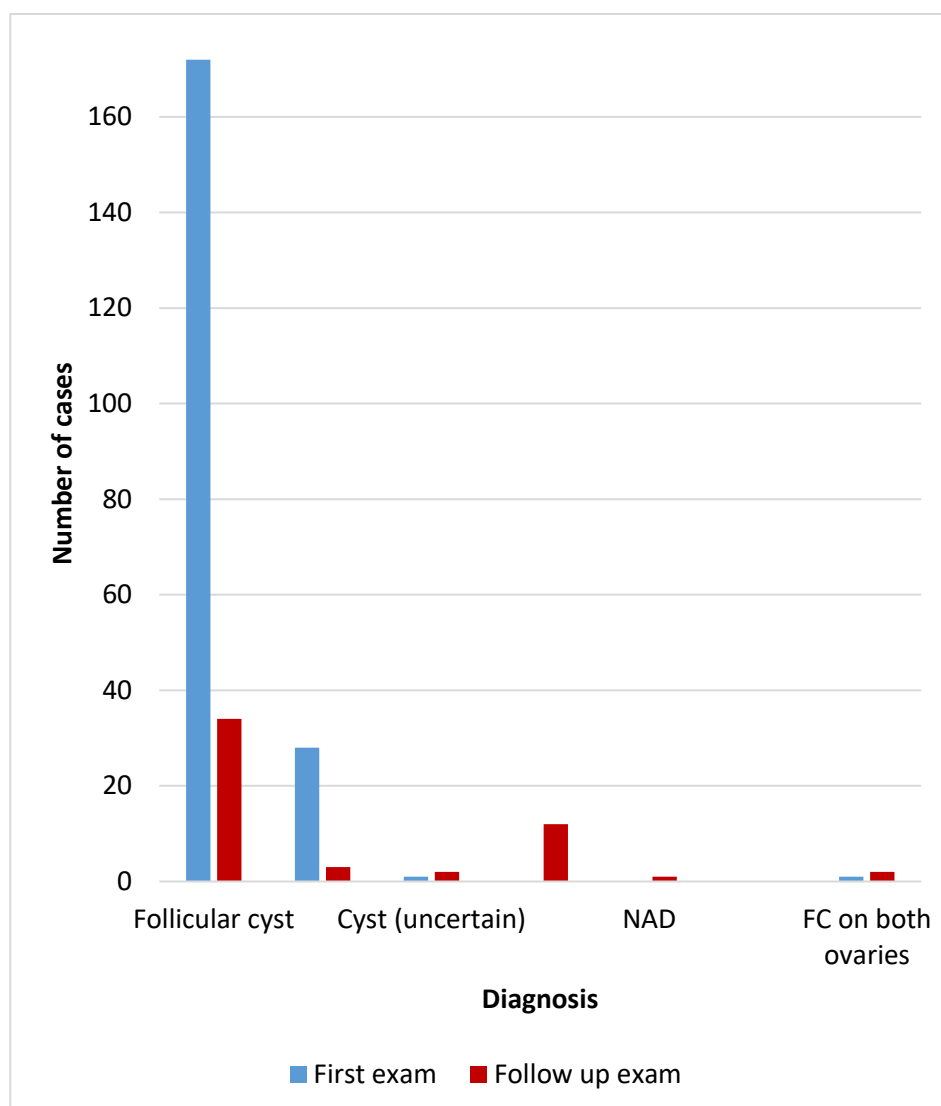


Figure 21 The diagnosis made at first and follow-up examinations by veterinary surgeons in Practice 1.

CL = corpus luteum, NAD = no abnormality detected, FC = follicular cyst.

The majority of cases were diagnosed by ultrasound examination (246/319; 77%) alongside history/clinical signs (69/319; 22%), with only a minority relying solely on manual palpation (4/319; 1%). The majority of cases were treated with GnRH (Figure 22). Free text indicated that all cases treated by manual rupture were an accidental consequence of examination of the reproductive tract via rectal palpation.

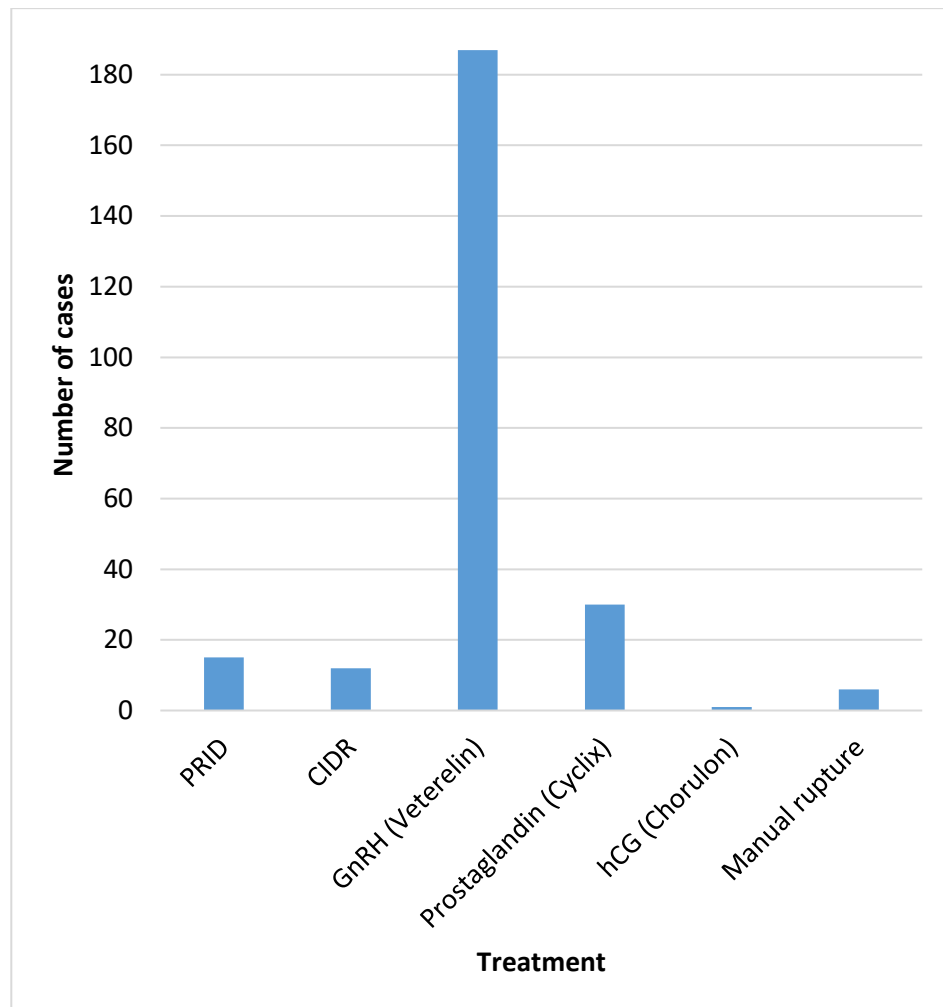


Figure 22 Treatment of cystic ovarian disease in cows examined by the veterinary surgeons in Practice 1

PRID = Progesterone Releasing Device, CIDR = Controlled Internal Drug Release, GnRH = Gonadotropin-releasing hormone, hCG = Human chorionic gonadotropin [Chorulon®, MSD Animal Health; CIDR®, Zoetis UK Limited; Cyclix, Virbac Limited; PRID® Delta, Ceva Animal Health Ltd; Veterelin, Laboratorios Calier]

Table 11 shows cows that were examined more than once. Cows were re-examined for a maximum of three times and received the same treatment at the follow-up examination in 41% of cases (11/27).

Table 11 Diagnoses made and treatment given to cows examined more than once

[FC = follicular cyst; CL = corpus luteum]

Cow ID	First examination		Second examination		Third examination	
	Diagnosis	Treatment	Diagnosis	Treatment	Diagnosis	Treatment
1	FC	Veterelin 5ml	FC	Veterelin 5ml & PRID 7 days		
2	FC	Veterelin 5ml	FC	Veterelin 5ml & PRID 7 days	FC	CIDR 8 days
3	FC	Veterelin 5ml	FC	PRID 7 days	FC	Veterelin 5ml
4	FC	PRID 7 days	CL	?		
5	FC	Veterelin 5ml	FC	Veterelin 5ml		
6	FC	Veterelin 5ml	FC	Veterelin 5ml	Follicles	Veterelin 2.5ml
7	FC	Veterelin 5ml	FC	CIDR 8 days		
8	FC	Veterelin 5ml	FC	Veterelin 5ml		
9	FC	Veterelin 5ml	FC	Veterelin 5ml		
10	FC	Veterelin 5ml	FC	Veterelin 5ml		
11	FC	Veterelin 5ml	FC	?		
12	FC both ovaries	10ml Chorulon	FC	?		
13	FC	PRID 10 days	FC	Veterelin 5ml		
14	FC	Veterelin 5ml	FC	Veterelin 5ml	CL	Cyclix 2ml
15	FC	Veterelin 5ml	CL	?	CL	Cyclix 2ml
16	FC	Veterelin 5ml	FC	Veterelin 5ml	FC	Veterelin 2.5ml

Cow ID	First Examination		Second Examination		Third Examination	
	Diagnosis	Treatment	Diagnosis	Treatment	Diagnosis	Treatment
17	FC	Veterelin 5ml	Cyst	Veterelin 2.5ml		
18	FC	Veterelin 5ml	CL	Cyclix 2ml		
19	FC	CIDR 7 days	FC	?	CL	Veterelin 2.5ml
20	FC	Veterelin 5ml	FC	Veterelin 5ml		
21	FC	Veterelin 5ml	FC & CL	Cyclix 2ml		
22	FC	Veterelin 5ml	FC	Veterelin 5ml		
23	FC	Veterelin 5ml	FC	Veterelin 5ml and manual rupture		
24	FC	Veterelin 5ml	FC	Veterelin 5ml		
25	FC	Veterelin 5ml	FC	Veterelin 5ml		
26	FC	Veterelin 5ml	FC	CIDR 8 days		
27	FC	Veterelin 5ml	Small follicles	PRID 7 days	FC	Veterelin 5ml

4.3.1.4 Discussing the results of the first round of clinical audit with Practice 1

A meeting was held on the 8th June 2015 to discuss the results of the first round of clinical audit with the veterinary surgeons. Just two veterinary surgeons were present; the partner who was the main contact for the clinical audit within the practice, and a new graduate vet who had recently started working at the practice and had not been involved with the clinical audit from the beginning. At the meeting the veterinary surgeons present were happy with the findings of the audit. The audit confirmed that the veterinary surgeons treated cystic ovarian disease in a similar way, and they were happy that consistent treatment approaches were being used by the veterinary surgeons. After the meeting an email was sent around to all veterinary surgeons to try to gather more responses to the data collected. One vet responded, suggesting that there would only be a need to change the treatments used if the outcomes of treatment were better with a certain treatment.

The veterinary surgeons did not wish to make any changes to what they were doing at the time unless this was indicated by collecting further information. The practice did not wish to run a re-audit as they were happy with the initial findings of the clinical audit.

4.3.2 Practice 2 clinical audit

Four veterinary surgeons indicated on the vet questionnaire (Chapter 3) that they had taken part in clinical audit before. The practice had previously carried out a retrospective clinical audit looking at the outcomes of LDA surgery. One of the veterinary surgeons had looked at the computer records and found farms that had had an LDA corrected (either by the roll and toggle method, or by surgery). The veterinary surgeon then called the farmer to find out if the cow was still in the herd and still productive. Because many of the farms at the practice only had one or two LDA procedures per year, it was memorable event for them and they could remember which cow had had

which procedure. The practice was happy with the findings of the clinical audit, but did not compare these to any published literature.

4.3.2.1 Preparing for the clinical audit

All the veterinary surgeons had a personal email that they accessed regularly, so email was confirmed as a good way to stay in touch with the whole team.

4.3.2.1.1 Choosing a topic

Practice 2 initially chose to audit the treatment of calves with pneumonia and their subsequent four-week survival rates. After six months of data collection only one case had been recorded. The calf pneumonia clinical audit was therefore suspended due to a perceived low case load.

Endometritis in dairy cows had initially been dismissed as a topic to audit but had been popular at the PSM. Only a small number of the practitioners regularly undertook routine fertility visits so the practitioners felt that the topic would limit the number of veterinary surgeons able to be involved. When the calf pneumonia clinical audit was abandoned due to a low case load, endometritis was chosen as the second topic to audit because it was likely to provide a high case load in a short period of time. This topic was therefore chosen despite the fact that it would limit the number of practitioners able to be involved in collecting cases for the clinical audit. Practitioners were asked to record cases of endometritis that they would normally diagnose as endometritis – no diagnostic criteria was provided.

4.3.2.1.2 Searching the literature

The literature search was conducted in April and May 2015. The search terms and inclusion/exclusion criteria used are shown in Appendix 10. The literature search identified 2492 publications. Ninety-nine relevant documents discussing the treatments used for endometritis were identified. Many different treatments were discussed but no studies suggested a 'best' treatment option or 'gold standard' and no guidelines were found.

4.3.2.1.3 Data collection methods

A discussion was held at the initial PSM about how the vets would like to collect the information for the clinical audit. The main request from the veterinary surgeons was that the forms should have as few questions as possible, and be quick and easy to fill out. The veterinary surgeons rejected the idea of a data collection app on their mobile phone due to lack of necessary equipment and technological knowledge. The practitioners requested a user-friendly system that they could use in future when they would not be assisted by the researcher. A laminated, bound notebook containing individual data collection forms, and an online version created on SurveyMonkey, was suggested. The vets would record each endometritis case on a paper copy whilst on farm, and transfer the data to the online form when they had time and were back at the practice where computer and internet access was available.

A paper data collection form and an online data collection form using SurveyMonkey were developed and pre-tested in the CEVM. It was also sent to one of the veterinary surgeons at Practice 2 for their opinion. Changes were made to meet the comments received.

4.3.2.1.4 Clinical audit pilot

The pilot data collection ran from May 5th 2015 to May 25th 2015. Thirty-two cases of endometritis were recorded by two vets on 12 different farms. The practitioners were asked for feedback on the pilot data collection via email – one veterinary surgeon responded highlighting a couple of questions that were on the paper form but not the online form. Two free text boxes were also changed to tick boxes to allow for easier data analysis.

4.3.2.2 Data collection

The data collection for the first round of clinical audit began on the 15th June 2015. The veterinary surgeons were advised that this clinical audit would run until the end of September 2015. The online data collection form used is shown in Appendix 11.

4.3.2.3 Analysing the data

The data were downloaded from SurveyMonkey into a Microsoft Excel V.14.0.6 (2010 Microsoft Corporation) spreadsheet for analysis. During the three and a half months of data collection 85 cases of endometritis were recorded, but on further analysis, 75 records were complete (in 10 cases, some details were missing or the record was blank and they were therefore unable to be used for analysis). Figure 23 shows the number of cases collected per month.

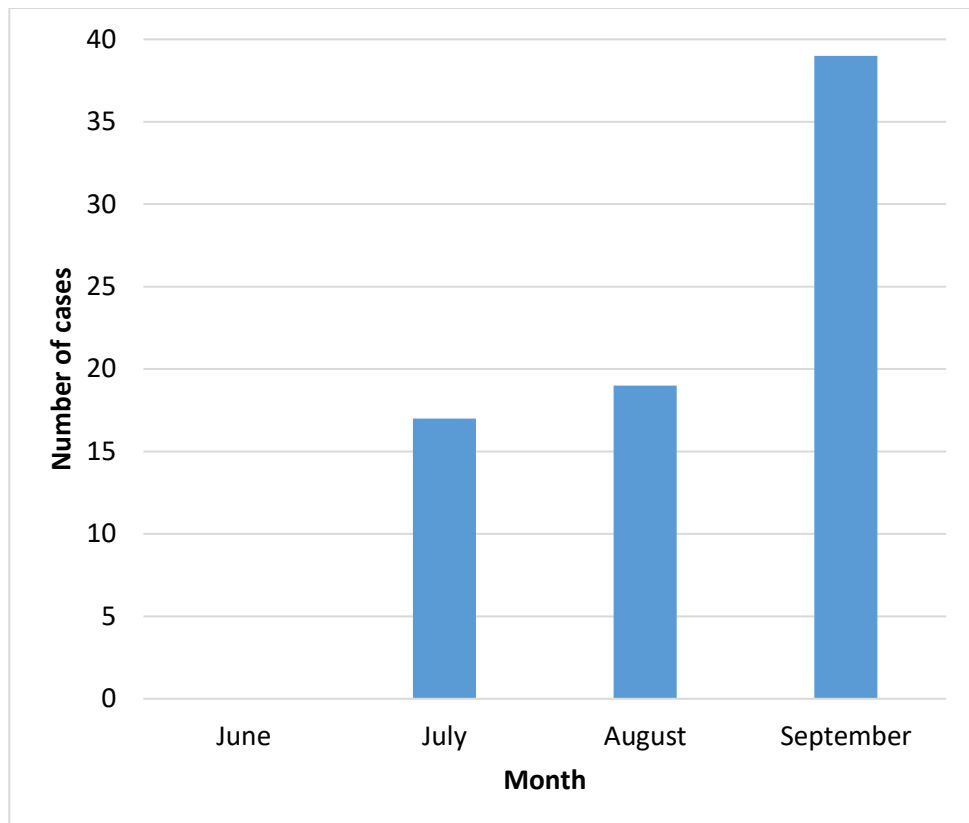


Figure 23 The number of cases of endometritis collected per month by Practice 2

Vet 10 collected 62 cases and Vet 12 collected 13 cases. Figure 24 shows the number of cases of endometritis collected per farm.

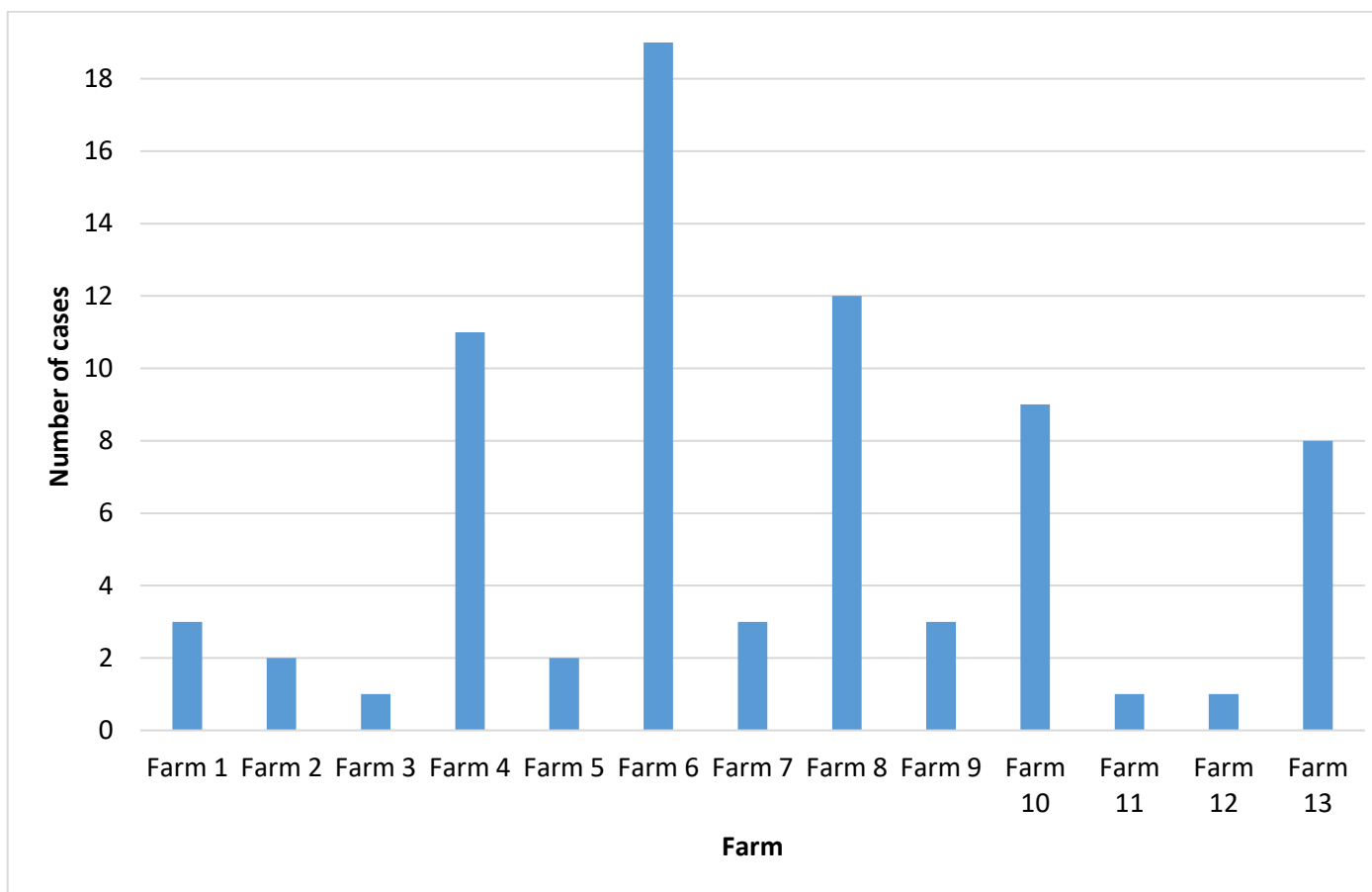


Figure 24 The number of cases of endometritis collected per farm in Practice 2

Figure 25 shows the treatments used for cases of endometritis. A wide range of treatments and dosages were used, with the majority involving Cyclix or Metricure.

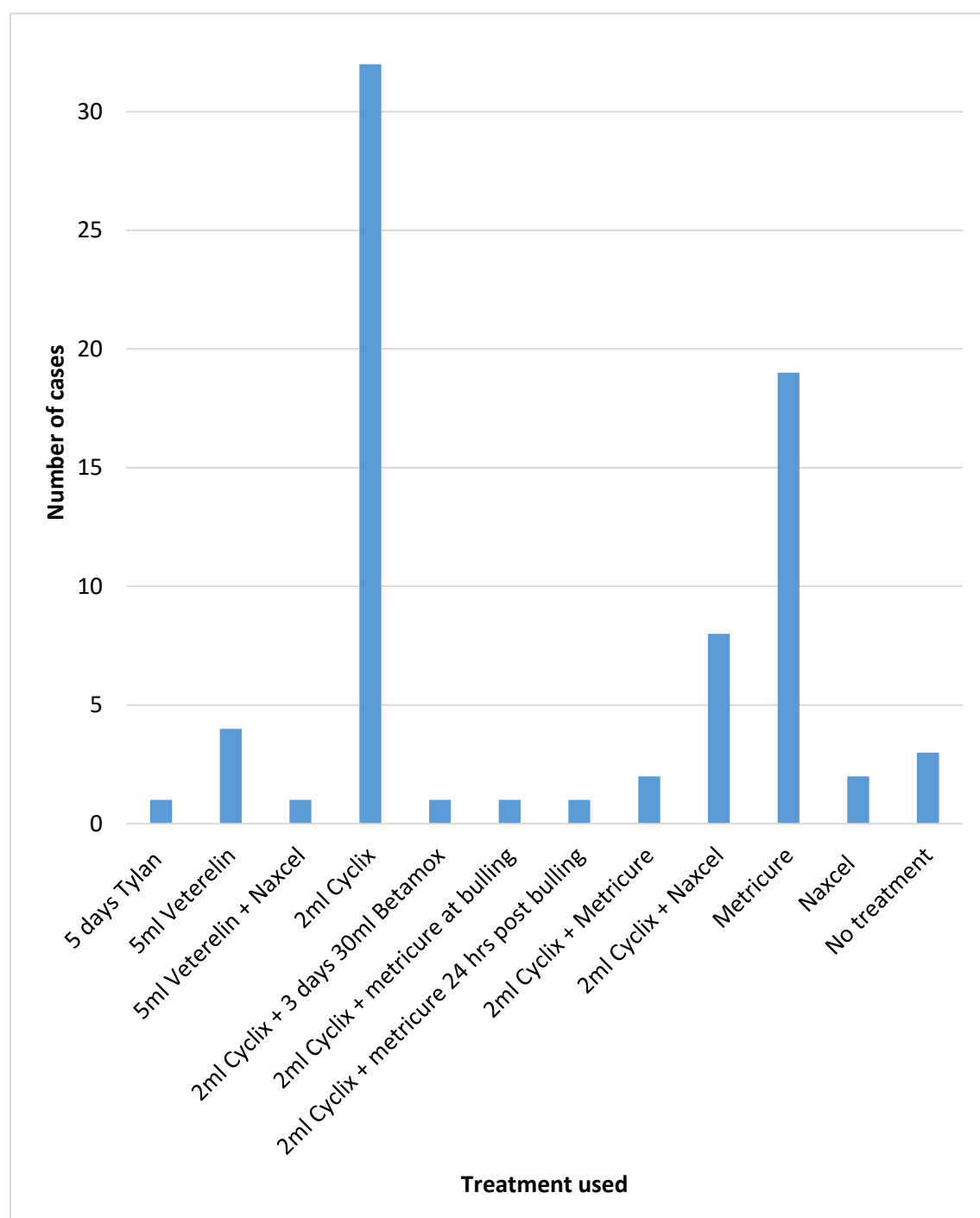


Figure 25 The treatments used for endometritis cases treated by the veterinary surgeons in Practice 2

[Betamox, Norbrook Laboratories; Cyclix, Virbac Limited; Metricure®, MSD Animal Health; Naxcel®, Zoetis UK Limited; Tylan™ 200, Elanco Animal Health; Veterelin (Buserelin), Laboratorios Calier]

The reasons for treatment selection are shown in Table 12. Metricure and Cyclix were most commonly used, with systemic antibiotics used for severe cases or for co-morbidities such as mastitis.

Table 12 Reasons why the treatment options were chosen to treat endometritis by the veterinary surgeons in Practice 2

CL = corpus luteum, PG = prostaglandin, AB = antibiotic

Treatment	Reason	No of cases
2ml Cyclox	Presence of CL	30
	No CL but farm on 12 month AB free contract	2
5ml Veterelin	Concurrent follicular cyst. Follow up with PG in 2 weeks.	4
Metricure	No CL. Cervix open	17
	No CL so unable to bring bulling. Metricure for local action.	1
	About to come bulling, use metricure 24hrs post bulling	1
No treatment - to go on barren list	Farmer choice	2
5ml Veterelin + Naxcel	Veterelin to treat cyst, followed with prostaglandin in 1wk. Naxcel for endometritis (zero milk withdrawal) as persistent case	1
2ml Cyclox + Metricure	CL. Metricure given as repeat offender.	1
	CL. Historic problems with clearing up endometritis on this farm so metricure also given.	1
2ml Cyclox and Naxcel	Still very dirty	1
	Naxcel 1 week ago - still lots of pus on scan - repeat naxcel and bring bulling	1
	Large pus filled uterus, needs to be brought bulling and treated with parental abs	3
	Unable to pass metricure catheter so given naxcel instead and cyclox to bring bulling	1
	Presence of CL plus non response from last treatment (hence Naxcel)	1
	Presence of CL. Naxcel given as persistent case plus zero milk withdrawal	1
Naxcel	No CL present + large amount of pus	1
	Closed cervix so unable to administer metricure + repeat case	1
2ml Cyclox + Metricure at bulling	Bring bulling and then metricure to act locally post bulling	1
2ml Cyclox Metricure 24 hrs post bulling	Too much pus for no antibiotics but to have metricure few hours post bulling	1
2ml Cyclox + 3 days 30ml Betamox	Still large amount of pus present after previous treatment	1
5 days Tylan	Concurrent mastitis	1
No treatment	In oestrus so likely to clear up on own	1

Fourteen cows were examined more than once. The clinical findings and treatment of these cows are shown in Table 13. Many cases had resolved by the second examination, but some cows still had signs of endometritis at the third examination.

Table 13 Clinical findings and treatments of cows examined more than once by the veterinary surgeons
in Practice 2

PG = Prostaglandin, CL = Corpus Luteum

Cow ID	First examination		Second Examination		Third examination	
	Clinical exam	Treatment	Clinical exam	Treatment	Clinical exam	Treatment
1	16.07.2015 >50% pus, no smell. No CL, cervix open.	Metricure	30.07.2015 >50% pus, no smell, CL	PG	10.09.2015 >50% pus, no smell, CL	PG and metricure
2	01.07.2015 >50% pus, CL, no smell	PG	23.09.2015 >50% pus, CL, no smell	PG		
3	01.09.2015 No smell, CL, >50% pus and U/S changes	PG	15.09.2015 No smell, CL, > 50% pus	PG and Naxcel		
4	24.07.2015 No smell, CL, <50% pus	PG	26.08.2015 No smell, No CL, cervix closed, <50% pus	Naxcel	23.09.2015 RESOLVED	
5	26.08.2015 No smell, CL, >50% pus	PG	23.09.2015 RESOLVED			
6	24.07.2015 Bad smell, CL, >50% pus	PG	26.08.2015 RESOLVED			
7	1.07.2015 Bad smell, >50% pus, no CL	Metricure	26.08.2015 No smell, CL, >50% pus	PG + Naxcel		
8	25.08.2015 No smell, <50% pus, No CL, cervix open	Metricure	1.09.2015 RESOLVED			
9	25.08.2015 No smell, no CL, <50% pus, cervix open	Metricure	1.09.2015 CL, >50% pus	PG	15.09.2015 No smell, <50% pus, Foll cyst	Naxcel, Veterelin (PG in one week)
10	25.08.2015 No smell, CL, >50% pus	PG	1.09.2015 RESOLVED			
11	4.08.2015 Bad smell, CL, >50% pus	PG and Naxcel	01.09.2015 Still filthy dirty - Bad smell, CL, >50% pus	PG and Naxcel		
12	07.07.2015 No smell, > 50% pus, no CL, about to come bulling	Metricure 24 hours post bulling	21.07.2015 No smell, CL, >50% pus	PG and Betamox		
13	23.07.2015 No smell, > 50% pus, no CL, cervix open	Metricure	27.08.2015 RESOLVED			
14	27.08.2015 No smell, CL flecks of pus	PG	18.09.2015 RESOLVED			

4.3.2.3.1 Discussing the results of the first round of clinical audit with Practice 2

The second meeting with the veterinary surgeons at the practice took place on 7th October 2015. Eighty percent of the original veterinary surgeons were present for the meeting; along with one veterinary surgeon who was new to the practice. The veterinary surgeons found the information that had been collected interesting, but they wanted more opportunity to collect further information, and therefore wished to extend their data collection period. The data collection period was therefore extended to 31st March 2016, which would enable autumn calving herds to be included in the clinical audit. The veterinary surgeons also wanted 'calving date' to be added on to the data collection forms to see how many number of days calved the cases were and if this differed between farms. The meeting also raised a number of questions that the practitioners requested further evidence on (for example, "Which is the best treatment for endometritis: prostaglandin, Metricure, or both together?" and "Does Metricure work if there is a large amount of pus in the uterus?") - the best evidence to these questions were found and passed on to the practitioners.

The data from the second round of clinical audit was analysed in April 2016. Analysis included data from the first and second rounds of audit. Forty-six extra endometritis cases were collected during the second round of clinical audit in March 2016 by Vet 10. No calving dates had been collected for the cases from the first or second round of data collection. Due to time constraints the findings from the second round of clinical audit, along with some literature found answering the questions that had been raised, were sent back to the practitioners in a Microsoft PowerPoint presentation via email. No further stages of clinical audit were conducted.

4.3.3 Practice 3 – Outcomes of LDA surgery clinical audit

Three veterinary surgeons in the practice indicated on the questionnaire that they had taken part in clinical audit before. The practice had previously conducted their own clinical audit looking at caesarean sections in cattle. Any

caesareans conducted had the reason for the caesarean being conducted, whether the calf was alive or dead and survival of dam and calf at 24 hours recorded into a folder kept at the practice. An office administrator chased up cases from the diary and this resulted in greater than 90% of the caesarean being recorded for the clinical audit. The practice thought their findings were very good, they were happy with the outcomes of the surgery and therefore they did not make any changes or go on to re-audit.

4.3.3.1 Preparing for the LDA clinical audit

All communication with the practitioners at Practice 3 was conducted through one individual veterinary surgeon via email. This was an assistant veterinary surgeon at the practice, and this individual changed part way through the project when a new assistant took over the role in August 2014.

4.3.3.1.1 Choosing a topic

At the Priority Setting Meeting the veterinary surgeons chose to audit three outcomes following LDA surgery – milk yields at the two subsequent milk recordings (as a percentage of herd average), 60 day survival rates and days to conception.

4.3.3.1.2 Searching the literature

The literature search was conducted in May 2014. The search terms and inclusion/exclusion criteria used are shown in Appendix 12. The literature search identified 2395 publications through CAB abstracts and 378 through MEDLINE. Fifty publications remained after screening and were analysed for outcomes of LDA surgery, specifically milk yield, survival and days to conception. Seven of these 50 publications had results that could be used as a 'benchmark' or starting point to compare the results of Practice 3 against (Table 14). These were emailed to the practitioners at the beginning of the clinical audit and used in later discussions.

