Patient safety in Veterinary Practice.

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Abstract

Patient safety is an active field of research in medicine and the driving force behind healthcare policy and practices to ensure the delivery of safe, quality patient care. However, it is a concept in its infancy in the veterinary profession. Veterinary medical error is under reported, poorly understood and inadequately managed with consequences for patients, owners and clinicians. The aim of this thesis is to explore the causes and types of error in veterinary practice and develop solutions to improve patient safety, and by extension quality of care for veterinary patients. A mixed methodology was employed in the investigation of this aim, with data gathered by focus groups, insurance claim review and questionnaires.

The findings of the study suggest that the causes of error in veterinary practice mirror those in other safety critical industries, namely individual errors and system failures. These findings led to the development of a reliable, validated safety culture survey for veterinary practice, to assess and understand the attitudes which drive safety critical behaviours of veterinary staff. This survey was then used as a pre and post training measure to assess the effectiveness of a teamwork training programme, VetTeams, as an intervention to improve safety culture, and by extension patient outcomes in veterinary practice.

The outcomes of this study are a framework to inform the understanding and analysis of veterinary error, a measurement tool of veterinary safety culture and a training programme for veterinary teams which addresses the non technical skills identified as critical to preventing mistakes. The findings suggest that changing attitudes to error through an understanding of the causative factors and education in non technical skills, is essential to drive behaviour change in clinicians and enable improved delivery of clinical care.

“ The most dangerous phrase in the language is ‘We’ve always done it this way “

Rear Admiral Grace Hopper

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Chapter 1

Introduction

"Primum non nocere: First, do no harm"

This thesis sets out to explore Patient safety in the context of veterinary practice. Medical error kills hundreds of thousands of human patients and costs health services billions of pounds every year (Mahajan, 2010). Patient safety is a vibrant field of research which directly informs medical best practice and is responsible for significant improvements in the delivery of clinical care. In contrast, it is a novel concept in veterinary practice. This study broadly aims to investigate the causes and types of veterinary error, assess the veterinary healthcare team's attitudes to clinical mistakes and develop an intervention to mitigate adverse events in veterinary practice. As such, it may be helpful to place it in context, in relation to both the medical and veterinary fields.

This introductory chapter will define the term Patient Safety, briefly describe its evolution and applications in human medicine and compare this to the current state of patient safety in veterinary practice. While they differ in many aspects, such as state oversight and funding, size of organisations and levels of technical skill, human and veterinary medicine share many characteristics. Traditionally, advancements in veterinary medicine follow from those in medicine, and there is much in the field of patient safety that could be applied to the veterinary profession.

Chapter Two will present the relevant literature which informs the direction and design of the research projects which comprise this thesis. Due to the lack of relevant studies in the veterinary profession, this will draw on predominantly medical literature, but with particular reference to its relevance to the veterinary profession. Chapter Three discusses the specific research questions addressed by this study and the methodology applied to their investigation. Chapters Four, Five and Six present the three distinct studies which makeup the thesis. These comprise the causes and types of error in veterinary practice, the measurement of veterinary safety culture and the design and application of a teamwork training programme for interprofessional education. Chapter Seven summarises the findings and presents recommendation for their application in veterinary practice and future research.

1.1 The history of patient safety in medicine

Patient safety is defined as 'the reduction of risk of unnecessary harm associated with healthcare to an acceptable minimum' (Runciman et al., 2009). More specifically, it is 'a discipline in the health care professions that applies safety science methods toward the goal of achieving a trustworthy system of health care delivery……that minimizes the incidence and impact of adverse events' (Emanuel et al., 2008). In real terms, patient safety drives research into quality improvement and the effective delivery of clinical care. It now embraces not only the discipline of safety science but also organisational culture and change management theory.

Patient Safety as a concept in medicine gained recognition following the publication of Brennan and Leape's seminal Harvard Medical study (Brennan et al., 1991). This

retrospective case review revealed that medical error was the 8th leading cause of death in the USA estimating that 3.7% of admissions to hospital resulted in some level of adverse event, of which 0.05% were fatal (Sexton et al., 2006). In real terms, this suggested that up to 91000 people were dying each year across the USA, due to mistakes and errors in their hospital care. Further incidence studies across the world suggested that this figure was likely to be a conservative estimate, and today the incident rate of adverse events on admission to hospital is thought to be at least 10% (de Vries et al., 2008).

The consequences of these research findings were immense. In 1999 the Institute of Medicine (IOM) published its ground breaking report 'To Err is Human', closely followed in the UK by the NHS's 'An Organisation with a memory' (Kohn et al., 2000, Donaldson, 2002). These reports placed medical error firmly at the forefront of debate amongst the profession and called for a sea change in attitudes with a shift of focus from medical malpractice to organisational culture and a systems approach. Governing bodies were charged with the responsibility to ensure standards were raised. The drive for improvements was to come from external forces, both financial and judgemental. Reinforced by public concern and political will, the reports called for a radical reassessment in the way the profession dealt with mistakes and triggered the debate and interest in the science behind medical error. Patient Safety was actively discussed with a dramatic increase in the funding and publishing of relevant literature (Stelfox et al., 2006).

1.2 Understanding error: the path to progress

Having quantified the problem, healthcare looked to other safety critical industries which had been investigating the causes of error for decades, for solutions. Studies investigating

the causes of disasters in nuclear power, offshore oil and aviation, suggested that human factors were major contributors to at least 70% of accidents (Reason, 1995). From this perspective, errors are seen as the result of interactions between the cognitive limitations of an individual and the environment or 'system' which influences their decisions. The aviation industry especially, had invested heavily in research into the causes of aircraft crashes, and had identified failures in non - technical skills and poor safety cultures as major contributing factors (Helmreich, 2000). This approach to error was widely accepted in medicine, and has led to a plethora of interventions, from the measurement and manipulation of safety culture, to the development of clinical tools to mitigate error, grounded in an understanding of error theory and human factors.

1.3 Patient safety today

Today, Patient Safety embodies both a drive to reduce medical error and increase quality of care. In 2004, the World Health Organisation launched the Patient Safety Programme (World Health Organisation, 2016a). Its mission is to coordinate, facilitate and accelerate patient safety improvements around the world and it has promoted several high profile projects such as the inception of the Safe Surgical Checklist, and international safety campaigns such as Clean Care is Safer Care (World Health Organisation, 2016b)

According to the National Patient Safety Foundation (NPSF), healthcare is safer today because health professionals have a greater understanding of high reliability theory, standard safety practices and efforts to improve culture (Gandhi et al., 2016). These concepts shape many policies and practices in modern healthcare, and are reflected in the

guiding vision of today's National Health Service (NHS): "The NHS aspires to the highest standards of excellence and professionalism…in the provision of high-quality care that is *safe*, effective and focused on patient experience (NHS choices, 2015). In the UK, patient safety is currently coordinated by NHS Improvement. It includes the National Reporting and Learning System (NRLS) for the reporting and analysis of adverse events and generation of patient safety alerts, the 'sign up to safety' programme and the Patient Safety collaboration, which aims to embed safety practices in hospitals and primary care facilities nationwide.

Safety is regulated by independent assessment, and is one of the fundamental standards on which hospitals are assessed by the Care Quality Commission. Healthcare institutions are also supported by numerous independent organisations such as the Clinical Human Factors Group CHFG and National Patient Safety Foundation NPSF, which provide education and resources to further enhance safety in healthcare.

1.4 Veterinary patient safety

In contrast, it is probably fair to say that patient safety as a concept is not fully understood by the veterinary profession. It is certainly not as prominently advocated or regulated by the profession's governing body, as is the case in medicine. Awareness of the topic has been described as 'embryonic' and the term 'patient safety' as a specific driver of policy and procedures in veterinary practice, is relatively unrecognised (McMillan, 2014).

Although it may not be labelled as such by many professionals, the underlying ideals of patient safety are introduced to veterinary surgeons at their induction, with the words "*I promise and solemnly declare that…..above all, my constant endeavour will be to ensure the*

health and welfare of animals committed to my care". While the edict 'Do no harm' is not explicitly stated in the Royal College of Veterinary Surgeons (RCVS) oath, it is inherent in three of their five principles of veterinary professionalism: Professional competence, Honesty and Integrity and Professional accountability. Although it is generally accepted that, 'as veterinary surgeons, the safety of our patients has always been a priority' the engenderment of this sentiment into a formal set of practices has yet to happen (Tivers, 2015)

Perhaps the closest the profession comes to the concept is within the context of clinical governance. 'Animal Safety' is addressed in the RCVS's code of conduct, which states that practices should have 'clear protocols in place to ensure all staff are familiar with procedures for ensuring patient safety'(The Royal College of Veterinary Surgeons, 2016). The RCVS's Practice Standards Scheme (PSS) goes into more detail, with specific advice regarding mortality and morbidity meetings, learning from unexpected outcomes and sentinel events, and recording clinical outcomes in a structured form of clinical audit. However, this is a voluntary scheme which, at the time of writing, has been embraced by only half of the profession in the UK (The Royal College of Veterinary Surgeons, 2015)

Unlike medicine, veterinary practice is a diverse profession, much more loosely regulated than an organisation such as the NHS. Standards can vary dramatically, and the RCVS's remit extends only to the regulation of individual veterinary surgeons and not their organisations. Clinical audit as an organisational tool is relatively underused and underdeveloped and there are significant barriers to its use in practice (Rose et al., 2016). There are few, if any, systems in place which facilitate the reporting and logging of adverse events, or their structured analysis. The profession lacks the national structure which facilitates a shared

database to mirror the NRLS and has no compound mortality and morbidity figures. The only comparable incidence studies in the veterinary literature are Brodbelt's (Brodbelt, 2009, Brodbelt, 2010) and Johnston's (Johnston, 1995, Johnston et al., 2002) influential studies of small animal and equine peri - anaesthetic mortality. These comprehensive studies identified many causes of death in relation to anaesthesia, but did not attempt to quantify the contribution of error in anaesthetic complications. It may be valuable to revisit such studies and include the application of human factors and a systems perspective to analyse the influence of clinical mistakes on mortality rates.

1.5 Understanding veterinary error

Safety science and the causes of clinical error have not been taught traditionally in UK Veterinary Schools, and there is very limited research to support the understanding of both the causes and potential solutions of medical error in the profession. At present, despite intuitive acknowledgement that mistakes occur, there is little evidence from which to evaluate the causes of error across the profession. Mellanby and Herrtage's (2004) study investigating the self-reported incidence and causes of mistakes from 108 recent veterinary graduates found that 78% admitted to making errors. The subjects of the study identified lack of experience, time or supervision as well as communication breakdowns between colleagues as the commonest causes of their mistakes. These observations are reflected in research regarding the components of veterinary professionalism. These studies reflect the need to understand and define veterinary professionalism in the context of veterinary education and clinician's ability to deliver the more traditionally recognised clinical skills (Mossop, 2012b). In a recent international study investigating the important competencies

of veterinary professionalism, subjects ranked non - technical skills of communication and collaboration with similar importance to technical competence (Bok et al., 2014). In a separate study, final year students and new graduates rated the skills of communication, recognition of own limitations, ability to cope with pressure and problem solving and decision making skills as unanimously important or very important professional skills (Rhind et al., 2011). However students say they feel insufficiently prepared for practice in relation to these skills and there is little post graduate training available (Bok et al., 2014). These findings are significant in the context of patient safety, as the professional skills they identify mirror many of the causative factors of medical and veterinary error (Kinnison et al., 2015a)

1.6 Barriers to patient safety

The fact that veterinary services are not free at the point of access produces an inevitable conflict between patient safety principles and the realities of running a profitable business in a competitive marketplace. Public concern, and the resultant political will, has been responsible for much of the drive in the human patient safety movement. This is unlikely to be the case in the veterinary industry. Performance figures of veterinary surgeons and hospitals, unlike hospital league tables, are certainly not available to the public. Related to this is the fact that the patient in veterinary practice is not in a position to directly reflect or comment on their experience, unlike human medicine. It is likely that patient safety will have to develop through the profession's inherent ambition to improve, rather than from external pressures.