Table 14 Standards found in the literature that were used to compare the findings from Practice 3's clinical audit against

Author	Year	Milk yield	Days to conception	Survival rate
Lyons et al	2009		131.1 +/- 9.05 days	
Haloun et al	2009	Mean daily milk yield in the 51 cured animals was 32.6 litres 30 days post operation.		Out of 60 cows, 7 died and 2 were culled by day 30 post op (85% survival rate at day 30)
Roy et al	2008	Milk yields were similar in both groups		88% survival rate at 60days lactation in laparotomy group
Pedersen	2006	305 day milk yield the same in both groups	157.85 days	At 60 days, 92% of cows remained in the herd
Loptien et al	2005	Milk yield level before getting sick was achieved within 10 days after surgical treatment.		
Raizman & Santos	2002		144 days	77% still alive at 70 days post op
Sexton et al	2007	83% cows were milking 4-5 months post-op	79.6% cows were in calf post-op	Overall survival rate was 90.7%

4.3.3.1.3 Data collection methods

The veterinary surgeons requested that data collection be quick and easy, with not too many questions. Each LDA surgery performed by the practice was carried out on farm with either two veterinary surgeons present, or a veterinary surgeon assisted by a veterinary student or a veterinary nurse. The practitioners were therefore confident that completing a form whilst doing the operation would be achievable. Some of the vets felt that stray bits of paper would get easily lost, and a paper data collection book was therefore designed that would be kept in the practice surgical kits and not individual vet's cars. One form was to be filled out per case, and the veterinary nurses back at the practice would take the form out of the LDA kits and put them on a spike ready for the clinical audit lead to collect and transfer the information onto the computer. A Microsoft Excel spreadsheet would be used to store all of the data, with the follow up information being collected from milk records.

Feedback was received during pretesting from nine individuals, and the forms were altered accordingly. The data collection forms were then piloted by three members of the clinical farm animal staff at the University of Nottingham School of Veterinary Medicine & Science and changes made according to their suggestions. The data collection forms were then sent to the veterinary surgeons in Practice 3 to ask for assessment and feedback. After a practice meeting, suggested changes were made to the data collection and data storage forms.

4.3.3.1.4 Clinical audit pilot

The pilot data collection started on the 22nd August 2014 and ended on the 22nd October 2014. Twenty-two cases of LDA were recorded, with some follow up data recorded for 13 animals. A couple of suggestions were made from the practitioners about the data collection forms after the pilot data collection – pre-existing conditions were added on and the position on the form of 'farm name' and 'farmer name' were swapped around.

4.3.3.2 Data collection

Due to minimal changes made after the pilot study, the cases collected for the pilot data collection were also included in the actual data collection. Sixty-eight LDA cases were therefore recorded during the data collection period that ran from the 22nd August 2014 to the 30th April 2015. The Excel spreadsheet that stored all day one and follow up data is shown in Appendix 13.

4.3.3.3 Analysing the data

Data was collected from the paper forms on to an Excel spreadsheet and updated versions were sporadically emailed to the researcher. Sixty-eight LDA cases were recorded by eight different vets on twenty-seven different farms during the eight and a half months of data collection. Ten out of the twenty-seven farms did not milk record so the collection of follow up data was therefore limited to 17 farms. Cases were recorded fairly consistently over the nine calendar months (Figure 26) with peaks in September and February.

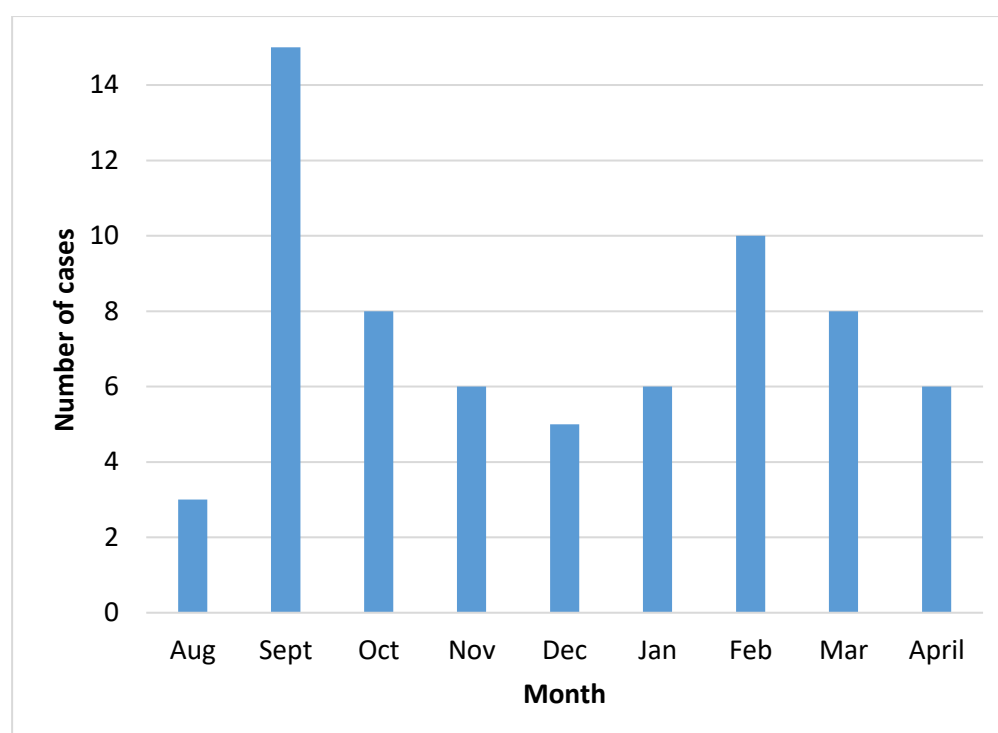


Figure 26 Number of LDA cases recorded by month by the veterinary surgeons in Practice 3

Eight veterinary surgeons recorded at least one case (Figure 27) and the number of cases recorded per farm varied from one to fifteen (Figure 28).

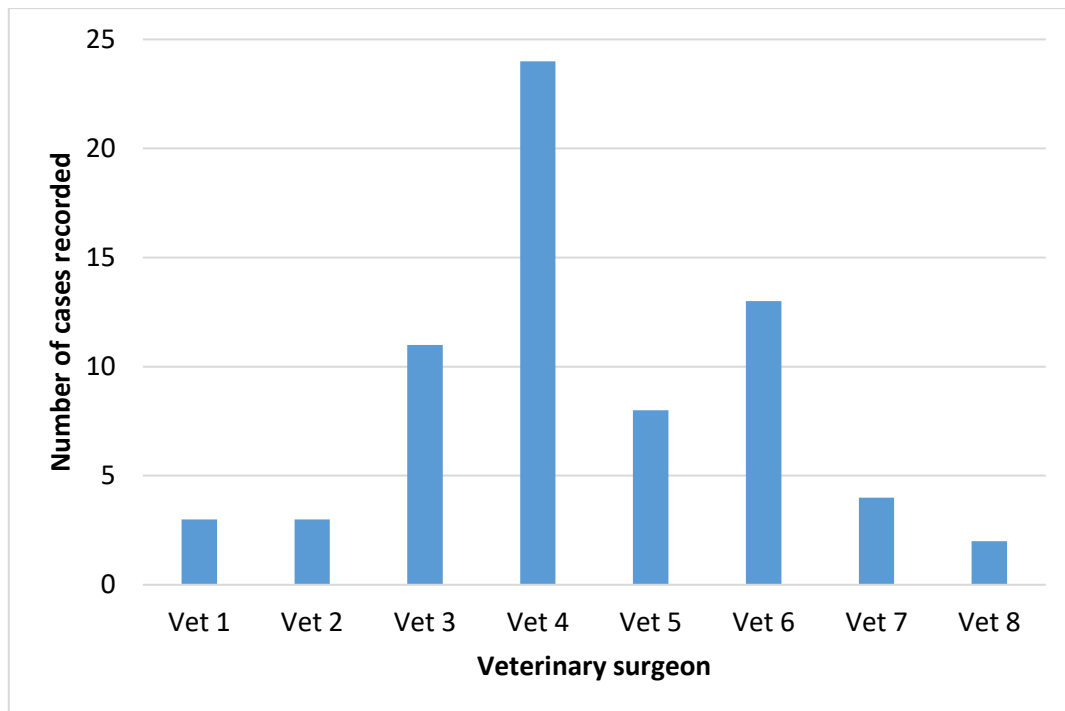


Figure 27 LDA cases recorded by each veterinary surgeon in Practice 3

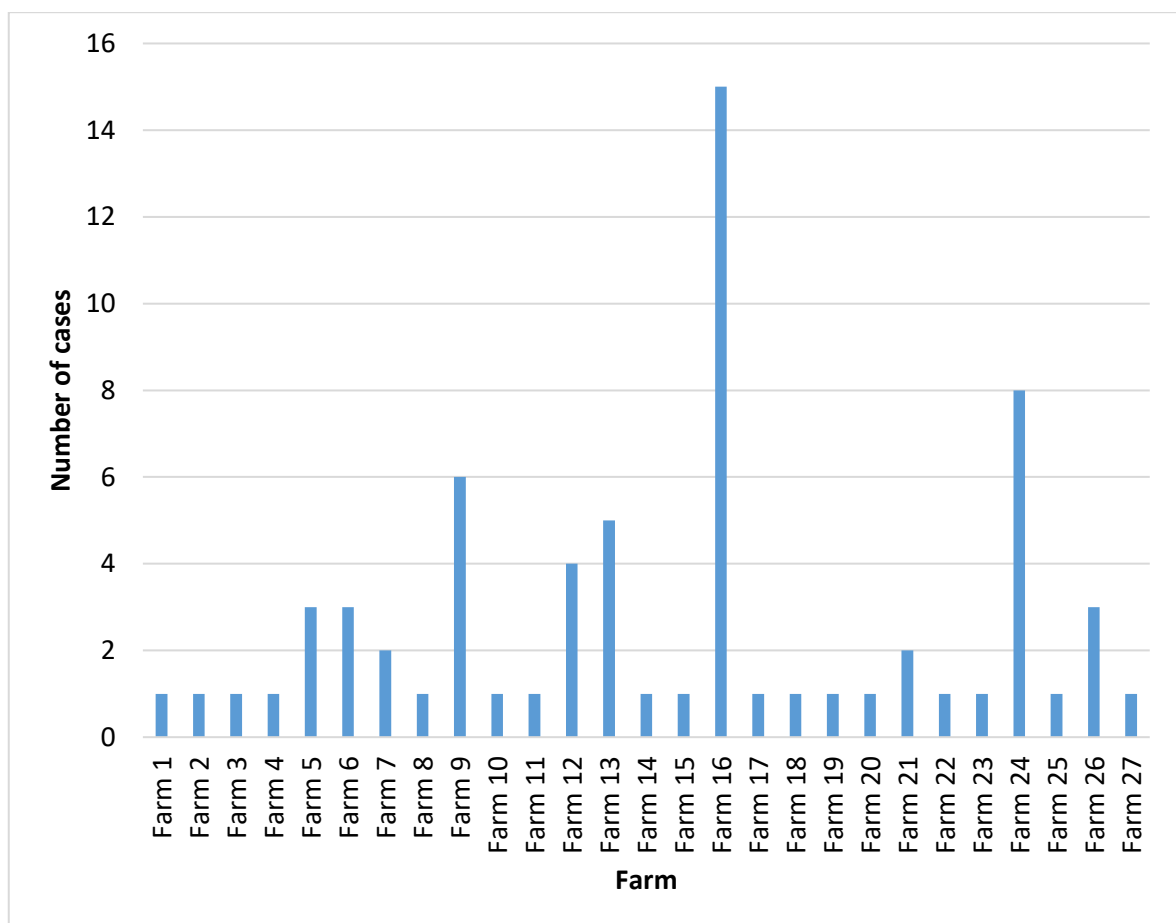


Figure 28 LDA cases recorded by farm in Practice 3

Forty-five cases had no concurrent diseases at the time of surgery while 22 cows had at least one disease diagnosed at the time that the LDA surgery took place (Figure 29). Uterine disease was the most commonly recorded concurrent disease recorded followed by metabolic disease.

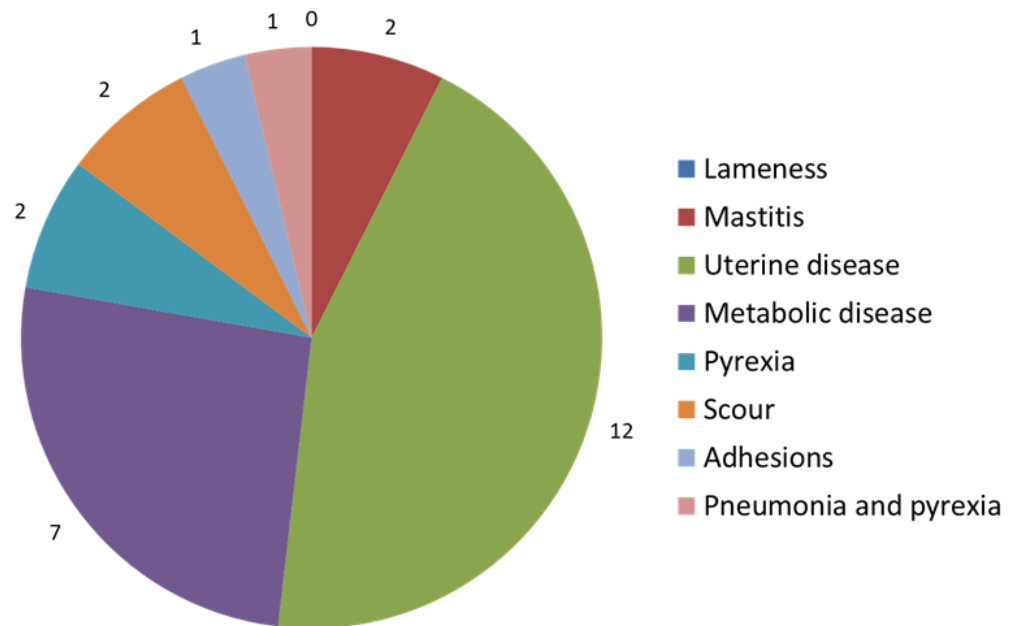


Figure 29 Concurrent disease diagnosed in 22 cows at the time of LDA surgery performed by veterinary surgeons in Practice 3

(n = 22, some cows had more than one concurrent disease)

All cows were alive at the end of the surgical procedure. Table 15 shows the prognosis given to each case at the time of the surgery and the subsequent survival rates at seven days and two months. All animals given a poor prognosis at the time of surgery were alive at two months' post op, while all four of the animals that died had been given a fair prognosis.

Table 15 Prognosis given to each case at the time of surgery and the subsequent survival rates

	Survival at 7 days			Survival at 2 months		
	Alive	Dead	No data	Alive	Dead	No data
Good prognosis	24	0	14	20	0	18
Fair prognosis	17	2	6	16	2	7
Poor prognosis	4	0	0	4	0	0

Milk yield data was collected for twenty cows (Figure 30). By the first milk recording, 65% of the cases were producing 30 litres with 63% (12/19) producing more than their herd average.

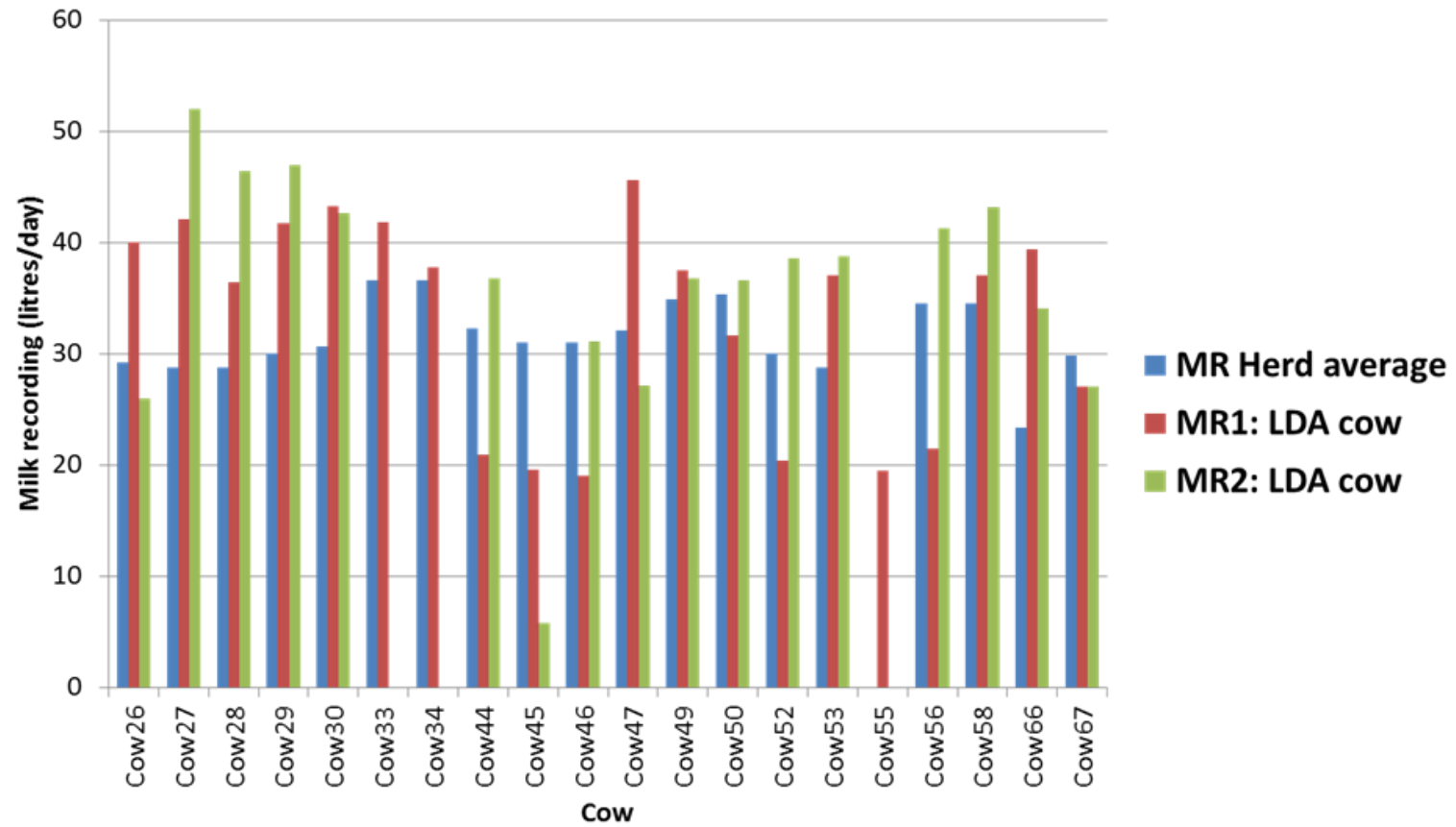


Figure 30 Milk yield per day at first and second milk recordings post LDA surgery.

MR = milk recording MR1 = 1st milk recording post-surgery, MR2 = 2nd milk recording post-surgery

Fertility data that allowed the calculation of calving to first service was collected for 26 animals. The average (mean) calving to first service was 68 days (Figure 31). Data was available to calculate calving to conception for ten cows, the average number of days to conception was 122 days.

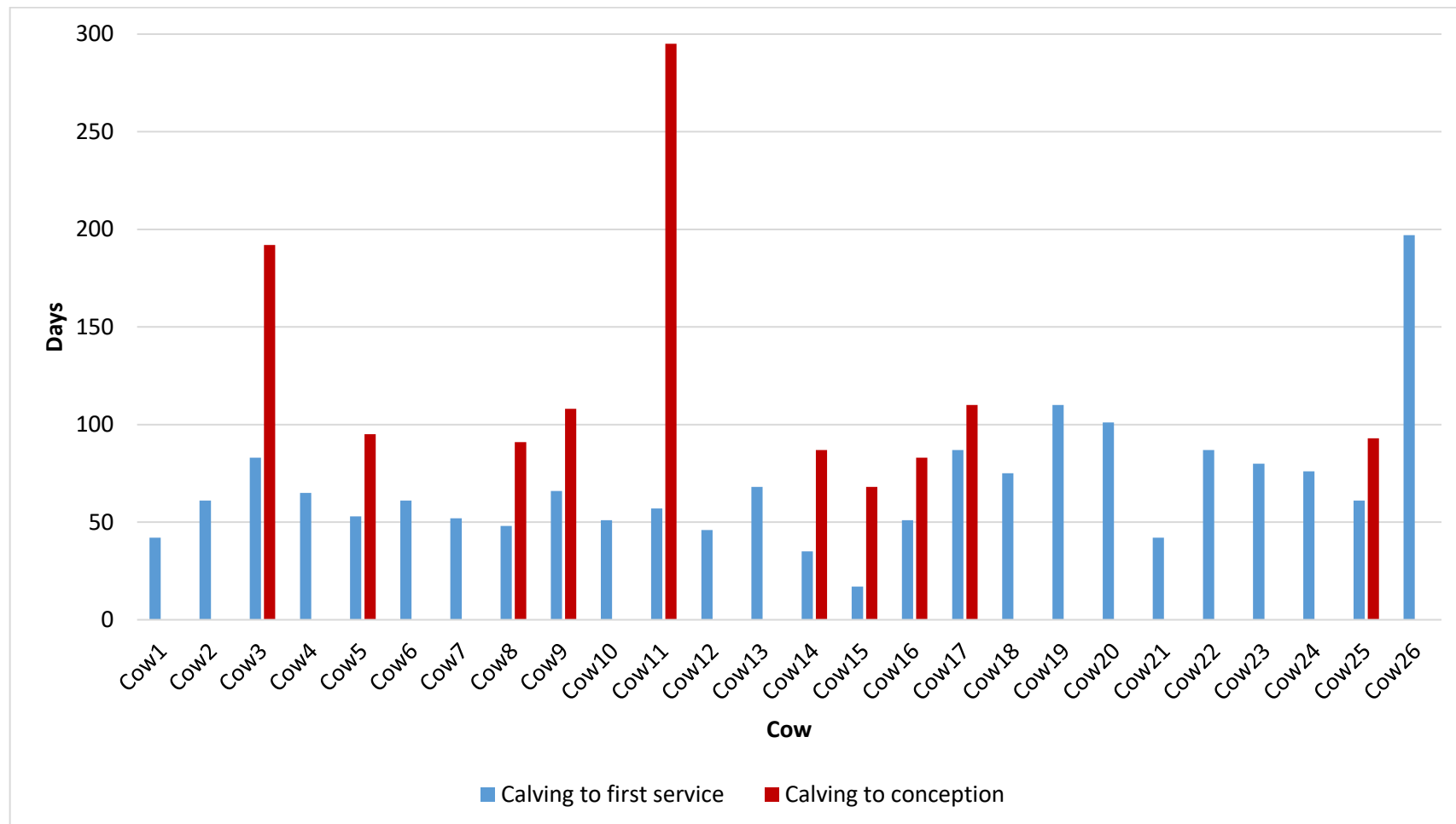


Figure 31 Calving to conception interval and calving to first service (both days) for cows undergoing LDA surgery in Practice

The first service conception rate for cows with available data (23) was 0%, 73% (19/26) had been served by 80 days in milk and 60% (6/10) had conceived by 100 days in milk.

4.3.3.4 Discussing the results of the first round of audit with Practice 3

A meeting was held on the evening of the 27th August 2015 to discuss the results of the first round of audit. Over half of the veterinary surgeons in the practice were present, including two who were new to the practice and the project. At the meeting the veterinary surgeons were presented with a PowerPoint presentation showing the results of their data collection and how their results compared to figures found in the literature. The veterinary surgeons were pleased that their outcomes matched or exceeded the figures in the literature. The practitioners felt that they wanted to collect more of the same data so that they could confidently say that the practice achieved good outcomes from their LDA operations. It was decided that data collection would continue until the end of May 2016.

The data from the second round of clinical audit was analysed in July 2016. Analysis included LDA surgical cases from the first and second rounds of clinical audit. Nineteen cases were collected during the second round of clinical audit with the majority of these (13/19) collected in May and June 2015. No cases were collected between September 2015 and January 2016 because the staff who cleaned the surgical kits assumed that the clinical audit had finished and so stopped putting the data collection books in the kits. Combined findings from the first and second round of data collection were very similar to the first round findings as discussed above. Due to time constraints the combined findings were discussed at the final meetings with the practitioners and no further stages of clinical audit were conducted.

4.3.4 Clinical audit timeline

Figure 32 shows a timeline of the clinical audits conducted in the three practices. The length of data collection for the clinical audits depended on topic chosen and subsequent caseload. The timings of meetings depended on

the availability of the practitioners; meetings were organised for times when there would be the most veterinary surgeons present.

	Practice 1	Practice 2	Practice 3	
Feb-14	PSM			
Mar-14	COD pilot clinical audit	PSM		
Apr-14			PSM	
May-14				
Jun-14				
Jul-14	1st round data collection COD clinical audit	Calf pneumonia pilot clinical audit	LDA pilot clinical audit	1st round data collection LDA clinical audit
Aug-14				
Sep-14		Calf pneumonia 1st round data collection		
Oct-14				
Nov-14				
Dec-14				
Jan-15				
Feb-15				
Mar-15				
Apr-15				
May-15	Endometritis pilot clinical audit			
Jun-15	Meeting to discuss first round findings	1st round data collection endometritis clinical audit		
Jul-15				
Aug-15			Meeting to discuss first round findings	
Sep-15			2nd round data collection	
Oct-15	Meeting to discuss first round findings			
Nov-15	2nd round data collection			
Dec-15				
Jan-16				
Feb-16				
Mar-16				
Apr-16				
May-16				
Jun-16				
Jul-16				
Aug-16	Final meeting		Final meeting	
Sep-16		Final meeting		

Figure 32 Timeline of the four clinical audits conducted in the three practices

4.3.5 Practice dynamics

Over the three years of the project, a number of staff changes took place within the three practices. Existing veterinary surgeons left and new veterinary surgeons started; staff went on and returned from maternity and paternity leave; office administration staff changed; veterinary assistants were promoted; practitioners went on and returned from long-term sick leave; new practice branches opened; workloads from external commitments increased and veterinary students became employed veterinary assistants.

4.4 Discussion

This study demonstrated a number of barriers to conducting prospective clinical audit in farm animal veterinary practice. The farm animal veterinary surgeons were happy and willing to engage in clinical audit activities and it was possible for data to be successfully collected prospectively on farm but none of the three clinical audits were fully completed, engagement of the practitioners waned and the process took a large amount of practitioner time. Although a number of barriers to the process were highlighted, this study found that conducting clinical audit can be of interest and benefit to practitioners.

4.4.1 Clinical audit topic

Surgical topics are often chosen for clinical audit as they are considered easy in terms of diagnosis and defining outcomes (Society of Practising Veterinary Surgeons/Professional Development Foundation, 2005). In Practice 1 and 2 medical conditions were chosen. Due to concern about the ease of determining which cases would count towards the clinical audit without doing a full, 'textbook' diagnostic work-up, cases were collected that the clinicians were treating for the particular condition (E.g. a veterinary surgeon in Practice 1 treating a cow for COD, would be recorded as a COD case). Defining the cases in this way worked well but also raised a large amount of discussion at the first and final meetings. Practitioners questioned how they were making their diagnoses and whether they were diagnosing cases correctly which led

to further consideration given to the action taken for treatment. Defining cases for clinical audit based on what the veterinary surgeons are treating is a sensible approach to collecting cases and discussion surrounding the diagnoses may be an extra benefit of clinical audit.

The topics chosen in Practice 1 and 3 required information to be recorded at more than one point in time (first examination and follow-up examinations for COD, and initial LDA operation with follow-up data collected via computer records). This two-tiered approach required additional effort and resulted in less follow-up information being recorded compared to the first event details. Although analysis and discussion could take place around the follow-up data, conducting a clinical audit that requires follow-up data may not be the easiest place to start in a practice conducting clinical audit for the first time. A simple, one-step clinical audit may be more easily attempted. The practitioners also often wanted to know answers to research questions about their topic. It was challenging to keep all individuals focussed on choosing topics suitable for clinical audit throughout the process and this also followed into requests for large amount of questions on the data collection forms. Choosing the topic for clinical audit does not appear to be what makes a clinical audit simple or difficult – this is more likely to be determined by the type and amount of data and how it is collected.

4.4.1.1 Caseload

There is no specific number of cases required for clinical audit as statistical significance is not required as in research (Viner, 2009; University Hospitals Bristol, 2009d; Wylie, 2015). Some medical documents suggest an arbitrary figure of approximately 40 cases (University Hospitals Bristol, 2009d). Due to unknown caseloads and potential effects of seasonality in farm animal practice the clinical audits were originally intended to run for 12 months. This was altered in all three practices for a number of reasons. In Practice 1, a large number of cases were collected in the first six months and the decision was made to stop data collection after nine months as it was felt that nothing new was going to be collected. The veterinary surgeons were also beginning to

wane in their enthusiasm for the clinical audit. This clinical audit could have been done over 3-6 months due to the high caseload. In Practice 2 no cases were collected over six months for the calf pneumonia clinical audit. This was due to a perceived low caseload seen by the practice. The same practice then collected a large number of cases over three months for the endometritis clinical audit. This clinical audit was kept short due to time restrictions on the overall research project. In Practice 3 a good number of cases were collected and this clinical audit stopped after nine months again due to time restrictions on the research project, as well as recognition that enough cases had been collected. Practitioner enthusiasm for case collection waned over time, but seasonality of LDAs led to an increase in cases at six months. Many conditions in farm animal practice are seasonal and this could be used as an advantage in clinical audit; preparation for clinical audit could take place in quieter times with data collection over busier periods where these are known. Cases collected by individual veterinary surgeons across all three practices varied greatly. The main contact for the research project in each practice collected the most cases which may have been due to interest and enthusiasm for the project, the desire to set a good example to the rest of the team and possibly to appear keen and involved with the research project as a whole. Having the clinical audit leads collect a large amount of cases did appear to motivate the other staff members. Practice 2 recognised that only two veterinary surgeons were likely to record endometritis cases as they were the only two to go on RFVs. Originally Practice 2 chose a topic where all vets would see cases as it was felt that was important for team involvement. Discussions in the practices where many members of staff had collected cases did appear to lead to more discussion about the topic and findings.

The topic chosen, and subsequent practice caseload, is likely to effect the number of cases recorded for clinical audit. The very low caseload for the calf pneumonia clinical audit highlighted opportunities for further clinical audits to investigate why cases were either not being seen or were not being recorded; the practice was aware that they were dispensing a large amount of

medicines to treat these cases on farm. However, the practitioners decided that they would rather audit a different topic. As predicted by the veterinary surgeons the reproduction topics did provide a large number of cases. Enthusiasm and interest for the project declined over time however which led to a reduction in the cases collected as the clinical audit progressed. This is recognised in the medical profession as audit fatigue (Dixon and Pearce, 2011).

Only one case is needed for a significant event clinical audit (Mosedale, 2014), but few cases for any topic and type of clinical audit could allow for discussions and subsequent changes. The 'right' number of cases should be determined by the topic chosen, the caseload seen by the practice and/or each individual veterinary surgeons and the number of cases that are collected as the clinical audit progresses. Defining how many cases to collect at the start of a clinical audit may not be successful and should remain flexible. If practices would like their clinical audit findings to be significant then a sample size calculation may be used to determine the number of cases required; this is common in the NHS where large scale decisions are made but may be less necessary for veterinary practices (University Hospitals Bristol, 2009d).

4.4.2 The clinical audit process

Completing the clinical audit cycle is recognised as one of the main challenges of clinical audit in the NHS. Reasons for this include time commitments, junior doctors moving on to the next rotation or inadequate training and support (Dixon, 2011). None of the clinical audits conducted during this study successfully completed a full cycle of clinical audit in the available time frame. The definition of clinical audit includes an element of service improvement, this therefore questions if any of the clinical audits conducted in this study can be called clinical audit. For Practice 1 a full audit cycle was not considered necessary as they were happy with the initial findings. The initial clinical audit conducted with Practice 2 had a low caseload and was suspended, while both Practice 2 (second clinical audit) and Practice 3 felt that they wanted to

expand on the information gained after the first round of audit before making a decision to change the way that they did things. A conscious decision to stop clinical audit after the first round of data collection because the findings are considered of a good enough quality, should not disqualify the work from counting towards clinical audit. Benefits may be felt by discovering what happens in a practice and the associated discussions stimulated, without necessarily changing what people do. It may be that no changes are necessary. Where this is the case the work should still count as a part of clinical audit. Stopping a clinical audit after the first round of data collection because a practice thinks that it is 'enough' to meet, for example, RCVS PSS requirements, should not be considered as clinical audit. Differentiating between these two reasons for stopping a clinical audit after the first round of data collection is therefore important when assessing the use of clinical audit in practice. For Practice 2 and Practice 3 the research project came to an end after they had collected the second round of data, so it is not known if the audit cycles would have been completed had the research project continued. The data collection periods in the clinical audits used in the study were however quite long. The chance of completing a clinical audit cycle may be increased by choosing a simple topic with easy data collection over a short period time.

4.4.3 Comparing practice findings to the evidence

Many authors advocate comparing the findings of clinical audit to standards published in the literature (Rayment, 2002; Viner, 2005a; Dunn, 2012; Wylie, 2015;). Practice 1 and Practice 2 both looked at the treatment of reproductive conditions in cattle. There was a large amount of literature on both endometritis and COD with many different treatments mentioned, however there was no 'gold standard' treatment defined. It was far beyond the scope of the clinical audits to find all the literature, compare studies and determine the 'best' treatment as may be done with a systematic review. The treatments used in these two practices were therefore discussed within the teams. The literature was considered, but more influence was placed on what people did

and why they chose one treatment over another. Discussing what veterinary surgeons do does open up channels of communication, encourages revision of medicine data sheets, encourages consideration of antibiotic usage and informs others of the approach to cases used by individuals. Depending on the current situation in the practice, this may be a useful outcome of clinical audit. If the clinical audits from Practice 1 and Practice 2 were published, these in themselves may act as benchmarks for other practices. Research defining a clear 'gold standard' treatment would make the clinical audit process easier and advise veterinary surgeons on the 'right' treatment choice, although not necessary.

Standards were found in the literature for Practice 3 to compare their findings to. One study (Pedersen, 2006) had been published from a practice in the UK that was considered comparable to Practice 3 and this provided a good benchmark to compare to. The practitioners here found it interesting to see what other practices had achieved. Practice 3 took into account the limitations that their findings had as clinical audit rather than research data, but were very happy with their findings when compared to the findings in the literature.

4.4.4 Data collection

4.4.4.1 Data collection on farm

All three practices found the data collection on farm easy to do. The practitioners were very positive about the data collection books that had been made, and found that farmers were happy with the information being recorded at the time the work was conducted. Practice 3 found the data collection using the books in the surgical kits very easy, especially because practice policy was to have two members of staff attend a caesarean. The main advantage of on farm data collection is accuracy as it rules out errors that occur when information is recalled at a later point in time.

4.4.4.2 Data collection tools

Transferring the data from the paper records to the electronic version in Practice 1 and Practice 2 introduced an extra step in the system. A couple of the veterinary surgeons admitted that they had not had time to transfer the information and one book was lost in the early stages of its use. These challenges could be negated if electronic methods of data collection were used on farm. Computer tablets could allow required information to be transferred directly back from the farm to the practice which would assist with the quality of clinical records as well as clinical audit. Some farm animal practices already use these which allows clinical records to be written on farm and directly transferred to the Practice Management System (PMS) via the internet. The three practices in this study did not, and were concerned about using a mobile app on their telephones in cases of bad internet coverage out on farms. Where data is transferred between data collection tools, protected time may be required for data to be transferred and care needs to be taken to not lose the information when it is in the paper form. The spike used by Practice 3 when transferring the paper forms from the books in the surgical kit to the clinical audit lead to type up on the computer proved very successful. The veterinary nurses checked the books after every caesarean, the forms were moved to the spike and the clinical audit lead collected the forms from the spike at a time to suit them. The one disadvantage that did effect the number of cases collected was when the veterinary nurses thought the clinical audit had finished and stopped putting the books in the kits. This may have been improved by better communication – the veterinary nurses did not attend the clinical audit meetings and this highlights the need to keep all stakeholders informed through the clinical audit (Viner, 2009).

Practice 1 and Practice 2 both used a SurveyMonkey form for a stage of their data collection. This was mainly to allow the researcher (working remotely from the practice) to have access to the cases collected. As information can be downloaded into a Microsoft Excel spreadsheet from SurveyMonkey, it may be a useful software for practitioners to consider for data collection. One

advantage is that cases can easily be submitted from anywhere with internet access. Due to confidentiality concerns the Microsoft Excel spreadsheet from Practice 3 was only shared via email with the researcher, this meant that the researcher did not have continued, up-to-date access to the data. In practices where clinical audit is not a part of a research project this would not be an issue. Access to a spreadsheet being used to collate all information for a clinical audit would need to be considered if there were multiple people entering data; online cloud storage options such as DropBox may be considered useful to keep the same version up-to-date (Burford, 2013). For simple data collection a spreadsheet stuck to the wall in the practice may be an easy way for information to be collected. Confidentiality should be considered for all types of data collection and handling.

Changes made to the data collection forms indicated that the practitioners wanted data collection to be quick and easy, for example by replacing free text boxes with tick boxes. Tick boxes have the advantages of speed and easy data analysis, but disadvantages in that they may influence the treatment chosen on the data collection form or even the treatment given to the animal. This type of disadvantage would be overcome by retrospective clinical audit if the information was available. Despite stressing the importance of having quick and easy data collection forms, the practitioners also wanted to add questions. This was associated with the desire to answer research questions and efforts were made to keep the data collection forms as short and concise as possible. As described by (Rayment, 2002), the pilot clinical audits in this current study proved useful for testing the data collection tools and assessing what information was collected.

4.4.5 Communication

Communication has been highlighted as a vital part of successful clinical audit in the medical field (Johnston et al., 2000). Many different channels of communication were set up at the beginning of this study to ensure that all veterinary surgeons within the practices remained informed of the process throughout. The success of these methods was not officially measured, but

many of the veterinary surgeons commented that they felt well informed of the process and the results. The practitioners in Practice 1 felt that weekly data collection email reminders was too often and that fortnightly was better. Communication should therefore be frequent enough to maintain engagement without being over bearing or time consuming. It may be particularly challenging in the farm animal environment as veterinary surgeons are mostly working alone, so defined time points for discussion with the whole team may be crucial for the success of clinical audits.

In Practice 1 and Practice 2 all communication by the researcher about the project was with all practitioners through email. Each individual was therefore directly informed about the progress of the clinical audit and personally received reminders for data collection. In Practice 3 all communication from the researcher to the individual practitioners was done through the clinical audit lead in the practice. It did not appear to make a difference to the number of cases collected or the motivation of the individual veterinary surgeons whether the communication was direct or through a second person.

4.4.6 Engagement

Engagement with the clinical audit project varied between individuals. This appeared to be affected by interest in the clinical audit topic, level of topic caseload, work-life balance priorities, external commitments (personal and professional), internal commitments (work load), time availability, obligations to work or bosses, recent CPD events and enthusiasm of the audit lead within the practice for the project. Incentives such as refreshments and additional CPD were used to try to encourage involvement throughout the project. Engagement with the clinical audit did appear to reduce in all three practices as the time went on. It is unknown how much of this was due to the length of the research project (three years) and how much was due to the length of the actual clinical audits being conducted. Maintaining staff engagement in the clinical audit is vital for it to be successful. Consideration should therefore be given to the length of the audit, the ease of data collection and topic being audited to keep staff members interest.

Personnel changes throughout the course of the clinical audits also affected the level of engagement from different individuals. A number of practitioners began work at the practices after the clinical audits had started but this did not necessarily affect their level of engagement with the project. Informing new personal of the details of the clinical audit worked well with getting people involved. Staff joining the team towards the end of the clinical audits did appear to have less involvement in the data collection, but were happy to join the discussions about the data collected and often brought other ideas from other places. Keeping the length of data collection short may reduce the affect that staff changes would have on a clinical audit.

4.4.7 Clinical audit stakeholders

Throughout the prospective clinical audits the veterinary surgeons did the majority of the work towards the clinical audits. Only veterinary surgeons attended the meetings held in each practice, occasionally accompanied by veterinary students. The veterinary surgeons entered all of their own data onto the computer when transferring it from the paper data collection forms. In Practice 3 veterinary nurses were in charge of putting the data collection forms in the surgical kits for the LDA clinical audit. The researcher did a large amount of administration work for the clinical audit including communicating the project between team members, creating the data collection forms and collating and presenting the results. The role of other stakeholders was not addressed as a specific area of investigation in this project but it was interesting to see that the veterinary surgeons naturally undertook the main bulk of the workload, when there were elements that could have been passed to other members of the practice team. This may have been different had the researcher not been assisting with the clinical audits, but time is consistently cited as a barrier to clinical audit and involving all team members to utilise appropriate skills may bring benefits to the whole process.

4.4.8 Challenges and benefits of conducting clinical audit

The challenges of conducting clinical audit such as the time required, the logistics of collecting data and keeping individuals involved and motivated as

discussed above were balanced with a number of benefits. The veterinary surgeons found the findings of the clinical audits interesting and informative both in terms of seeing what the practice achieves, and discussing how other people perform the same clinical procedure. The practices were re-assured about the treatments individual veterinary surgeons carried out and this was deemed especially helpful for farm animal practice where contact between individual veterinary surgeons can be limited. The benefit of this for new graduates, or new employees, was especially highlighted. The clinical audit stimulated other discussion and encouraged communication within the practice that may not have otherwise taken place. Two of the practices did not find the time for practice meetings and found that discussing clinical audit allowed the team to get together.

4.5 Study limitations

This study considered four clinical audits conducted in just three different farm animal veterinary practices. Although the practices were all first opinion veterinary practices, it cannot be assumed that the practitioners in the three practices directly represent all veterinary surgeons who undertake farm animal work in the UK. Resources available to practices such as time, money, staff, computer knowledge, literature access and ability to interpret papers will all differ so clinical audit capabilities will vary from practice to practice. Clinical audits can also be run on a huge range of topics for variable time frames - the topics chosen here and the time frame over which the clinical audits were conducted will affect the results. Although all data were kept anonymous, the practitioners may have potentially changed their behaviour because they were working with an external organisation. However, during the practice meetings, most of the practitioners appeared honest when discussing good and bad aspects of the project. The facilitators, barriers and benefits of conducting clinical audit found here may be different to a similar study conducted in a different practice or on a different clinical audit topic. The researchers provided refreshments for the practitioners at the practice meeting. At the end of the project a thank you present was given to the main

contact within the practice, and a thank you card and cake given to the other team members. It is not known if the incentives had any effect on the turnout of vets to the meetings, or the submission of cases as part of the clinical audit.

4.6 Conclusion

No previous studies have attempted to describe the process of undertaking prospective clinical audit in farm animal practice in the UK. This study has demonstrated the challenges and facilitators of prospective clinical audit in the farm animal practice setting, along with some of the additional benefits of conducting the process. Clinical audit should be kept simple, whilst considering the individual requirements, resources and expectation of each individual practice and team of practitioners.

Chapter 5 Feasibility of conducting retrospective clinical audit in farm animal practice

5.1 Introduction

Both retrospective and prospective clinical audit has been discussed in the literature. The NHS perceive retrospective clinical audits to be the most useful where significant events have occurred (Copeland, 2005). Data collection is, however, often considered the tiresome part of clinical audit and this is particularly true when considering the effort required to perform a prospective clinical audit (Dunn, 2012). Benefits such as saving time, money and effort on unnecessary prospective data collection can be reaped from using data that already exists. The process of conducting a prospective clinical audit can lead to clinical improvements in itself (Dunn, 2012; Haessler, 2014), but retrospective data collection can provide the true picture on what is really happening prior to any intervention. Retrospective clinical audit can therefore have some advantages over prospective clinical audit.

In the NHS detailed electronic clinical records, often with access shared by more than one hospital, allows retrospective clinical audit to be conducted with relative ease (Mettias et al., 2012). Specific codes may be used to find the information to aid the process (Mettias et al., 2012). The free text of clinical notes have also been shown to be information rich and these can improve the quality of coded parts of records, but are often more difficult to search (Bansler et al., 2016; Ford et al., 2016). Bansler et al. (2016) found that clinical records about patients can be found in many different places in both electronic and paper-based forms.

McKee (1993) suggests that three factors should be considered when using pre-existing data for clinical audit; completeness, accuracy and precision. The depth of information recorded within veterinary practice management systems is likely to be variable. The level of data that exists may depend on

the computer software utilised by the practice and the detail recorded by individual veterinary surgeons (British Veterinary Association, 2003). When searching free text equine electronic medical records for research purposes, Duz (2016) found the same conditions were often recorded in different ways (e.g. diarrhoea/d+/scour), information was missing and the reliability depended on the importance placed on recording the information by the attending veterinary surgeon. The free text of equine medical records was also time consuming to search (Duz, 2016). In small animal practice, systems such as the VeNom coding nomenclature have been developed which help to facilitate clinical audit (O'Neill, 2012). At the time of writing, VeNom codes for equine and farm animals were undergoing peer review (VeNom, 2016).

No studies have attempted to assess the possibility of searching farm animal clinical notes for clinical audit purposes. The purpose of this study was to further investigate if and how retrospective clinical audit could be carried out in farm animal veterinary practice.

5.2 Methods

The three veterinary practices working with the CEVM to conduct prospective clinical audits were visited to investigate the possibility of carrying out retrospective clinical audit in farm animal practice. Visits were made to each individual practice where information recording and storage was discussed with a nominated member of the practice team.

5.2.1 Data collection methods

The way that the practices collected and stored information was examined from the time that farmers telephoned the practice to arrange a visit, through to the bill being created and distributed from the practice management system. Collection and collation of data by the veterinary surgeons and veterinary practice staff was investigated, as well as evaluating how the practices stored and utilised clinical data. How the information was stored by the practice was recorded during the visits, and further questions were asked if required. It was decided that any data collected from cases occurring during

the 2013 year would be targeted. Any data relating to this year was sought and collected from any of the practice data systems as identified above.

5.2.2 Data analysis

Collation of data was carried out by the researcher, with assistance from a practice staff member in each practice. The data was transferred into a Microsoft Excel V.14.0.6 (2010 Microsoft Corporation) document and descriptively analysed. Figures were created from this data and transferred to a Microsoft PowerPoint document for use during presentations to the individual practices. The findings were discussed with the practitioners, in combination with the data from the prospective clinical audits (Chapter 4).

5.3 Results

5.3.1 Practice 1 – Cystic Ovarian Disease (COD)

5.3.1.1 Potential sources of data

Practice 1 used practice management system Robovet for billing purposes and to record clinical information. Interherd, a herd management software, was used by the practice to record data relating to individual cows on a herd level and paper records called Herd Health Visit Record Sheets (HHVRS) existed for routine fertility visits (RFVs).

The practice used an online diary to manage their daily workloads. When a call was received and a visit requested by a farmer, an entry was made into the online calendar. This was accessible from any computer with internet access for members of staff with the correct login. Once work had been completed on farm, a three-layered invoice ticket was written up to record the work carried out. One copy was given to the farmer at the time of the visit, one kept by the vet and the final copy handed to the administration staff back at the practice. The administration staff transferred the information from the ticket to Robovet for the vets; this ensured that the work was charged for correctly. The data was entered into the relevant fields; free text for clinical information relating to the animals seen on the visit, medicines were charged through product sales, a visit fee was added on and the time the vet spent on

farm was booked by the minute. Some conditions seen were also booked as a 'no charge fee' which could add more detail to the record, for example 'examine cow'. Clinical details about each visit or case recorded by each vet varied in detail. Animal identification such as freeze brand or ear tag number did not appear to be recorded in most cases. All medicines used were always recorded, as was the time spent on farm (these were 'chargeable items' of a visit and if not recorded, the farmer did not get charged correctly). Any services or products to be paid for were visible on the billing part of the farmer's record and could be searched for in 'product sales'. Figure 33 shows the different parts of a Robovet clinical record seen by Practice 1 employees relating to a visit to a farm.

RoboVet In Use 8

Change User Exit RoboVet

Suppliers Price Look Up Help

Clients Product List Orders Organiser Communications Insurance Schemes

Diary Records Selling Accounts View

Release New Work Entry Estimate To Consult Unlock Notes Statistics Add Wastage

Quick Credit Note New Stat. Locations/Batches Show VAT Secondary Products Collapse All Secondary Prices Products Sold View

Drug Docket Consultation Address Label Prescription Animal Label Print

, Dairy, 01y 09m 25d, Gender Unknown, Vacc: None, Flea: None, Worm: None

Thu 01 Jan 2015 10:52 Consultation Visit Mode Off

Address New Find Clear

Find Clear

Cow down, previously diagnosed with heart condition, deliver live twins, advise LA abs

1

Waiting Consulting Inpatient

To Pay

Discount [excl VAT]

NUM 10:18

01 Jan 2015 Cow down, previously diagnosed with heart condition, deliver live twins, advise LA abs

31 Dec 2014 Monthly Farm Attendance

29 Dec 2014 rpt. VWD

24 Dec 2014 Drug Order

23 Dec 2014 RFV, 3PD+ 2PD- 5PNC

12 Dec 2014 Not used

09 Dec 2014 RFV, 4PD+ 1PD- 1cystic, 3PNC, 4NSB

08 Dec 2014 Heifer freshly calved, injured mouth, h+, swollen nasal bone ?# but not displaced.

30 Nov 2014 Cow pneumonia T104.4, suspect bacterial

30 Nov 2014 Monthly Farm Attendance

27 Nov 2014 Heifer, large calf, caesarian, live calf.

25 Nov 2014 RFV, 3PNC, 2PD-, 8PD+, 4NSB.

05 Nov 2014 RFV, check bullin gheller Hx IBR/pneumonia - chest not too bad but risk of long term

31 Oct 2014 Monthly Farm Attendance

30 Oct 2014 Ministry T12 all clear

27 Oct 2014 Ministry T11 x ~200

22 Oct 2014 Repeat prescription

17 Oct 2014 Repeat Prescription

14 Oct 2014 RFV, Scan 18, 5PD+ 0PD-, 6PNC, 6NSB, 1 Cyst

01 Oct 2014 Drug Order

30 Sep 2014 RFV, 6PD+ 3NSB, 8PNC, 1 meticure.

30 Sep 2014 Monthly Farm Attendance

24 Sep 2014 Cow with temperature >106 with noisy rales in chest with "RR" - some nasal/ocular

16 Sep 2014 RFV, Scan x14.

02 Sep 2014 RFV, Scan 14, 4PD+, 1PD-, 1xRFM, 1x endomet, 2cystic.

21 Aug 2014 Monthly Farm Attendance

Farm Attendance - Out of Hours 1.0

Fees - Hourly Rate 1.0

FA Fees

30.0 x Fees - Hourly Rate (Min 1.0)

Lidocaine & adrenaline-ml injected 100.0

0.0 x 3424-602 exp: 17/10/2015

1.0 x Injection Fee (FA)

Emergency Caesarian performed - Bovine 1.0

Consumables - Farm animal surgery

1.0 x Consumables - Farm animal surgery

Brelanox LA 100ml-ml injected 10.0

0.1 x 3155-50 exp: 12/04/2015

1.0 x Injection Fee (FA)

Immuzeal Calf Colostrum 200g 2.0

Attachments (none)

Figure 33 A clinical record for a farm on Robovet.

Green box = clinical notes (free text), Red box = clinical history by date and clinical notes, Purple box =billing information. Confidential information has been censored.

Searches of the clinical records including the free text box, the product sales lists and the billing data were carried out in Robovet to gain an understanding of the availability of data. The free text box and the product sales list were examined for a number of clinical events, conditions or products sold such as 'Examine cow', 'Caesarean' or 'Veterelin'. As most cases of COD were seen at RFVs, the recording of this information was examined in more detail. Most RFVs were completed on a fortnightly basis; during these visits, records were made by the farmer for each cow examined by the veterinary surgeon. Herd Health Visit Record Sheets (HHVRS) were used for this purpose. The term 'HHVRS' covers a broad range of ways this information was recorded which included the specifically designed Herd Health Visit Record Sheet (Appendix 15), Genus print offs and photos of the farmers' diaries. The vets kept a copy of these (either the original HHVRS or a photo of the original) and returned them to the practice to be used for billing purposes.

5.3.1.2 Collecting the data and data analysis

5.3.1.2.1 Robovet

Specific searches were carried out for information relating to the treatment of COD in cows at first and follow-up examinations on Robovet; the practice started using the programme in February 2013 so only 11 months of data was available.

The free text was searched for 'cyst', 'cystic' and 'cystic ovaries'. Product sales were examined for the treatments used to treat cystic cows including Veterelin, Cyclicx, PRID and CIDRs. Individual visits carried out for routine fertility purposes were looked at and cases that had been booked as 'examine cow' were also examined.

Individual clinical records for known RFVs (found by searching for farms known by the admin staff to have routine fertility visits) were examined. The amount of clinical notes recorded by each individual vet in the 'clinical notes' free text box varied. The admin staff advised that details recorded varied greatly between veterinary surgeons – some veterinary surgeons would record clinical visits in a large amount of detail with details about individual

animals, whilst some would record minimal detail. Generally, all the veterinary surgeons would at least include the reason for the visit in the 'clinical notes' section, even if no further detail (e.g. about clinical findings or treatment plans) were included.

Figure 34 shows a screen shot of one RFV that was recorded on the system. Clinical notes explaining the reason for the visit was encouraged by the practice, but the detail that was recorded varied greatly between the vets. In Figure 34, 'RFV: 4PD+, 1 PD-, 1 cystic, 3 PNC, 4 NSB' (Routine fertility Visit: Four cows diagnosed as in calf, one cow examined and not in calf, one cow diagnosed with COD, three post-natal checks and four animals examined because they had not been seen bulling) was recorded for this fertility visit. This was the most information found recorded for a RFV across the cases searched in 2013. Some vets did not record the specifics, while others recorded a similar level of detail to this example. The section highlighted in purple in Figure 34 is the billing part of the clinical record. Some events such as 'examine cow', 'lambing' or 'cow caesarean' are recorded on Robovet with a £0.00 charge, allowing these data to be searched via the 'product sales' route. 'Scan' is recorded as a product sale for billing purposes –between 1/2/2013 and 31/12/2103, 942 'fertility' visits were recorded, with 20,000 scans taking places. These 'scans' will include some COD cows, but will also include all cows scanned for other fertility purposes including pregnancy diagnosis and cows not seen bulling.

When searching for COD cows on Robovet one veterinary surgeon suggested that a more reliable method, due to a lack of clinical records, may be to search for a treatment that is fairly specific to cystic cows. Product sales was searched for '5ml Veterelin' in Robovet. In the 11 months that Robovet was in use by the practice in 2013, 284 doses of '5ml Veterelin' were sold.

5.3.1.2.2 Interherd

The administrator advised that COD cases were not recorded on Interherd for any farms, except one. Information was entered into Interherd by the admin staff only; the farmers and the vets did not enter data into the system. The majority of farms registered with the practice milk recorded with The Cattle Information Service (CIS). Samples of milk were collected once per month and tested for a number of quality markers. During milk recording, fertility information was also recorded, such as calving date. The milk records were only downloaded to Interherd if and when requested. Interherd was not searched for this study as the admin staff confirmed that records regarding COD would not exist.

5.3.1.2.3 Herd health visit record sheets (HHVRS)

Due to a lack of available data on Robovet and Interherd, a retrospective clinical audit was attempted using the paper Herd Health Visit Record Sheets (HHVRS) that were held at the practice for 2013. The HHVRS records were put into date order and examined in detail. Cows that had been recorded as 'cystic', which may have been written as 'cystic', 'luteal cyst', 'follicular cyst', 'FC', 'LC', 'cystic ovary', 'cystic L', 'cystic R' or similar, were followed from date of diagnosis to the end of 2013. Diagnosis and treatment given were recorded for each individual cystic animal from each visit until the end of 2013, or until the cow was diagnosed as pregnant, whichever came first.

One hundred and ninety-eight HHVRS sheets were found for the year 2013 (Figure 35). These sheets had 169 individual animal records, from 13 farms, relating to cows with COD. Eleven records were unable to be read due to poor clarity. Seventy-four cows were seen for a first examination where they were diagnosed as 'cystic', and 42 of these were seen for a second examination.

Eighty-four 'follow up' examinations were recorded in total; these included second and subsequent examinations for the 42 animals mentioned. Of the 169 entries that contained information about cows with COD, only 20 records had the vet identity recorded.

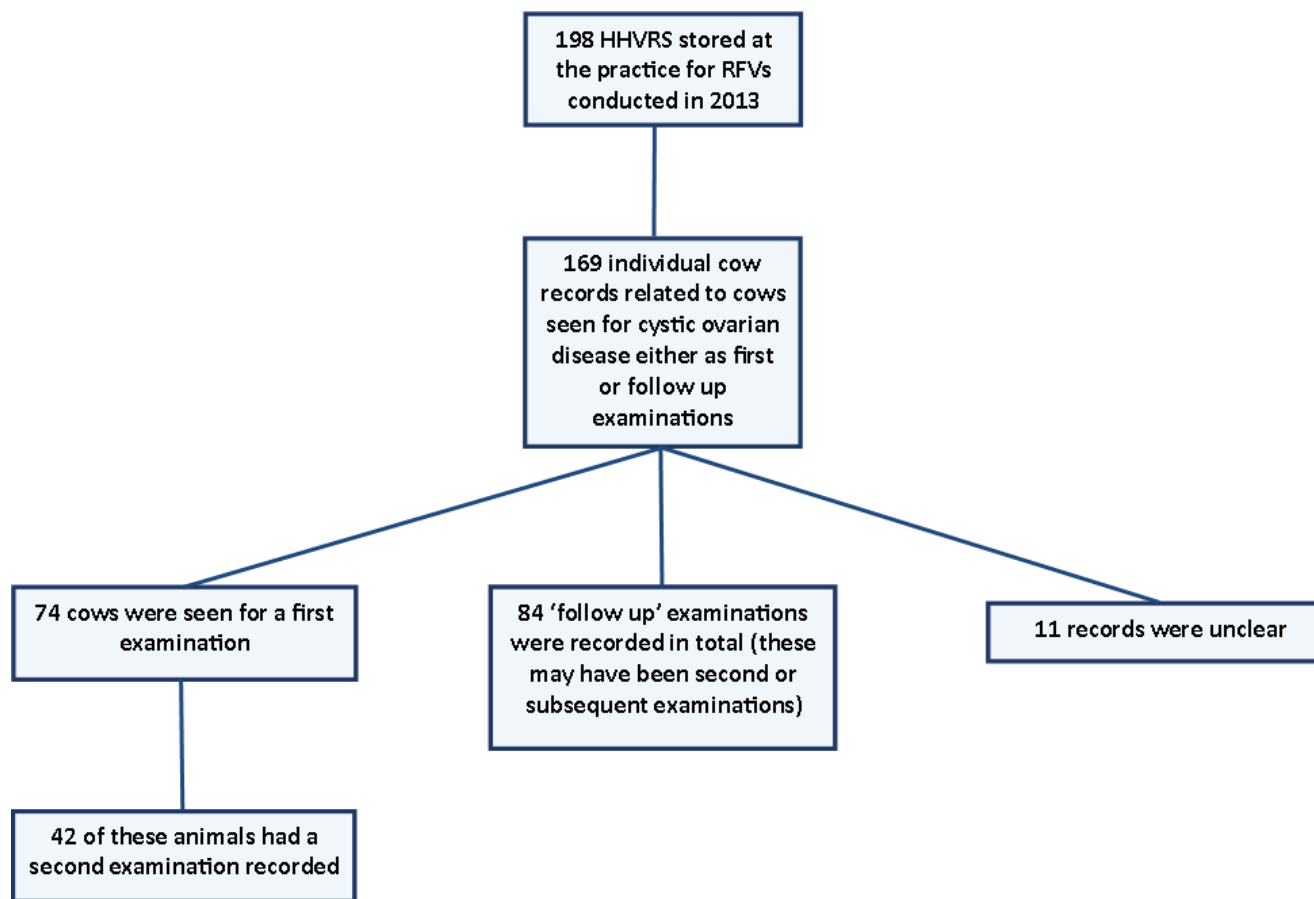


Figure 35 Flow diagram showing the number of herd health visit record sheets found in Practice 1 and what the 169 individual cow records were about in 2013

The number of HHVRS found per farm varied between one for Farm 15 and over 40 for Farm 8. The number of HHVRS however cannot be correlated to the number of RFVs conducted as it is unknown what proportion of HHVRS made it back to the practice. For every farm where a HHVRS existed, at least one case of COD had been recorded, up to a total of 14 for Farm 13.

One hundred and fifty-eight individual records were legible to read and related to animals examined for COD. The diagnostic findings for these 158 first and follow-up examinations are shown in Figure 36. Eighty-nine of these records had a written diagnosis of 'cystic ovarian disease'. This may have been at a first or subsequent examination, and included follicular and luteal cysts. The remaining 69 records were follow-up examinations for these cases and included diagnoses that the cow was cycling normally or back in-calf.

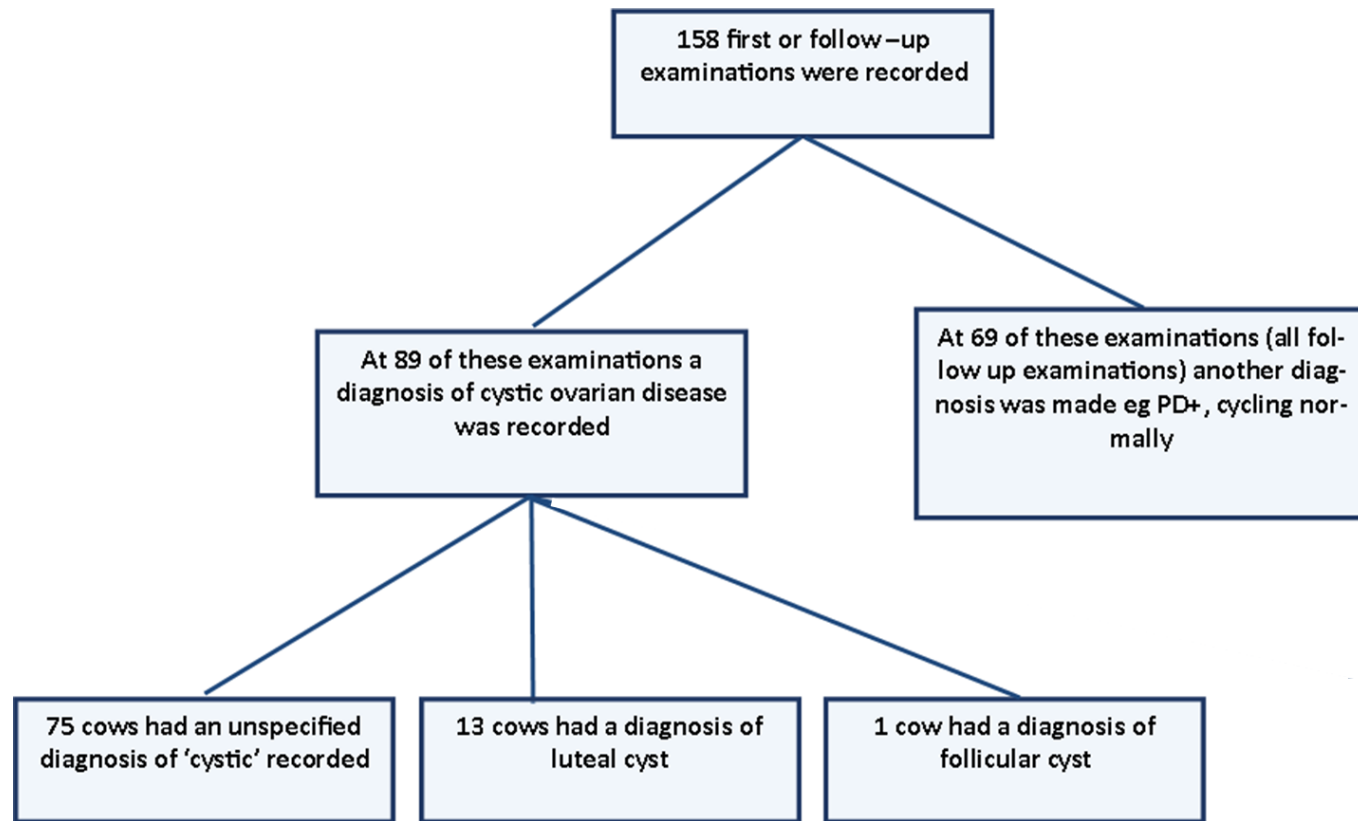


Figure 36 Flow diagram showing how the legible records found in Practice 1 from 2013 were described diagnostically

Eighty-nine of the first and follow-up examinations contained a diagnosis of COD of some sort. Of these, thirteen cysts were specifically recorded as 'luteal' and these were treated in a variety of ways (Figure 37).