Internal reluctance to address error is also a factor in the development of patient safety. As Tivers (2011) notes, 'nothing is more natural than to be reluctant to report complications' in relation to surgical error. Hartnack et al's (2013) Delphi study of veterinary anaesthetists found a universal recognition that mistakes and near misses occur, but that a fear of punishment ensured an acknowledgement that 'nobody speaks of them'. This suggests that blame culture, oft cited in medicine, is active in the veterinary profession (Heard et al., 2012). There is also a fine line between the open discussion of errors and the concept of 'whistleblowing'. The RCVS code of professional conduct specifically states that clinicians 'should not speak or write disparagingly about another professional colleague' (The Royal College of Veterinary Surgeons). As such, potential whistle-blowers must be confident that they can distinguish between malpractice and genuine mistakes, or risk professional sanction and potential discipline. In an industry which has a limited understanding of safety science and human factors this can present a challenge. In addition, in a small profession such as the veterinary industry, raising concerns may mean reporting on a friend, colleague or employer with far reaching personal and professional consequences (Welsh and Bayliss, 2012).These fears represent significant barriers to developments in event reporting and organisational learning. In terms of the second victim phenomenon, it may also have implications for individual veterinarian's health and welfare (Welsh and Bayliss, 2012).

1.7 The future of patient safety in veterinary practice

The limited application of patient safety in the veterinary profession is in part explained by the paucity of relavant studies in the literature. Patient safety awareness however, is growing. There has been a significant increase in the number of publications relating to the

subject in the recent veterinary literature and anaesthetic checklists were introduced to the RCVS PSS last year. Recent publications include the development of adverse event reporting systems and checklists for use in anaesthesia and surgery (McMillan and Darcy, 2016, Hofmeister et al., 2014, Bergström et al., 2016) Computerised data collection systems such as SAVSNET and VetCompass may have potential applications regarding clinical audit (Radford et al., 2010, O'Neill, 2012). In the absence of a national structure, reporting and learning may be possible in a more collaborative framework, as suggested by Tivers (2015) and exemplified by projects such as the proposed international audit and clinical database of equine colic surgery (Mair, 2009)

This study evolved from a need for evidence regarding the causes of veterinary error and an understanding of the attitudes of clinicians and their response to mistakes. These attitudes dictate whether safety initiatives succeed or fail, and are represented by the concept of safety culture. The experience of the medical profession, in its efforts to introduce changes such as surgical checklists and the barriers it has encountered, guided the direction of this research and focussed the remainder of the project on safety culture. For the overwhelming majority of veterinary surgeons, nurses and care assistants, their priority and constant endeavour is truly, '*to ensure the health and welfare of animals committed to my care'*. Patient safety research represents an underdeveloped area of veterinary professionalism which can further this aim. Levels of technical knowledge and competence are strictly enforced and regulated by the universities and the Royal College. However, delivering those technical skills as part of an interprofessional team, within the context of a private

organisation which is run for profit presents significant issues. Patient safety has the potential to address those issues to improve the way veterinary professionals deliver care.

Chapter 2

Patient safety: A review of the literature

2.1 Introduction

The study of patient safety begins with an understanding of the causes of mistakes. Error is a complex, multifactorial phenomenon, with far reaching influences. This section will initially define the term and describe error using a human factors perspective: the psychological mechanisms underlying the errors of individuals, together with the 'system' effect on mistakes. The capacity for medical organisations to learn from and prevent error will then be discussed through a review of the reporting and discussion of error and the effect of the organisational response to mistakes.

Leading on from this, the review will focus on the attitudes and beliefs of personnel regarding medical error and the role of organisational culture in patient safety. A discussion and review of the development of safety culture surveys in medicine, along with the part safety culture plays in the uptake of patient safety interventions and initiatives will follow.

Finally, this chapter will review teamwork theory, its links to safety culture and its application via educational interventions to improve the safety attitudes and behaviours of medical staff. This will include a discussion of tools such as checklists and interprofessional teamwork training programmes.

The majority of the research presented draws from studies in human medicine, due to the lack of research relating to these topics in the veterinary field. However, the final section of

this review will discuss the potential relevance to veterinary practice and the evolution of the research questions which the subsequent studies attempt to answer.

2.2 Understanding Error

2.2.1 Defining Error

Before beginning a discussion of error, it is important to define the term. In the complex, shifting world of medicine 'blameless failure' and error can be too easily confused and the distinction between clinical complications and clinical mistakes is, at times, ambiguous (Pani and Chariker, 2004) This can be problematic, as the classification of error varies enormously between groups of professionals (Ginsburg et al., 2009). At first it may be equated with failure but this is dependent on the set of circumstances in which the 'error' occurs. A simple definition from psychology is 'the failure of an action to achieve its intended goal'(Pani and Chariker, 2004). In the context of patient safety it has been defined as 'an act of omission or commission in planning or execution that contributes to or could contribute to an unintended result' (Grober and Bohnen, 2005). This definition emphasises the importance of using a process driven definition rather than one which focuses on outcome and in doing so includes near misses as well as actual adverse events. It may be taken as the working definition of the term for the purposes of this discussion.

Human factors

Other safety critical industries have been investigating the causes of error for decades. Industrial accidents and plane crashes are public and costly and these factors have driven

the research agenda forward. Investigations led by industrial psychologists and human factors experts in NASA, Nuclear Power, Oil and Aviation industries recognise that the majority of mistakes are caused by human error rather than simply a failure of equipment or lack of specialist knowledge (Reason, 1995). A human factors approach to patient safety assumes the view that problems are complex and rarely caused by one factor or component of the system (Gurses et al., 2012). Error from this perspective is viewed as an interaction between the normal limitations of human cognition and the environment in which decisions are made rather than simply the careless actions of an individual. This concept was stressed in the Institute of Medicine's seminal 'To Err is Human' report which stated the importance of a systems approach to error (Kohn et al., 2000). Today, this is reflected by the application of human factors in medicine, defined by the World Health Organisation (WHO) in relation to Patient Safety as the 'environmental, organizational and job factors, and human and individual characteristics which influence behaviour at work in a way which can affect health and safety' (World Health Organisation).

2.2.2 Individual factors: The psychological causes of error

Error is inevitable, especially when examined from a psychological viewpoint. Indeed many safety critical industries view a system which depends on a human as the last line of defence, to be bound to fail. It is a product of evolution; the price we pay for our ability to perform many highly complex tasks with taken for granted ease, or the negative side of the 'cognitive balance sheet' (Reason, 1990). An appreciation of the psychological mechanisms which underlie error is essential, to understand many of the causes of error in practice and to inform the development of interventions aimed at mitigating them. A comprehensive

review of the psychological error literature is beyond the scope of this project, but the subject is dominated by the three overlapping perspectives of, Norman (1981), Rasmussen (1982) and Reason (1990) which will briefly be discussed here.

Norman (1981) proposed that the underlying cognitive mechanism responsible for errors was the faulty activation of blocks of knowledge or 'schemata'. A schema is 'an active organisation of past reactions or of past experiences' (Bartlett and Burt, 1933). In other words, schemata are preformed sequences of behaviour which are triggered by the recognition of particular conditions, and act to simplify our response to multiple stimuli by recognising patterns and responding appropriately. If actions are driven by schema, then errors occur when incorrect schema are activated (Norman, 1981). This can be due to misinterpretation of the triggering conditions. The wrong schema may be selected due to similarities in triggering conditions or a schema may be applied either too late or too early. This type of mechanism is particularly pertinent to skilled work.

Rasmussen (1982) explained errors in terms of levels of cognitive control. A skill-based automatic response is expected in tasks which are familiar and routine, and refers to Norman's schemata model. Knowledge-based responses are determined by mental effort and significant conscious attention, and would be applied to tasks which are complicated or unfamiliar. In between these extremes are the rule-based responses, where a situation must be identified and a 'rule' selected from memory to provide an appropriate response.

Reason's classification of errors encompasses both these models of error, and describes them as slips, lapses and mistakes, which occur on skill and knowledge based levels. As most studies in the medical literature refer to Reason's cognitive theories, a more detailed

discussion of them will be presented here. For more detail the reader is referred to (Reason, 1990).

Slips and Lapses

Slips and lapses are 'absentminded' errors, where conscious focus is diverted from the task in hand and mindful control of automatic processes is distracted. Slips are errors in the execution of an action. Lapses are due to internal forgetfulness or failure of memory, where a stage in a task is omitted or replaced out of sequence. Both involve automatic processing or schema and are common in repetitive recurrent, well-rehearsed tasks, and both usually involve some form of distraction (Reason, 1995). Such expertise relies on having a 'bank' of routines and mental maps to deal with a wide range of relevant scenarios. Such errors are therefore relevant to highly skilled, highly trained professionals who, paradoxically, relinquish more control of their actions to automatic processes the more skilled they become at any given task (Reason, 1990).

For the majority of the time, and under intermittent supervision and direction from the conscious mind, these automated functions perform remarkably, but they are not infallible. Cognitive mechanisms such as schema serve to simplify the overwhelming stimulus input from the world we live in and allow us to function. A manifestation of that simplification is the subconscious predilection to return to the most common, most often or most recently used patterns of behaviour. Therefore, a schemata which has been activated more often or more recently is the most likely to be selected, in response to a similar situation. This inclination manifests as an availability or frequency cognitive bias and unconsciously affects our actions (Reason and Mycielska, 1982). The slip or lapse occurs when the oversight of the

conscious mind is distracted enough to allow the automatic processes to revert to their habitual or most commonly followed path, rather than the one most suitable to the circumstance in hand.

Mistakes

Mistakes are more complex and have been described as errors in planning, as they are the result of a conscious decision making process rather than automatic thought and are prompted by the need to respond to a situation. They involve the application of an incorrect plan to the given situation, or the failure to execute a good plan correctly, and overlap with Rasmussen's description of rule or knowledge based errors (Rasmussen, 1982).

Rule based mistakes, or failures of expertise, rely on the selection of pre-determined plans based on previous experience or training, which are erroneously exploited in similar situations. This can involve application of a bad rule, use of a good rule in the wrong situation, or simply the omission of applying a good rule when required (Reason, 1990).

Knowledge based errors involve the highest cognitive functions, working on a novel problem as it unfolds. This type of cognition is powerful but very taxing, and places large demands on the working memory and conscious attention, both of which have been shown to be fragile and fallible. Working memory is only able to 'hold' 7 items to the fore at any one time and is very susceptible to distraction and overload (Miller, 1956). As is the case with slips and lapses the intrusion of habit becomes significant in the form of cognitive bias, the most significant of which is confirmation bias: the tendency to confirm previous experiences and memories rather than challenge and discard them (Nickerson, 1998).

Violations

The final category of human errors are violations. These involve 'workarounds', or the deliberate departure from a set of known rules, but without the intent to cause damage or harm (Reason, 1990).

2.2.3 System failures: Organisational causes of error

System factors relate to the importance of the effect of 'latent factors' or 'pathogens in the system' and inform a systems approach to error in medicine, in combination with an understanding of human limitations (Reason, 1995, Dekker, 2006, Vincent, 2011). These latent errors are described by Reason's (2004) famous 'swiss cheese' model of error which demonstrates that the layers of defence built in to many systems in an effort to prevent error are all ultimately fallible (see figure 2.1). On occasions, these 'holes' in the defences align and allow a series of seemingly minor mistakes or oversights to coalesce into an action which results in patient harm (Reason, 1990, Shouhed et al., 2012). As such, those clinicians at the 'sharp end' are recognised as victims who inherit latent errors present in the system which adversely affect their decisions, many of which are potentially manageable. An appreciation of this model allows managers and accident investigators to conceptualise weaknesses in the organisation, from specific entities such as poor design of equipment to more amorphous concepts such as safety culture.

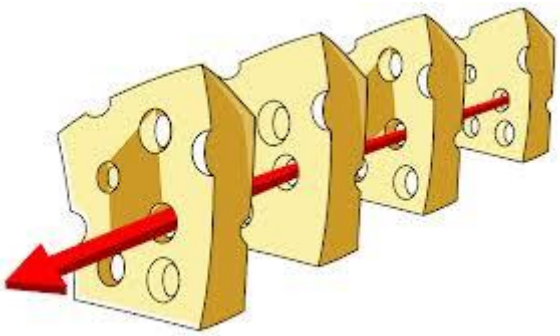


Figure 2.1 Adapted from the swiss cheese model of error (Reason, 2004)

The potential impact of latent factors within systems becomes more profound, the more closely an organisation is deemed to be ‘complex’ and ‘tightly coupled’. This concept of organisational structure draws from the work of the sociologist Charles Perrow, which was further adapted by Reason (Perrow, 2011). As technological advances introduce more computerisation into the design of everyday tasks, and systems become more complicated, they increase the likelihood of errors by increasing the opacity of a system. Tightly coupled systems occur when there is little ‘space’ between steps in a process and a change in one component has an active and immediate effect on the following stage. Systems such as these have a higher probability of developing latent factors, or those hidden from personnel at the sharp end (Reason, 1995).