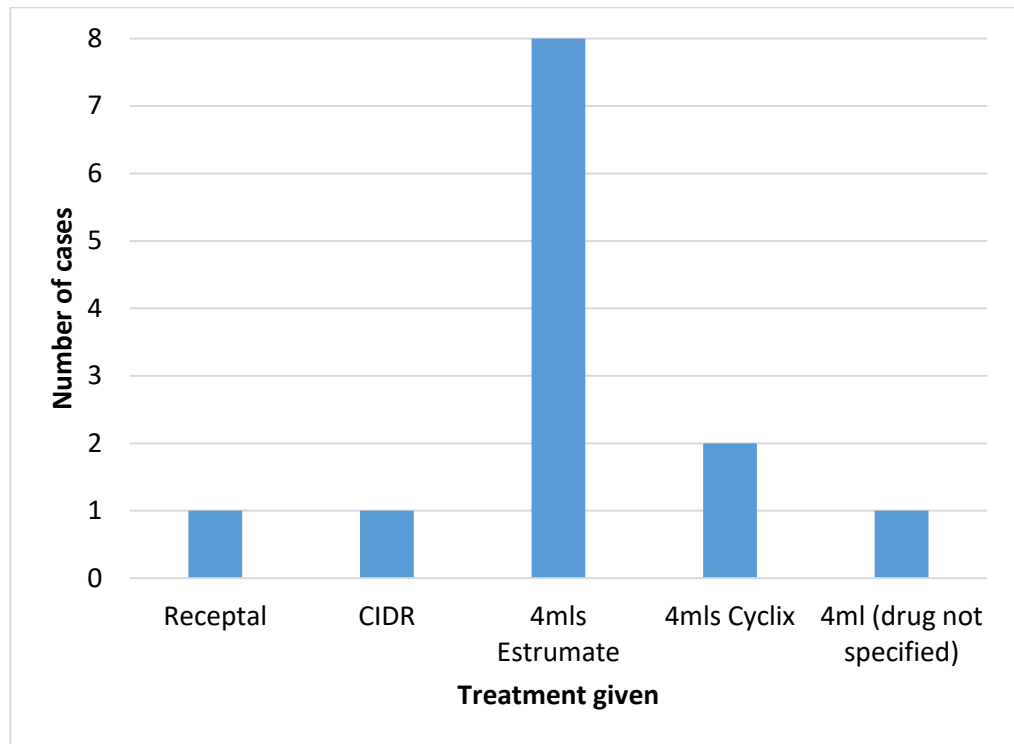


Figure 37 Treatment of the 13 luteal cysts recorded in 2013 by veterinary surgeons in Practice 1

[CIDR®, Zoetis UK Limited; Cyclix, Virbac Limited; Estrumate®, MSD Animal Health; Receptal®, MSD Animal Health]

One record had 'follicular cyst' recorded, this animal was treated with 5mls of Receptal. Seventy-five records had undefined 'cyst' recorded (these were presumed to relate mainly to follicular cysts). Figure 38 shows how these cows were treated. The remaining records were follow-up examinations where the animal may have recovered and for example was recorded as being 'PD+' or 'cycling normally'.

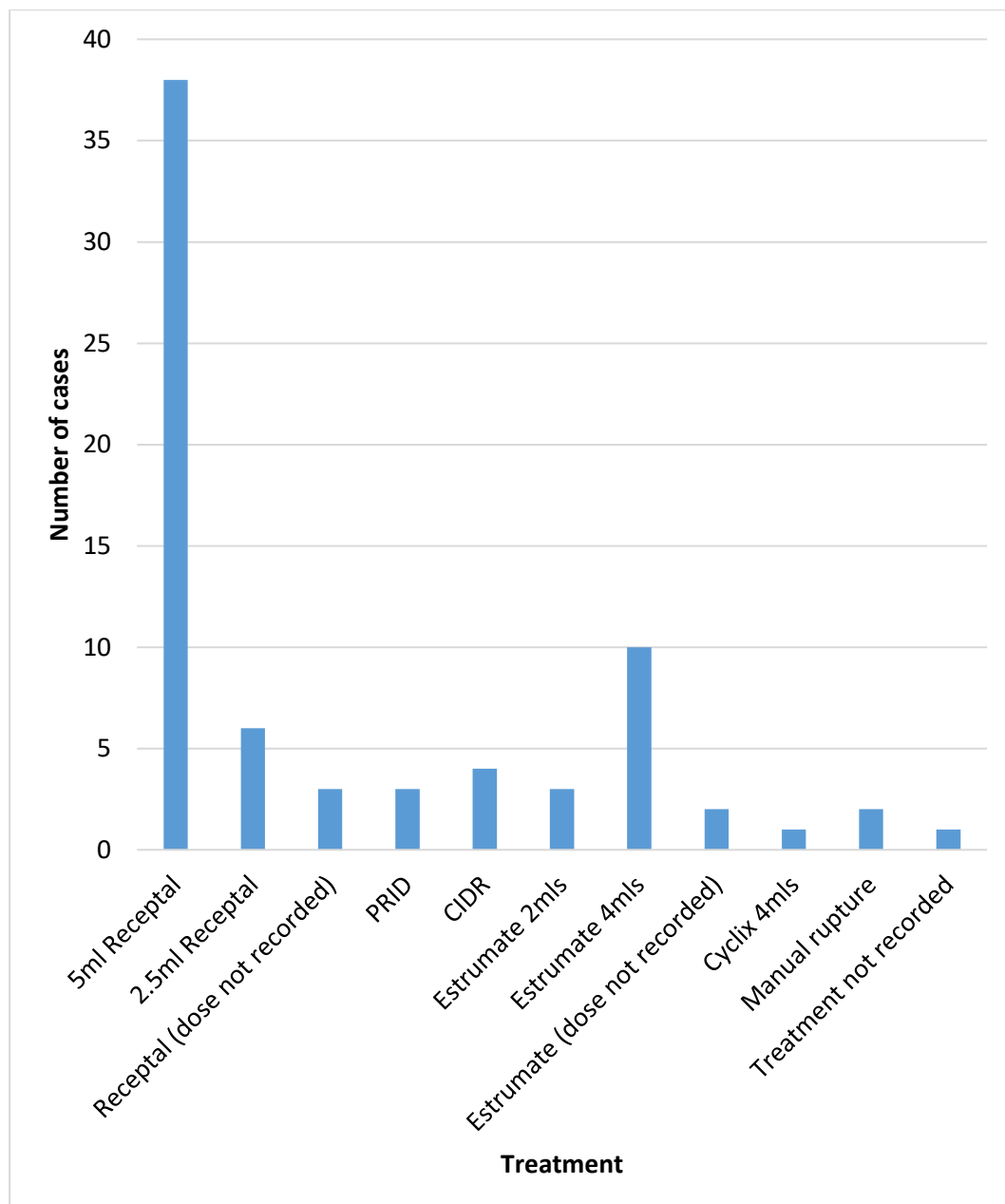


Figure 38 Different treatments administered to 'cystic' cows in 2013 by veterinary surgeons in Practice 1

[Cyclix, Virbac Limited; CIDR®, Zoetis UK Limited; Estrumate®, MSD Animal Health; PRID® Delta, Ceva Animal Health Ltd; Receptal®, MSD Animal Health]

Ten out of the total 86 cows treated for COD had a follow up plan recorded, for example 'see again 1 week'. Appendix 16 shows the diagnoses and treatments for all cows recorded as being examined more than once. These cows were examined on between two and six occasions. Records were found for many cows that included the events leading up to a PD+ diagnosis.

5.3.1.3 Discussing the findings with Practice 1

The practitioners felt that a fair amount of data had been found on COD from a source they had not expected to be useful. They thought that the farm animal veterinary profession was generally fairly poor at recording information and so were pleased that the data did exist. The clinicians were also surprised that all the information had been found and collated for 11 months in one day.

The practitioners did express concern about the reliability and usefulness of the data. They felt that the information from the HHVRS would vary in reliability as often the information was recorded on farm by the farmer. This meant there was potential for the information recorded to have been misheard or misunderstood. The veterinary surgeons felt that the use of the data at the time of the discussion in 2015 was limited as since 2013 many things had changed. A number of veterinary surgeons in the practice were different, and farms had left or joined the practice with many increasing the frequency of their RFVs.

5.3.2 Practice 2 – Treatment of calves with pneumonia

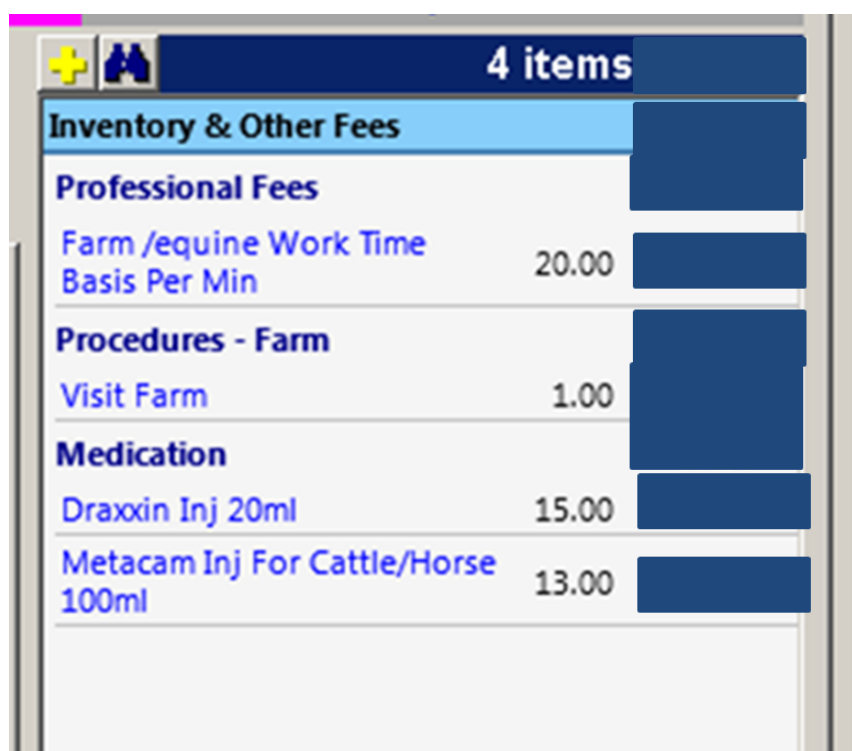
The first topic that Practice 2 chose was the treatment of calves with pneumonia and the four-week survival rate. This was the topic that was examined for the feasibility of conducting retrospective clinical audit.

5.3.2.1 Potential sources of data

Practice 2 used practice management system RxWorks for billing purposes and to record clinical information. When a telephone call was received by the practice the details were recorded in the 'day book', a large A4 paper diary with a page per day. One day book was used per year. Once the visit had been completed on farm, a duplicate invoice ticket was written up with one copy left with the farmer, and the other copy retained by the vet. The vet then took their copy back to the practice where the details of the visit were entered on to the computer system by the farm animal administrator.

When an entry was made into the day book some details of the visit were recorded such as 'sick calf', with this detail based on the information provided by the farmer and then interpreted by the receptionist.

On farm, the vets recorded the details of the visit including time on farm and drugs dispensed. Details were transferred from the invoice ticket to the relevant field in RxWorks back at the practice. An example of a visit to a sick calf is shown in Figure 39.



		4 items
Inventory & Other Fees		
Professional Fees		
Farm /equine Work Time Basis Per Min	20.00	
Procedures - Farm		
Visit Farm	1.00	
Medication		
Draxxin Inj 20ml	15.00	
Metacam Inj For Cattle/Horse 100ml	13.00	

Figure 39 Screen shot seen in Practice 2 showing detail recorded in RxWorks for a 'sick calf' visit

5.3.2.2 Collecting the data and data analysis

The day book was examined for entries relating to visits for calves with pneumonia. However, it was acknowledged that entries in the day book were based on interpretation of clinical signs by the farmer then being interpreted over the phone by practice admin staff. Calls relating to calves with pneumonia could have been entered in to the diary as 'sick calf' visits, or visits may have been recorded as 'calf with pneumonia' when the eventual diagnosis made by the vet differed. One of the veterinary surgeons also indicated that it was not uncommon for calves with pneumonia to be

examined when the clinician had primarily been on the farm for another purpose, in which case the calf with pneumonia would not have been mentioned in the day book record.

Clinical records on RxWorks were also examined for the possibility of carrying out a retrospective clinical audit looking at survival rates of calves with pneumonia. The practice routinely recorded time spent on farm, a visit fee and the medication given (these were the 'chargeable items' of a visit and if not recorded, the farmer did not get charged correctly). No clinical details about the cases were recorded in RxWorks. The practice had charged clients by time spent on the farm since April 2011. Prior to this, certain events such as 'examine calf', 'calving' and 'lambing' had their own codes within RxWorks, which allowed for those events to be searched. It was still possible to enter 'no fee codes' for certain events and this was being done for a caesarean clinical audit being carried out in-house.

Product sales of antibiotics and anti-inflammatories commonly used to treat calves with pneumonia were searched for. A search for 'Draxxin' in drugs sales for 2013 showed that 4205ml were sold in 50ml bottles, and 510mls were sold in 20ml bottles. This drug may however have been dispensed for other purposes, so although it may give an idea as to the level of pneumonia cases over a season, the product sales information would not be an accurate foundation for a clinical audit.

It was therefore not possible to carry out a retrospective clinical audit in Practice 2 on the treatment of calf pneumonia and survival rates. No written clinical records were recorded about individual animals, so it could not be confirmed that a calf had been treated for pneumonia on examination. Calf identification was also not recorded which would have been necessary to determine four-week survival rates.

5.3.2.3 Discussing the findings with Practice 2

Practice 2 had recently changed their billing system from itemised billing (where a code was used with a fixed charge e.g. 'Examine cow') to charging by

time spent on farm. This was proposed as the main reason for little data found on the PMS. The clinicians felt this was likely to have affected many other farm animal practices in the country and in doing so, much retrospective data will have been lost.

The practice was using 'free' codes for ongoing caesarean and LDA clinical audits and this meant there were easy to find when all details were needed. However, they also stated that surgical, or 'one off' type procedures, were easier to follow-up because very few of those events happened on each farm. Farmers could therefore easily remember which cow had been involved where follow-up information was required. The vets thought that coding for calf pneumonia would not be as beneficial without individual animal ID also being recorded. Farmers were unlikely to remember the individual animal treated for calf pneumonia. For this clinical audit to be successful the veterinary surgeons would have to collect the animal ID at the time of treatment and record on the PMS, which was cited as a barrier to clinical audit. This was suggested as the main advantage for retrospective clinical audit in small animal practice; each record was automatically about an individual, named animal so animal ID did not need to be recorded by the veterinary surgeon.

5.3.3 Practice 3 – Outcomes of LDA surgeries (milk yield, survival, fertility)

5.3.3.1 Potential sources of data

Practice 3 used an online day-book, practice management system Robovet for clinical records and billing purposes, and Interherd as the herd management software. Information on farm was recorded onto paper invoice tickets. When a call was received by the practice, the visit was booked in to the designated vet's column on the online daybook. This was an online diary allowing remote access, which the vets would do while out of the practice by using a 3G internet connection. Each visit or entry in the day-book had the name of the farmer, the farm name and the reason for the visit. Extra information could be recorded there, including notes relating to the case and duration of time

spent on farm. All information in the day-book was entered at the time of the phone call by the farm animal administrators at the practice, and was therefore based on information provided by the farmer which was interpreted and entered by the administrators. Visits were coloured blue while the vet was on the farm, green once the visit had been completed, and grey once the visit had been 'booked up' (once the clinical records and billing information had been entered in to Robovet for billing). The vets phoned into the practice at the end of each visit to advise that they had finished the visit, at this point the entry in the day book was updated to include the final duration of time spent on farm (to the nearest 15-30mins) and any further clinical details (e.g. if entered as 'calving' initially, it may then be changed to 'calving – caesar' if a caesarean had to be performed). The online day book had been used by the practice since October 2013. It provided the veterinary surgeons with a real time update of what was happening in the practice. All out of hours visits also got put onto the online day book after the event.

Once work had been completed on farm an invoice ticket was written up to record the work that had been done. Each vet had their own book of tickets, and the tickets were either written up on farm, or back at the practice. The vets were fined £1 per ticket if the ticket had not been written up by 5pm on the day following the visit, this ensured that the majority of tickets were written up within 24 hours of a visit being carried out. At the time of this study, the farmers did not get a copy of the ticket. One copy got filed away and archived, while the carbon copy was kept by the veterinary surgeon.

Information was entered from the tickets onto Robovet by a member of office staff (assisted occasionally by other members of staff when needed). Clinical notes recorded were brief, but did include the reason for the visit (e.g. 'examine cow – toxic mastitis', 'calving – caesar, large bull calf'). Medicines were all recorded and billed on Robovet; when drugs were dispensed directly from the practice they were not accompanied by clinical notes. Farmers had pre-written protocols in their herd health plan explaining which drugs should be used for which condition. Robovet was mainly used for billing purposes. All

staff members had different 'permissions', meaning that some members of staff were not able to search for certain things.

Information from RFVs were recorded onto Interherd for all farms, whether by the farmer or by the Interherd manager back at the practice, if the farmer was a paying Interherd management client (farmers could pay a monthly fee to have their Interherd data managed by the practice).

5.3.3.2 Collecting the data and data analysis

Details of past LDA surgeries were searched for in the pre-existing data held by the practice. To be able to search for any data on Interherd about cows that had had LDA surgeries in the past, the clinical audit required the individual cow identification to link up the LDA surgery and the outcomes on Interherd.

The online day book, paper tickets and Robovet clinical records were examined for availability of data. The clinical notes section of individual Robovet clinical records was searched for clinical events using the 'search' button at the bottom of the clinical notes page. A previous search, carried out by another member of staff who had different programme permissions on Robovet, was analysed for the caseload of LDAs.

An 'LDA surgery' event was recorded onto the farm record on the practice management system. A list of 'LDA surgeries' could be downloaded using a login that allowed this action to be undertaken. This would show where and when all LDA surgeries were performed within a specified time frame. The individual cow identification was not however recorded on the ticket at the farm, so no individual cow identifications were found on the PMS. The number of LDA surgeries undertaken by the practice could be determined; but a retrospective clinical audit looking at the outcomes of LDA surgery was not possible based on the data that existed. Recording the cow ID on the ticket on farm and having it recorded in the clinical records would make this topic possible as a retrospective clinical audit in the future.

5.3.3.3 Discussing the findings with Practice 3

LDAs were one of the few procedures that Practice 3 still billed for as a chargeable item, rather than as time spent on farm. They recognised this as a factor that made finding the cases much easier. Many of the practitioners agreed that all that was needed to complete this retrospective clinical audit was to record individual cow ID on the ticket written on farm. They felt that this should be very easy, but it often just did not happen in practice. The clinicians agreed that preparing for a future retrospective clinical audit by improving the information recorded on clinical records may be easier than collecting the data prospectively on farm.

5.4 Discussion

This study suggests that the ability to conduct retrospective clinical audit may be limited in farm animal veterinary practice. Although there are a number of different ways in which farm animal practices store data, the amount and quality of information found in the three practices was limited. Extensive literature in the medical field mentions the use of retrospective data collection for clinical audit based on thorough and sound clinical records (Mettias et al., 2012). The NHS use computer records to carry out retrospective clinical audit as specific criteria can be used to search for data and a large sample size is usually readily available (Hexter, 2013). In the veterinary literature publications exist that describe the use of existing data for retrospective clinical audit (Dunn and Dunn, 2012; Morgan et al., 2012; Proot and Corr, 2013) but no previous studies have examined the feasibility of conducting retrospective clinical audit in farm animal practice.

5.4.1 Availability of data

In this current study although information was found in a number of different places, there was limited information recorded by the veterinary teams to enable retrospective clinical audit to be carried out successfully. In Practice 1, the paper herd health records kept by the practice for billing purposes provided sufficient detail to allow the COD clinical audit to be attempted. This

suggested that when searching for data to use for clinical audit all possible sources should be considered, as the same information was not available on the PMS in this practice.

Practice management systems have a wide capability for recording, storing and searching data (Dunn, 2012). The clinical records in these three practices were for each farm, rather than for individual animals as would be found for small animal and equine clinical records. Finding the records of an individual cow that has been seen more than once, if these details existed, would therefore require the whole farm record to be searched. This may be overcome in practices that use herd management software such as Interherd or VetImpress where individual cow information can be recorded and searched with ease. Little detail was recorded in the clinical notes part of the clinical record in all three practices. Billing information (including medicines dispensed) appeared to be the most available and reliable as this information is required to ensure the farmer is charged correctly.

Animal ID was a main component of information required to allow the clinical audits in Practice 2 and Practice 3 to be conducted. This information does not have to be recorded in farm animal practice to meet any regulations. The RCVS Code of Professional Conduct requires detailed clinical records to be made and kept about animals treated by veterinary surgeons (Royal College of Veterinary Surgeons, 2016) and the PSS requests that records are kept for each animal or herd where appropriate, but that the information recorded must allow any veterinary surgeon to '*proceed with the continuity of care*' (Royal College of Veterinary Surgeons, 2015). For practices meeting the General Practice Standard, the PSS suggests that individual animal identification may be useful, but it is not compulsory (Royal College of Veterinary Surgeons, 2015). None of the practices in this study recorded the individual cow ID in any of the cases viewed when attempting the retrospective clinical audit. This has been highlighted by veterinary surgeons in the current study as a barrier to carrying out clinical audit, and has been

discussed as a time consuming and difficult detail to record on farm (Chapters 2&3).

Duz (2016) suggests that even when data exists there can be problems with finding required information. This may be due to the same condition being entered in a different way (for example Practice 1 described COD as 'cyst', 'cystic', 'FC', 'LC' and 'COD'), misspelling of information or the information being in the wrong part of the clinical record. As discussed in Chapter 4, the use of computer tablets that allow information to be recorded while on farm may result in better clinical records for retrospective clinical audit.

Some small animal practices use clinical coding within their practice management systems which can ensure that data is available for retrospective clinical audit (VetsNow, 2013; VeNom, 2016). All three practices mentioned adding clinical codes to the clinical records. This had been used for various clinical audit or billing purposes in the past and the practitioners felt that it was fairly easy step that could be taken to ensure cases were easily found in the future. Practice 2 had previously coded all farm visits, but had ceased doing this when they moved to charging farmers on a 'per minute' basis instead of per task carried out. Although wanting to continue coding, the vets within Practice 2 suggested that it was more challenging to code PMS entries when it was not essential for billing purposes. When not coded, Practice 2 found that information entered onto the PMS in free text varied, for example a uterine prolapse may be entered as 'prolapse', 'uterine prolapse' or 'calf bed out', meaning that they may not all be found if searched for using a single term (Jones-Diette, 2014). Due to the resources and detail required, and difficulties associated with the free text mining of clinical notes (Duz, 2016), codes added to the bill for certain procedures combined with animal ID may be the easiest way to allow future clinical audit based on clinical records.

5.4.2 Accessing the data

Difficulties may arise with accessing farm animal practice data. Permissions to access data on the PMS may vary between users, and this should be taken

into consideration when selecting staff to undertake clinical audits. Some users may be able to access more or different information, or conduct different searches. In all three practices partners of the business or staff working on the practices accounts had more permissions than the veterinary assistants. In Practice 3 the veterinary assistant was unable to download a list of coded LDA surgeries, but a more senior member in the practice could. The capabilities of the PMS used within the practice, and the PMS user knowledge within the practice team, should be fully investigated prior to attempting retrospective clinical audit.

5.4.3 Reliability of data

The quality and reliability of data that do exist may vary (Duz, 2016). Different veterinary surgeons may consider different clinical findings to be of different importance. Information that is recorded by different people will also vary in reliability; office administrators may interpret comments given by clients in a different way to how a veterinary surgeon might, or hand writing transferred from a ticket written on a visit to the PMS may be misinterpreted (Duaz, 2016). In this current study the chain of information transfer from farmer phone call to eventual billing was long with multiple people involved. Information required for billing purposes was found to be very reliable, whereas the other information that existed varied in quality. Care should be taken with the interpretation of data recorded in the practice day book as this information is based on the information provided by the farmer, and the subsequent interpretation by the individual that answers the phone in the practice. Additional cases seen while already on farm for another reason may also not be recorded here – Practice 2 felt that calf pneumonia cases were often seen while the vets were already on the farm on RFVs. Tickets written up on farm can provide a valuable source of reliable data when written up within 24 hours; recall bias may increasingly affect the reliability of information recorded over time. Data that is entered on to the PMS from hand written documents by a third party may contain errors through misinterpretation of handwriting. These errors are less likely when input by

more experienced and familiar staff. The clinical records on the PMS are legal documents, so accuracy levels should be high. Assuming treatments represent diagnosis did not appear to be a reliable way to collect information for clinical audit. The treatment may have multiple indications and it therefore cannot be assumed that its most common use is its only use. The vets also discussed the fact that different clinicians use the same treatment for different things as well as treating the same condition in different ways. Searching the 'product sold' was not a reliable way to find information on cases for calf pneumonia or COD and is therefore not suggested as a reliable way to conduct retrospective clinical audit.

5.4.4 Advantages and disadvantages of retrospective data collection

Retrospective clinical audit has a major disadvantage in that it relies on data to exist, and to be of good quality. These were the main barriers found in this study. If good quality, plentiful data does exist, retrospective data collection could be conducted by one person resulting in time for individual practitioners being saved. This may however result in the other individuals feeling less involved in the clinical audit. Retrospective clinical audit can show what is happening in practice before the action of conducting a clinical audit effects the way that people do things. As shown with Practice 1, if data is collected from some time ago the findings may not still be relevant and this is important to consider. One advantage of the retrospective clinical audit in Practice 1 over the prospective data collection was that the retrospective data collection allowed events that happened over a long period of time (e.g. a cow getting in calf, calving and getting back in calf again) could all be collected in a very short period of time rather than having to wait for the events to happen in real time. An advantage of clinical audit over clinical research is that there is no specified number of cases required, and it does not matter if cases are missing. Some clinical records on some cases may provide enough information to start discussions within the practice team which may prove beneficial, even if there is not enough information to complete a robust clinical audit.

The ability to carry out retrospective clinical audit in farm animal practice will depend on the clinical audit topic selected, the recording system used by the practice, the information that already exists and the ease of gathering the data required. The way data is collected and stored will affect if and how a clinical audit can be conducted retrospectively, and this will differ between practices. An initial examination of data recording and storage within a practice will provide an overview of the feasibility of conducting retrospective clinical audit. This should be carried out before a clinical audit is initiated to ensure data collection will be productive.

5.4.5 Study limitations

This study has provided an insight into the quantity and quality of clinical records that may be available for retrospective clinical audit in farm animal practice. The findings here cannot however be assumed to represent the level of records held in all farm animal veterinary practices in the UK. Indeed, the findings suggest that clinical details recorded are likely to vary between veterinary practices and individual practitioners. The searching of clinical records in this study mainly focussed on the specific clinical audit topics chosen by the veterinary practices. Although they suggest general trends for each practice, it cannot be assumed that the same level of detail is recorded on each clinical record existing within the three practices on different topics. Records were searched for the year preceding the visit to the practice so if other years were included the data may have been different. The number of individual records that could be searched was also limited due to time constraints; a thorough search of all individual clinical cases for a number of years may have found different results. The researcher also relied on a nominated person within the practice to explain and demonstrate how the various systems worked which may have been limited by the knowledge of the nominated person.

5.5 Conclusion

The ability to carry out retrospective clinical audit in farm animal veterinary practice is likely to vary greatly between practices. This study suggests that retrospective clinical audit may not be immediately possible in all farm animal practices for all topics. Retrospective data collection will not be possible in practices, or for certain topics, where data does not exist, is of the wrong type, of poor quality or where the data cannot be easily searched or collated. Before attempting retrospective clinical audit data availability should be thoroughly investigated. An audit of current clinical record recording and storage may provide practices with a baseline on which to improve, in order to conduct retrospective clinical audit in the future with relative ease. Detailed record keeping and exploitation of the extensive capabilities of the PMS is likely to improve the potential for carrying out successful retrospective clinical audit in farm practice.

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Chapter 6 Clinical audit, protocols and guidelines; a case study of a surgical protocol used in a farm animal veterinary practice

6.1 Introduction

The use of standardised methods of treatment, such as clinical guidelines and protocols, is increasingly discussed and encouraged in the veterinary profession (Viner, 2009; Wapenaar, 2011; Fletcher et al., 2012; Freeman and Curtis, 2015; Royal College of Veterinary Surgeons, 2015; American Animal Hospital Association, 2016; Royal College of Veterinary Surgeons, 2016; RCVS Knowledge, 2016a;). There are numerous benefits associated with their use such as providing a better quality of care for patients, improving outcomes, reassuring clinicians and the public and keeping personnel up to date (Swinglehurst, 2005; American Animal Hospital Association, 2016).

The RCVS advocate the use and revision of evidence-based clinical guidelines and protocols, suggesting discussions on them be a part of clinical effectiveness (Royal College of Veterinary Surgeons, 2015). Viner (2003 and 2006) suggests creating protocols and guidelines within a practice. The creation of clinical guidelines however requires a specific methodology that incorporates evidence-based medicine with consensus recommendations by a panel of experts (McGee, 2015). This may not be easily done in veterinary practice.

There is a lack of veterinary literature that discusses the value of protocols or guidelines to veterinary practice, and little guidance on how they should be created in practice. The benefits and challenges of using protocols or guidelines in farm animal veterinary practice and the opinions of practitioners towards such tools are also unknown. The aim of this case study was to investigate the use of a protocol in farm animal practice. The study aimed to determine the awareness of veterinary surgeons to existing protocols and investigate how protocols are used in practice. Benefits and challenges of

following a protocol, and opinions on how they are used was also investigated.

6.2 Methods

Throughout this chapter the 'protocol' is referred to as such as named by the practice. Discussion as to the appropriateness of this label takes place in the discussion.

6.2.1 Recruitment

While working with Practice 3 on the clinical audit project, the use of their LDA surgical protocol was raised in discussion at the initial meeting. The CEVM researchers approached Practice 3 after the meeting and asked if they would be happy to discuss the use of their protocol. Initial detailed discussions about the potential for a case study to focus on the use of the LDA surgical protocol took place with the veterinary assistant leading the clinical audit project within the practice, and with one of the partners in early summer 2015. The veterinary assistants within the practice were made aware of the protocol case study project at the second meeting held at the practice in August 2015 when the project plans were in the early stages.

6.2.2 Interview question development and piloting

Interviews conducted by telephone were planned to collect the data. A question guide was developed to ensure that each clinician was asked the same questions in the same order. The question guide was sent to members of the CEVM by email to be pretested (Burke and Miller 2001) and seven responses were received. The guide was altered according to the feedback received.

The telephone interviews were piloted with three clinical staff members at the University of Nottingham School of Veterinary Medicine & Science to ensure that the flow of the planned questions would work over the phone (Burke, 2001; Musselwhite et al., 2007). This also allowed for the recording equipment to be checked for functionality. The final question guide had eleven open questions; each question had a prompt question that could be

asked should the participant not understand the initial form (Appendix 17). The first four questions asked for awareness of the protocol's existence and knowledge of how it was created. The next three questions asked about compliance with the protocol. The following two questions asked for positives and negatives associated with the protocol and the final two questions asked for the thoughts of the clinicians on the use of clinical protocols in a wider context.

6.2.3 Data collection

An interview schedule was created by the lead veterinary surgeon for the clinicians within Practice 3. The telephone interviews were booked into the practice diary during working hours for each individual veterinary surgeon for a half hour time slot. The interviews were expected to take approximately ten minutes. Each telephone interview was recorded using a dictaphone. The researcher read a short introduction followed by the consent conditions for the interviews. Participants were advised that the interview would be recorded if they consented, and participants were expected to give verbal agreement to participating in the study over the phone. The questions were then asked and the researcher ended the interview once all questions had been answered.

6.2.4 Data analysis

The recordings from the telephone interviews were transcribed into a Microsoft Excel V.14.0.6 (2010 Microsoft Corporation) spreadsheet. The transcripts were checked against the recordings for accuracy before being exported into a Microsoft Word document for analysis. Colour highlighting of the text was used to group comments into inductive themes.

6.3 Results

Ten veterinary surgeons were involved in the project. Telephone interviews were conducted with three different veterinary surgeons. One took place on October 23rd 2015 and two on October 28th 2015. Several attempts were

made to conduct the remaining seven interviews over the telephone but the daily work load in the practice prohibited this.

The veterinary surgeons that were unable to be interviewed by telephone were sent paper-based questionnaires to complete in their own time. The telephone interview schedule was adapted to the questionnaire format to ensure that it would be easily understood without the researcher present to give explanations. It was kept as similar to the original interview schedule as possible to reduce the effects of collecting the data via two different methods. The paper based version was pretested by three of the researchers at the CEVM. The paper based version was not pre-tested or piloted by any clinical staff as the questions were very similar to the telephone question guide. The questionnaires were all sent to the lead veterinary surgeon, who distributed them accordingly. The names of the veterinary surgeons that were to complete the questionnaire were put on the top of each questionnaire and three blank questionnaires were also sent should a second copy be needed. The paper-based questionnaires were deliberately not kept anonymous from the researcher as the phone interviews conducted previously had not been anonymous. A paper consent form was stapled to the back of the questionnaire and the participants were asked to read and sign this before answering the questions. Reminder emails were sent sporadically to the veterinary surgeon leading the project within the practice, who then reminded the rest of the team to complete the questionnaires. The responses from the paper-based questionnaires were recorded into a separate Microsoft Excel V.14.0.6 (2010 Microsoft corporation) spreadsheet. Data analysis was completed in Microsoft Excel V.14.0.6 (2010 Microsoft Corporation) and Microsoft Word V.14.0.6 (2010 Microsoft Corporation) as described above for the telephone interview data. Four veterinary surgeons filled in and returned the paper questionnaire. These were completed between the 1st March and the 3rd May 2016. The remaining three veterinary surgeons at the practice did not participate in the project.

6.3.1 Awareness of the protocol's existence

All seven veterinary surgeons who completed the questionnaire had heard of the surgical protocol that was used by the practice. Two people did not know who had been involved in making the protocol and four of the veterinary surgeons suspected it to be the team of farm vets at the practice, with three specifically naming the current partners. One respondent advised that as a partner in the practice, they had formalised a previously existing protocol. An original protocol for bilateral LDA surgery had been constructed by two previous partners which had been adapted by this respondent to the right flank approach with the support of another current partner, after a *'dabble with the paramedian approach'*.

Six out of the seven clinicians suggested that the protocol had been created to provide a consistent or uniform approach to LDA surgery by the vets in the practice; *"to create consistent approach"*. Two of the veterinary surgeons thought it was the technique considered to be best practice while one thought it may have been for training purposes. The partner confirmed that the protocol had been created to allow a consistent approach that delivered high success rates; *"Originally created two vets bilateral approach for support and consistency to deliver high success rate. The right flank modification that has been standard for the last 10 years is quicker, less wound to heal and suited to one vet surgeon with an assistant (that may be another vet, nurse, student): more flexible as practice expanded and efficiency increased"*

Five of the veterinary surgeons reported learning about the protocol when they started working at the practice, one clinician stated they became aware of it when they did their first LDA operation as all the vets performed the same procedure, and the partner advised they had developed the protocol with the current version being in place since approximately 2006.

6.3.2 Compliance with the protocol

Four veterinary surgeons advised that they followed the protocol exactly in approximately 90% of cases, one in 80% of cases, one in 100% of cases and

one advised that they followed the protocol exactly in the majority of cases. All veterinary surgeons advised that the surgery would be altered away from the protocol if clinically indicated. The discovery of adhesions in the abdomen, a concurrent clinical condition, a dehydrated animal that required additional treatment, a previous surgery or a concurrent pregnancy were all recorded as possible reasons as to why deviation from the protocol may be necessary; *“If you find something unexpected like adhesions..”, “...different clinical presentation - adhesions, concurrent pregnancy (later lactation LDA), previous surgery...”* and *“The odd case that's not compatible. Complications/adhesions or metritis case and need to adapt protocol...start all with intention of following it”*.

Client preference (*“Couple of clients request different protocol, but they're not my clients - based on what previous vets did”*), differing logistical situations (*“Recumbent animal, - health and safety compromise: aggressive cow/no handling”*) and economics (*“Economics - Compromise => Roll or S-G toggle at client request”*) were also cited as reasons for straying from the protocol.

6.3.3 Positives and negatives associated with the protocol

All of the veterinary surgeons thought that the protocol provided a uniform, standardised approach between the vets in the practice; *“Client perception - looks good to all being doing the same thing. United front. No right or wrong way. No need to justify your choice of treatment. All do the same.”* and *“Consistent approach between vets, clients familiar with procedure and knows what to expect”*. This resulted in flexibility for the practice; *“All surgeons acceptable to clients – flexibility”*. Three veterinary surgeons felt that they were delivering evidence-based best practice which would achieve the best outcomes and the least errors. From a practice point of view, the clinicians suggested that the protocol allowed each surgical kit to be the same and therefore easily prepared, a quick procedure to be performed on farm, a team approach where each person could predict what the other would need or want and a consistent approach to training new members of staff and students; *“...Practicalities - all have the same kit. Able to advise each other on*

what to do. Slick team - done as a pair and know what the person is going to do next.", *"Easier kit preparation (multiple standard kits ready at all times)"* and *"Not confusing when training nurses/student nurses"*. One veterinary surgeon felt that it provided a resource for clinical audit while two others thought that the protocol allowed for better clinical discussion, early identification of pitfalls and provided an easy way to monitor success rates; *"better clinical discussion around problems etc, and will help for early ID of pitfalls"*.

Three veterinary surgeons felt that there were no negatives to following a protocol for the LDA surgeries performed in the practice. Downsides listed by others included: *"limits clinical freedom"*, *"new members to the team may have to adjust procedure they already felt comfortable with"*, *"Can delay adaptation to individual circumstances on farm"* and *"inhibits adoption of new techniques"*. One respondent suggested that there would always be times when the protocol was not entirely appropriate due to the *'lack of straight lines in nature'*.

6.3.4 Thoughts on the use of clinical protocols in a wider context

Two veterinary surgeons felt that the practice should not have any other protocols for other clinical procedures as they restrict clinical freedom. Two of the clinicians advised that other protocols already existed within the practice for procedures including caesarean section, digit amputation, vasectomies and reproductive procedures. A written set of guidelines also existed for medical management but that these were more loosely implemented and mainly used at induction for new staff members. Three veterinary surgeons thought the practice should have more protocols in place to ensure a consistent approach, but the need to allow for clinical freedom was also stressed; *"Clinical cases are all slightly different so more difficult as need different approaches. Gives a good united front, on same page, but need clinical freedom within that"*. One veterinary surgeon suggested having more protocols for new graduates to use; *"Have more protocols for new grads but don't have to be followed"*.

Only the phone interviewees were asked whether they thought all clinical procedures in veterinary practice should have a protocol. All three veterinary surgeons disagreed as they felt it would reduce clinical freedom and as one veterinary surgeon stated, *“you are not sure what you might find in each case until you get there”*. Two veterinary surgeons felt that protocols made life easier for new graduates. Generally the clinicians felt that there was a place for protocols, but that they could become a bad thing if they were too stringent; *“A place for them but not for everything”* and *“Not for all, but for some things. As get more experiences able to realise when not suitable. Makes life easier for students and new grads. If too stringent then becomes a bad thing”*.

When asked for any further comments on the topic one veterinary surgeon thought that protocols were good if used and interpreted correctly, one felt that all protocols laid down should have a strong evidence base and one respondent felt that protocols could maintain standards in a growing organisation and manage the risk of litigation *“Good if used and interpreted correctly”*, *“I believe all protocols that are laid down should be justified with a strong evidence base”* and *“Valuable to deliver consistent clinical outcomes. Manage client expectations. Manage risk of litigation. Maintain standards in a growing organisation. Promote discussion through procedural review. May limit clinical freedom”*.

6.4 Discussion

This study demonstrates that a clinical protocol can have an impact on how veterinary surgeons conduct clinical procedures in farm animal veterinary practice. A consistent, uniform approach to the procedure and the advantages this brings has been highlighted as the major benefits of following a protocol. However, restricted clinical freedom has been stressed as a major concern of using protocols in farm animal veterinary practice.

Opinions were divided between the veterinary surgeons on many of the points discussed. Some veterinary surgeons felt strongly that the practice

should not have further protocols for other clinical procedures, while others thought this helpful, especially for new graduates. All of the veterinary surgeons were aware that the LDA surgical protocol existed and all used it routinely. However, other protocols existed within the practice that the practitioners were not all aware of.

In agreement with Viner, who suggested clinical protocols were common place in practice in 2003, this protocol had been in place for a number of years but the evidence on which it was based could not be substantiated. Some individuals in the practice assumed the protocol was 'best practice' but this protocol may be eminence, rather than evidence-based. No national clinical guidelines or protocols currently exist for LDA surgery. To improve the evidence-base of this practice's surgical protocol a number of individual points would need to be researched which would require a large amount of time and resources (e.g. which surgical approach to use, which anaesthetic technique is best, how best to close the wound). The evidence may not exist for all the details required.

The mention of other existing guidelines within the practice suggests that this practice considers there to be a difference between protocols and guidelines, in agreement with other authors (Suarez, 2005; Swinglehurst, 2005; Greenhalgh, 2010; Wapenaar, 2011). However, when discussed with the partner who created the current protocol, there was definite agreement that this protocol was only to be used as a 'guide' to LDA surgery, and that the procedure should be altered based on clinical findings. Some of the veterinary surgeons concerned about clinical freedom may have been unaware of this fact and this may have been due to the use of the term 'protocol' which suggests a more rigid framework to follow. This protocol had been labelled as such because the practice was keen that the procedure was more rigorously followed than the guidelines suggested for the treatment of medical conditions. However, the partner stressed that clinical findings should always be taken into consideration and adaptations made where necessary. The LDA surgical protocol used in this case is not a 'protocol' as described by

Swinglehurst (2005), as the outcomes are not predictable and individual judgement is required for each case, nor is it a clinical guideline as it does not appear to have been developed systematically (Swinglehurst, 2005). It is however a document that the practice wishes a certain amount of adherence to demonstrate a uniform approach. A more appropriate term for use in the veterinary profession where evidence may be lacking and clinical judgement for each case is actively encouraged may need to be developed. Any standardised methods of treatments used could also be accompanied by a statement suggesting which elements should be more strictly adhered to; enabling clinicians to know what is expected of them. The level of expectation of adherence to any described procedure could also be discussed within the team to ensure clinical freedom and autonomy can be maintained by individuals.

6.4.1 Protocols, guidelines and clinical audit

The LDA surgical protocol in Practice 3 was raised as a potential topic for clinical audit in the larger project being conducted with the practice (Chapters 3 and 4). The clinicians had discussed the fact that they were supposed to follow a protocol for LDA surgery and so the clinical audit could have assessed if all veterinary surgeons follow the protocol when operating. This audit would have been a similar format to the clinical audits often conducted in the NHS where NICE guidelines are audited against to see if procedures are being followed (National Institute of Health and Care Excellence, 2016a). The veterinary surgeons in Practice 3 however, did not consider that to be a useful or interesting clinical audit to run in their practice. The clinicians were all very sure that the protocol was followed the majority of the time; especially as the practice usually had two members of staff (two veterinary surgeons, or one veterinary surgeon plus a veterinary nurse or student) present at every LDA surgery. So although Viner (2003 and 2006) suggest auditing against protocols or guidelines, this may not be considered by veterinary surgeons in practice as a priority. This does not preclude the suggestion that protocols or guidelines can be used as the basis for a clinical audit (either to check they are being

followed or to create a local guideline or protocol) but importance must be placed on ensuring these are evidence-based to avoid team members from being encouraged to conduct procedures in a way that is out of date or incorrect. The evidence-base for this protocol was unknown and so may not have been 'best practice'.

Auditing against a protocol, guideline or guidance, or creating protocols, guidelines or guidance to then audit against is a legitimate clinical audit. However, great care must be taken when developing these tools to ensure that they are evidence-based, and agreed upon by all for this to work within a team. A level of expectation of adherence to any described procedure must also be discussed within the team to ensure clinical freedom and autonomy can be maintained by individuals.

6.4.2 Study limitations

This study only provides the opinions and experiences of seven veterinary surgeons working in one veterinary practice, discussing one protocol. Although a number of important points have been raised, the results cannot be assumed to represent the population of farm animal veterinary surgeons in the UK as a whole. However, the study has raised questions about the correct definitions of quality improvement tools and the attitudes of veterinary surgeons towards them.

Due to difficulty in contacting the participants by phone, two different methods of data collection were implemented. This may have affected the quality of the data collected (Bowling, 2005). Anonymity was not given to the participants at the time of participation which may have resulted in lower disclosure rates. Data was not collected from all veterinary surgeons in the practice; veterinary surgeons less compliant with the protocol could have been less likely to be involved with the project.

6.5 Conclusion

Most of the veterinary surgeons followed the LDA surgical protocol in the majority of cases. Protocols were considered a useful tool for veterinary

practice assuming veterinary surgeons could maintain clinical autonomy to make the best decisions for each case. There is clear confusion associated with the terminology of standardised treatment methodologies both within the practice and the wider literature, and clarification is required to ensure clarity for users. Auditing against a clinical protocol was not considered useful by this practice although it is a possible option for clinical audit.

Chapter 7 Final thoughts from the practitioners in the three veterinary practices

7.1 Introduction

At the end of a clinical audit the process itself should be audited (Rayment, 2002; John et al., 2004; Viner, 2005a; Burford, 2013). This analysis allows for encountered problems to be addressed and improvements to be implemented for future clinical audits (Rayment, 2002; Burford, 2013).

Evaluation of research conducted in veterinary practice is also important at the end of a study to ensure improvements can be made for future research (Heneghan and Badenoch, 2006). The aim of this small study was to collect final thoughts and opinions from the practitioners in the three veterinary practices about the clinical audits conducted and about the research project as a whole.

7.2 Methods

7.2.1 Data collection

Final meetings were held at the individual practices to gather thoughts on the process of clinical audit, the experiences of practitioners with the researchers, and the creation of guidance for farm animal veterinary surgeons conducting clinical audit in the future.

A brief summary of the findings of the clinical audits were presented as a reminder to stimulate discussion. An overview of the whole project, an update on where the work had been presented, and plans for future progress were also reported using a Microsoft PowerPoint V.14.0.6 (2010 Microsoft Corporation) presentation. Suggested guidance for veterinary surgeons in practices wishing to conduct clinical audit was presented by the researcher and thoughts of the practitioners about these were collected. The meetings were recorded using two dictaphones. A consent form was completed by all the vets present at the meetings prior to the start of the recording. This

explained that the information collected would be anonymous and treated confidentially, that the veterinary surgeons involved would not be identifiable in the completed work and that they had the right to 'opt out' and switch the dictaphones off at any point during the meetings. The consent form also highlighted that the raw data would only be accessible to researchers within the CEVM working on the project and that the veterinary surgeons could access their data at any point during the study.

Refreshments were provided for the practitioners at the meetings. An hour of CPD on a different topic was also offered as a 'thank you' for the practices' participation; this offer was taken up by Practice 1 and Practice 3.

7.2.2 Data analysis and management

The researcher listened to the recordings of the meetings and logged significant statements from the participants into a Microsoft Word V.14.0.6 (2012 Microsoft Corporation) document. General themes and specific statements were identified.

7.3 Results

The final meetings for Practice 1 and Practice 3 were held in August 2016 and for Practice 2 in September 2016.

7.3.1 Auditing the clinical audits

The practitioners felt that the clinical audits had generally been useful and interesting. Information had been collected that had allowed for discussion to take place about the ways that things were done in the practices.

The clinical audits across the three practices confirmed for the practitioners that they were all doing similar things and that there was not anybody doing something out of the ordinary which they found reassuring; *"nobody is using 10ml of Veterelin just to be sure are they?!"*.

A veterinary surgeon in Practice 1 noted that many changes had been made to the way they treated COD as a natural progression over the time since the clinical audit had taken place; *"I think we've all moved on since this anyway"*.

The practitioners also felt it would be interesting to repeat the clinical audit as findings were likely to be different due to changes within the practice such as available treatments and new staff members: *"It would be interesting to do this all again because we've changed products and changed vets....and different farms as well, new clients...I don't...I sort of have changed a wee bit but that's probably because I've been abroad"*.

Data collection techniques were discussed. The practitioners stressed again that this should be easy, straight forward and not require too many details. Despite this the clinicians were still keen to collect lots of information to answer questions; *"maybe that would be an interesting question as well – I know we didn't want to make the form too big but you could have another tick box to find prognosis before surgery and prognosis after surgery"*. The veterinary surgeons suggested that having data collection tools on farm as the procedure was being conducted increased the chance of recording reliable data; *"I think that's the thing with having the forms in the kits though, at the time of surgery though, so you have to fill them in then, whereas I think with previous audits where we sort of filled in when you got time to fill it in, like, um, it was sort of two days post-surgery and then so a) you're more likely to forget about them and then you might select more to not fill it in for poor ones"*. The prospective data collection had also proved easier to do than had been expected; *"The way it's worked has been pretty non-painful"*.

Many factors also affected whether cases got collected. For example, in the endometritis clinical audit in Practice 2 it was discussed that most of the cases were from two seasonal calving herds where all cows received a post-calving check at three weeks. These farms may therefore appear to have a bigger perceived problem just because the cases are recorded, while on other farms early cases may be missed because the three week checks are not conducted routinely; *"It's interesting the two biggest farms there in terms of case submission are seasonal calving herds and we do three week checks as part of their fertility management. We tend not to do three week checks on other farms. So you know, you could argue therefore that some of the cases of*

endometritis will spontaneously clear before some of the others would present them, but then you don't know what delay or effect that's having on fertility without anybody knowing." Some cases were not recorded because the clinician suspected a bad outcome and some information just was not available to capture (for example the farm did not milk record); *"The danger with prospective is you can choose - if this one's not gone well.....we'll not record it"*.

One practitioner from Practice 2 felt that a lack of cases could be a useful finding; the calf pneumonia clinical audit highlighted that the veterinary surgeons were not seeing as many cases as they thought they were and they discussed that this could lead to further investigation, especially as the number of medications dispensed suggested that a large amount of calf pneumonia was being seen and treated on farm.

The challenges of clinical audit were also highlighted. One veterinary surgeon was concerned that clinical audit could never be considered robust without extensive research to back it up; *"a lot of people that have defined clinical audit want it to be evidence-based, but often the evidence isn't there! If people want us to implement clinical audit, how can they justify that when it's not research based?"*. One veterinary surgeon was concerned about the financial impact of clinical audit on veterinary practice as a business; *"It's very difficult from a commercial point of view...we live by our profits basically"*.

Audit fatigue was discussed at length in all three practices; many of the practitioners felt that they had become less enthused about collecting cases as the time went on. The practitioners explained that they had started off very keen to collect cases, but then the reality of life had taken over and good intentions were lost to more important tasks; *"We had good intentions...it's just then the reality of life kicks in"* and *"Even with good intentions we kind of lost momentum"*. The practitioners felt that short, sharp stints may be the best way to keep people engaged in future clinical audits and suggested running a different clinical audit in every other three month block. The difficulty of defining a diagnosis was again raised at the final meetings: *"What*

was the definition of cyst?” and “looking at the raw data last year...I submitted a lot of cases and it made me wonder, am I over diagnosing cysts? Was it really a cyst? Does it matter?”

The difficulty of clinical audit was discussed with respect to the many factors that are involved in the way that treatment is delivered and the resulting outcomes. Lots of different factors, including farm, individual animal and veterinary surgeon were discussed as affecting the outcome of a case; *“I think that is where it gets really skewed with the client management. Because I think there are some clients that...it does change...it would be very variable”* and *“But then ask the farmer...you have maybe five vets that visit the farm for routines in the year. Farmers will say ‘every vet that comes on the farm will have their own way of doing things’”*. It was highlighted that ‘success’ may also mean different things in different cases: *“Sometimes we aim for different outcomes...sometimes we’re aiming to have something salvageable for slaughter rather than to keep it alive for weeks”* and *“It’s what you define as success...you probably say if they get up to 35L they are probably going to do alright...”*

Staff within the practices were praised by the principles for managing cases well and achieving good results which appeared beneficial for team moral *“Seriously, well done guys, these are really good results”*.

7.3.2 Thoughts on the recommendations for conducting clinical audit in farm animal practice

The practitioners generally agreed with the recommendations made by the researcher for conducting clinical audit in farm animal practice (listed in Chapter 8). The veterinary surgeons thought that having an individual to lead a clinical audit would greatly increase the chances of it being conducted successfully, especially due to the assistance given to the practices by the researcher. They felt it was vital that clinical audit topics were kept simple, as that ensured that all subsequent steps of the clinical audit would be easy and less time consuming. The practitioners agreed that clinical audits should

always be kept short, that clinicians must be able to discuss cases in a 'no-blame' environment and that good communication is maintained throughout the clinical audit process.

7.3.3 Thoughts about the overall research projects

Some of the practitioners felt that the project had changed their view on what clinical audit was and helped to differentiate clinical audit from clinical research: *"That was the problem from the beginning wasn't it? Vets immediately go away from the concept of auditing what you are doing...which is simply the outcomes or treatment outcomes of what you're doing, it's not success really. That wasn't the objective was it? We weren't looking to see if Veterelin was the right thing or not to do were we? We were looking at outcomes compared to different treatments...what people were doing"*

One practitioner felt that a closer relationship was needed between researchers in universities and veterinary surgeons in practice as the gap was currently too big. The clinicians felt that clinical audit could help to bridge that gap; *"The distance between research and what is happening on the ground is too far away at the moment, or in general, so this [clinical audit] should bring it closer together"*

Some of the practitioners felt that the project had re-ignited their enthusiasm for clinical audit after they had previously been involved in a long, ongoing clinical audit for which they had lost enthusiasm for.

7.4 Discussion

The aim of this study was to collect final thoughts and opinions from the practitioners in the three practices on the clinical audits conducted and the overall project. Many points were raised about the clinical audits that had been conducted. These were often things that could be changed in future clinical audits and supported findings in the literature that suggest 'auditing the audit' to be a useful step in clinical audit (Rossdale, 2000; Rayment, 2002; Viner, 2005a; Burford, 2013). Auditing the clinical audits also led to further discussions about different topics and many suggestions of topics that could

be audited in the future. The discussions also allowed for further dialogue on how things were done and how things had changed in the practices.

The conduct of clinical audit has been shown here to be of interest to the practitioners that conduct it because it initiates discussion, even if the clinical audit cycle is not necessarily completed. Good results were just as useful as unsuccessful findings and the clinical audit discussions provided a time for work and success to be recognised. The difference between clinical audit and clinical research, and the relationship between the two was discussed at length in the final meetings suggesting more needs to be done to clarify the situation. The difference between clinical audit and clinical research is difficult in a profession where there is relatively little clinical evidence (Wylie, 2015). The practitioners felt that the research project as a whole worked well in their practices and were keen to interact with similar research projects in the future.

The practitioners agreed that guidance on clinical audit for other farm animal practitioners wishing to undertake the process should promote a user-friendly and time resourceful process.

7.4.1 Study limitations

At the meeting at Practice 2 one of the dictaphones appeared full of data and was not used. The other dictaphone ran out of battery half way through the meeting. This was not discovered until the end of the meeting so the second half of the discussion was not recorded, therefore the conclusions drawn are not based on all the collected data.

The amount of discussion at the final meetings in Practice 1 and Practice 2 may have been curtailed as these meetings were conducted at lunch time in the middle of normal working days. The feedback on how the project had gone may have been affected by the presence of the researchers. The recording of the meetings, and the presence of colleagues may also have influenced how much the practitioners were happy to discuss.

7.5 Conclusion

The veterinary practitioners in the three practices used in the project felt that the clinical audits conducted in their work places had been useful and interesting for a number of different reasons. Many suggestions were made about how to improve future clinical audits suggesting that auditing the clinical audit can be a valuable step in the process. The practitioners involved considered the research project to be a useful and beneficial exercise. They would therefore be interested in being involved in similar projects in the future.

Chapter 8 Discussion and conclusions

8.1 Findings from the study

A number of conclusions and suggestions about the suitability of clinical audit for quality improvement in farm animal veterinary practice can be drawn from this study.

Through the nationwide survey (Chapter 2), the work conducted with the three farm animal veterinary practices (Chapters 3, 4, and 5) and general discussions held with veterinary practitioners throughout the course of this project, it is apparent that the awareness, understanding and use of clinical audit varies widely between practices and between individual veterinary surgeons. Despite the emphasis put on the process by the RCVS, there was no existing literature on how clinical audit was used or understood specifically by farm animal practitioners and little on veterinary practitioners in general. If the current status is unknown then the effect that rules, regulations or suggestions might have on veterinary outcomes is difficult to predict or measure.

The results of this study suggest that veterinary surgeons need more guidance and support if clinical audit is to be used effectively in farm animal practice. A user-friendly and practical approach to how clinical audit can be conducted may encourage more people to attempt it in practice. As in medicine, the use of clinical audit as a part of quality improvement does have a place in farm animal veterinary practice. The use of clinical audit also encouraged an evidence-based approach to practice. The veterinary surgeons consulted in this study were supportive and positive about its use in farm practice with the clinical audits conducted deemed possible within farm animal veterinary practice. Clinical audit is important in farm animal practice as it can potentially provide a method for the assessment of clinical services in a team that spends much of its time with members working on farm alone.

8.1.1 Defining clinical audit in the veterinary setting

Review of the literature suggests that the development of clinical audit in the veterinary setting does not appear to have been a straight forward direct translation from medicine. This may be because veterinary authors have attempted to mirror the developing concept used in human medicine, where resources and health care structure differ. Little peer-reviewed research has been conducted and published on the use of clinical audit in veterinary practice and the literature that does exist is mainly opinion pieces (Mosedale, 1998; Rayment, 2002; Viner, 2009; Dunn and Dunn, 2012; Dunn, 2012). This has led to confusing and conflicting guidance for veterinary practitioners who are encouraged to undertake the process in practice (Royal College of Veterinary Surgeons, 2015; Royal College of Veterinary Surgeons, 2016).

Considering the existing differing definitions of clinical audit and the availability of resources and evidence in the veterinary profession, the definition of clinical audit should remain simple for ease of use and understanding, and to allow practical application. Veterinary practices vary hugely in resources that they have available, but very few will have staff and money to specifically dedicate to clinical audit. Evidence is lacking and guidelines are few. For these reasons a definition similar to the early definitions used in medicine may be more appropriate for current veterinary clinical audit. Figure 40 shows the extensive amount of time that medical audit has existed and been developed over. In comparison veterinary clinical audit has existed for a small proportion of that time; starting at a point in time when medical clinical audit had already advanced and evolved.

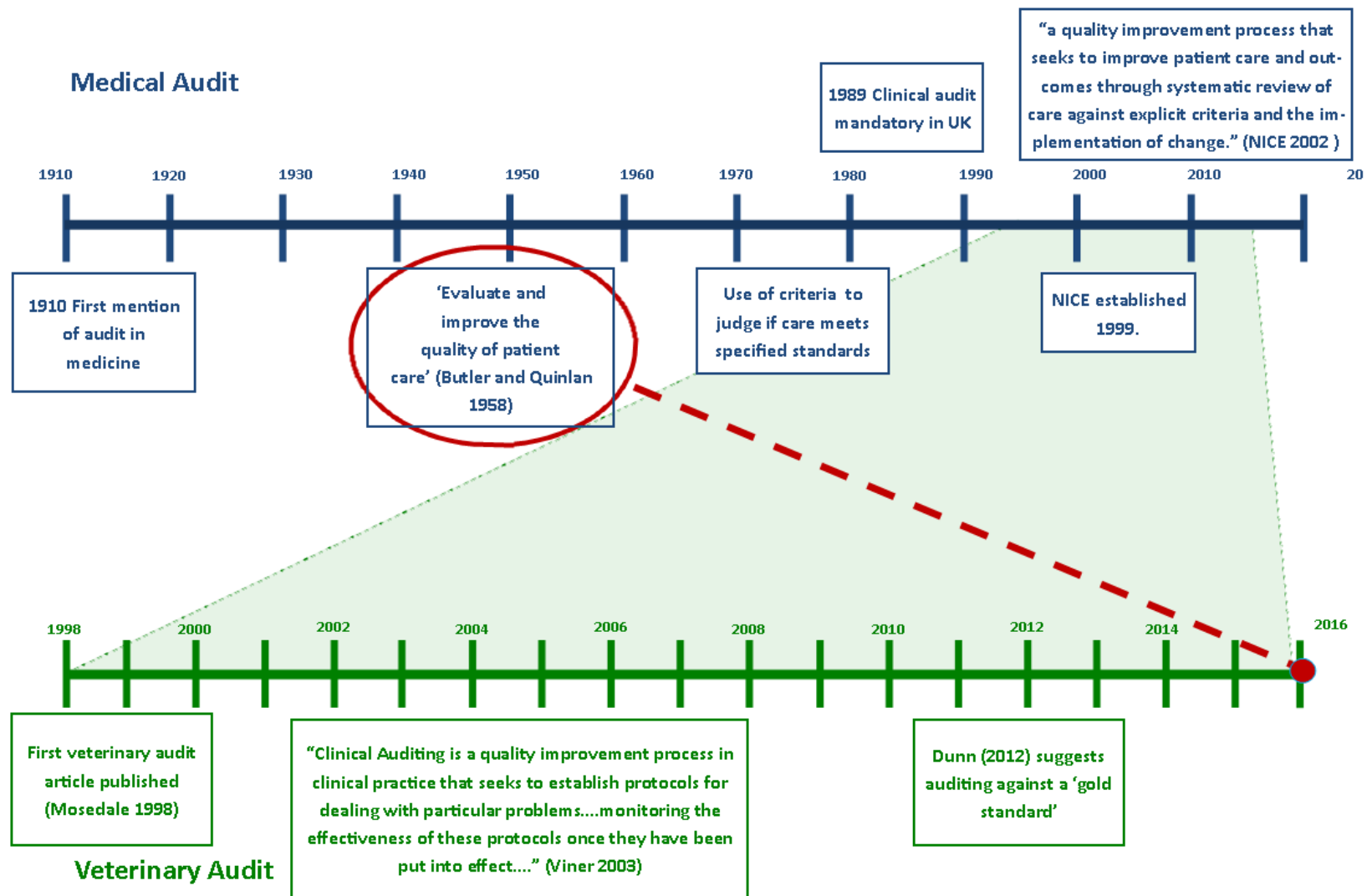


Figure 40 Timeline of medical audit showing the introduction of clinical audit in to the veterinary profession in the late 1990s.

Defining veterinary clinical audit in the 21st century in a similar way to how it was defined by Butler and Quinlan (1958) in 1950's medicine, allows for a large degree of flexibility for veterinary surgeons wishing to undertake it. This definition of clinical audit is very similar to the definition that was initially used by Mosedale for veterinary medicine in 1998. If clinical audit is defined as 'the assessment and improvement of patient care' where practitioners can look at what they do and try to make it better, many different types of clinical audit can be undertaken that would fulfil this definition (Table 16). A clinical audit could involve measuring practice against existing evidence-based standards where they exist, it could involve the creation of a local protocol, guideline or guidance for which to audit against, or it may just involve looking at what is happening and trying to make it better. Veterinary surgeons can choose the type of clinical audit most suitable to their practice, available resources, clinical audit experience and topic chosen. Providing a simple definition of clinical audit alongside a range of 'types' makes clinical audit a flexible quality improvement tool for any veterinary surgeon in any practice to use.

Table 16 Suggested different types of clinical audit that could fulfil the 'assessment and improvement of clinical practice' clinical audit definition

(Modified from Waine and Brennan (2015))

Type of clinical audit	Description	Notes	Retrospective or prospective data collection?	Examples	Positives	Negatives	References
Process	Examines the process of the medical care provided.	Can be compared against an evidence-based standard where they exist to determine if the right thing is being done, can set a target within the practice or the first round of audit can be run to set a benchmark for future clinical audits.	May be done retrospectively (depending on data available) or prospectively.	The management and treatment of down cows. Digit amputation surgery. The treatment of endometritis. The reporting of lab results to farmers.	Gives an overview of how clinical care is being carried out. Could help to develop a uniformed approach to cases if required.	Need to take into account that processes may differ depending on the clinical presentation of the patient and other variables.	Moore and Klingborg (2003), Viner (2009)
Outcome	Examines the outcomes and results of clinical practice	Can be compared against an evidence-based standard where they exist to determine if the right thing is being done, can set a target within the practice or the first round of audit can be run to set a benchmark for future audits. If results from outcome audits are less than satisfactory, a process audit could be run to see where things need improving in the system	Retrospective (if required data exists), or prospective	Survival post LDA surgery. Days to conception post caesarean.	Demonstrates the results of the clinical care being provided. Allows individuals to monitor results of individuals or groups of cases	Outcomes are not always the most important part of clinical care to review. Many different factors can affect an outcome - especially when a third party, such as the client, is involved in care	Mosedale (1998); Rayment (2002); Moore and Klingborg (2003)

Structure	Assesses facilities and equipment available	Can make a big change to the services offered just by ensuring individuals are correctly equipped. Does not have to involve items being bought – consider changing how things are done, where things are stored or swapping kit between individuals depending on usage.	Possibly retrospective but more likely that prospective will be required	Car boot clinical audit - what equipment and medicines are kept in the car boot.	Can be very simple to do but can bring significant benefits	May highlight areas that suggest expensive equipment is required	Donabedian (1966), Dugdale (2016)
Significant event	Is run in response to a significant event which may be good or bad	Must create a no-blame culture when discussing adverse events to ensure details are gathered and incidents can be prevented in the future. Can also be run on 'near miss' events.	Retrospective	A cow that died on a TB test. Successfully rescuing a heifer from a swimming pool.	Allows all staff members involved with a significant event to discuss what happened, with the goal of ensuring it is prevented in the future (if an adverse event), or repeated it if it was something that went well	Needs all staff members involved in the event to be brought together for the discussion. Staff can be made to feel like it is a blaming exercise if not handled correctly	RCVS Knowledge (2015)

Figure 41 shows a proposed clinical audit cycle that fits with any type of clinical audit being conducted. Again, the cycle is kept practical and unambiguous to ensure it is user-friendly. The use of 'audit' for the first part of the cycle where changes are not made, and 'clinical audit' for a cycle where changes are made may be confusing; as found in this current study, 'clinical audit' is commonly shortened to 'audit'. Rather than focusing on the terminology used, more importance should be placed on the consideration given to the approach, the overall plan, the reasons behind stopping or continuing after the initial data collection and whether that decision was appropriate to the situation.