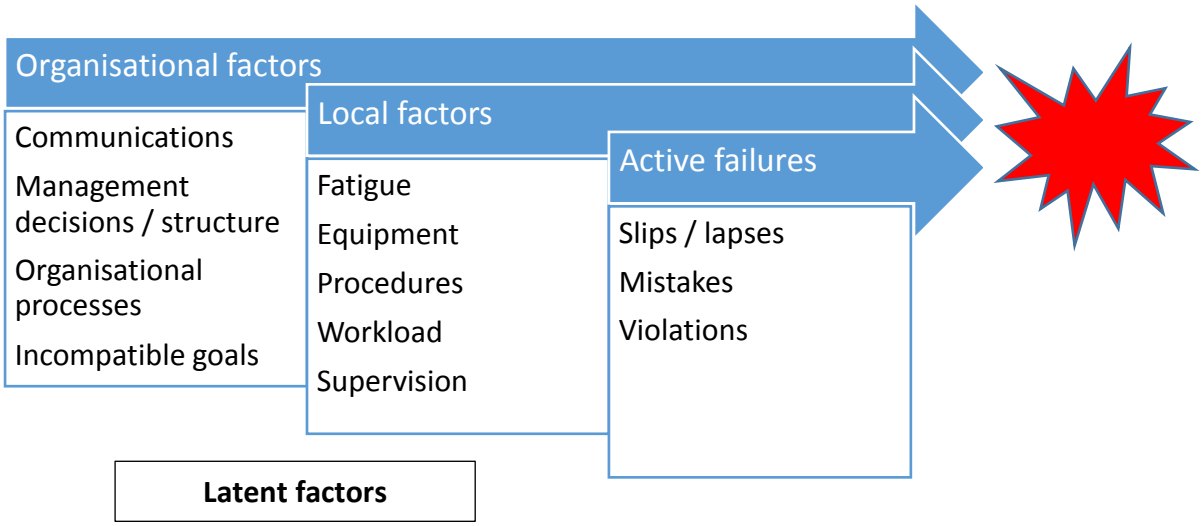


Figure 2.2 Adapted from Reason's (1995) Anatomy of an Organisational Accident model

Reason's (1995) Anatomy of an organisational accident model further conceptualises the swiss cheese model to present a framework for viewing latent factors within the context of an organisation (see figure 2.2). It shows how decisions made by management, themselves influenced by political and social pressures, can affect outcomes on the front line, and how blaming individuals will have little or no effect on preventing errors from recurring.

Modern health care has been described as a complex, tightly coupled process (Kohn et al., 2000). Doctors and nurses essentially work in a high reliability industry and are just as susceptible to cognitive limitations as the next person. Their decisions are often made in stressful circumstances based on incomplete sets of data. Technology, in the form of diagnostic and therapeutic machines, becomes more sophisticated every year and sick patients are finely balanced physiological systems which can destabilise quickly and

catastrophically. As such the application of a human factors perspective and theoretical concepts is essential to ensure understanding and prevention of errors in medicine.

2.2.4 Learning from error

Within this theoretical framework, medical error may be interpreted as much more than the thoughtless actions of a careless individual. Although technological advances have allowed many forcing functions or safeguards to be built in to systems, healthcare is still delivered primarily by people. Taxonomies defining the causes of medical error have been developed on the premise that to design a system which can deal with the cognitive limits of humans, you must first understand those cognitive mechanisms (Zhang et al., 2004). Taib (2011) stresses the importance of referring to a conceptual framework of error in the development of taxonomies of causes of medical error, to allow a thorough appreciation of system and individual factors to be achieved. In the absence of this, taxonomies built from bottom up analysis of incidents, tend to focus on behavioural issues and risk missing latent factors. As such they are ill suited to inform the development of interventions as they are incomplete, a view echoed by Chang (2005).

Traditionally, medicine has taken the view that those at the 'sharp end', the doctors and nurses who actively deliver care to the patient are immune to the inevitability of error. This 'perfectibility model' infers that mistakes therefore occur when someone who is highly trained to perform their duty is careless, lazy, sloppy, or inattentive (Heard et al., 2012). It feeds on a 'just world theory' that when something goes wrong there must be someone to blame and, critically, ignores the effect of the system and its latent factors on the incident (Reason et al., 2001). While acknowledging the improvements in human factors knowledge

and application in healthcare in recent years, medicine remains one of the few high risk organisations where 'operators (eg physicians, nurses) investigate adverse events and develop solutions without the experts who understand people, systems and how they interact' (Gurses et al., 2012, Catchpole, 2013)

The resulting traditional approach of disciplining or retraining those who err makes little allowance for human fallibility, the limitations of psychological mechanisms or the effect of the environment in which people are forced to make decisions. There is also serious doubt about investigator's ability to avoid their own cognitive biases in the form of hindsight and outcome biases, which can impede fair judgement of clinicians accused of error (Dekker, 2011). Not only does this approach to error management have very little effect in preventing a recurrence of the error, but by 'moralising' the discussion of error and creating a culture of 'blame and shame' it stifles the reporting of error and forces discussion underground, limiting the organisational capacity to learn.

Reporting Error

Measuring medical error and adverse events is difficult and there is a lack of a defined methodology with which to reliably quantify the incidence of errors (Thomas and Petersen, 2003) .The gold standard method is observational studies. These yield rich data but are also the least cost effective in terms of time and finances, requiring trained personnel to monitor activities as they occur and catalogue slips, lapses, mistakes and near misses. Clinical record review is often employed but cannot detect near miss events which are often not recorded, and is less able to capture the detail of a timeline leading up to a mistake. These limitations increase the chances of underestimating the problem and restrict the potential to learn

from incidents (Sari et al., 2010). Interviews and focus groups are used to gain insight and depth of data surrounding errors, but are potentially limited by attendance, bias and a potential disinclination to be totally forthcoming about a sensitive subject. They are also limited in the ability to generalise their results to the wider population. Mandatory or voluntary reporting of errors is the most cost effective, and in theory one of the most useful methods. In theory, a snapshot of incidences can be taken to gauge the levels of error in an institution and to assess the effect of interventions but this is not the case in practice (Leape, 2002). Underreporting of adverse effects is a major problem and is thought to run at between 50 and 90% (Barach and Small, 2000). A study in 2002 found that of those States in the USA who had mandatory reporting systems in place, only 6 received more than 100 reports annually compared with the Aviation Safety Reporting System which received over 30,000 reports a year (Leape, 2002).

The reasons for such low levels of reporting are well documented. Vincent et al identified eight common barriers to reporting (Vincent et al., 1999) of which Leape acknowledged two to be the most important: fear, and a lack of belief that such a report will have any positive result. (Leape, 2002) . Commonly cited and investigated is medicine's 'blame culture' which surveys and focus groups of doctors and nurses have found to be a recurrent theme and a real concern (Waring, 2005, Heard et al., 2012). Doctors often associate the consequence of reporting an incident to be punishment – either of themselves or of a colleague, often by a management system which is perceived to be run by non-clinicians who cannot understand or appreciate their decisions (Waring, 2005). There is concern that report statistics will be turned into further targets, or used against them at a later stage in their career. This fear of blame, in the context of medicine, can come from two sources: externally from employers, hospital trusts, public opinion and political pressures, or internally from collegiate and pier

support, or lack of it, and professional pride and identity. Closely associated is the fear of legal repercussions.

The National Reporting and Learning System (NRLS) was set up in the United Kingdom by the National Patient Safety Association in 2003 as a central body to collate, assimilate and provide learning material from adverse event reports. Analysis of reports to the NLRS between 2005-2008 shows that those trusts with a higher level of reporting tended to log a lower proportion severe AEs, while those with lower levels of reporting submitted less moderate AEs such as slips, trips and falls and proportionally higher numbers of serious events (NHS, 2009). This 'skew' in reporting can be significant as it can misdirect policy by falsely altering the epidemiological picture of error, and suggests that the barriers identified by Vincent and Leape are still active today (Noble and Pronovost, 2010). Lack of feedback embodied as a sense of futility, fear of personal retribution and practical constraints such as lack of time and facility are still influential factors on doctors reporting behaviour (Brubacher et al., 2011, Hartnell et al., 2012). Although attitudes may have improved somewhat in terms of greater willingness to discuss error, a lack of effective systems and feedback is key to poor formal reporting rates. This leads to more informal 'in house' discussions amongst colleagues and denies the institution the opportunity to learn (Garbutt et al., 2008). Such findings suggest inherent mistrust and misunderstandings of the aims of the organisation.

Other industries, most notably aviation, have been held up as examples of a developed safety culture, with reporting at its core. They have certainly evolved adverse event reporting systems which are dramatically more effective in capturing the incidence of errors and near misses than is presently the case in medicine. To overcome similar barriers to

reporting, the aviation industry addressed those issues of working culture which drove the attitudes and behaviours of its staff, and developed a reporting system which is anonymous and non-punitive with fast effective feedback. These policies were informed by Reason's essential components of good organisational safety culture : one which embraces learning, is flexible, involves reporting and is perceived to be just (Reason, 2000a). Surveys comparing attitudes of personnel in cockpits and operating theatres found similarities in working cultures between the two professions (Helmreich, 2000). This suggests the importance of educating those at the sharp end to recognise the essential value of reporting and learning from mistakes and near misses and changing the underlying culture of the profession.

2.3 Safety Culture

Since the 1999 'To Err Is Human' report recommended that safety culture was made an explicit organisational goal and top priority, it has been touted as one of the most important factors in patient safety outcomes (Kohn et al., 2000). Yet definitions of the concept within the literature are often poor or left implicit (Edwards et al., 2013). It is considered a subset of organisational culture, which is itself an amorphous, complex subject with multiple descriptions (Scott et al., 2003).

2.3.1 Organisational and Safety Culture

Culture is not a static phenomenon, but evolves with the organisation. Zohar (2008) describes this evolution from a top down and bottom up perspective. On one hand it is generated by social sense making – the propensity of groups within a working environment

to relate their shared experiences with each other in order to make sense of those experiences. This generates culture from the bottom up, and applies social pressure on newcomers to conform to the accepted norm, the 'social glue' of an organisation. The top down approach is influenced by worker's perceptions of management or senior supervisors. In theory, their leadership gives guidance to behaviours which the organisation will reward and encourage. In practice, this may be true to the ethos of the organisation or divert from that at subunit levels, depending on the observable actions, rather than the edicts, of those in leadership roles. Indeed Schein (2010) considers culture and leadership as being two sides of the same coin. Links between organisational culture and outcomes in finance, quality and safety are well documented and accepted (Singer et al., 2009).

Safety culture is a sub unit of organisational culture and is assumed to be created by similar means although it is described from many perspectives. Theoretical models include normative, anthropological and pragmatist approaches to its definition, while more conceptual approaches include Westrum's (2004) Pathological, Bureaucratic and Mature model to define the concept (Edwards et al., 2013). Despite the heterogeneity of these descriptions, most definitions agree that culture at all levels represents the concept of a shared set of beliefs, attitudes or practices; shared mental models and collectively held goals, colloquially referred to as 'the way things are done around here'(Davies et al., 2000).

In healthcare, Reiman (2010) has suggested a three layered model of patient safety culture which mirrors the Zohar model, (see figure 2.3), showing the various influences which shape the concept: Organisational, Social and Psychological. At the organisational level, it is influenced by policy and management, the external drivers of change. At a social level, it concerns the effect that the professional group has on how behaviours are received and

interpreted. The psychological level explores the subjective experience of individual personnel.