Figure 41 A clinical audit cycle appropriate for use with any type of clinical audit
(Waine and Brennan 2015)

Clinical audit is a fluid process and therefore needs to be flexible to allow implementation and completion. Every veterinary practice is different and one size will not fit all. The benefits of a clinical audit in one practice may not benefit a different practice. Clinical audit should be tailored to each individual practice and team to ensure benefits can be felt by those conducting it. If a nationwide clinical audit is being conducted, thought must be given to the

aims, and the perceived benefits to each participating practice before the clinical audit commences.

8.1.2 Terminology of evidence-based standardised methods of treatment

Evidence-based standardised methods of treatment (e.g. protocols, guidelines, standard operating procedures, best-practice recommendations) have been shown to have many advantages in medicine (Anon, 2016) and these are beginning to be appreciated and used in veterinary practice (Oxtoby and Mossop, 2016). This current study found that a 'protocol' can affect the treatment delivered by veterinary surgeons and can bring advantages to farm animal practice. It also found that mislabelling guidance can cause confusion among clinicians when adherence expectations are not clear. While it is vital that clinicians consider the best available evidence they must also be able to maintain clinical autonomy in order to make the best decisions for each individual patient or case (Greenhalgh, 2010). To be able to do this the terminology needs to be clarified. There are already many different terms for this guidance as discussed in Chapter 1; this may be in an attempt to avoid using words like 'protocol' or 'guidelines' which appear to tell people what to do. With articles in the literature highlighting the current confusion between protocols and guidelines, increasing the number of terms used is only likely to exacerbate the problem. Viner originally replaced 'protocols' with 'guidelines' in 2006 in his definition of clinical audit, and authors are now attempting to replace the term 'guidelines' with other, less instructional names such as 'best practice recommendations' and 'consensus proposals'. This suggests that in years to come the new terminology will again need replacing. For practitioners to be able to use the evidence to assist, not restrict their decision making then the terminology needs simplifying. Clear terminology for the guidance, with clear expected levels of adherence may help to reassure veterinary surgeons that the evidence is worth using while still maintaining clinical ownership of their cases.

With clear terminology, auditing against the guidance to ensure best practice can be a viable option for clinical audit where appropriate. If clinical audit is to be used to ensure that veterinary surgeons are performing a certain procedure in a specified way, or used to create a document instructing how a procedure should be performed, there should be confidence that the protocols or guidelines constructed outline best practice.

The veterinary profession has a unique position in being able to learn from medicine, albeit with considerably restricted available resources in comparison and a completely different clinical, business and economic setting. With evidence-based guidance the positive and negative aspects of NICE guidelines are a great resource to learn from (Anon, 2016). However, the veterinary profession must consider what aspects are useful and appropriate to adopt, and learn from the successes and mistakes made in medicine (Swinglehurst, 2005; Greenhalgh, 2010). Without having to follow restrictive clinical guidelines, veterinary surgeons are able to treat each patient depending on individual circumstance; this art of veterinary medicine should only be improved and enhanced through evidence-based guidance, whatever it may be called.

8.1.3 The difference between clinical research and clinical audit

The difficulty of creating a clear distinction between clinical research and clinical audit was observed at a number of points throughout this project. During the topic prioritisation exercise in the three practices at the beginning of the study the discussions often strayed into areas of clinical research. As scientists, veterinary surgeons are keen to find answers and the clinicians in the current study had a lot of clinical questions that they wanted answers to. In the nationwide survey some definitions suggested that clinical audit was about finding the best treatment or the best way to things. The practitioners were often reminded across the course of the research that the intention of clinical audit is to evaluate current practice rather than find answers to questions. At the final meetings the understanding of a number of the

practitioners appeared to have changed dramatically as they had started to appreciate the difference between the two concepts.

The confusion between research and clinical audit may in part, stem from the lack of evidence available on clinical topics. With a lack of evidence, there is a lack of standards to compare practice to. In search of an answer, this often lead the practitioners in this study to ask how things should be done or what is the best way. Simplifying the explanation of clinical audit may help to clarify the difference between the two. Comparing findings from practice to published evidence-based 'gold' standards may be applicable for some scenarios, but not for the majority. Where evidence does not exist, practitioners should be encouraged to look at what they do and discuss it, rather than be left wondering what the best thing is because they can't identify literature on their topic. Clarifying the different types of clinical audit may also be beneficial so practitioners can see where research sits alongside clinical audit.

Further reason for the confusion may be that clinical audit and clinical research can be very similar and can potentially produce the same, or similar, data. There are some features that are very clearly only applicable to clinical research: interventions using completely new treatments, an absolute requirement for ethical approval and a clearly defined methodology with repeatable results. There are others that are very clearly only applicable to clinical audit: never any use of randomisation, allocation or intervention and a responsibility to act on the findings. Some types of research studies, such as randomised controlled trials, are very clearly not clinical audit, but other types of research, such as retrospective case-control studies or a case series, may be harder to distinguish. As discussed in Chapter 1, many authors advise that clinical research is about creating new knowledge (Smith, 1992; Rayment, 2002; Viner, 2009; Dunn, 2012). Findings from Chapter 3 suggest that veterinary surgeons would like to be able to use clinical audit to produce data useful to the profession. Dunn (2012) argues that the purpose of clinical audit is not to create new knowledge. However, when clinical audit is conducted

and reported in an area where there is no existing evidence, new knowledge may be created. This may be where much of the confusion comes from in veterinary medicine. Figure 42 shows a simplified example of how a research study and a clinical audit could ultimately produce the same data. Although the same data may be collected, the key difference between the two is how the process is approached and how the results are interpreted and used. New knowledge may be created from a clinical audit, but it must be interpreted with care as clinical audit data are unlikely to be as robust as those found from a good research project.

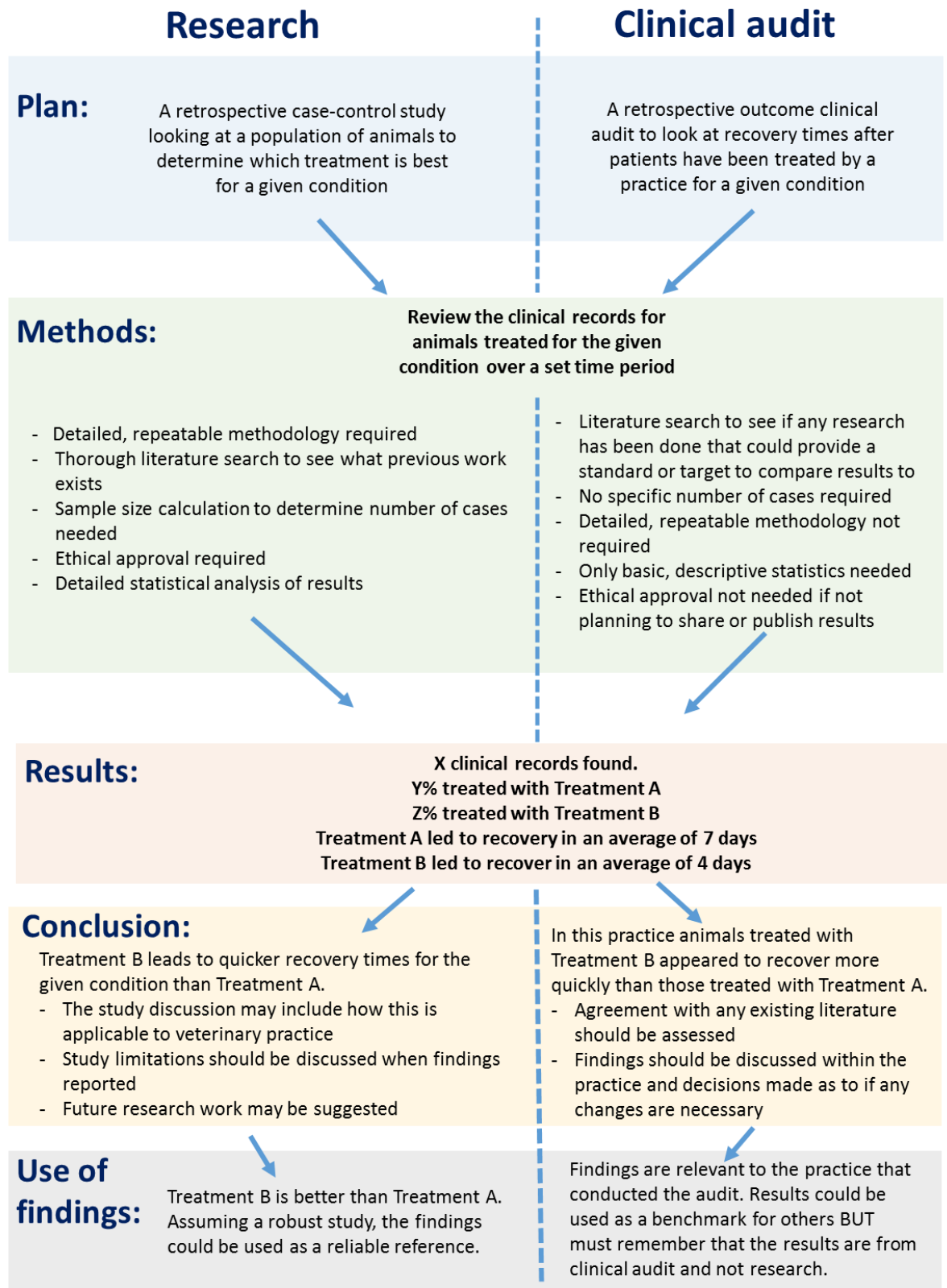


Figure 42 Points at which it may be possible for research and clinical audit to produce the same data

The distinction and intention of a project should be clear from the outset as the process between research and clinical audit does differ. If work is appropriately labelled and understood the findings can be correctly interpreted for quality and subsequently utilised. This means clinical audit findings could be used as a reference for other work or used as a benchmark by others. Where clinical audits are published, publishing formats should ensure that the clinical audits are clearly clinical audit, and are not moulded into a research template which may lead to confusion.

8.1.3.1 Ethical approval

As suggested by Viner (2009) and Wylie (2015), clinical research requires ethical approval while clinical audit usually does not. However, because the distinction between the two can be unclear the decision to seek ethical approval should not just be based on the label of 'research' or 'audit'. The requirement for ethical approval should also not be a reason for mislabelling work (British Medical Journal 2016).

The Data Protection Act (1998) must be adhered to at all times. In the NHS, if clinical audit involves collecting client information, sharing data outside of the practice or if there is an intention to publish the findings then ethical approval should be sought (University Hospitals Bristol, 2009). Ethical approval by an individual institution does not however guarantee that the work is morally sound (British Medical Journal, 2016). Suggesting practitioners should seek ethical approval for many, or even some, clinical audits in the veterinary profession is not currently practical. Ethical approval for research projects is granted through universities, often only to groups associated with the university in question. Only very recently has an Ethical Review Panel been set up by the RCVS for research projects conducted in practice (and independent from a university institution) that involve cats and dogs (Royal College of Veterinary Surgeons, 2017). There are suggestions that this may be extended to other species, but even if this occurs, the panel would be unlikely to have the capacity to cope with a large caseload of clinical audits to review, which could be a barrier to vets seeking review for their clinical audits.

When conducting clinical audit in veterinary practice The Data Protection Act 1998 and the section on Client and Clinical Records in the RCVS Code of Professional Conduct must be adhered to at all times. The Code of Professional Conduct states that client confidentiality should be maintained at all times, while The Data Protection Act (1998) states that relevant and not excessive data can only be obtained and processed for the specified purposes. The Data Protection Act (1998) controls how organisations use 'personal' data, so anonymised data can be used for clinical audit. Practices must therefore ensure that data is anonymised which may mean removing more than just a client's name and address from data. Abiding by the Data Protection Act (1998) and the RCVS Code of Professional Conduct means that ethical approval for veterinary clinical audits should therefore only be required if the audit has requirements of the client beyond normal medical management, such as client surveys. Anything further than medical management conducted on the patient is likely to be research, in which case the intentions of the 'clinical audit' should be revised.

8.1.4 Retrospective and prospective clinical audit

This study has found that prospective, on-farm data collection is feasible in farm animal veterinary practice; the practitioners found the data collection forms easy to use and data was successfully transferred to an electronic format to allow for data analysis. The involvement of individual veterinary surgeons varied within the practices; differing caseloads, interest in the topics and time available appeared to affect how many cases were collected by each veterinary surgeon. The number of cases collected over time varied between practices and topics. Although season may affect the caseload of some topics, the practitioners admitted that as time went on the enthusiasm to collect more cases dwindled with other aspects of work prioritised. The ability to conduct retrospective clinical audit differed from prospective clinical audit in the three practices. Although enough data was found to look at the treatment of COD in Practice 1, the lack of any clinical data in Practice 2 and the lack of cow ID recorded in Practice 3 prohibited any form of retrospective clinical

audit on the chosen topics. The data that was found in Practice 1 was from an unexpected source where the quality was not as good as the information collected in the prospective clinical audit. Few clinical details for individual animal treatments were found in the free text clinical notes on the PMS in all three practices. Product sales and billing appear to be the most reliable sources of data. The ability to conduct retrospective clinical audit will depend on the availability and quality of existing data, and this is likely to vary hugely between practices.

In agreement with many other authors, this study has shown that retrospective and prospective data collection for clinical audit both have advantages and disadvantages (UHB, 2009d; Dunn, 2012; Haessler, 2014). The decision to collect data retrospectively or prospectively should be made based on the topic to audit, the data required for the clinical audit, the existence of data, the capabilities of the practice management system, the abilities of the team to access the information on the PMS, and the staff and practice wishes. If the use of clinical records for clinical audit is preferred (i.e. where data can be collated and analysed by one person) but the required data does not already exist, changes could be made to the recording of clinical data (e.g. adding cow ID to the invoice ticket on farm) and a clinical audit could be attempted at a later date. This may also lead to improved clinical records longer term.

8.1.5 Data collection

In agreement with other authors (Dunn, 2012), data collection in this study proved to be fairly labour intensive. Creating the data collection forms in all practices was a compromise between a request for quick and easy forms to fill in versus a desire for comprehensive information to satisfy the demands for detailed knowledge by the practitioners. There was some reluctance to collecting cases on farm at the time an animal was seen amid concerns as to time available and views of the farmers. The number of animals recorded as follow-up examinations was low which may have been due to these animals not being presented on farm, problems with the data collection methods or

practitioners choosing not to record these cases. The number of cases collected per vet and over time varied hugely, with a drop in the number of cases collected the longer the clinical audits continued. Guidance was given by the researchers to create simple data collection forms for the clinical audits, although it was felt that these could still have had less questions with the same resulting benefits. Consideration should therefore be given as to what will be done with all the data once it has been collected. Although initially slightly reluctant to collect data at the time an animal was seen on farm, the practitioners felt that the paper data collection forms worked very well and were very easy to use. The practices involved in this project did not have access to advanced hardware and software that may be more suitable to the farm environment. This may be more commonly used for clinical data collection and hence clinical audit in the future. The collection of follow-up cases and data did add an extra level of difficulty to the clinical audits, but enough follow-up information was collected to allow discussion. The practitioners felt that the decline in cases collected over time was due to audit fatigue as interest and inclination declined. To overcome this, suggestions were made to keep the period of data collection per clinical audit short (less than three months) with continuous clinical audits repeated a couple of months each year, rather than all year round.

8.1.6 Clinical audit stakeholders

In all three practices the only staff members involved in the whole clinical audit process from the initial stages of choosing a topic to audit, through to the final meetings, were the veterinary surgeons. No other staff members attended the meetings or had any consistent communication about the clinical audit from the researcher. This was not deliberate, stakeholder involvement was not a specific focus for this thesis and this arrangement merely extended from the initial meeting that the lead practitioner organised in each practice. In each of the practices however, other staff members played important roles in the conduct of each clinical audit. In Practice 1 the farm animal administrator was the main team member to assist with the

retrospective data collection and knew what information could be found within the practice. In Practice 2 the administration staff were involved with planning the meetings and collecting together information from the clinical audit for the practice's RCVS PSS inspection. In Practice 3 the veterinary nurses ensured that there were always data collection forms in the surgical kits and removed completed forms from the kits ready for the data to be transferred. In all three practices there were other steps that could have been conducted by team members other than the vets. Data collected on farm by Practice 1, 2 and 3 could have been entered onto the computer by administration staff, searching the clinical records for the retrospective data could have been done by an office administrator in Practices 2 and 3, and collecting the follow-up data in Practice 3 could have been done by an administrator familiar with Interherd. The researcher also did a large amount of administrative work for the clinical audits and therefore another individual would need to undertake these roles during conventional clinical audits.

Time is consistently reported as a barrier to clinical audit (Glew et al., 2014; Cai et al., 2009). In this study it was cited in the nationwide survey as an obstacle to conducting audit, and in the three practices it was often raised as an area of concern. Other staff members within a practice, including veterinary nurses, practice managers, administration staff or visiting veterinary students have many skills that may be beneficial to the clinical audit process. The involvement of all types of staff in a clinical audit may help to share the workload, and therefore reduce the amount of time individual practitioners need to dedicate to the process. Team members will have different skills that will be beneficial to other stakeholders and make the overall process more efficient. For example, if attempting retrospective clinical audit the administrators may have the best idea of the quality and quantity of data that might exist which may save another staff member the time of searching for it. In agreement with Viner (2009), involving all stakeholders from the beginning is important to improve engagement with

the process. This includes selecting the topic, conducting the clinical audit and informing all of the results.

8.1.7 Benefits of clinical audit in farm animal practice

If personal and practice level benefits of clinical audit are recognised, enthusiasm for the process may be more likely and this may result in more successful clinical audits. The purpose for conducting a clinical audit should be carefully considered, outlined, and the team consulted throughout the process to ensure desired benefits can be realised. There are no known direct financial incentives, gains or reimbursement for conducting clinical audit in veterinary practice. It is therefore necessary that the process is not time consuming, is easy to understand and that the practice benefits in other ways.

A number of benefits of clinical audit have been highlighted during this current study. In agreement with Dunn (2012) who suggested that simple clinical audits can empower clinicians, the practitioners here felt that the information collected enhanced their awareness of what was happening in their practices leading to positive change. The veterinary surgeons involved considered the process to improve communication and team work within the practice, found the information collected to be interesting and thought that the process may help new graduates gain confidence in procedures. The individuality of each practice must be remembered when comparing the benefits of clinical audit between practices. A clinical audit in one practice may have many differences to a clinical audit in a neighbouring practice, and assessment of clinical audit use must be taken into consideration alongside size and type of practice, resources available and the culture that exists. Benefits felt in one practice may not be beneficial to another.

8.1.8 Challenges of undertaking clinical audit in farm animal veterinary practice

Farm animal veterinary surgeons face many challenges when attempting clinical audit as work is conducted in a very different environment to medical practitioners in a hospital. Farm veterinary surgeons are mainly based in a

lone environment, often working out of a vehicle, with varying levels of technology and mobile internet capabilities. Veterinary practices are required to carry out all steps of the clinical audit process, with no assistance from dedicated clinical audit professionals to conduct the process. Time may be limited and access to resources constrained. In this current study these challenges were overcome by encouraging good communication and picking clinical audit topics and data collection methods to suit each individual practice. The practitioners felt that the researcher's assistance in conducting the clinical audits was a great help to all individuals involved, suggesting that a clinical audit lead could greatly increase the chances of a clinical audit being successful. Expected time commitments from each individual was kept to a minimum, and resources were chosen for use based on those already available.

For clinical audit to be viable, it must be adapted to fit each individual veterinary practice. The simple definition and clear clinical audit cycle above, along with the types of clinical audit, aim to make the process flexible from the outset. This should reduce the impact of the challenges faced by farm animal practitioners on clinical audit.

8.1.9 Clinical audit from a wider perspective

The current emphasis placed on clinical audit by the RCVS through the PSS and RCVS Knowledge suggest that the requirement for veterinary surgeons to conduct clinical audit in practice is set to remain. Clear benefits of conducting clinical audit have been suggested before and shown in this study.

Practitioners already conducting clinical audit appear to be doing it for many reasons. However, the findings from this study also suggest that veterinary practitioners require further support and guidance on the subject.

Many previous articles have discussed clinical governance as a reason for conducting clinical audit. This may lead to clinical audit becoming a 'tick box' exercise and it is important that other benefits of the process are recognised and realised. However, clinical governance should be all about improving

practice, and so perhaps boxes should not be ticked unless improvements have been seen as a result of clinical audit; perhaps the outcomes of clinical audit should be what counts, not necessarily just the process.

8.1.10 Costs of clinical audit in farm animal veterinary practice

Within the NHS, clinical audit is backed and funded by the government (Viner and Jenner, 2005). It is also implemented for economic reasons to ensure resources are utilised in the best way possible for a large-scale business which in turn bring financial benefits. In veterinary practice, any costs relating to clinical audit must be funded by the private business, which means that in turn, the cost is passed on to the client (Viner and Jenner, 2005). Veterinary practices have continued pressure to deliver good quality patient care while needing to make a profit (Oxtoby and Mossop, 2016). The practitioners in the three practices and in the nationwide survey suggested uncertainty about the ability of clinical audit to be financially beneficial to practices. There is no funding for clinical audit to be conducted in veterinary practice and the process has been shown to incur costs, in the NHS this is mainly in the form of labour (Lock, 2000). Clinical audit should therefore avoid excessive costs; this can be done by keeping the process simple and using practice resources already in existence. Potential financial benefits to veterinary practice are as yet unknown.

8.1.11 Alternatives to clinical audit

Quality improvement tools that could be used as alternatives to clinical audit were discussed in Chapter 1. This thesis has highlighted a number of challenges and problems with using clinical audit in the veterinary setting and it may be time to declare clinical audit unfit for purpose in favour of other techniques. However, relatively significant progress has been made in this field in the veterinary profession. Chapter 2 demonstrates that many practitioners are aware of the process, even if they are unclear what it involves. Clinical audit has been incorporated into the RCVS Code of Professional Conduct and the RCVS Practice Standards Scheme, it is listed as an RCVS CPD activity and a clinical audit module exists for the RCVS Certificate

in Advanced Veterinary Practice. Relatively large amounts of time and resources have been spent on researching and promoting clinical audit in comparison to other quality improvement methods. This has highlighted many barriers to clinical audit, but barriers to other quality improvement tools are still unknown. Withdrawing clinical audit from these programmes and initiatives now is likely to lead to confusion, while the resources already invested will have been wasted.

Clinical audit should remain a part of quality improvement but the description and approach cannot stay the same. Despite its presence in the profession a huge amount of confusion surrounds it that is preventing practitioners from implementing it effectively. One type, description or approach to clinical audit will not fit all topics, in all practices, with all practitioners. For clinical audit to be successful across the profession it needs to be flexible to fit the environment, the resources, the topic, the evidence available and the individual practitioners in each different practice. Emphasis must now be placed on cementing the foundations of clinical audit correctly and providing user-friendly guidance for veterinary surgeons to be able to conduct the process effectively.

Many other tools may improve outcomes in veterinary practice, but all tools should be flexible and easy to use, take little time and have significant benefit. Often clinical audit can incorporate other methods of quality improvement such as benchmarking, guidelines and checklists. To have the greatest chance of improving the quality of clinical care delivered across the profession practices should use the tool most suited to their practice and the situation (Healthcare Quality Improvement Partnership, 2015d). For some clinical audit may not be suitable to their practice environment, while for others it could be used alone, or alongside other quality improvement tools. Simple and short clinical audits have the potential to bring benefits to any practice while incurring little cost. These types of clinical audit could and should be attempted by any practice before concluding whether it is a suitable Quality Improvement tool for use within the practice.

8.1.12 Resources and support for veterinary practitioners

Unlike the medical profession where a framework for clinical audit exists and resources are in place to assist all staff levels with the process, farm animal veterinary surgeons need to take full responsibility for all stages of the process (Dixon, 2011; Hexter, 2013; Healthcare Quality Improvement Partnership, 2015b). Protected time is vital, as one veterinary surgeon may perform as much of the clinical audit cycle that may be assigned to a whole team of people within the NHS.

McCarthy and Byrne (1997) and Greenwood et al. (1997) suggested that a lack of formal training and ongoing clinical audit support were some of the reasons for clinical audit failure by junior doctors. The current study has shown that some individuals have never heard of clinical audit, while some have already run more than ten clinical audits in their practices. Guidance is therefore required to ensure that first time clinical auditors are supported, while experienced auditors can continue to conduct the process with maintained enthusiasm. In agreement with junior doctors, this study has found that despite the lack of resources and support when conducting clinical audit, veterinary surgeons still feel positive about the concept (Greenwood and others 1997). The nationwide survey results suggest that clinical audit was incorporated into the veterinary undergraduate curriculum for the 2010 cohort of graduates. This suggests that there is still a large knowledge gap within the existing group of practising clinicians. This must be taken into consideration when veterinary practitioners are expected to undertake clinical audit.

8.2 Recommendations for practitioners conducting clinical audit

As a result of this thesis recommendations have been created that may assist practitioners wishing to conduct clinical audit. These recommendations bring together findings from the current study with previous suggestions from the literature to create one resource on how to conduct clinical audit in farm

animal veterinary practice. The guidance is based on the clinical audit cycle in Figure 41. Suggestions from previous authors have been recognised.

8.2.1 General advice when conducting clinical audit for the first time

- Keep it simple

Where very little information currently exists or is collected, the undertaking of a clinical audit that provides any data will be of interest. Start simple – how do different vets do different things? How many of a certain case do you see? How much of a certain product do you sell? Difficult topics can discourage future clinical audit activity.

- Keep it short

Whether conducting a prospective or retrospective clinical audit, start with an audit that takes a small amount of time. That might mean short data collection forms (less than 10 questions) or a short amount of time over which data is collected (< 3 months). Avoid long audits that can lead to audit fatigue and communicate the results clearly to allow individuals to see the benefits.

- Keep it interesting

Choose a topic that the majority of the team have an interest in. Show the benefits that can be gained by collecting and analysing data simply. Aim for success rather than answers to too many complicated questions.

- Keep the clinical audit flexible

There is no need to rigidly stick to the original audit plans if the clinical audit is not working. Clinical audit should meet the needs of the practice; a completed audit cycle may not be necessary or appropriate, the period of time an audit needs to be conducted over may need to be lengthened or shortened once an audit is underway or a topic may need to be changed due to lack of caseload. Any changes should be fully discussed and clearly communicated to all team members involved in the audit.

8.2.2 Prepare for clinical audit

Preparation is the key to a successful clinical audit. Time spent on this stage should increase the chance of conducting a useful and effective clinical audit.

Audit lead

An individual within the audit team needs to take ownership of the clinical audit to drive it forward within the practice. The audit lead can be any member of practice staff; veterinary assistant, office administrator, partner/director or veterinary nurse, and they may be junior or senior staff members. The audit lead position may be best suited to the person most enthused about the topic, and benefits may be felt from having a different audit lead for each clinical audit conducted. The audit lead should oversee the entire clinical audit process and ensure that it progresses, is completed and that it benefits the practice and those involved. They should motivate the team about the clinical audit throughout the process and ensure that new and returning staff members are aware of the audit progress.

Engage all team members in the process

Establish the audit team (Viner 2005). This may include veterinary surgeons, veterinary nurses, office admin staff and visiting veterinary students. Engage all stakeholders in the process from the beginning and keep them informed throughout. Because farm animal practitioners are often working alone, it is even more important that engagement occurs at the early stage of the clinical audit.

Ensure a no-blame culture from the start

A no-blame culture is vital for clinical audit to work (Viner 2005; Viner and Jenner 2005). If practitioners are unable to feel comfortable discussing and sharing experiences, then clinical audit will have little benefit. In practices with a culture where this may be difficult, an audit lead should be chosen for initial clinical audits that will create, promote and manage a successful no-blame environment in which the audit can be conducted and discussed. In

practices where this is impossible, individuals may consider conducting clinical audits of their own activities.

Determine resources available

Before conducting a clinical audit, find out what resources are available in your particular practice. This may be time available to dedicate to the process, knowledge and clinical audit experience of team members, capabilities of the practice management system (PMS) software or the availability of data or information held by the practice.

Create clear communication strategies

Successful audit requires successful communication (Rayment 2002). Clinical audit can also have huge benefits for encouraging and enhancing communication within a practice. Ensure communication channels are used that allow all team members to easily stay up to date; discuss the best channel of communication to use (e.g. emails, memos, posters, PMS messages, notes in pigeon holes, WhatsApp groups etc.) at the beginning of the process. Don't allow communication to become over-bearing or time consuming. Frequency will depend on the length of clinical audit, method of communication and caseload seen.

Choose a topic to audit

Choose a topic to audit based on the interests of the team. An initial meeting to discuss the clinical audit plans and to choose the topic to audit may be beneficial:

- Staff involvement is crucial so the meeting should be held at a time that suits as many of the team as possible. Plans should be made for distributing the information discussed to members of staff unable to attend, or those that get called away from the meeting. Incentives should be provided (such as food and drink) where staff are giving up their free time.

- Ask everybody involved to suggest topics to audit prior to the meeting; this could be done via email or a suggestions box. The audit lead should ensure that the meeting stays on track and that the clinical audit discussion does not stray into a clinical research discussion.
- Expand on the original topics suggested to create more detailed audit choices if necessary e.g. move from 'cystic ovarian disease' as a topic initially to 'treatments used for cystic ovarian disease' or 'outcomes of cystic ovarian disease treatment'.
- Some topic ideas will be rejected at this stage – try to cut down to less than five for the detailed discussion. With the remaining five (or less) topics, hold a detailed discussion into the advantages and disadvantages of each topic. Consider caseload seen, the interest surrounding the case, how easy it will be to record, collect or find the data and how useful the results may be. Then narrow your list down to at least two topics.
- Think carefully about the process of the audit, the potential caseload and the methods of data collection. Choose the final topic to audit.

The discussion should allow all stakeholders involved in the audit to have a say and voice their opinions. Any concerns raised about the clinical audit need to be acknowledged and addressed before the audit begins to avoid subsequent issues. After the meeting communicate the findings to everybody that will be involved in the clinical audit.

The topic you choose may be something that has a high caseload, carries a high risk or involves a high cost, or it may be the topic from a recently attended CPD course, the subject of a newly published paper or an area you want to develop within the practice. Because farm animal clinicians are often working alone, they are less likely to observe other vets and potentially the variability in case approach, so without regular practice communication it is possible that individuals may be using very different techniques. Therefore, clinical audit discussions are important to highlight any areas of variability and reasons behind why this is. You might choose to do a significant event audit

on a good (e.g. successfully rescuing a cow from a swimming pool) or bad (e.g. a cow dying during a bTB test) critical event that happened recently, in which case your topic may have been chosen for you.

Once you have chosen your topic, the next step is to decide what area you want to focus on. Figure 43 uses the broad topic of calf pneumonia as an example to describe the different types of audit that can be conducted. Not all topics will be amenable to every type of audit.