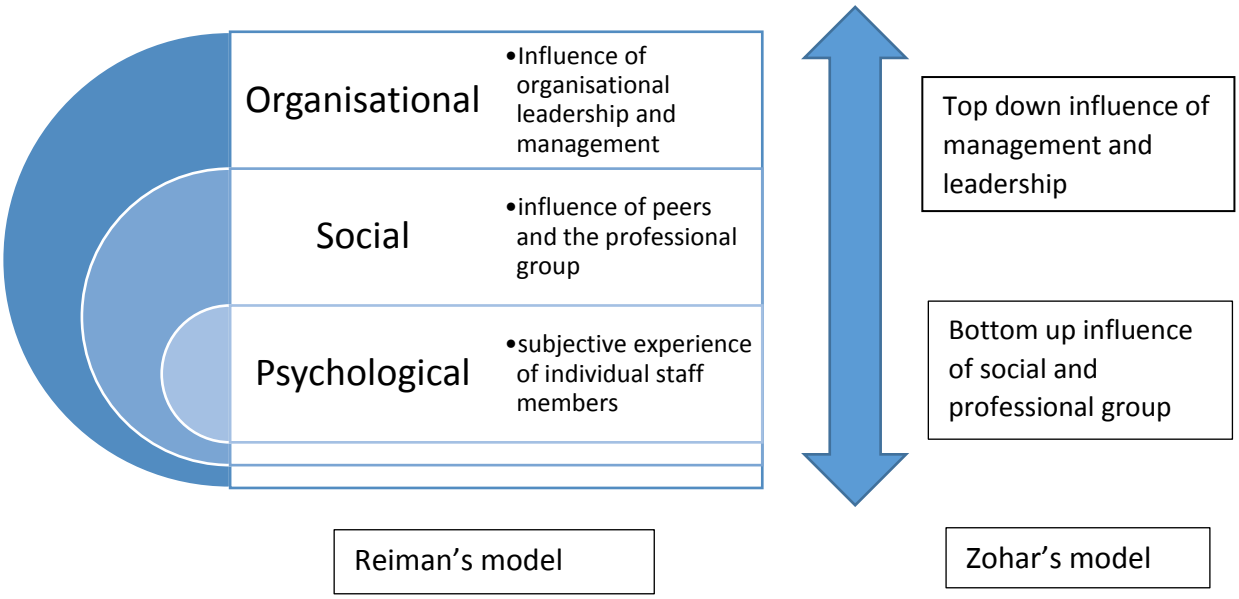


Figure 2.3 Comparison of Reiman's (2010) three layer model of safety culture with Zohar's concept of organisational culture (2008)

Understanding how culture is generated is important in relation to its conception by managers and its potential manipulation. It is useful to describe a theoretical concept in a way which enables the elements to be visualised and acted on. Sammer's (2010) review aimed to identify key concepts in the safety culture literature and present them as a model of the recognisable properties of safety culture. They distilled seven themes from over 200 studies to develop an easily accessible model with the aim of helping hospital staff create and improve safety culture in their organisation (see figure 2.4)



Figure 2.4 The seven subsets of safety culture identified from a review of the safety culture literature (Sammer et al., 2010)

The effects of culture

Culture is a theoretical heuristic, but it has tangible effects on an organisation, as it influences the attitudes and therefore the behaviours of the workforce (Parker et al., 2006). These attitudes are relatively sensitive to targeted training, which in turn can alter negative behaviour and promote safety positive actions. This has been demonstrated in the aviation industry which has used attitude measurement tools and subsequently tailored training programmes to dramatically change its working culture (Sexton et al., 2000).

Culture has been identified as a predictive measure of safety outcomes across industries (Dov, 2008), and in healthcare it is linked to satisfaction levels of patients and their families, as well as safety behaviours of staff (Ginsburg et al., 2014). Positive safety culture in medicine is associated with increases in error reporting and reductions in adverse event and mortality rates. The promotion of safety culture is a National Patient Safety Foundation for Safe Practice (Weaver et al., 2013, Mahajan, 2010) and poor safety culture is continually identified as a contributing factor in healthcare failures such as Bristol Heart Babies, Mid Staffs and Morecombe bay midwifery unit (Kennedy et al., 2000, Francis, Kirkup, 2015).

Although the link between positive safety culture and outcomes is weak, it is intuitive, and evidence is growing (Sammer et al., 2010). Recent studies have demonstrated that mortality levels are inversely related to positive and supportive organisational values, and use of the WHO SSC, an intervention partly designed to address issues of culture, has been shown to reduce mortality rates by up to 47% (Dixon-Woods et al., 2014, Treadwell et al., 2014). Improvements in safety culture have also been linked to decreased levels of patient safety indicators (PSIs) as well as improved perceptions of safety amongst frontline workers (Singer et al., 2009).

2.3.2 The measurement of culture

In order to meet the challenge of changing safety culture, healthcare needed means to measure the concept. Culture itself is a fluctuating entity which cannot be directly quantified and must be conceptualised by quantifiable factors or 'domains' (Singer and Vogus, 2013). This measurable aspect of culture is referred to as safety climate, and is most commonly evaluated through the use of attitude questionnaires. These surveys attempt to

'tap in' to the beliefs and perceptions of the participant, relative to a certain construct to provide a snapshot of the underlying phenomenon. Typically, questionnaires are made up of individual questions or 'items' presented as sliding Likert scales, which cluster into subdomains defining the overarching concept. The number and description of these subdomains varies between instruments, but most have a degree of overlap. Flin's (2006) comparison of 12 published survey instruments, identified up to 73 different domains making up the construct. These condense into ten major themes which overlap with the findings of Colla's (2005) related study and the findings of Sammer's (2010) literature review discussed previously (see table 2.1).

Flin 2006	Colla 2005
Management /supervision	Leadership
Safety systems	Policies and procedures
Risk perception	Staffing
Job demands	Communication
Reporting / speaking up	Reporting
Safety attitudes / behaviours	
Communication / feedback	
Teamwork	
Personal resources (stress)	
Organisational factors	

Table 2.1 Comparison of the domains of safety culture measured by published survey instruments

This overlap has led to calls for a standardised set of 'core' themes which define the construct but in reality it is likely that safety culture will be subtly different depending on setting. Each survey's development should be sensitive to this, rather than forcing organisations to 'fit' a rigidly dictated framework (Flin et al., 2000). As such, surveys cannot be easily transferred for use in other settings. Some have been adapted from other industries, others designed from the ground up and not all have robust psychometric properties. Flin (2006) and Rattray (2007) warn that determining the quality of the

instrument, in terms of construct validity and reliability is essential to protect against misleading and invalid results.

Many healthcare questionnaires have been developed but they vary greatly in design and theoretical grounding (Scott et al., 2003). Halligan (2011) identified the 4 most commonly listed tools employed to investigate safety climate in medicine. Of these the Safety Attitudes Questionnaire (SAQ) and Hospital Survey of Patient Safety (HSOPS), are the most commonly used, so a brief overview of their development will be given here

The Safety Attitudes Questionnaire (SAQ)

The SAQ originated in the aviation industry as the Flight Management Attitude Questionnaire (FMAQ). Investigations into fatal crashes had identified personnel failings as the most common cause of errors. The industry used survey data to collect information on attitudes of its crews, as these were deemed to drive behaviours, and were thought to be amenable to training (Sexton et al., 2000). The University of Texas Human Factors research project adapted this FMAQ for use in the medical setting, and the SAQ is now the most commonly used measurement tool in the healthcare setting (Bondevik et al., 2014, Etchegaray and Thomas, 2012). 25% of the original FMAQ items were carried forwards into the current SAQ, with the remaining questions generated by discussions with industry experts and theoretical frameworks from the error literature (Sexton et al., 2000). The original FMAQ evaluated factors such as stress, hierarchy, teamwork and error and many of these themes are reflected in the six factor structure of the current tool, see table 2.2. The tool has since been adapted for use in a variety of settings including operating rooms,

intensive care units and ambulatory practice, has been translated into numerous languages and is one of the most validated survey tools (Sexton et al., 2006).

In recent years, there has been some debate about the inclusion of the stress sub domain within the construct of safety culture with Taylor et al (2013) finding poor correlation with the overall heuristic. They argue that stress is probably a subdomain more relevant to the construct of fatigue and clinician burnout and as such it should be removed from the SAQ. This finding reflects Flin (2006) and Colla's (2005) warnings that care should be taken when adapting tools from other industries to medicine.

Hospital Survey on Patient Safety (HSOPS)

Unlike the SAQ, the Hospital Survey of Patient Safety (HSOPS) was specifically developed as a tool for healthcare systems. First piloted in 2003 it drew from a literature review of other safety critical industries, and the results of two previous healthcare safety culture surveys. The resulting 42 item survey explores different levels of safety climate, with 7 unit level and 3 hospital level items, as well as demographic and outcome measures (Sorra and Dyer, 2010). Initial psychometric analysis was solid and it was re piloted in 2007 using a larger set of data. The results from this confirmed a 12 factor, 42 item structure of patient safety climate (see table 2.2), with the important ability to evaluate climate on multi levels. Since organisations such as hospitals have a 'nested' structure, the ability of this questionnaire to explore the perception of staff at the individual, unit and hospital levels is advantageous.

This model must be interpreted with caution however. Recent studies in the UK have found that the HOSPS survey when adapted for use in the UK does not prove so psychometrically

sound. Waterson et al (2010) found exploratory and confirmatory factor analysis (EFA and CFA) did not produce a good fit for the original safety culture dimensions using UK data and warns against the use of surveys with populations different from those they are specifically developed for. This has been highlighted by other studies across the globe, all of which resulted in subtle alterations of the 12 factor structure of the construct, relative to their individual settings (Hedsköld et al., 2013, Haugen et al., 2010, Najjar et al., 2013). That said, the survey has been translated into 18 languages and used in 30 countries (Sorra and Dyer, 2010)

Safety climate features (Flin 2006)	**Safety Attitudes Questionnaire (Sexton 2006)**	**Hospital Survey of Patient Safety (Sorra 2010)**
Management / superiors	Teamwork climate	Communication openness
Safety Systems	Job satisfaction	Feedback and communication re: error
Risk perception	Perceptions of management	Frequency of events reported
Job demands	Safety climate	Handoffs and transitions
Reporting / speaking up	Working conditions	Management support for safety
Safety attitudes / behaviours	Stress recognition	Non punitive response to error
Communication / feedback		Organisational learning and continuous improvement
Teamwork		Overall perceptions of patient safety
Personal resources (eg stress)		Staffing
Organisational factors		Supervisor expectations and actions promoting safety
		Teamwork across units
		Teamwork within units

Table 2.2 A comparison of the domains of safety climate defined by literature review (Flin et al., 2006), SAQ and HSOPS

The measurement of culture in the NHS is a growing industry, as healthcare recognises culture as a potential risk factor for failures of patient care. One third of hospitals undertake some form of culture questionnaire as part of their clinical governance activities in an effort to understand and improve (Mannion et al., 2009). Safety climate questionnaires are useful predictive instruments, highlighting defects in a system before it fails; a feedforward strategy rather than one which relies on retrospective feedback data such as mortality and morbidity rates (Flin et al., 2000). In an industry where such failures result in injury or death, the advantages are obvious.

The results are used in medicine as a tool to benchmark performance within and across hospitals, to assess the impact of staff training and to detect areas for further training and resource allocation. They inform organisational policy at the highest levels, and on the frontline can be seen as an intervention in themselves, as they raise awareness and discussion amongst workers and signal the importance management places on safety attitudes and behaviours (Singer and Vogus, 2013, Morello et al., 2013).

The findings from safety culture surveys have informed the development of numerous interventions designed to improve patient safety. Many of the domains of safety culture identified and measured in healthcare relate to teamwork and non technical skills. Many teamwork training programmes have been developed, offering training in skills such as leadership, communication, feedback, job demands and personal resources. These are the skills which can influence and improve safety culture and by extension, patient outcomes.

Examples include Leadership walk rounds, structured interdisciplinary ward rounds and comprehensive staff training programmes, such as TeamSTEPPS and CUSP (Weaver et al., 2014, Pronovost et al., 2005, Thomas et al., 2005).

The final section of this review will examine the teamwork literature in relation to medical training programmes, and its relationship to safety culture.

2.4 Teamwork

Culture is closely linked to teamwork, though they are thought to be interdependent and associated in a complex way, rather than the one directly affecting the other (Korner et al., 2015). Team training is now recognised in healthcare as being critical to quality of patient care and outcomes (Hughes et al., 2016). The pursuit of effective team function is one of the five principles recommended in the 1999 IOM report and team training was identified in 2013 as a 'top patient safety strategy' (Shekelle et al., 2013, Weaver et al., 2013, Buljac-Samardzic et al., 2010). This has led to the development of many teamwork training programmes, a focus on interdisciplinary training and the increased use of simulation in the teaching of non technical skills.

2.4.1 A definition of teamwork.

Teamwork, in any industry, is a skill frequently touted as essential for success but less often well defined and conceptualised (Xyrichis and Ream, 2008). Underlying most teamwork models is the overarching Input-Process-Output model (I-P-O) of team function. This defines

teamwork as the result of inputs from the environment, task demands and team members, the assimilation of this in the form of coordinated collaborative task work and the resulting productivity or efficiency of the whole (Ilgen et al., 2005). There are important differences between task work, the combined efforts of individuals performing set jobs, and teamwork as the inherent collaboration of a group of people. As Salas and Burke both recognise, a nominal group of skilled members does not ensure success; 'a group of experts does not comprise an expert team' (Salas et al., 2005, Burke, 2004).

Defined as 'two or more individuals with specified roles interacting adaptively, interdependently and dynamically towards a common and valued goal' (Dyer, 1984) Teamwork or 'interprofessional collaboration' is complex and there is no universally accepted model of the concept (Careau et al., 2015) . Salas's (2005) review of the literature found over 138 models of teamwork and more than 20 functions which underpinned a 'successful' team . The authors distilled these into 5 main themes which were proposed as the main components of teamwork; leadership, mutual performance modelling, backup behaviour, adaptability and team orientation. These building blocks were facilitated by mutual trust, closed loop communication systems and the development of shared mental models (Figure 2.5)

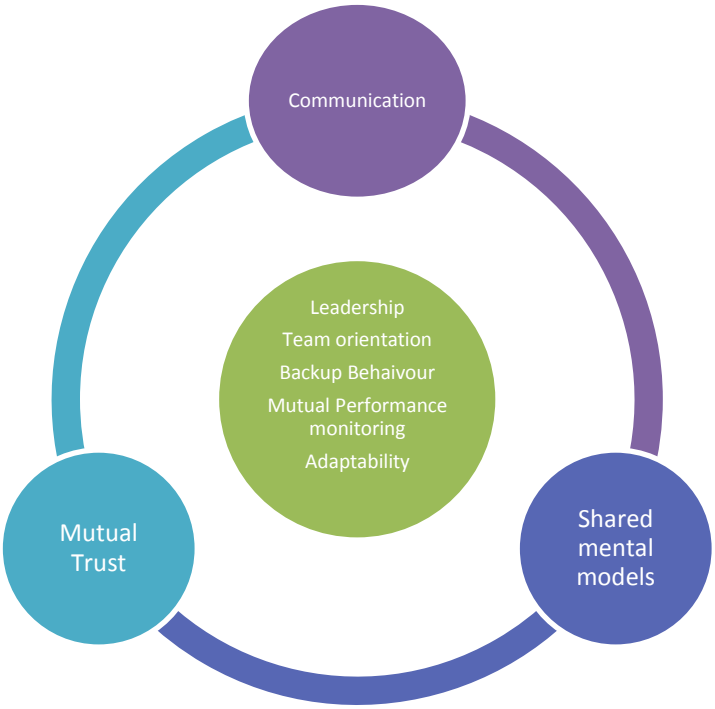


Figure 2.5 Schematic representation of Salas's model of Teamwork (Salas et al., 2005)

Baker et al's (2006) study distilled similar themes, which they described in terms of the Knowledge Skills and Attitudes (KSAs) or core competencies of teamwork. These mirror the conception of teamwork amongst front line care providers who identified coordination, leadership, its role in patient safety and staff well-being as components of the term (Silén-Lipponen et al., 2002). These conceptual models now serve as a guide for medical teamwork training and have been used to develop post graduate programmes for clinicians.

2.4.2 The importance of teamwork

Teamwork is valued in medicine because of its 'critical importance' in assuring patient safety (Manser, 2009). Both retrospective analysis of incidents and observational studies

agree that communication and teamwork failures contribute to approximately a third of all errors (Manser et al., 2013), while Weaver's (2014) review of the literature suggests that 52-70% of adverse events can be linked to poor teamwork or communication. In surgery, failures in communication are the root cause of 66% of operating room errors and 30% of all interactions within the operating room are judged as communication failures resulting in inefficiency, team tension, patient inconvenience and procedural errors (Dedy et al., 2013, Shouhed et al., 2012). In addition, 24% of malpractice claims are linked to teamwork or communications breakdowns (Weaver et al., 2014).

In the past 5 years the strength of evidence linking improvements in teamwork to patient safety outcomes has grown considerably (Manser, 2009). At the *patient* level, team coordination is associated with reduced post op pain, improved quality of care and post op functioning as well as reduced length of hospital stay (Gittell et al., 2000). At the level of the *team*, effective working, and especially leadership is associated with employee outcomes such as emotional exhaustion (Sluiter et al., 2005), burnout (Lederer et al., 2006), job satisfaction (Kalisch et al., 2007), and mental health (Korner et al., 2015) as well as greater efficiency (Poulton and West, 1999). These factors have obvious consequences on a clinician's ability to care for their patients and ensure optimal patient safety. Finally, at an *organisational* level, good teamwork is associated with cost savings in terms of better staff retention (Xyrichis and Ream, 2008) and increased efficiency (Grumbach and Bodenheimer, 2004). It is also inherently linked to improvements in safety culture (Korner et al., 2015). Teamwork training programmes have been linked to improved staff attitudes and behaviours, reduced errors, improved outcomes and lower surgical mortality (Capella et al., 2010, Morey et al., 2002, Neily et al., 2010)

2.4.3 Teamwork Training

Teamwork can be promoted in three ways; by altering the environment in which a team works, by selecting people with the correct set of knowledge, skills and attitudes (KSAs) through effective recruitment strategies, or by training (Baker et al., 2006). Teamwork training is now recognised across the high reliability organisations of the military and aviation as fundamental to success and improved outcomes, and has been shown to improve teamwork and enhance team performance across many fields (Baker et al., 2006, Salas et al., 2008).

Aviation was one of the first industries to recognise the importance of team working following the investigation of crashes in the 70s and 80s, and the conclusion that many were due, at least in part, to deficiencies in non technical skills such as leadership, crew coordination and decision making (Zeltser and Nash, 2010). These causes of error are mirrored in medicine with a lack of similar non-technical skills responsible for 60% of major perioperative complications (Dedy et al., 2013). Both industries require teams of people to work under the effects of time pressure, overwork, stress and fatigue, making critical decisions which can result in life or death. However, unlike aviation, medics have been traditionally trained as individuals, with little or no inter professional education, or guidance as to the critical skills which facilitate teamwork.

In response to these findings, Cockpit Resource Management (CRM) was developed in aviation, based on the research which identified behaviours linked to poor outcomes (Carne et al., 2012). CRM in aviation is now combined with simulation and used to train teams in both routine and emergency situations. It was mandated in the USA for military flight crews in 1990, and in commercial airlines in 1998. Although the impact of CRM is not proven and

the scientific evidence linking it directly to safety outcomes is weak, it has been credited with reducing the number of aviation accidents and has been linked to positive attitudes, learning, behaviour change and the potential to improve safety (Salas et al., 2006). It is now used in aviation and offshore oil, and is the method most commonly adapted for teamwork training in medicine (Burke, 2004)

The potential benefits of CRM in medicine were first recognised by anaesthetists, who developed programmes such as Anaesthesia Crisis Resource Management (ACRM) and Team orientated medical simulation (TOMS) (Gaba, 2010, Howard et al., 1992). Since then, the principles have been adapted for use in many domains of healthcare including emergency departments, operating rooms, critical care and less acute wards such as outpatient and ambulatory practice. The underlying principles of CRM are displayed in figure 2.6.



Figure 2.6 A schematic representation of the core skills of CRM training. Adapted from (Carne et al., 2012)

These core skills underpin the curriculum of CRM. They are also the characteristics most likely to encourage teamwork, as identified by a Delphi study of experts in healthcare CRM and training (Clay-Williams and Braithwaite, 2009). They closely mirror Salas's (2005) theoretical model of teamwork and overlap with many of the domains of medical safety culture, see table 2.4.

Safety Culture domains (Flin et al., 2006)	**Teamwork skills and attitudes (Salas et al., 2005)**	**CRM core skills (Carne et al., 2012)**
Management / superiors	Leadership	Leadership and role clarity
Safety systems	Communication	Communication
Risk perception	Shared mental models	Task and situational awareness
Job demands	Mutual trust	Ask for help in time
Reporting / speaking up	Back up behaviour	Know your environment
Safety attitudes / behaviours		Discuss and form a plan
		Allocate attention wisely

Table 2.4 A comparison of the similarities between elements of safety culture, teamwork and CRM.

Many forms of CRM inspired training now exist, with 333 educational programmes identified in the USA alone in a recent investigation by the AHRQ (Agency for Healthcare Research and Quality, 2013). Examples include initiatives such as TeamSTEPPS, MTT and MedTeams (King et al., 2008, Dunn et al., 2007, McConaughey, 2008). Despite a heterogeneous mix of teaching styles assessment and duration, these programmes most commonly include communication, situational awareness, leadership and situational monitoring as behavioural targets (Weaver et al., 2013). Most forms of training are delivered by a combination of didactic and simulation training in the form of toolkits or

multifaceted training packages. These have the advantage of being adaptable and easily modified to best suit each particular organisation, and would appear to be the most successful form of the intervention. There is also growing evidence to support the use of simulation in the delivery of CRM type skills (Rosen et al., 2012). Boet's (2014) review focussed on assessing the effect of CRM training programmes at levels three and four of the Kirkpatrick hierarchy. This is a commonly used method of assessing the effectiveness of medical training, with levels one and two representing superficial learning, and higher levels reflecting a deeper and more effective transfer of knowledge with subsequent effects on behaviours (Yardley and Dornan, 2012). The review suggested that CRM programmes which included an element of simulation were more effective at achieving transfer of knowledge to the workplace and changes in outcomes, than those which used didactic practices alone (Boet et al., 2014).

However, despite a strong element of face validity, and obvious cross overs in their constituent domains, the evidence supporting the use of teamwork training to specifically improve culture scores is weak (McCulloch et al., 2011), and there is a lack of studies directly linking interprofessional education efforts to clinical outcomes (Reeves et al., 2013). Morello's (2013) systematic review of the effects of such interventions on safety culture, found that there was limited evidence to suggest that they significantly improved climate scores, and by inference, outcomes. However, the authors acknowledged that this lack of evidence does not necessarily signify a lack of effectiveness of such safety strategies, but may reflect an immature understanding of the culture concept, the complexity of its interrelationships, and subsequent difficulties in study design and resourcing.

More recent research continues to support the use of team training in healthcare, with evidence of improved outcomes and sustained effects of learning (Hughes et al., 2016). Other studies have suggested that a combination of teamwork training and change management techniques are required to improve culture and outcomes, and that this is enhanced when supported by the work environment (Robertson et al., 2015, Willis et al., 2016). There is growing recognition that adequate preparation for training initiatives, and structures to support their sustainment, are as vital to success as the programmes themselves (Jones et al., 2013). Many training programmes now recognise that a combination of education and change support is necessary to ensure best outcomes and some have integrated this into the design of their curriculum. It is beyond the scope of this review to discuss them all, however, two have direct relevance to this project, the TeamSTEPPS initiative and the World Health Organisation's Safe Surgery Checklist, and they will be discussed in more detail here.

***TeamSTEPPS*.**

Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS^{TM}) is an example of interprofessional teamwork training. It was devised by the Department of Defence (DoD) and the Agency for Healthcare Research and Quality (AHRQ) in the USA and released as a public resource in 2006 (Agency for Healthcare Research and Quality). It is grounded in the principles of teamwork described by Salas (2005), and aims to integrate those knowledge, skills and attitudes (KSAs) into practice, by presenting them as a set of core competencies which can be taught meaningfully to frontline clinicians (see figure 2.7).