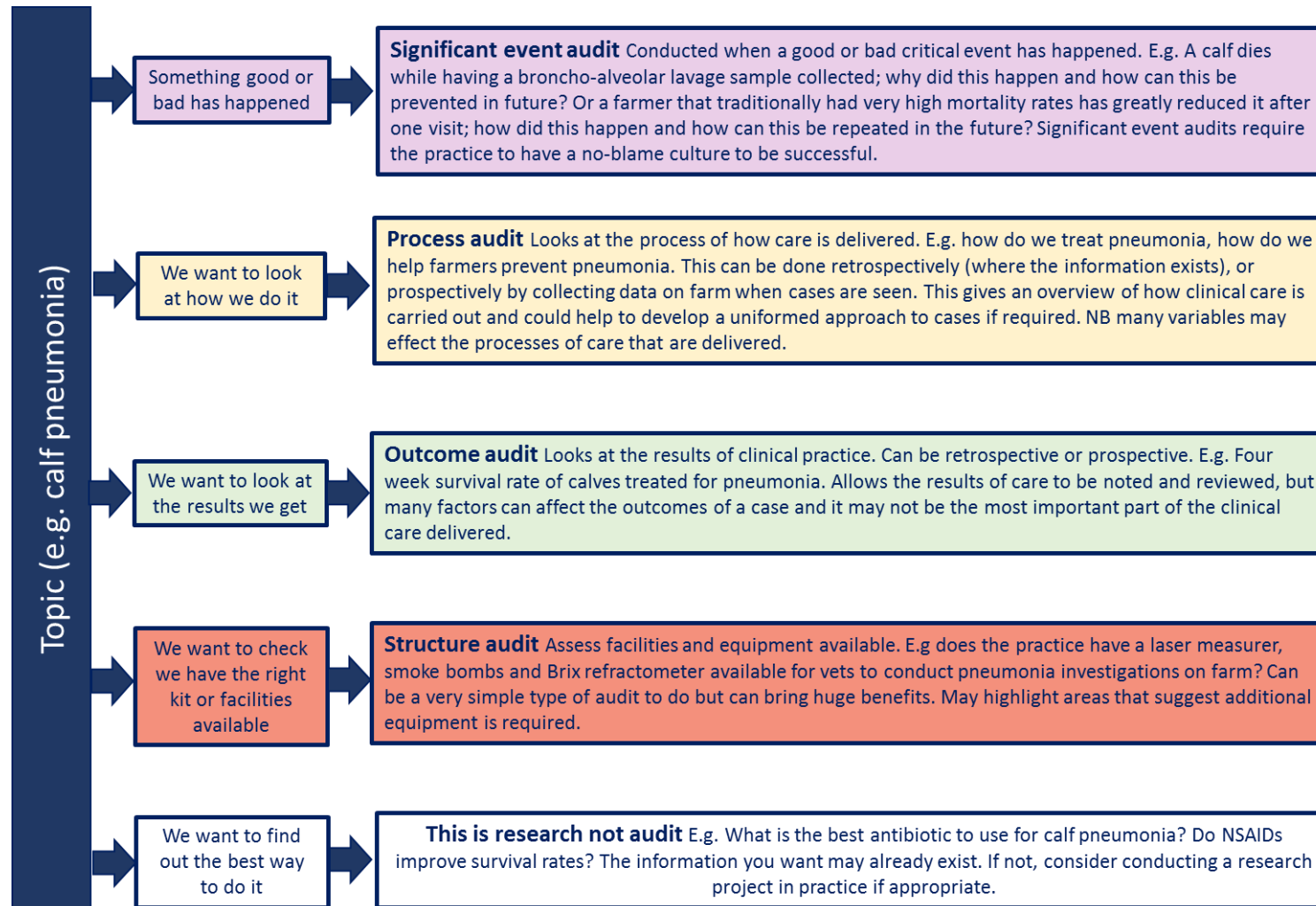


Figure 43 Deciding the specific topic and type of clinical audit to conduct

Search the literature

Once the topic to audit has been chosen, the literature should be searched for any relevant evidence. Grindlay and others (2012) recommend searching Medline and CAB Abstracts for the best coverage of the veterinary journals. Finding references through relevant article citations or a search of Google and Google Scholar may also yield results.

Literature searches should be thorough with the aim of finding any existing standards, guidelines or discussion of current techniques used in relation to your clinical audit topic. Any information found may be useful to your clinical audit (Rayment 2002).

Setting a standard

Traditionally, clinical audit compares practice against a set, evidence-based standard. However, this is not always possible in veterinary medicine where evidence is often lacking. There are a few approaches you can take, depending on the information that you find on your topic:

- If you have found consensus guidelines you may want to use them as your standard to compare your current practice to, or use them to make your own local practice guidelines. For example, Wapenaar et al (2011) published evidence-based guidelines on the management of uterine prolapse in cattle. You could:
 - Compare your current practice to the guidelines
 - Implement the guidelines in your practice and then compare how well they were followed
 - Use the guidelines to create your own local practice guidelines if you would like all vets to take a similar approach to managing uterine prolapses
 - Use the guidelines as a benchmark and see what you currently do in your practice
- You may have found previous literature that you could compare your practice to. For example, if doing an outcome audit looking at the

survival of cows after surgery for a left displaced abomasum (LDA), you could compare your findings to a standard published by Pedersen (2006) who found that at 60 days after surgery, 92% of cows remained in the herd.

- You may not have found any peer-reviewed evidence relating to your clinical audit topic. If this is the case, you could discuss the clinical audit topic within your practice team and set your own standard (E.g. Perhaps you would like 90% of caesareans to receive a post-op check within 48 hours). Or, you could conduct the first round of your audit and use the findings as a future standard to audit against.
- You might not need a standard or evidence to compare to. For example you might want to audit what you keep in your car; the right answer may be specific to the individual veterinary surgeon or practice and what other people do may not be applicable.

Use seasonal variation to your advantage

If topics for clinical audit have been chosen that are known to be seasonal (e.g. calf pneumonia, summer mastitis in cows or pregnancy toxemia in ewes) then perhaps think about running the audit during the busiest period to allow maximum cases to be collected over the shortest period of time. Use quieter times of year to prepare for the audit and to analyse the results.

Research vs clinical audit

Ensure the clinical audit you want to do is not actually research. There can be a fine line between clinical audit and clinical research; research determines the right thing to do, while audit looks at what is being done (Smith 1992; Wylie 2015). Clinical audit should be no more than normal clinical management (Viner 2009) and should not involve the identification of which approaches or treatments are the most efficacious.

Client confidentiality

Ensure methods used for clinical audit maintain client confidentiality and meet the requirements of the Data Protection Act (1998).

Ethical consideration

Clinical audit can easily be conducted without ethical review, but you should ethically consider your intended audit before going ahead with the process. Firstly, ensure your clinical audit is audit, and not research. Ensure any data collection, sharing or publishing meets the requirements of the Data Protection Act 1998 and the section on Client and Clinical Records in the RCVS Code of Professional Conduct. Clinical audits that require clients to do something more than what is required for normal clinical management, e.g. complete a questionnaire, may require ethical approval. There isn't currently anywhere to get ethical approval for farm animal clinical audits, so until there is, avoid using client questionnaires as part of clinical audit.

Preparing for data collection

Data collection for any clinical audit should be kept quick and easy, especially if this is the first clinical audit being conducted. Consider what you want to know and how you will analyse the data once it has been collected. Only collect data that is relevant to the clinical audit and ensure that somebody is capable, and has the time available, to analyse the data.

Clinical audits can be conducted retrospectively, by looking at data that already exists within the practice, or prospectively, by collecting the data at the time the action happens. Retrospective data collection may be possible depending on the topic chosen and the availability of data; check what information exists within the practice before choosing to do this type of data collection. Practice management software (PMS), billing tickets, paper records, the day book or diary and herd management software such as Interherd may all be potential sources of data that could be used for clinical audit. Data can also be collected prospectively, by using paper data collection forms or software on computer tablets, completed for each relevant case at the time they are seen on farm. Online data collection forms (such as those that can be designed on SurveyMonkey) could be used and completed on farm or back at the practice. Excel spreadsheets shared via an online file

storage program (e.g. Dropbox or Google Drive) or kept on one computer, or a chart stuck to the office wall to be filled in when a certain case is seen may also be used.

Discuss with the team members how they would like to collect their data and what they think will be easiest for them. Think about the way that procedures within the practice occur and use established routines to help facilitate data collection. For example, if the practice has designated large animal surgical kits, keep a data recording booklet with the kits to facilitate data recording for surgical clinical audits. Keep the number of questions on a data collection form to a minimum (maximum of 10). Consider what you are going to do with each piece of information at the analysis stage; if you don't know what you'll do with the information, you don't need to collect it in the first place. Set a time limit for data collection. Try to keep this short (less than 3-6 months), especially for the first time you run a clinical audit. Some practices like to have an ongoing 'rolling' clinical audit to use as a base line for other activities within the practice. If you find you have trouble keeping this going, consider instead running the audit for a couple of months each year to avoid audit fatigue within the team.

Pilot the audit

A short pilot of the clinical audit will allow for any difficulties or general misunderstandings to be ironed out before the actual clinical audit takes place. The pilot is also a time to test the data collection tool functions well and collects the required information.

Keep good records of the clinical audit

Ensure clear records are kept from the beginning so that there is a good record that the clinical audit happened (for governance purposes), so that you can see what you did and so that somebody else can see what you did.

8.2.3 Data Collection

Where cases are being collected over time, a defined time period should be stated at the beginning of the audit so that the individuals collecting the data know how long it will go on for. During the data collection period, reminders may need to be sent regularly to prompt your colleagues to continue to collect the data. For example, an email could be sent around every 2 weeks.

The pilot of the clinical audit should have highlighted any potential problems with the data collection stage but respond to any concerns that arise during the data collection process. If things are not working then consider modifying or stopping the audit.

If a large number of cases are being collected, staff members may need protected time or assistance to get the data entered into a database or spreadsheet – ensure support is available where necessary.

8.2.4 Analyse the data and discuss

Analysing the data

Analysis of the data collected should be simple and accurate (Mosedale 1998). Once the information has been gathered it should be collated in a way that can be easily analysed and then presented to the rest of the team. Analysis will depend on knowledge and resources available – little data may be analysed by hand; larger quantities may require a programme such as Microsoft Excel. Pie charts, bar graphs, charts and tables may help to display the information that has been found. Statistical tests may be used to verify the results obtained where appropriate but these are not a necessity – descriptive statistics (e.g. how many people used a particular treatment or what percentage of animals survived) can provide some useful discussion points within the practice.

Discussing the findings

The findings of the clinical audit should be discussed with the team when the majority of team members are available. It is unlikely that all farm animal

clinicians will be present in the practice at the same time for the discussion so results should be disseminated via the method most suited to each practice (e.g. email or hand written memo) for those who can not attend.

This is the stage of clinical audit where a no-blame culture is vital, as discussing the results can be seen as a threat to some individuals (Morrell and Harvey 1999). Analysis of the results may have highlighted a procedure that doesn't appear to give as good a result as another, or an individual that has a higher failure rate compared to the rest of the team. It may be beneficial to display audit findings anonymously for discussion within the team.

Anonymous or not, all findings must be discussed tactfully. Full support should be given to the individuals involved with the aim of discussions leading to improvement of the area.

The results should be readily accessible to all the team members and discussed in detail.

Where standards or information is available in the literature, the practice findings can be compared to these, taking into consideration how applicable the literature is to the practice and the type of work conducted (e.g. specialist practice versus first opinion practice; studies conducted in the USA versus UK based veterinary practice). Where no information is found in the literature, the team should discuss the findings and decide if and where changes need to be made. Where good or excellent practice has been demonstrated, staff should be congratulated and successes celebrated (Morrell and Harvey 1999).

8.2.5 Make changes

Where improvement is needed, all stakeholders should have a say in what changes need to be made. Changes may include a revision of practice procedures, extra training, investment in further equipment or facilities, improved record keeping, the implementation of practice guidance or other actions required to improve practice (Rayment 2002). Agreeing on actions to take can be difficult. For each area of change there should be a consented course of action, a named person responsible for ensuring the action is

changed and a time-scale over which it should take place (Morrell and Harvey 1999).

If changes are to be made, they should be clearly communicated and expectations of staff members clearly described. Support should be given where necessary.

8.2.6 Re-audit

Where changes have been made a re-audit should be conducted to see if the changes have made a difference. This should take place after an agreed period of time (Mosedale 1998).

The same data collection methods should be suitable for the re-audit as were used for the initial round of clinical audit. Re-audit data should be analysed and discussed as before, with further changes made if necessary.

Clinical audit is a continued cycle of improvement, so where no changes were required a re-audit should still be conducted in the future (for example, 6months, 12 months or even 2 years later) to ensure good standards are being maintained.

8.2.7 Post-audit

Audit the clinical audit. At the end of the clinical audit gather views on how people thought it went and what they would perhaps do differently. Were people interested in the topic? Did they engage with the process? If not, why not? What might help increase engagement next time? Keep a few notes so that the same mistakes can be avoided in the future.

8.3 Recommendations for the RCVS, RCVS Knowledge and education providers

A number of recommendations for actions that could be taken in the near future can be made based on the findings of this study.

8.3.1 RCVS

The RCVS should resist the urge to develop the requirements for clinical audit further, until further education and resources are offered to veterinary surgeons to allow the profession to 'catch up'. When evaluating the use of clinical audit in practice (such as through the PSS) the RCVS should look for thought and interpretation surrounding a clinical audit as well as application of findings to change practice where appropriate. Discussion should be held around why a topic was chosen, what the practice hoped to achieve, what was done and how things were or were not changed as a result. Improvement and progress, or reassurance of current practice, should be the key outcomes of conducting a clinical audit.

8.3.2 RCVS Knowledge

Multiple resources provided for practitioners can give confusing messages about requirements, definitions and expectations of clinical audit. RCVS Knowledge holds a unique position within the profession; it is linked to the RCVS so can clarify RCVS requirements for clinical audit, but it also works independently and is already established as a provider of EVM resources that veterinary professionals can access for free (RCVS Knowledge, 2012). This could therefore be the ideal place to locate a clinical audit 'hub', similar to the medical profession's Journal of Clinical Audits. Practitioners could visit the hub to learn about clinical audit and what is required from an RCVS perspective. A 'how to' guide with clinical audit examples for all species could demonstrate how to conduct a clinical audit. This would also be a good place for clinical audits to be published hence providing further knowledge and benchmarks for other practitioners.

8.3.3 Education providers

The BVA, along with its species divisions such as BCVA, and other CPD providers should continue to support practitioners through appropriate CPD. Due to the knowledge gap in the existing population of practitioners, good quality, useful CPD should be available. Where CPD is delivered, the same

definition of clinical audit and options for how it can be conducted should be used to avoid causing confusion among practitioners. RCVS Knowledge could define the terms to ensure others are able to easily access it and use it.

Universities and colleges have a responsibility to educate undergraduate and postgraduate veterinary surgeons and veterinary nurses on how to conduct clinical audit. Encouraging simple clinical audits to be conducted with practitioners while students are on placement may help to reach and educate more people on the topic.

8.4 Future work

A number of conclusions and suggestions can be made from the results of this study. However, there is a large amount of future work to be conducted that could improve the use of clinical audit in farm animal veterinary practice and beyond.

8.4.1 Defining clinical audit

A definition of clinical audit, different types and a clinical audit cycle have been suggested as a result of this work. These suggestions need to be verified as suitable for use in veterinary practice. A study, similar to the current study, could be conducted where veterinary surgeons in different types of veterinary practice choose from a selection of practical clinical audits. This could include topics such as:

- The use of fluoroquinolones and 3rd & 4th generation cephalosporins in farm animal practice. Drug name and reason for use could be collected and the findings then discussed.
- Medicines and equipment kept in car boots. Details of the medicines and equipment kept in veterinary surgeon's cars could be collected and discussed. This may find equipment that is needed, no longer needed or broken, or medicines that are out of date.
- Reporting of laboratory results. A target could be set for the expected time that lab results should be reported back to farmers. Data collected

would then show whether these targets are being met and if any changes need to be made.

Similar types of clinical audit could be tried in small animal and equine practice to see if the findings here can be generalised across the profession.

8.4.2 Terminology

The terminology of the various evidence-based standardised methods of treatment needs to be defined. This could be done using a Delphi methodology, or focus groups to reach a consensus. Once defined, their use in practice needs to be evaluated. If deemed to be appropriate for use in the veterinary setting, an online resource could be created to allow practitioners to easily find all available resources. This could be similar to the CEVM's VetSRev website where all veterinary systematic reviews are listed. Expected levels of adherence must also be investigated along with legal implications of following, or not following the guidance.

8.4.3 The difference between clinical research and clinical audit

The work here has suggested that differentiating between research and clinical audit is not always straight forward. Further guidance needs to be developed to demonstrate the differences and similarities. This information could be made accessible on the RCVS Knowledge clinical audit 'hub' to assist practitioners when they are starting a clinical audit in practice.

8.4.4 Data collection

Collecting data from farm animal practice in different ways should be investigated further. Practice management systems have a wide range of capabilities which could assist with clinical audit. Hardware and software is also available which means that the use of computer tablets to record clinical notes on farm is a reality. If data collection is a time consuming part of clinical audit, methods to reduce the time required should be explored. This may also assisted with the feasibility of conducting retrospective and prospective clinical audit on farm.

8.4.5 Costs of clinical audit

Clinical audit has hidden and direct costs, and potential hidden and direct financial gain. Research into the cost effectiveness of conducting clinical audit may help to determine its financial value to veterinary practices.

8.4.6 Resources and support

Recommendations for practitioners have been created and could be condensed to provide a useful piece of guidance for practitioners. These recommendations have not been verified however, and to ensure the steps are appropriate this should be done. A working group could be created to reduce the recommendations to two sides of A4, and they could be tested alongside the more simple clinical audits conducted as suggested for future study above.

8.4.7 International use of clinical audit

It was beyond the scope of this thesis to fully investigate the use of clinical audit outside of the UK. However, a number of conclusions have been drawn which could be extrapolated internationally. As no clear guidance for clinical audit in farm animal practice could be found from within or outside of the UK, it suggests that other countries may be in a similar position. A nationwide survey in other countries could provide further detail on the state of clinical audit, which would aid the development of suitable resources and guidance if found to be required.

8.5 How the findings from this study affect the stakeholders

Table 17 shows what has been learnt from this study, what the findings mean and what needs to be done in relation to the main stakeholders involved in farm animal practice clinical audit.

Table 17 How the findings from this study affect the stakeholders

	What has been learnt?	What does this mean?	What is needed?
Veterinary surgeons	There is a varied understanding and use of clinical audit by practitioners.	Clinical audit is being used extensively by some vets, and not at all by others. Lack of knowledge and support may prevent practitioners from conducting clinical audit in practice.	There needs to be easily accessible and free resources that share a uniform approach to clinical audit. CPD should be available for vets wishing to learn more about the subject.
	Practitioners are positive about conducting clinical audit.	Veterinary surgeons are happy to be involved with clinical audit in practice	Vets need to be supported by other colleagues, practices and education providers to be able to conduct clinical audit in practice.
	Protocols can affect clinical decision making on farm but there is confusion over what they are and how they should be interpreted.	Veterinary surgeons may not know how strictly to adhere to protocols/guidelines or if they are based on the best available evidence. They may be unsure as to if and when guidance is appropriate to use.	Terminology needs to be defined. A resource needs to be created where all evidence-based protocols/guidelines can be found so that veterinary surgeons can have confidence in the guidance they are following.

	What has been learnt?	What does this mean?	What is needed?
Farmers	Clinical audit was being carried out inconsistently across the country.	Many practitioners work in isolation. They may be unaware of what they do and may not have kept their clinical skills up to date. This may affect the level of care provided on farm.	More clinical audit is needed to increase the use of EVM in farm animal practice, encourage discussion among practitioners and improve the quality of care provided on farm.
	Farmers were amenable to data collection for clinical audit.	Veterinary surgeons should not assume that farmers will be a barrier to data collection on farm.	Farmer education may raise awareness of clinical audit and associated benefits. Farmers should be informed of the process and data collected in accordance with the Data Protection Act (1998).
	Veterinary surgeons may follow protocols/guidelines when delivering care on farm.	This can affect the decisions that vets make on farm. It may mean that a better quality of care is delivered, but this is not always the case.	Farmers need to be aware that protocols/guidelines exist. They need to know when and why veterinary surgeons may or may not choose to follow them, and how they fit in the delivery of clinical care.

	What has been learnt?	What does this mean?	What is needed?
Veterinary practices	Veterinary practices are not all the same. They have different cultures, resources, staff and requirements.	The same clinical audit cannot be conducted in the same way, with the same expected outcomes in every practice.	Clinical audit needs to be flexible to fit the practice in which it is being conducted. Practices should choose a clinical audit that benefits their own practice.
	Clinical audit takes time to do.	Clinical audit may not fit into a normal working day.	Staff may require protected time to undertake clinical audit.
	Any member of practice staff could be involved in a clinical audit.	Clinical audit can involve more than just veterinary surgeons.	Staff involvement should be chosen around a desire to be involved, interest in the topic, knowledge of available resources and time availability.
	Confusion exists around the use of protocols and guidelines	Veterinary surgeons may be unsure what guidance should be followed when.	Practices need to consider what protocols/guidelines are being used within their practices, how strictly they expect practitioners to adhere to them, how evidence-based the guidance is and if it's appropriate for use.

	What has been learnt?	What does this mean?	What is needed?
The RCVS	Clinical audit is not yet widely used or understood.	Regulations can suggest that clinical audit should be done, but that does not mean it is happening.	Requirements for clinical audit to be conducted need to remain static for a number of years until the veterinary surgeons are better informed about the topic and have more available resources to assist them.
	Confusion exists around the use of protocols and guidelines.	Care should be taken when suggesting practices create protocols or guidelines.	Resources need to be available to assist practitioners in making local, suitable guidance where applicable.

8.6 Study limitations

The interpretation of the results and conclusions of this study should take a number of factors into consideration when applying the findings to farm animal veterinary practice. It cannot be assumed that the findings of this study represent the opinions and experiences of all veterinary surgeons that undertake farm animal work in the UK. All three practices had volunteered to work on this project and therefore the veterinary surgeons working on this study may have been more likely to hold more positive views than their peers towards clinical audit. However, when discussing clinical audit, more negative points were raised compared to positive so it is unlikely that this affected the findings. The results can also not be assumed to be applicable to other sectors of the veterinary profession, or to veterinary practice in other parts of the world. The clinical audits conducted here were only done so within three veterinary practices on a small number of topics. Different results may have been found if different practices or different topics had been used. As the project was driven externally by the researcher, the practices may have arrived at different conclusions about clinical audit had they been conducting the study by themselves. The protocol case study is only based on one clinical protocol in one practice, again if a different practice or protocol had been chosen the findings may have been different.

However, as this is the first study to have thoroughly investigated the use of clinical audit in farm animal practice, this work should provide a starting point for further research that may help to improve and develop the evidence-base on this subject.

8.7 Conclusion

Clinical audit has been shown to benefit medicine and this study has shown it can benefit farm animal veterinary practice too. Veterinary surgeons appear positive about the concept, but may lack the knowledge and support required to undertake audit in practice. Increasing emphasis is being put on the use of the process in veterinary practice, and farm animal practice is no exception.

Current veterinary practice cannot fit the current concept of clinical audit as applied in medicine so clinical audit must therefore adapt to fit veterinary practice. It may then be more easily implemented by practitioners. A simplified, more practical version should make it more user friendly and accessible by all with further experience enabling more complicated audits to eventually be conducted. Above all, every veterinary practice is different and that should be remembered when attempting clinical audit.

Moving forwards, it is vital that lessons are learnt from medical colleagues in order to avoid making the same mistakes. However, it must be remembered that the resources and requirements of the two professions differ and for these reasons it should not be assumed that clinical audit strategies can be directly translated across from one to another. Medical and veterinary audit should be treated as two separate entities with both allowed to develop independently to suit their respective environments.

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Appendices

Appendix 1 The nationwide survey questionnaire



Experiences and attitudes towards clinical audit of veterinary surgeons undertaking farm animal work in the UK

Introduction

We would like to invite you to take part in a study organised by the Centre for Evidence-based Veterinary Medicine (CEVM) at the School of Veterinary Medicine and Science, University of Nottingham.

We are conducting a survey of veterinary surgeons who undertake farm animal work in practice in the UK, to collect information on experiences and attitudes towards clinical audit. The information gathered will assist the development of guidelines for veterinary surgeons in farm practice on how to carry out clinical audit. The survey will take between 5 and 10 minutes to complete. If you do not wish to participate in this study, please exit the webpage now.

At the end of the questionnaire you are invited to submit your email address to enter the prize draw or receive a summary of the results. Your email address will be removed from the rest of your responses so that individual answers cannot be tracked back to you. Your email address will also not be passed on to anyone.

This research has received ethical approval from the School of Veterinary Medicine and Science Ethics Committee, The University of Nottingham.

If you would like more information about the study, the Centre for Evidence-based Veterinary Medicine, or have any other questions please contact Katie Waine at svxkw@nottingham.ac.uk or Marnie Brennan on 0115 951 6577 (phone), or email marnie.brennan@nottingham.ac.uk. More information about the study can also be found at: <http://www.nottingham.ac.uk/cevm/documents/practice-based-research/experiences-and-attitudes-towards-clinical-audit-of-veterinary-surgeons-undertaking-farm-animal-work-in-the-uk.pdf>

Many thanks in anticipation of your help.

Katie Waine BVSc MRCVS (PhD Student)

Marnie Brennan BSc(VB) BVMS PhD PGCHE DipECVPH(PM) FHEA MRCVS (Deputy Director of

Experiences and attitudes towards clinical audit of veterinary surgeons undertaking farm animal work in the UK

Background information

* 1. Are you a Member of the Royal College of Veterinary Surgeons (MRCVS) working in the United Kingdom (UK)?

☐ Yes

☐ No

* 2. Please tick the box that most accurately describes your caseload when working as a veterinary surgeon in the UK:

☐ Farm animal only

☐ Equine and farm animal

☐ Small animal and farm animal

☐ Small animal, farm animal and equine

☐ Small animal with occasional pet farm animals at practice premises

☐ Other

Please specify:

3. Do you work as a veterinary surgeon in veterinary practice on a full time or part time basis?

☐ Full time

☐ Part time

☐ Other

Please specify:

4. What year did you graduate with your veterinary degree?

* 5. What year did you become an MRCVS?

☐ The same year that I graduated with my veterinary degree

☐ A different year to when I graduated with my veterinary degree (Please enter the year below)

Clinical audit

* 6. Had you heard of clinical audit before receiving this questionnaire?

☐ Yes

☐ No

☐ I don't know

Clinical audit

7. Did you receive any undergraduate training on clinical audit?

☐ Yes

☐ No

☐ I don't know

8. Have you received any postgraduate training on clinical audit, for example as part of Continued Professional Development (CPD)?

- ☐ Yes
- ☐ No
- ☐ I don't know

* 9. Please define what you think the term 'clinical audit' means in your own words:

Experience of clinical audit

RCVS Knowledge describe clinical audit as a way for practices to find out where their services are doing well and where improvements can be made. It is a process of assessing, evaluating and improving procedures for each stage of care, diagnosis and intervention.

3

* 10. Have you ever been involved in a clinical audit within veterinary practice (associated with any species)?

- ☐ Yes
- ☐ No
- ☐ I don't know

* 11. Have you ever been involved in a clinical audit within farm animal veterinary practice?

- ☐ Yes
- ☐ No
- ☐ I don't know

Your most recent clinical audit

Please answer the following three questions in relation to the MOST RECENT clinical audit that you were involved with.

12. Why was this clinical audit conducted? (Please tick all that apply)

- ☐ To meet RCVS Practice Standard Scheme requirements
- ☐ To meet RCVS CPD requirements
- ☐ As a result of a significant event within the practice
- ☐ To gather information on what happens in the practice
- ☐ I don't know why this clinical audit was conducted
- ☐ Other

Please specify:

13. What was the topic of the MOST RECENT clinical audit you were involved in?

14. Why was this topic chosen to audit?

Involvement in clinical audit

*** 15. Please indicate your involvement with clinical audit in farm animal practice:**

- ☐ I have set up and run clinical audit(s) in farm animal practice
- ☐ I have participated in clinical audit(s) but I have never set up and run my own clinical audit
- ☐ I don't know

Experience of coordinating a clinical audit

Clinical audit involves four main steps:

Stage 1: Preparation and planning

Stage 2: Measuring performance

Stage 3: Making and implementing changes

Stage 4: Sustaining improvement through re-audit

The following questions relate to individuals who have set up and run clinical audits in farm animal practice.

16. How many clinical audits have you set up and completed that included all four of the stages described above?

- ☐ 0
- ☐ 1-2
- ☐ 3-4
- ☐ 5-10
- ☐ >10

17. Based on a full clinical audit including all four steps listed above, how many clinical audits have you set up but not completed?

- ☐ 0
- ☐ 1-2
- ☐ 3-4
- ☐ 5-10
- ☐ >10

18. Often in clinical audit, standards are used at the beginning of the audit process to determine if there is any guidance on best practice, or at the end of the audit to compare the audit results to.

Thinking of the MOST RECENT clinical audit that you ran, did you use any standards in any part of the audit process? (Please tick all that apply)

- ☐ I used standards found in the published literature
- ☐ I used pre-existing local standards (for example practice guidelines or protocols)
- ☐ Standards were created within the practice for the purpose of the clinical audit
- ☐ I ran the clinical audit once and used the results to create my own standard
- ☐ No standards were used
- ☐ I don't know if standards were used
- ☐ Other

Please specify:

19. What advice would you give to somebody who is about to set up a farm animal clinical audit for the first time?

* 20. Additional to setting up your own clinical audit, have you ever participated in a clinical audit that was set up by somebody else?

- ☐ Yes
- ☐ No
- ☐ I don't know

Experience of participating in clinical audit

These questions relate to individuals who have participated in farm animal clinical audit. Participants may have been involved with various stages of the audit such as collecting data or choosing a topic to audit.

21. How many clinical audits have you participated in that have been set up by someone else in farm animal practice?

- ☐ 0
- ☐ 1-2
- ☐ 3-4
- ☐ 5-10
- ☐ >10

22. Thinking about the MOST RECENT clinical audit that you participated in, do you feel that you were kept well informed of the initial aims of the audit?

- ☐ Yes
- ☐ No
- ☐ I don't know

Please enter any additional comments here:

23. Thinking about the MOST RECENT clinical audit that you participated in, were you made aware of how the clinical audit process would be carried out in your practice?

- ☐ Yes
- ☐ No
- ☐ I don't know

Please enter any additional comments here:

24. Thinking about the MOST RECENT clinical audit that you participated in, were you kept well informed of the progress of the audit?

- ☐ Yes
- ☐ No
- ☐ I don't know

Please enter any additional comments here:

25. Thinking about the MOST RECENT clinical audit that you participated in, do you feel that you were well informed about the final results of the audit?

- ☐ Yes
- ☐ No
- ☐ I don't know

Please enter any additional comments here:

26. What advice would you give to someone participating in a farm animal clinical audit that was set up by someone else?

* 27. Please indicate your level of agreement with the following statements:

	Strongly agree	Agree	Neither agree nor disagree	Disagree	Strongly disagree	I don't know
Clinical audit improves clinical standards in veterinary practice	☐	☐	☐	☐	☐	☐
Clinical audit improves job satisfaction	☐	☐	☐	☐	☐	☐
Clinical audit can bring financial benefit to veterinary practice	☐	☐	☐	☐	☐	☐
Clinical audit is interesting	☐	☐	☐	☐	☐	☐
Clinical audit is time consuming	☐	☐	☐	☐	☐	☐
Clinical audit aids my own professional development	☐	☐	☐	☐	☐	☐

Please enter any additional comments here:

28. Please include any further comments that you may have about clinical audit in farm animal practice here:

29. Where did you hear about this study? (Please tick all that apply)

- ☐ I received an email from Katie Waine
- ☐ I received an email from the British Cattle Veterinary Association (BCVA)
- ☐ I received an email from the Sheep Veterinary Society (SVS)
- ☐ Twitter
- ☐ Facebook
- ☐ Other

Please specify:

* 30. Thank you for completing our survey!

If you would like to be entered in to the prize draw to win £50 worth of vouchers for a store of your choice and/or if you would like to be informed about the results of the study, please tick the relevant box(es) below. You will then be asked to enter your email address. Your email address will be removed from your responses before any analysis takes place.

- ☐ I would like to be entered into the prize draw
- ☐ I would like to receive a summary of the results
- ☐ I would NOT like to be entered into the prize draw or be informed about the results of the study.

Appendix 2 Project outline for practitioners

The main aim of the PhD is to investigate how farm animal veterinary practices can get involved in the process of evidence-based veterinary medicine. This includes the cycle of clinical audit as well as practice-based research.

The objectives of this PhD are:

1. To identify important veterinary conditions highlighted by practising farm animal vets via research priority setting meetings

Three different farm animal practices will be involved independently in this project.

Ideas of specific conditions to investigate for each practice will be discussed at the research priority setting meetings, and one idea will be taken forward to look at in more detail. These topics will be decided upon primarily by the vets within each practice, with some input from the research team. The topic will be taken forward for 'clinical audit', and data gathered for research.

2. To develop methods for the collection of clinical data on these prioritised topics. This will be via the collection of data from clinical cases (prospective data collection) and through the computer software systems (retrospective data collection) of the practices

Depending on the topics chosen in each practice, a data collection form will be developed by the PhD student with the help of the vets and piloted within the practices. This form could be paper-based or online, depending on the preferences of the vets in the practice and the topic. The vets in the practice will collect data over a 12 month period, with assistance from the PhD student who will make regular visits to the practice to help with the process. The research team will work hard to ensure that the amount of work required by the vets is minimal, with only essential information being collected.

If feasible, the PhD student will also work with the computer software system within each practice to retrospectively look at past cases on the particular topic.

3. To discuss the findings from the data collected with the vets to identify possible areas for change, with a view to improving clinical outcomes

The results from both the prospective study and retrospective study will be summarised by the PhD student and presented back to the practices. Discussions will be held to look at how the data compares, and also how it compares to the published literature on the topic. The discussion will be recorded, and will be made available to the vets in the practice after the meeting. Any changes that are planned will be noted, and data will be collected for a further 6 months.

4. To identify, if changes are made, the challenges and facilitators of the process of making those changes

After 6 months, the collected data will be summarised and fed back to the vets in the practice. Discussions will be had looking at how easy or difficult any changes were to make, and suggestions for how the process could be improved will be recorded. A 'guide to clinical audit' will be created with input from the vets in the

practice to help with other audits in the future. It will also be made available to other vets in the profession.