To develop the TeamSTEPPS curriculum, the elements of Salas's theoretical model were classed as either trainable, or an outcome of training. Elements of the theoretical model which were not directly teachable were broken down and incorporated in the core elements of TeamSTEPPS. For example, a shared mental model is seen as an outcome of learning skills such as monitoring, back up behaviours and mutual support (King et al., 2008).



Figure 2.7 The TeamSTEPPS^{TM} instructional framework

The TeamSTEPPS core competencies of trainable skills are leadership, situation monitoring, mutual support and communication. Principles of each core competency are taught alongside tools to facilitate their practical use. For example the leadership module contains tools such as BRIEF and DEBRIEF, structured formats for leading a planning discussion or delivering feedback to a team. The results of mastering the core skills are shown in the

corners of the model, with outcomes in performance, knowledge and attitudes. Table 2.5 shows the core competencies and their corresponding TeamSTEPPS tools.

TeamSTEPPS core competency	TeamSTEPPS tool or strategy
Leadership	Brief, Huddle, Debrief
Situation monitoring	STEP, Cross monitoring, Feedback
Mutual support	Advocacy and assertion, The two challenge rule, CUS, DESC
Communication	SBAR, Call - out, Check - back, Handoff

Table 2.5 TeamSTEPPS core competencies and their corresponding Tools and Strategies

Recognising the challenge of changing behaviours and sustaining that change in practice, the TeamSTEPPS curriculum includes instruction on 'Implementation', a structured process of integrating change based on John Kotter's organisational change research (Kotter, 1996). A TeamSTEPPS initiative therefore has three phases, 1.Assesment, 2.Planning training and Implementation and 3.Sustainment. Before any teamwork training is undertaken, a training needs analysis is conducted to identify specific areas for improvement in that organisation. The HSOPS survey tool is used to assess the staff's attitudes and beliefs relating to the existing culture and patient safety. Following this, a change team is formed and a targeted plan developed, tailoring the curriculum to the needs of the unit or hospital. Phase Two, involves the change team undergoing an intensive 'train the trainer' course, and the development of a specific Implementation and Action plan which details exactly what the initiative will be targeting in that institution. Phase Three involves the change team acting as

coaches, maintaining the initiative through staff feedback and reinforcement of the TeamSTEPPS skills and tools (King et al., 2008).

Team STEPPS has been used extensively in hospitals across the USA and implemented in military, community and academic clinical settings, with over 5000 master trainers trained (Lisbon et al., 2014). Improvements have been reported in communication skills, clinical outcomes in ICU units and emergency departments and safety culture where the programme has been implemented (Mayer et al., 2011, Lisbon et al., 2014, Thomas and Galla, 2013, Capella et al., 2010). It represents a comprehensive, evidence based, practical approach to teamwork training in healthcare which delivers quantifiable results.

2.4.4 Checklists

One of the first checklists in medicine was an intervention designed to decrease central line catheter infection rates (Berenholtz et al., 2004). It was employed as one component of a five part, multifaceted study at John Hopkins University in the USA, and dictated a set of best practice steps to be followed on the insertion of central lines in the Intensive Care Unit. Baseline measurements in the three months before the study showed that clinicians followed infection control procedures in only 62% of cases and the catheter related blood stream infections (CR-BSI) rate ran at 11.3/1000 catheter days. Rates following the study dropped to 0/1000 catheter days. This result was achieved through the use of a checklist as part of an intervention which included education, standardisation, improved communication and the empowerment of nurses to stop the procedure if guidelines were not followed. In short, an intervention which encouraged teamwork.

Checklists, at their most simple are an aide memoire, a 'visual or oral aid that enables the user to overcome the limitations of short term memory' (Mahajan, 2011). They are simple tools, derived from aviation, which aim to standardise and simplify a process and protect the clinician from simple cognitive limitations and subsequent 'absentminded' errors. More subtly, they improve team communication, enhance the group's shared mental model and foster the ability to speak up (Mahajan, 2011, Russ et al., 2013, Merry and Mitchell, 2016). These skills mirror fundamental components of both the Salas teamwork model and TeamSTEPPS curriculum, and a checklist serves as a tool to facilitate their practice.

The WHO safe surgery checklist was subsequently developed and introduced in 2008. The 22 item, three phase list focusses on safety critical steps which are often overlooked but which have potentially deadly consequences. The three phases were designed to complement the natural timings of an operation: before anaesthesia, before skin incision and before the patient leaves the operating room (Weiser et al., 2010). Initial studies across eight countries showed a remarkable decreases in mortality (1.5%-0.8%) and morbidity (11%-7%) following use of the checklist, which was effective across all types and levels of institution (Haynes et al., 2009). Subsequent research has repeated the results of checklist implementation and strengthened the claims that it is a powerful tool for quality improvement (Haynes et al., 2015).

Barriers to checklists

Despite seemingly overwhelming evidence to support their use, it seems the safe surgery checklist does not always reach its full potential. Urbach et al's comparison study of outcomes in 101 hospitals before and after implementation of the tool failed to find any significant improvements in results (Urbach et al., 2014). They concluded that checklists may

have more impact with more intensive team training. Although small in scale, this study is a useful insight into the actual benefits of checklists 'in vivo'. For them to be completed meaningfully requires a team's understanding and acceptance, otherwise they represent nothing more than a tick box exercise, a fact that mandating their use does little to improve. The NHS made the use of a surgical checklist compulsory in all UK operating rooms in 2010. However Pickering's (2013) observational study found evidence that compliance with the checklist varied dramatically and was much lower than administrative figures suggested. The authors concluded that culture assessment and improvement was required to improve uptake. Barriers to the use of checklists include confusion over the practical use of the tool, challenges to efficient workflow, attitudes and beliefs of staff and longstanding habits and ingrained medical hierarchy (Treadwell et al., 2014). The ability to modify the checklist for individual institutions, a pilot testing phase with subsequent adaptation, refinement and creation of local champions followed by an institution wide education programme to explain both how to use the tool and the subtleties of its benefits, is essential to its success. In short, considered implementation programmes which include attention to safety culture and education of front line staff are now recognised as essential for success, as is continuous feedback, in terms of auditing its use and relating use to outcomes (Haugen et al., 2013).

2.5 Errors, culture and teamwork in veterinary practice

Patient safety in medicine has evolved dramatically over the last 25 years but the concept is in its infancy in the veterinary profession (McMillan, 2014). Improvements and advancements in veterinary practice often filter down from medicine. The two professions

have many similarities, more perhaps than those shared between medicine and aviation, the industry which inspired many of the developments in human patient safety. Although the technical knowledge and skill set may have fundamental species differences, the *delivery* of clinical care is highly comparable. Therefore, there is good reason to suppose that the advances in medical patient safety should be relevant and applicable to veterinary professionals. When faced with the evidence of unacceptable levels of iatrogenic harm in Kohn's (2000) report, medicine responded by researching the reasons behind medical error, then probing for solutions. At present there is very little in the literature which discusses error or its causes in the veterinary context, other than the recognition that it occurs and is a significant source of stress to individual clinicians (Mellanby and Herrtage, 2004).

There is also no evidence to describe the heuristic of safety culture in veterinary practice and no standardised appropriate terminology on the subject (McMillan, 2014). Consequently, there is little understanding of the term in the profession, although related themes have been identified and linked to errors. Teamwork and communication, the discussion of error and workplace stress have been discussed in the literature, but they have not been overtly linked to veterinary safety culture (Bartram and Baldwin, 2005, Kinnison et al., 2015b, Mellanby and Herrtage, 2004). This lack of awareness signifies a significant gap in both research and education for the veterinary profession and is reflected by a general lack of available training and resources in concepts which influence culture, such as leadership skills and processes such as clinical audit and adverse event reporting. Stress relating to clinical mistakes, immature safety cultures and the resultant effects of blame and shame, the second victim phenomenon and links with staff engagement may also have some relationship with the high levels of poor mental health experienced by the profession. However, in direct contrast to medicine and other high reliability organisations, there are no

validated, reliable survey tools available with which to measure the construct and no veterinary specific frameworks of non technical skills (Armitage-Chan, 2014).

Unlike the medical profession, there is also very little training or education available to vets in non technical skills. While the teaching of communication skills is increasing at undergraduate level, there is still very little developed for postgraduates, and 'teamwork training' of interdisciplinary groups is virtually unheard of (Mossop, 2015). A comprehensive safety programme such as TeamSTEPPS enables human hospitals to analyse their need for training through pre training assessment with the HSOPS measurement tool, implement bespoke non technical skills training and sustain the learning and behaviour change from such an intervention to improve the safety culture of the unit. The veterinary profession at present lacks both the knowledge and tools to attempt the same.

In part this is due to a lack of resources. The veterinary profession does not have the facilities, resources or equipment of other industries. Most notably the development of simulated animal patients lags far behind comparable 'sim dolls' and aircraft cockpits. Low fidelity simulators in the form of part task trainers for practical demonstrations and practice at undergraduate levels are becoming more sophisticated and commonly used (Valliyate et al., 2012). Models such as the haptic cow and 'Critical care Jerry' are used to teach skills such as rectal pregnancy diagnosis and canine intubation techniques, however, the development of fully functioning high fidelity 'simulated patients' is still in its infancy (Baillie, 2007).

Recent research in the profession has begun to focus on non technical skills and their application within the veterinary team, its dynamics and the effects on outcomes (Kinnison et al., 2015a, Kinnison et al., 2015b, Kinnison et al., 2015c). There is also interest in

veterinary practice in the use of tools such as surgical checklists and adverse event reporting systems. However such tools rely on both teamwork and safety culture to be used meaningfully. Without research and development of tools specific for veterinary clinicians, they potentially face the same barriers to implementation as experienced in medicine, and their potential for improvement will be lost.

2.6 Summary and research questions

This chapter has discussed the relevant literature surrounding the three core studies within the thesis, and presented the need for the following research. This thesis presents the first steps along a pathway for improving patient safety in the veterinary profession, examining veterinary error and safety culture and investigating possible solutions, inspired and informed by the experience of medicine and other safety critical industries. In response to these findings the aims of this research project and specific research questions are as follows:

Aim: To improve patient safety in veterinary practice

1. What are the causes of error in veterinary practice?

2a. What defines safety culture in veterinary practice?

2b. How can we measure it?

3. Can we improve veterinary safety culture through teamwork training?

The following chapter will discuss the methodological approaches to the above research questions, and outline the research strategy employed in their investigation.

Chapter 3

Methodology and methods

This chapter aims to outline the methodological approach to the research presented in this thesis, and describes the methods selected to generate, collect and analyse that data. It will begin with a discussion of the mixed methods form of research, and a brief overview of the research paradigm. The research strategy, data collection and analysis methods, and the justifications for their choice will then be presented, with more details of the methods themselves provided in the following relevant chapters. Finally, the ethical considerations of the project will be considered.

3.1 Mixed methods

Mixed method study has been described as the third paradigm of research (Johnson et al., 2007). It is currently defined as 'a type of research in which the researcher combines elements of qualitative and quantitative approaches …. for the broad purposes of breadth and depth of understanding and corroboration' (Johnson et al., 2007). However, it is also recognised that this is an evolving field and this definition is likely to alter over time. Traditionally, quantitative and qualitative research methodologies have been seen as conflicting entities with opposing and irreconcilable philosophies, aims and methods. This 'paradigm war' has resulted in two entrenched research cultures, the first valuing reliable and repeatable facts, the second depth, breadth and richness of meaning.

Quantitative research places great value on objectivity and the pursuit of the single, scientific truth. It treats the study of social constructs in much the same way as it does that of the physical sciences, and assumes that all aspects of social phenomena are governed by objectively measurable 'laws'. This assumption follows a positivist philosophy, that measurement is achieved by rigorous and deductive scientific method and that human behaviour must be viewed in terms of cause and effect, or the relationships between variables (Bowling, 2014). The methods used in a quantitative methodology relate to this, usually generating numerical data, which can be generalised to the greater population using statistical techniques, to ensure validity and reliability as measures of research quality (Braun and Clarke, 2013).

Qualitative research, in contrast, sits at the opposite end of the philosophical scale. Its post positivist stance rejects the concept of one universal truth and aims to capture and understand the 'messiness' of social interactions, inductively interpreting patterns of behaviour within their social context (Braun and Clarke, 2013). It values the subjectivity of the researcher, and does not aim for replication as a measure of quality, as it recognises that reality is *constructed* by its subjects, inseparable from time and context and therefore variable. Qualitative methods are recognised as being especially useful when little is known about a topic, or emotions feelings and attitudes are under scrutiny (Strauss and Corbin, 1998). Words form the bedrock of qualitative data, and these are analysed by a wide variety of methods, to produce 'rich and thick' descriptions which enhance understanding of the subject of study (Johnson and Onwuegbuzie, 2004). The formal assessment of quality in qualitative research is less precise and clear cut than that for quantitative studies and is not measured by similar means. Methods to ensure robust and trustworthy results include member checking and triangulation, the comparison of results from multiple sources and

studies to substantiate common themes. Qualitative research is therefore less generalizable to the population at large than quantitative research. However, this reflects the aim of the research – the achievement of depth of understanding rather than the ability to extrapolate results (Marshall, 1996).

Mixed methods as a research methodology has emerged in response to the needs of social science research, and the investigation of complex social phenomenon. The goal of mixed methods research is not to replace either of the traditional approaches, but to employ the most effective methods to answer complex research questions, using a combination of both approaches (Johnson and Onwuegbuzie, 2004). Mixed methods research attempts to minimise the inherent disadvantages present in all methods, by combining them to best effect. This form of research allows the selection of methods from both methodologies, much like the selection of tools from a toolbox. Just as the successful craftsman will select the most appropriate tools for the job in hand, the successful researcher may choose a combination of methods most appropriate to answer the research question. This approach is justified by a pragmatist philosophy, that the 'ends justify the means' (Doyle et al., 2009).

Doyle (2009) summarised the reasons for conducting a mixed methods study : Triangulation, Completeness, Offsetting weaknesses, Answering different research questions, Explanation of findings, Illustration of data, Hypothesis and Instrument development and testing. These represent the benefits inherent in a mixed methods approach but there are limitations to be considered. Mostly, these revolve around the seeming incompatibility of the research paradigms, with purists arguing the case for black and white, and others advocating shades of grey on the philosophical continuum (Creswell and Clark, 2007). There can also be practical problems related to mixed methods research, with issues regarding the same

researcher running concurrent projects which differ in nature, and the extra demands of additional methodological knowledge required to successfully employ both techniques.

Traditionally, research in human healthcare has placed high value on a positivist, quantitative philosophy and methodology. However, mixed methods has become common in recent years, as it can provide 'hard' outcomes data in answer to pressures from policy makers, but also offers valuable context to those outcomes (Doyle et al., 2009). For example Mary Dixon Woods (2014) multifaceted, multi centre control study utilised mixed methods to produce an overarching descriptive discussion of the NHS, supported by hard data in the form of outcome measures such as levels of staff turnover and engagement. It is often employed as a combination of qualitative study alongside a randomised controlled trial (RCT), but is also valuable in other contexts, such as survey development (O'Cathain et al., 2007).

By contrast, its employment in the field of veterinary research is relatively new. The veterinary profession traditionally places high value on rigorous, reliable quantitative 'science'. Aside from pockets of research in areas such as veterinary education, the majority of research is clinical in nature. Qualitative studies are relatively rare, and there is a paucity of veterinary related sociological studies (Mossop, 2012a). As such, the mixed methods format is unfamiliar to the profession. However, its benefits may be realised as the research questions generated by the profession develop, to encompass more complex and sociological phenomena such as veterinary staff welfare, professionalism, working culture, staff engagement and patient safety.

3.2 The scientific paradigm

The mixed methods approach makes the contemplation of scientific theory and paradigms important. The research paradigm represents our world view . It influences how we know things (epistemology), our interpretation of reality (ontology), our values (axiology) and our choice of research methods (methodology) (Doyle et al., 2009). At first glance, the combination of two such radically opposing schools of thought seems impossible, as the philosophy behind a quantitative methodology is at odds with that guiding qualitative method. Successful mixed methods research unites these two opposing viewpoints, by designing studies which maintain a rational philosophy and meaningful methodology. This is achieved by a pragmatist philosophy which bows to the dictates of the research question, rather than those of the researchers own paradigm (Tashakkori and Teddlie, 2010). Therefore, the choices the researcher makes should be guided by the questions they are trying to answer, while maintaining an awareness of their internal motivation.

Relevance to this Project

Mixed methodology was applied in this study, to allow the selection of the most suitable research tool to answer the questions in hand. It stands to reason, that the broader the question, the more diverse the toolkit a researcher may employ to seek the answer. The aim of the project, and subsequent research questions presented in this thesis, presents a very broad remit requiring diverse approaches to achieve the best results.

Researcher reflexivity

The 'ability to recognise the tendency towards bias', is a fundamental characteristic of a good researcher (Strauss and Corbin, 1998). In quantitative studies, bias is eliminated through rigorous scientific method, in qualitative studies it is recognised as inherent to the research process itself. As such, it is important to realise the difficulties faced by the researcher in separating themselves from the cultural, social and political aspects of their research group. Reflexivity, described as 'thoughtful conscious self - awareness' it is a method by which a researcher can actively assess their influence on data gathering and analysis (Finlay, 2002). As a practicing vet and therefore closely involved with the subject of the research, this is especially pertinent in this study. It was important to resist the temptation to assume that all members of my profession thought similarly to myself regarding the issues I was researching, or that I consistently shared their terminology and approaches to the subject. This was especially important during the qualitative phase and focus group interviews, due to the danger of 'leading' my research subjects through my forms of questioning.

It is also important to state my own assumptions regarding the research paradigm, so they can be clearly accounted for throughout the analysis of data and resulting conclusions. At heart, I would describe my overriding beliefs as pragmatist, constructivist and qualitative in nature. However, I appreciate the need to visit other 'homes' of research methodology, to address questions using the most appropriate methods, and as such would probably define myself as a 'qualitative dominant' mixed methods researcher (Johnson 04).

Such conflict is exemplified in this project, by the research question 'Can we measure safety culture in veterinary practice?' The methodology chosen for this part of the project involved quantitative methods to gather numerical data and apply statistical techniques to allow the findings to be generalised to the population of veterinary practitioners as a whole. However, my post positivist tendencies would question whether this approach is sufficient, and would reframe the question as 'Can we accurately measure safety culture in veterinary practice by a single means which is valuable to that population?' In reality, a quantifiable measurement of such a phenomenon is a valuable addition to the literature, and in real terms, a useful tool for veterinary practice. The collection of data through the large scale use of surveys is now an important aspect of healthcare research, but I do not believe that it valuably and accurately measures safety culture *on its own*. For this, the additional use of qualitative method is valuable, to gain a deeper understanding of such a complex phenomenon, a view shared by others in relation to safety culture in human healthcare (Morello et al., 2013). This betrays my underlying position on the qualitative-quantitative paradigm, and my subsequent assumptions, which have contributed to my decisions and shaped the research design.

3.3 Research Strategy

The context of the study is the understanding of veterinary error and veterinary safety culture. Both these phenomena are 'new' in the field of veterinary science, and very little is known about them. Certainly there was virtually no published research available at the time this study began, relating to either aspect. Qualitative methods were used therefore to elicit a greater understanding about the beliefs, attitudes and perceptions of clinicians regarding

veterinary error, its causes and effects. The themes which evolved from this qualitative phase were triangulated against those in the related medical literature. The oft quoted drawback of qualitative research is its lack of general application to the wider population. However, the themes drawn from this qualitative phase informed the development of the second quantitative phase, the results of which can be more confidently attributed to the veterinary profession as a whole. Quantitative methods were subsequently employed to create a validated measurement tool of the social phenomenon of veterinary safety culture.

The project evolved inductively, as the central research questions emerged and were shaped through an iterative process. The study was divided into three phases, each one informing the next. A general sequential exploratory strategy developed, with elements of concurrent embedded design included in the middle phase, see figure 4.1. This strategy is recognised as the procedure of choice when developing instruments when existing ones are unavailable, as was the case with veterinary safety culture (Cresswell et al., 2012).

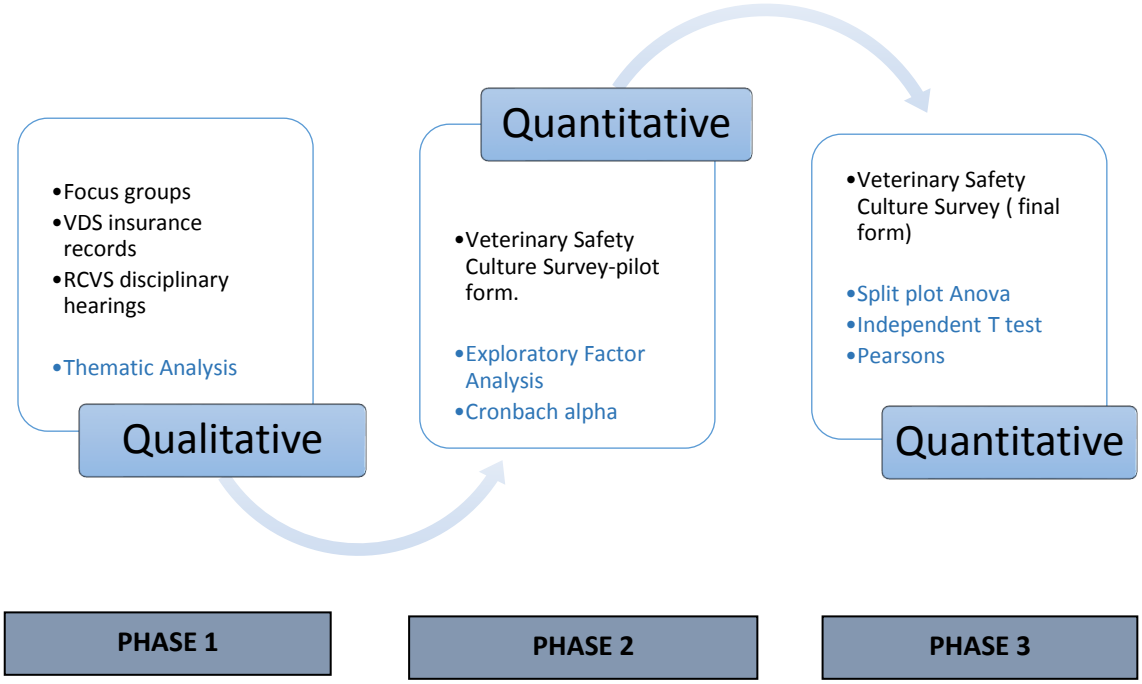


Figure 4.1 Visual representation of the sequential exploratory research strategy, showing data collection and analysis methods. Adapted from (Creswell and Clark, 2007)

An overview of the project as a whole and the placement of the research questions within it is presented in figure 4.2. This depicts the three phases of the project and shows their linked and interdependent nature.