Appendix 3 Practice 1 Clinical audit topics

<u>Initial idea suggested by the practice via email</u>	<u>Areas suggested by the researcher</u>	<u>Specifics suggested</u>
Retained fetal membranes (RFMs)	When to intervene?	Record 'Nothing outcomes'
		Routine visits
		Specific visit
		Phone advice
	Treatments (Only record when 'do' something)	Pull or not
		Antibiotics - Systemic vs intrauterine
		NSAIDs?
		Other
	Outcomes	Complications eg metritis, endometritis, DA, ketosis
		Milk yields
		Calving to first service
		Calving to conception
		Re-checked
Cystic ovaries	Diagnosis	Palpation
		Scanning
		Scanning and measuring
		Clinical signs/history
	Treatments	Buserelin (Receptal)
		PRID
		PGs
		Manual popping
		None
		Culling
	Outcomes	Calving to first service
		Calving to conception
		Milk yield
		Culling
		Re-check

Metritis	Diagnostic criteria	
	When to intervene?	
	Treatments	Antibiotics - systemic vs intrauterine
		NSAIDs
		Wash out
	Outcomes	Calving to first service
		Calving to conception
		Complications: endometritis
		Re-check
		Culling

Endometritis	Diagnostic criteria (Grades, time post calving?)	
	When to intervene? (Grades?)	
	Treatments	Antibiotics - systemic vs intrauterine
		Wash out
		Estrumate
		None
		NSAIDs
		Culling
	Outcomes	Calving to first service
		Calving to conception
		First service conception?
		Re check
		Culling

LDA Correction methods	Treatments	Ex Lap surgery (Right/left/both sides/paramedian)
		Laparoscopic surgery
		Toggle
		Roll
		Cull
	Outcomes	Recurrence
		Culling
		Milk yield
		Calving to first service
		Calving to conception
		Herd level intervention?

Ketosis therapies	Treatments	Steroid injection
		Propylene Glycol
		Intravenous glucose
	Outcomes	Complications
		Herd level intervention
		Secondary issues?
		Milk yield

Toxic <i>E.Coli</i> Mastitis	Treatment	Fluids - oral/Intravenous fluid therapy
		Antibiotics
		NSAIDs
		Other

Vet assisted calving and associated disease/ productivity	Process	Time taken
		Type of dystocia - methods used
	Treatment	NSAIDs
		Antibiotics
		Clenbuterol
		Epidural
		Oxytocin
		Fluids
		Euthanasia
	Outcomes	Cow/calf immediate outcomes
		Calving to first service
		Calving to conception
		First service conception rate
		Prolapse
		Caesar
		Cull/Died

Use of Micotil at drying off	Treatment	Number of cows treated
	Outcomes	SCC

Appendix 4 Practice 2 Clinical audit topics

<u>Initial idea suggested by the practice via email</u>	<u>Audit type</u>	<u>Areas suggested by the researcher</u>	<u>Specific audit ideas suggested by the researcher</u>
Calf pneumonia	<i>Process</i>	Diagnosis	Diagnostic tests used in calf pneumonia
		Treatment	Decision making in the treatment of calf pneumonia
			Weighing and treatment of calves with pneumonia
			Treatments used in calf pneumonia
	<i>Outcome Audits</i>	Outcomes	Various
	<i>Significant Event</i>	Any recent problems or unexpected results?	
Metritis	<i>Process</i>	Diagnosis	The diagnosis of metritis
		Treatment	Treatments used for metritis
			The decisions involved in choosing a treatment for metritis
	<i>Outcome</i>	Outcomes	Various
	<i>Significant Event</i>	Any recent problems or unexpected results?	
Endometritis	<i>Process</i>	Diagnosis	The diagnosis of endometritis
		Treatment	Treatments used for endometritis
			The decisions involved in choosing a treatment for endometritis
	<i>Outcome</i>	Outcomes	Various
	<i>Significant Event</i>	Any recent problems or unexpected results?	

Anoestrus cows	<i>Process</i>	Diagnosis	The diagnosis and definition of anoestrus
		Treatment	Treatments used for anoestrus cows
	<i>Outcome</i>	Outcomes	Various
	<i>Significant Event</i>	Any recent problems or unexpected results?	

Cystic ovarian disease	<i>Process</i>	Diagnosis	The diagnosis of COD
		Treatment	Treatments used for COD
			The decisions involved in choosing a treatment for COD
	<i>Outcome</i>	Outcomes	Various
	<i>Significant Event</i>	Any recent problems or unexpected results?	

Common bovine eye problems	<i>Process</i>	Treatment	Treatments used for bovine eye conditions
			The decisions involved in choosing a treatment for bovine eye problems
	<i>Outcome</i>	Outcomes	Various
	<i>Significant Event</i>	Any recent problems or unexpected results?	

Toxic <i>E. Coli</i> Mastitis	<i>Process</i>	Treatment	Treatments used for <i>E. Coli</i> mastitis
			The decisions involved in choosing a treatment for toxic <i>E. Coli</i> mastitis
	<i>Outcome</i>	Outcomes	
	<i>Significant Event</i>	Any recent problems or unexpected results?	

Bovine acidosis	<i>Process</i>	Diagnosis	
		Treatment	
	<i>Outcome</i>	Outcomes	Various
	<i>Significant Event</i>	Any recent problems or unexpected results?	

Appendix 5 Practice 3 Clinical audit topics

<u>Initial idea suggested by the practice via email</u>	<u>Audit type</u>	<u>Areas suggested by the researcher</u>	<u>Specific audit ideas suggested by the researcher</u>
Left displaced abomasum	<i>Process</i>	Treatment	The treatment of LDAs e.g. roll & toggle, left side, right side etc
			Surgical technique e.g. local used/omentopexy/abomasopexy/ suture material etc
			Analgesia used at surgery
			Antibiotics given at surgery
	<i>Outcome</i>	Outcomes	Wound infection rate
			Various fertility outcomes
			Milk yield
			Survival times
	<i>Significant Event</i>	Any recent problems or unexpected results?	
Toxic Mastitis	<i>Process</i>	Treatment	Treatments used for toxic mastitis
			Antibiotic choice
	<i>Outcome</i>	Outcomes	Various
	<i>Significant Event</i>	Any recent problems or unexpected results?	

Digit amputation	<i>Process</i>	Treatment	Surgical technique
			Antibiotics used
			Analgesia given
	<i>Outcome</i>	Outcomes	Milk yield
	<i>Significant Event</i>	Any recent problems or unexpected results?	Post-op follow up

Pre-weaning scour (calves)	<i>Process</i>	Diagnosis	The diagnosis of calf scour
		Treatment	Treatments used for calf scour & advice given
	<i>Outcome</i>	Outcomes	Mortality
	<i>Significant Event</i>	Any recent problems or unexpected results?	

Right-sided pings	<i>Process</i>	Diagnosis	Diagnosing right-sided pings
		Treatment	Treatment of right sided pings
	<i>Outcome</i>	Outcomes	Various
	<i>Significant Event</i>	Any recent problems or unexpected results?	

Appendix 6 Vet questionnaire

Questions about you

1. Year of Graduation _____ 2. University _____

3. What type of clinical work do you do? (Please circle)

Mixed (Small and Farm)	Mixed (Small, Farm and Equine)	Large Animal (Farm and Equine)	Farm animal only

4. Do you work full time or part time? (Please circle)

Full time Part time

5. Do you hold any postgraduate qualifications? (Please circle all that apply)

RCVS Certificate	DBR	European Diploma	RCVS Diploma	MSc	PhD	Other

6. Are you currently enrolled in any postgraduate qualifications? (Please circle all that apply)

RCVS Certificate	DBR	European Diploma	RCVS Diploma	MSc	PhD	Other

7. Do you have any special areas of clinical interest?

8. Have you taken part in a clinical audit before? (Please circle)

Yes No Don't know

9. Please outline what your understanding of clinical audit is:

Please rate your level of agreement on the following statements by ticking the most appropriate box:

	Strongly Disagree	Disagree	No opinion	Agree	Strongly Agree	I don't know
10. I think I understand the concept of 'clinical audit' well						
11. I think clinical audit can improve clinical standards in farm animal veterinary practice						
12. I think clinical audit can bring financial benefit to farm animal veterinary practice						
13. I think clinical audit can enhance job satisfaction						
14. I think clinical audit takes up a large amount of time						
15. I think carrying out clinical audits should be compulsory for all farm animal veterinary practices						

16. What do you think are easy aspects of carrying out clinical audits in farm animal veterinary practice?
17. What do you think are difficult aspects of carrying out clinical audits in farm animal veterinary practice?
18. Please add any further comments that you might have about clinical audit:

Thank you for taking the time to complete this questionnaire

Appendix 7 Practice questionnaire

About the practice

1. Total number of vets undertaking farm animal clinical work in the practice

.....

2. Total number of farm animal practice support staff (including receptionists and nurses)

.....

3. Please estimate what percentage of the farm animal practice time is spent with each species:

	% practice time spent per species
Cattle	
Sheep	
Pigs	
Poultry	
Other farm species	

4. How do you charge for work done on farm? (Please circle)

Time on farm

Per Procedure

Other (Please specify).....

5. Approximately how many farm animal clients do you currently have registered?

.....

6. Are you part of the RCVS Practice Standards Scheme? (Please circle)

YES

NO

If YES, which Tier? (Please circle)

Core

General Practice

7. What is the name of the Practice Management Software system used in the practice?

.....

Thank you for completing this questionnaire.

Appendix 8 Practice 1 search terms and inclusion/exclusion criteria

CAB abstracts

(cow.mp. OR cows.mp. OR cattle.mp. OR bovine.mp. OR bovines.mp. OR bos.mp. OR exp cattle/ OR exp cows) AND (cystic ovaries.mp. OR ovarian cyst.mp. OR ovarian cysts.mp. OR follicular cyst.mp. OR follicular cysts.mp. OR luteal cyst.mp. OR luteal cysts.mp. OR cystic follicle.mp. OR cystic follicles.mp. OR cystic ovarian disease.mp. OR ovarian cystic disease.mp. OR cystic cow.mp. OR cystic cows.mp. OR cystic ovary.mp. OR luteinised cysts.mp. OR cystic graafian follicle.mp. OR cystic graffian follicles.mp. OR cystic corpora lutea.mp. OR cystic corpus luteum.mp. OR exp ovarian cysts/) AND (GnRH.mp. OR PGF2.mp. OR PG.mp. OR PRID.mp. OR CIDR.mp. OR receptal.mp. OR buserelin.mp. OR enzaprost.mp. OR juramate.mp. OR ovarelin.mp. OR gonadorelin.mp. OR dinoprost.mp. OR estrumate.mp. OR chorulon.mp. OR gonadotropin.mp. OR prosolvin.mp. OR luprostitol.mp. OR lutalyse.mp. OR progesterone.mp. OR cloprostenol.mp. OR cyclix.mp. OR ovsynch.mp. OR ovsynch.mp. OR manual rupture.mp. OR "cysts (pathological)".sh. OR gonadotropins.mp. OR prostaglandin.mp. OR prostaglandins.mp. OR progesterone releasing device.mp. OR progesterone-releasing intravaginal device.mp.)

MEDLINE

(cow.mp. OR cows.mp. OR cattle.mp. OR bovine.mp. OR bovines.mp. OR bos.mp. OR exp cattle/) AND (cystic ovaries.mp. OR ovarian cyst.mp. OR ovarian cysts.mp. OR follicular cyst.mp. OR follicular cysts.mp. OR luteal cyst.mp. OR luteal cysts.mp. OR cystic follicle.mp. OR cystic follicles.mp. OR cystic ovarian disease.mp. OR ovarian cystic disease.mp. OR cystic cow.mp. OR cystic cows.mp. OR cystic ovary.mp. OR luteinised cysts.mp. OR cystic graafian follicle.mp. OR cystic graffian follicles.mp. OR cystic corpora lutea.mp. OR cystic corpus luteum.mp. OR exp ovarian cysts/ OR exp Follicular Cyst/) AND (GnRH.mp. OR PGF2.mp. OR PG.mp. OR PRID.mp. OR CIDR.mp. OR receptal.mp. OR buserelin.mp. OR enzaprost.mp. OR juramate.mp. OR ovarelin.mp. OR gonadorelin.mp. OR dinoprost.mp. OR estrumate.mp. OR chorulon.mp. OR gonadotropin.mp. OR prosolvin.mp. OR luprostitol.mp. OR lutalyse.mp. OR progesterone.mp. OR cloprostenol.mp. OR cyclix.mp. OR ovsynch.mp. OR ovsynch.mp. OR manual rupture.mp. OR gonadotropins.mp. OR prostaglandin.mp. OR prostaglandins.mp. OR

progesterone releasing device.mp. OR progesterone-releasing intravaginal device.mp. OR exp Buserelin/ OR exp Gonadotropins/ OR exp Dinoprost/ OR exp Cloprostenol/)

Duplicates of articles found through both searches were removed. The publication titles and abstracts were then assessed against the inclusion and exclusion criteria for the literature search.

Inclusion Criteria	Exclusion criteria
- The study must be on the treatment of cystic ovaries in cattle (Including follicular and luteal cysts) - The study must be on dairy cattle, specifically breeds commonly used for milk production in the UK (HF, Jersey, Guernsey, Brown Swiss etc) - The study should have diagnosed the cases they are treating as 'cystic' by at least manual palpation or ultrasound - Treatments discussed in the study must be available to be used in the UK, preferably licensed or commonly used, and must be legal. - The study should have been published in a peer reviewed journal - Studies can be included where cases were and were not followed up - The study can have been written in any year	▪ Studies that have not been published in peer reviewed journals will not be included initially. Articles relevant to vets in practice eg UK VET and In Practice articles will be kept to one side and reviewed at a later date. ▪ Studies on breeds of cattle not commonly used in the UK for milk production will not be used ▪ Studies looking at treatments that are not widely available in the UK or are illegal, will not be considered. ▪ In vitro studies will not be included

Appendix 9 Practice 1 online (SurveyMonkey) data collection form

Cystic Ovary Audit			
1.			
Vet code			
Farmer surname			
Farm name			
Date of examination			
Date:	DD	MM	YYYY
Cow freeze brand			

Is this the first examination for this condition, or a follow up examination?

- ☐ First examination
- ☐ Follow up examination

What did you find on examination? (Please tick all that apply)

- ☐ Follicular cyst
- ☐ Luteal cyst
- ☐ Cyst (uncertain)
- ☐ Corpus luteum
- ☐ No abnormalities detected
- ☐ No structures found
- ☐ Other (please specify)

How did you diagnose this? (Please tick all that apply)

- ☐ History/Clinical signs
- ☐ Ultrasound
- ☐ Manual palpation
- ☐ Other (please specify)

Was this cow given any treatment?

- ☐ No treatment given
- ☐ Treatment given

What treatment was given? (Please tick all that apply)

- ☐ PRID
- ☐ CIDR
- ☐ GnRH/GnRH analogue (Veterelin)
- ☐ Prostaglandin (Cyclix)
- ☐ hCG
- ☐ Manual rupture
- ☐ Other (Please specify below with drug name and dose)

Other

Appendix 10 Practice 2 search terms and inclusion/exclusion criteria

CAB abstracts

(cow.mp. OR cows.mp. OR cattle.mp. OR bovine.mp. OR bovines.mp. OR bos.mp. OR exp cattle/ OR exp cows) AND (endometritis.mp. OR endometriosis.mp. OR whites.mp. OR uterine infection.mp. OR uterus infection.mp. OR PVD.mp. OR purulent vaginal discharge.mp. OR VLD.mp. OR uterine discharge.mp. OR vaginal discharge.mp. OR vulval discharge.mp. OR uterine disease.mp. OR exp endometritis/ OR exp uterine diseases/) AND (GnRH.mp. OR PGF2.mp. OR PG.mp. OR receptal.mp. OR buserelin.mp. OR enzaprost.mp. OR juramate.mp. OR ovarelin.mp. OR gonadorelin.mp. OR dinoprost.mp. OR estrumate.mp. OR chorulon.mp. OR gonadotropin.mp. OR prosolvin.mp. luprostinol.mp. OR lutalyse.mp. OR progesterone.mp. OR cloprostenol.mp. OR cyclix.mp. OR ovsynch.mp. OR gonadotropins.mp. OR prostaglandin.mp. OR prostaglandins.mp. OR metricure.mp. OR cefapirin benzathine.mp. OR cefapirin.mp. OR metriject.mp. OR metrijects.mp. OR intrauterine antibiotics.mp. OR intrauterine infusions.mp. OR washout.mp. OR wash out.mp. OR oxytetracycline.mp. OR chlortetracycline.mp. OR penicillin.mp. OR trimethoprim.mp. OR ceftiofur.mp. OR TMPs.mp. OR antibiotic.mp. OR antibiotics.mp. OR antibacterial.mp. OR antibacterials.mp. OR anti-microbials.mp. OR anti-microbial.mp. OR antimicrobial.mp. OR antimicrobials.mp. OR NSAID.mp. OR NSAIDs.mp. OR Non-steroidal anti-inflammatory drug.mp. OR anti-inflammatories.mp. OR meloxicam.mp. OR flunixin.mp. OR carprofen.mp. OR ketoprofen.mp. OR tolfenamic acid.mp. OR exp non-steroidal anti-inflammatory agents/exp OR treatment.mp. OR treatments.mp. OR therapy.mp. OR therapies.mp. OR dextrose.mp. OR citric acid.mp. OR chlorhexidine.mp. OR iodine.mp. OR lugol's iodine.mp. OR iudols iodine.mp. OR pessaries.mp OR exp treatment/ OR exp therapy/)

MEDLINE

(cow.mp. OR cows.mp. OR cattle.mp. OR bovine.mp. OR bovines.mp. OR bos.mp. OR exp cattle/) AND (endometritis.mp. OR endometriosis.mp. OR whites.mp. OR uterine infection.mp. OR uterus infection.mp. OR PVD.mp. OR purulent vaginal discharge.mp. OR VLD.mp. OR uterine discharge.mp. OR vaginal discharge.mp. OR vulval discharge.mp. OR uterine disease.mp. OR exp endometritis/ OR exp uterine diseases/) AND (GnRH.mp. OR PGF2.mp. OR PG.mp. OR receptal.mp. OR buserelin.mp. OR enzaprost.mp. OR juramate.mp.

OR ovarelin.mp. OR gonadorelin.mp. OR dinoprost.mp. OR estrumate.mp. OR chorulon.mp.
 OR gonadotropin.mp. OR prosolvin.mp. luprostinol.mp. OR lutalyse.mp. OR
 progesterone.mp. OR cloprostenol.mp. OR cyclix.mp. OR ovsynch.mp. OR gonadotropins.mp.
 OR prostaglandin.mp. OR prostaglandins.mp. OR metricure.mp. OR cefapirin benzathine.mp.
 OR cefapirin.mp. OR metriject.mp. OR metrijects.mp. OR intrauterine antibiotics.mp. OR
 intrauterine infusions.mp. OR washout.mp. OR wash out.mp. OR oxytetracycline.mp. OR
 chlortetracycline.mp. OR penicillin.mp. OR trimethoprim.mp. OR ceftiofur.mp. OR TMPs.mp.
 OR antibiotic.mp. OR antibiotics.mp. OR antibacterial.mp. OR antibacterials.mp. OR anti-
 microbials.mp. OR anti-microbial.mp. OR antimicrobial.mp. OR antimicrobials.mp. OR
 NSAID.mp. OR NSAIDs.mp. OR Non-steroidal anti-inflammatory drug.mp. OR anti-
 inflammatories.mp. OR meloxicam.mp. OR flunixin.mp. OR carprofen.mp. OR ketoprofen.mp.
 OR tolfenamic acid.mp. OR exp non-steroidal anti-inflammatory agents/exp OR
 treatment.mp. OR treatments.mp. OR therapy.mp. OR therapies.mp. OR dextrose.mp. OR
 citric acid.mp. OR chlorhexidine.mp. OR iodine.mp. OR lugol's iodine.mp. OR ludols
 iodine.mp. OR pessaries.mp OR exp therapeutics/ve [veterinary])

Duplicates of articles found through both searches were removed. The publication titles and abstracts were then assessed against the inclusion and exclusion criteria for the literature search.

Inclusion Criteria	Exclusion criteria
- The study must be on the treatment of endometritis in cattle - The study must be on dairy cattle, specifically breeds commonly used for milk production in the UK (HF, Jersey, Guernsey, Brown Swiss etc) - Treatments discussed in the study must be available to be used in the UK, preferably licensed or commonly used, and must be legal. - The study should have been published in a peer reviewed journal - Studies can be included where cases were and were not followed up - The study can have been written in any year	▪ Studies that have not been published in peer reviewed journals will not be included initially. Articles relevant to vets in practice eg UK VET and In Practice articles will be kept to one side and reviewed at a later date. ▪ Studies on breeds of cattle not commonly used in the UK for milk production will not be used ▪ Studies looking at treatments that are not widely available in the UK or are illegal, will not be considered. ▪ In vitro studies will not be included

Appendix 11 Practice 2 online (SurveyMonkey) data collection form

Endometritis clinical audit

Vet code

Date of examination:

Date:

DD

 /

MM

 /

YYYY

Farmer surname

Farm name

Cow freeze brand

Calving date

Is this the first examination, or a follow up examination?

☐ First exam

☐ Follow up exam

What did you find on examination? (Please tick all that apply)

- ☐ Clear mucus
- ☐ No unpleasant smell
- ☐ An unpleasant smell
- ☐ Indicators of endometritis on ultrasound
- ☐ A corpus luteum on rectal exam or ultrasound
- ☐ Clear mucus containing flecks of white pus
- ☐ Discharge containing <50% white, cream or bloody pus
- ☐ Discharge containing >50% white, cream or bloody pus
- ☐ No abnormality detected
- ☐ Other (please specify)

If this was a follow up exam and the endometritis has now resolved, please indicate here:

- ☐ This was a follow up exam and the endometritis has now resolved
- ☐ This cow has endometritis and has been treated

Endometritis clinical audit

What treatment was used to treat the endometritis in this cow? (Please include drug name(s) and dose(s))

Why did you choose to use this treatment for this cow?

Appendix 12 Practice 3 search terms and inclusion/exclusion criteria

CAB abstracts

(cow.mp. OR cows.mp. OR cattle.mp. OR bovine.mp. OR bovines.mp. OR bos.mp. OR exp cattle/ OR exp cows) AND (LDA.mp. OR DA.mp OR torsion.mp. OR twist.mp. OR twisted stomach.mp. OR DAs.mp. OR LDAs.mp. OR abomasum.mp. OR abomasal.mp. OR abomasal.mp. OR abomasums.mp. OR exp torsion/ OR exp twist/ OR exp abomasum/) AND (milk yield.mp. OR lactation.mp. OR milk production.mp. OR calving to conception.mp. OR days to conception.mp. OR survival rate.mp. OR days open.mp. OR exp milk yield/ OR exp lactation/ OR exp milk production/)

MEDLINE

(cow.mp. OR cows.mp. OR cattle.mp. OR bovine.mp. OR bovines.mp. OR bos.mp. OR exp cattle/) AND (LDA.mp. OR DA.mp OR torsion.mp. OR twist.mp. OR twisted stomach.mp. OR DAs.mp. OR LDAs.mp. OR abomasum.mp. OR abomasal.mp. OR abomasal.mp. OR abomasums.mp. OR exp Abomasum/) AND (milk yield.mp. OR lactation.mp. OR milk production.mp. OR calving to conception.mp. OR days to conception.mp. OR survival rate.mp. OR days open.mp. OR exp lactation/ OR exp survival rates/)

Duplicates of articles found through both searches were removed. The publication titles and abstracts were then assessed against the inclusion and exclusion criteria for the literature search.

Inclusion Criteria	Exclusion criteria
- The study must be on the treatment of LDAs in cattle - The study must be on dairy cattle, specifically breeds commonly used for milk production in the UK (HF, Jersey, Guernsey, Brown Swiss etc) - The study should have been published in a peer reviewed journal - Studies can be included where cases were and were not followed up - The study can have been written in any year	▪ Studies that have not been published in peer reviewed journals will not be included initially. Articles relevant to vets in practice eg UK VET and In Practice articles will be kept to one side and reviewed at a later date. ▪ Studies on breeds of cattle not commonly used in the UK for milk production will not be used ▪ In vitro studies will not be included

Appendix 13 Practice 3 Microsoft Excel spreadsheet for the LDA clinical audit

[illegible]

[illegible]

Appendix 16 Practice 1 Retrospective clinical audit follow up cows

LO = left ovary, RO = right ovary, CL = corpus luteum, LC = luteal cyst, Est = Estrumate, Rec = Receptal, PD+ = pregnant, PD- = Not pregnant, Ov = Ovsynch, AI = Artificial insemination, Foll = Follicle, FO = Follicle, Dx = Diagnosis, Tx = Treatment

Cow ID	First examination		Second examination		Third examination		Fourth examination		Fifth Examination		Sixth examination	
	Dx	Tx	Dx	Tx	Dx	Tx	Dx	Tx	Dx	Tx	Dx	Tx
1	Cyst LO (22.11.2013)	5ml Receptal	CLRO (20.12.2013)	Estrumate								
2	Foll cyst (21.03.2013)	5ml Receptal	Cyst (05.04.2013)	5ml Receptal								
3	Cyst RO (27.09.2013)	5ml Receptal	CLLO and RO (10.10.2013)	Est	PD+ (22.11.2013)							
4	Luteal cyst (21.02.2013)	4ml	FOLL RO (18.04.2013)	Rec	PD- Foll RO (30.05.2013)	OV	PD+ (05.09.2013)					
5	Cystic (18.11.2013)	Receptal	DNB (25.11.2013)									
6	Cystic LO (11.11.2013)	5ml Receptal	CLLO (18.11.2013)	See one week	CLLO (25.11.2013)	Est	Early CLLO (09.12.2013)	Receptal	CLLO (16.12.2013)	Est (Ovsynch)		

7	Cyst RO (24.10.2013)	4ml Estrumate	CLRO (5.11.2013)	Estrumate	CLLO (13.11.2013)	Est	Cystic LO (19.11.2013)	4ml Estrumate				
8	Cyst (11.03.2013)	2.5ml Receptal	CLLO (18.03.2013)	See 2 weeks	FOLO (25.03.2013)	Watch	FORO (02.04.2013)	2.5ml Receptal	CLRO (08.04.2013)	Estrumate	PD+ Twins (13.05.2013)	
9	Cyst LO (04.07.2013)	5 Receptal	PD+ (10.10.2013)									
10	Cyst (30.09.2013)	Popped, 2.5ml receptal	OK (07.10.2013)	Leave for 2 weeks	(14.10.2013)	Leave	CLRO (21.10.2013)	Est	PD+ (25.11.2013)			
11	Cyst LO (22.11.2013)	5ml Receptal	Bulling (22.12.2013)	AI tomorrow								
12	Cyst (21.10.2013)	5ml Receptal	CLRO (28.10.2013)	Est	On list (09.12.2013)	Not seen	On list (16.12.2013)	Not seen	On list	Not seen (23.12.2013)	Wash out (30.12.2013)	Est
13	Cyst LO (30.08.2013)	5ml Receptal	LO Cyst (13.09.2013)	5ml Receptal	Cyst LO (27.09.2013)	PRID						
14	L cyst (21.10.2013)	5ml Receptal	2 x CLRO (28.10.2013)	Est	FOLO (11.11.2013)	Receptal	CLRO (18.11.2013)	Est				
15	? Cyst Fol (05.07.2013)	2.5ml REceptal	PD+ (16.08.2013)									

16	Cystic (19.08.2013)	5 receptal	Cystic 26.08.2013)	2.5ml receptal	OK (09.09. 2013)		PD+ (21.10.2013)					
17	Cyst L/R (05.12.2013)	5 Rec	CLLO/RO Cyst L/R (19.12.2013)	2 est								
18	Lut Cyst (21.02.2013)	4ml Estrumate	PD+ (13.06.2013)									
19	Cyst (10.09.2013)	5ml Receptal	(24.09.2013)	CIDR 10 days								
20	Cyst (25.07.2013)		PD+ (03.10.2013)									
21	Cystic (05.11.2013)	5ml Receptal	Still cystic (13.11.2013)	4ml estrumate	PD+ (20.12. 2013)							
22	Cyst RO (06.06.2013)	5ml Receptal	Cyst (20.06.2013)	5 Receptal	Cyst LO (04.07. 2013)	CIDR	PD re check (12.09.2013)		PD+ (26.09. 2013)			
23	Cyst LO (05.03.2013)	4ml Cyclix	PD+ (16.04.2013)									
24	Cystic (05.11.2013)	5ml Receptal	CLLO (19.11.2013)	Est								
25	Cyst LO (23.04.2013)	5ml Receptal	PD+ (16.07.2013)									

26	Cyst L&R (12.09.2013)	5 Rec	Cyst RO CLLO (26.09.2013)	CIDR	PD+ (5.12.2013)							
27	Cystic CLRO (05.09.2013)	Est (needs 2.5ml when served)	CLRO (19.09.2013)	Est	PD- FLO (05.11.2013)	Ovsynch	PD (20.12.2013)					
28	Cyst (21.03.2013)	5ml Veterelin	PD- (21.05.2013)	2ml estrumate	CLLO (18.06.2013)	2.5ml receptal (ovsynch)	CLRO (09.09.2013)		PD+ (07.11.2013)			
29	Cyst LO (15.08.2013)	5ml Receptal	CLRO (21.11.2013)	2mls estrumate								
30	Cyst RO (15.08.2013)	5ml Receptal	PD- CLRO (10.10.2013)	Estrumate								
31	LCLO (01.10.2013)	4ml Estrumate	PD+ (10.12.2013)									
32	LCRO (30.04.2013)	4ml Estrumate	LCRO (14.05.2013)	CIDR	LCRO (28.05.2013)	4ml Estrumate	(11.06.2013)	CIDR	PD+ (17.09.2013)			
33	LCLO (28.05.2013)	4ml Estrumate	FORO (11.06.2013)	Veterelin	PD+ (20.08.2013)							
34	Luteal cyst (09.01.2013)	4ml cyclix	PD+ (25.10.2013)									

35	Cyst RO (10.10.2013)	5 Receptal	Served, no cyst (24.10.2013)										

Appendix 17 Protocol interview question guide

Hello

Thank you for taking the time to talk to me today. I'll try not to keep you too long.

The purpose of these interviews is to find out more about the use of protocols for clinical procedures in farm animal practice. I'll be asking you a few questions about the LDA protocol that your practice has.

I would like to record our conversation to make the analysis at the end easier and more accurate. The conversation is not currently being recorded because I need to get your consent first. I'm going to read you the consent form now **[read consent form]**.

Are you happy to be recorded? Yes ☐ No ☐

Ok, I'm going to start the recording now.

[Switch on Dictaphone]

Just for the sake of the recording:

Are you happy that the purpose of the study and the consent process has been fully explained to you? Yes ☐ No ☐

And are you happy to be recorded today? Yes ☐ No ☐

That's great thank you. I'm now going to start asking the questions. When you finish answering each question there may be a fairly long pause. This is not supposed to be uncomfortable; I just want to make sure that you've finished what you want to say without me interrupting your answers.

1. Did you know that your practice has a written protocol for performing LDA operations?

.....

----- If 'NO' go to Question 10-----

2. Do you know who was involved in making this protocol?

.....

- a. *(Was it the vets/nurses/other staff in the practice who created this protocol?)*

3. Do you know why this protocol was created?

.....

- a. *(Was the protocol created for a particular reason? Was the protocol created in response to something?)*

4. When did you find out about the protocol?

.....

- a. *(Were you told about the protocol when you started working here?
Did you know about the protocol before you carried out your first LDA
operation at this practice?)*

5. Do you follow the protocol when you perform LDA surgery?

.....

6. In approximately what percentage of cases would you say that you follow the protocol exactly?

.....

- a. *(In what percentage of cases do you stick to the protocol and follow each step as it is written down?)*
----- *If 100% go to question8* -----

7. When you choose not to follow each step of the protocol exactly, what's your reasoning behind this?

.....

- a. *(When you do not follow the protocol, what are your reasons? In what situations would you choose not to follow the protocol? What factors determine whether you follow the protocol, or not? Why would you choose not to follow the protocol?)*
b. *(Are there any problems or restrictions that having a protocol for clinical procedures brings?)*

8. What do you think are the good points about having a protocol to follow for your LDA surgeries?

.....

- a. *(If you were trying to sell the benefits of having a protocol to somebody, what would they be?)*

9. What do you think are the bad points about having a protocol to follow for your LDA surgeries?

.....

[If No to Q1 – Your practice has a written protocol which explains how to carry out an LDA operation. This was created within the practice. It describes how to do an LDA operation step by step, along with which drugs to give etc]

Do you think you might use the protocol now that you know it exists?

.....

10. Do you think your practice should have more protocols for other clinical procedures?

.....

- a. *(Do you think protocols have a place in other clinical procedures you perform in your practice?)*

11. Do you think that protocols should be used for all clinical procedures in veterinary practice?

.....

- b. *(Do you think that all clinical procedures should have a protocol that should be followed?)*

Is there anything else you would like to add in relation to protocols in veterinary practice?

.....

Thank you very much for your time today. I'll now switch the tape recorder off.

If you'd like a copy of the results or if you'd like any further information then please email me, or give me call. Thank you very much for your time.