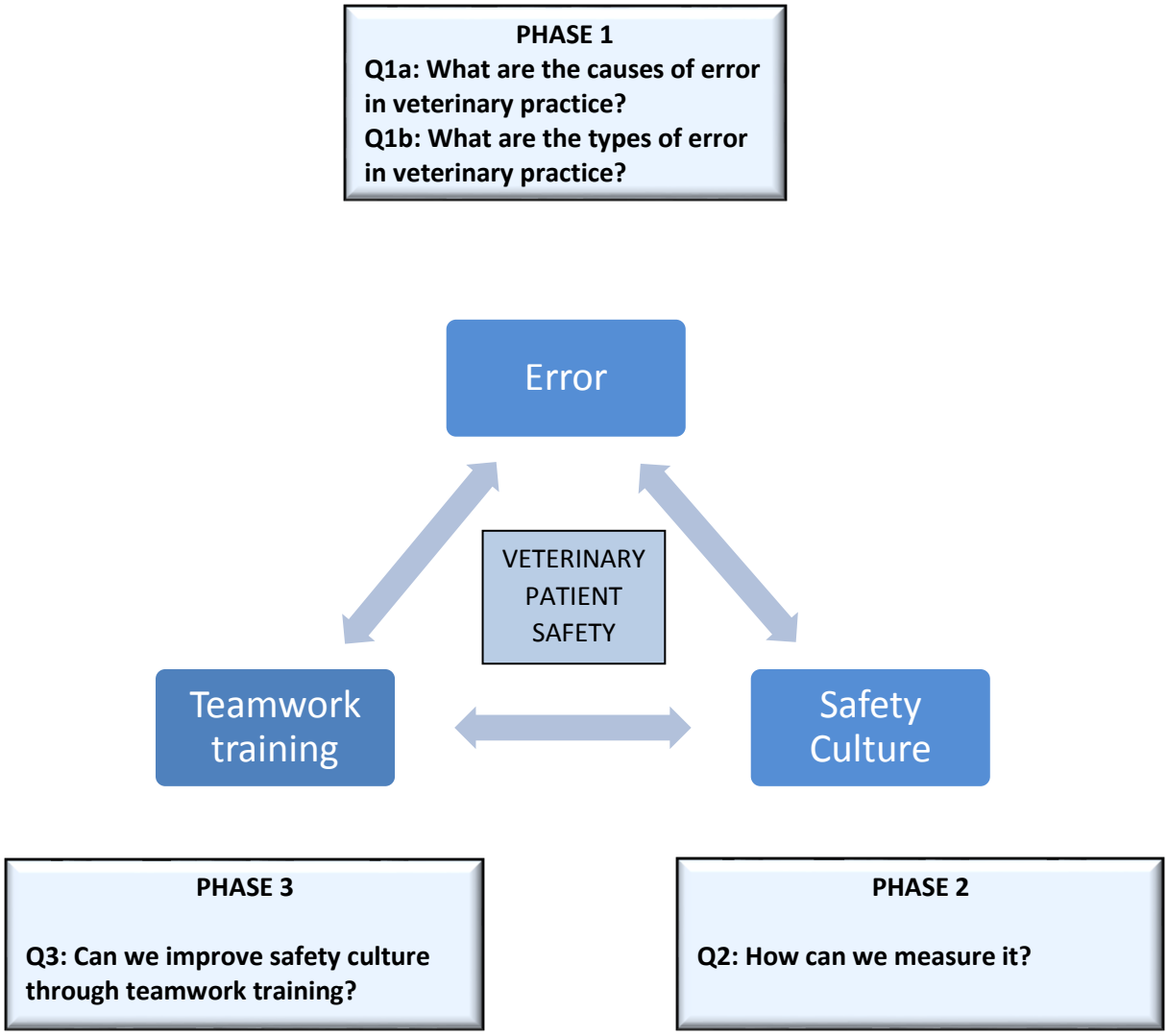


Figure 4.2: Overview of the project, three phases of study and relevant research questions

3.4 Data Collection

As a mixed methods study, both qualitative and quantitative data was generated through a variety of methods. These will be examined in general terms below, with more detail provided within the relevant following chapters.

3.4.1 Qualitative techniques

Focus groups and interviews

Focus groups are a well-recognised method of gathering data to understand how people feel or think about an issue, and gather opinions. They are particularly useful for exploring ideas and concepts, as the interaction of a social group encourages the discussion and exploration of both personal and group perceived themes. Together with in depth interviews, they are the most commonly used form of qualitative data gathering in healthcare research (Tong et al., 2007).

Participants are selected for their experience of the phenomenon under study, and a group of 6-12 people is led by a facilitator who creates a 'safe' environment in which people can discuss the topic of interest. People are most likely to disclose their true opinions when they feel comfortable, respected and trust their environment. Much of this is facilitated by the skill of the moderator, whose job it is to maintain the focus of the discussion on the area of interest, diffuse hierarchical or personality issues and keep the discussion moving (Tashakkori and Teddlie, 2010).They are often used to provide insights into organisational issues, such as development and quality.

Criticisms of focus groups include the effect that social desirability bias can have on participants answers, and the tendency for participants to 'intellectualise', describing their actions and behaviours in terms of rational thought processes rather than the slightly more messy and emotional responses which occur in real life. (Krueger and Casey, 2014). They can also be dominated by one or two particularly opinionated people, limiting the prime objective of allowing discussion as a group, and the findings cannot be generalised to the greater population, calling into question the 'validity' of the findings. There can also be

practical difficulties in recruiting participants. However they are often used in the initial phases of research to generate hypotheses, and inform the development of subsequent research, or used at the end of a research project to deepen the understanding of previous results.

Focus groups were used in this study, to create an environment for the discussion of veterinary error, its causes and effects. As a sensitive subject for discussion at both a personal and organisational level, it was especially important the participants felt safe to discuss their experiences, and that the groups were run in a non - judgemental manner. Developing a rapport with the group and engendering trust was an important part of generating quality in the data, and was facilitated by the researcher's own experience of veterinary practice and the perception that they were 'part of the club'.

Secondary data sources

Pre-existing data sources may include the selection of words which already exist in written form, and which the researcher played no part in producing, such as official documents, newspaper and magazine articles. They can be useful, as the responses have not been shaped or biased by the data gathering technique, and can help to answer research questions concerned with 'experience, understandings and perceptions, accounts of practice and influencing factors' (Braun and Clarke, 2013). It is important to define a particular inclusion criteria for this type of data, and a justifiable sampling strategy. There is also a particular question of ethics surrounding the use of data which is in the public domain.

Two sources of 'pre-existing textual data' were collected as part of this research project. Historical records of insurance claims were obtained from the profession's largest insurance provider, and combined with primary data from the focus groups. Publically available data regarding the outcomes of the Royal College of Veterinary Surgeons disciplinary hearings process was acquired from the College website.

3.4.2 Quantitative techniques

Questionnaires

Questionnaires are commonly used tools to generate large sets of data, through relatively cheap and easy means, often while maintaining a respondents anonymity (Gillham, 2008). They are a frequently used method of data collection in health service research (Cook et al., 2009). Their design and application deserve careful consideration as they have significant effects on response rate, type and quality of data received. Questionnaires can be unstructured and exploratory, generating qualitative data, or structured and 'closed ended', with a limited choice of responses producing numerical data. Some forms employ both methods with a combination of closed and open ended questions.

Structured questionnaires can be successfully distributed via post or email to large groups of people, or given to participants personally, so facilitating a deeper interaction between the participant and researcher (Bowling, 2014) One of the main disadvantages of structured questionnaires is that the limited choice of answers may 'force' participants to choose an answer which does not fully reflect their viewpoint. They also assumes that a) participants can read and understand the question b) that they interpret that question as the researcher

intends and c) that they can formulate a coherent answer. Here lies an inherent weakness of surveys, especially those which attempt to measure attitudes, beliefs and experiences, as not everyone shares the same perspective. Responder bias in the forms of social desirability, recall, and responses to question framing are also potential problems, as is the issue of non-response bias or the effect of self 'de - selection'.

Likert scales are frequently used in surveys which attempt to measure attitudes and are the most popular format employed as a method to transform participants answers into numerical form (Oppenheim, 2000). They are easy to construct and allow the participant to place themselves on an attitude continuum, in response to a statement, usually ranging through 5 – 7 positions from strongly agree to strongly disagree, including a neutral midpoint. Reliability of Likert scales is generally good, but one of their most common criticisms concerns the interpretability of scores in the mid-range. These answers could indicate a lack of understanding, lack of attitude, or simply a 'lukewarm' response to the question (Oppenheim, 2000). Additionally, there is much debate about the common assumption that Likert score results represent interval data, and the subsequent employment of parametric statistical techniques in their analysis. This will be discussed in more detail in Chapter 5

As well as the strategy employed to distribute such a measure, the selection of the tool itself must be carefully considered. Establishing the psychometric reliability and validity of a survey is essential to assess the quality of the data it produces. The internal reliability of an instrument is a statistical measure of how consistently and repeatedly it generates data. Types of reliability assessment include test - retest, alternate – form and internal consistency. Similarly, there are various measures of survey validity which assess how

successfully the tool measures that which it pertains to measure. These include, in increasing levels of robustness, face, content, criterion and construct validity (Litwin, 1995).

The use of a survey in this project presented some unique challenges. While a wide range of instruments were available to assess safety culture in the medical field, there was no measurement tool designed specifically for the veterinary profession. Consequently, phase two of the project involved the development, piloting and validation of such a survey, employing all the methods outlined above. These will be discussed in greater detail in Chapter 5.

3.5 Sampling methods

Sampling methodology is a key component in the quality of any study design, however the aims of sampling differ between quantitative and qualitative methodologies resulting in a wide variety of techniques available to the mixed methods researcher. The selection of each technique must inevitably be a compromise between a desire to use the most robust and appropriate method, and the constraints of feasibility.

3.5.1 Qualitative techniques

The aim of qualitative research is to explore and understand constructs, *not* to produce results which are generalizable to the greater population (Bowling, 2014). Sampling methods reflect this. They are often purposive, non – random and chosen from a selected group identified as being most likely to generate data in the area of interest, and smaller in size than quantitative samples. Indeed there are no 'rules' to guide sample size decisions,

rather, the concept of saturation is often used to determine their limits. Saturation, is the point reached when *more* data fails to produce *fresh* data, when no new themes or information are produced from subsequent data, over and above what has already been generated. It is the commonest determinant of sample size employed in the field. (Braun and Clarke, 2013)

Some common purposive sampling strategies include convenience, snowballing or friendship pyramiding, stratification, theoretical and criterion sampling. Participants for this study included clinical veterinary staff, veterinarians, veterinary nurses and care assistants, all of whom work long hours, often with limited, ad hoc breaks and fractured shift patterns. Recruitment of these participants to take part in a study which discussed concepts both potentially sensitive and poorly understood by that population presented a significant challenge. Recruitment strategies employed included identifying key individuals, or 'gatekeepers', contacting professional organisations, through which access to participants could be gained, and harnessing the reach of social media using Facebook. These strategies dictated the use of both convenience and snowballing sampling techniques to generate populations of study participants. Criterion sampling was also used to generate data sets from specific sources, such as the insurance records from a particular company, and information available on the Royal College of Veterinary Surgeons (RCVS) website (Patton, 2005). This is an example of sampling data from specific events or criteria, in this case, veterinary malpractice claims and the disciplinary hearings of the RCVS.

3.5.2 Quantitative techniques

Traditional quantitative methodology values random sampling as the gold standard method by which to generalise results to a given population. In a truly random sample, each individual has an equal chance of selection from the population, and the resulting sample can be inferred to be a true representation of the greater mass. Methods of sampling which aspire to achieve this include unrestricted and simple random sampling, systematic, stratified and cluster sampling.

These methods, although they were considered, were not judged suitable for the quantitative studies presented in this thesis. As discussed above, the eligibility criteria for the sample population comprised practicing clinicians under constant time and financial pressure. Response rates to 'cold call' surveys are generally poor, with Gillham (2008) quoting rates as low as 30%, and are affected by issues such as survey length and issue salience (Sheehan, 2001). Phase two of this project involved the distribution of a survey in pilot form. As such it was long, more than usually time consuming to fill in and concerned the issue of safety culture – a poorly understood concept for the profession. Practical restraints such as a lack of funding precluded the possibility of offering individual incentives or employing widespread advertising. It was therefore decided to use the contacts established from phase one of the project, and employ snowballing within a convenience sampling framework to generate participants for the project. As a non -random method, this does not fall within the remit of probability sampling and so statistical measures of sample error do not apply (Oppenheim, 2000).

The aim of phase three was to explore the feasibility of running a training programme linked to safety culture, not to generalise those results to the greater population of veterinary

practices. Cluster sampling was used within a convenience framework to select a group of practices. The use of such a non-probability sample is justified as the study was intended to be a pilot, to explore the potential effectiveness of such a programme on a larger scale. (Fink, 2003).

3.6 Data analysis

3.6.1 Qualitative techniques

Thematic Analysis (TA)

Thematic analysis (TA) has been described as the search for themes which impart meaning to the description of a phenomenon. It is a form of 'pattern recognition' which involves the scanning of data for 'tags' or 'themes', which then become the focus of analysis. This process may be inductive, deductive or a combination of the two (Fereday and Muir-Cochrane, 2006). Inductive analysis uses a 'bottom up', data driven approach to extract themes solely from the data. In contrast, a deductive or 'top down' analysis applies a preconceived theoretical framework to the data, to identify relevant themes. A combined approach was used in the majority of this project.

Thematic analysis' flexibility, in part, stems from a lack of prescriptive data collection method. TA can be used on a wide variety of qualitative data, including interviews, focus groups, and secondary data sources as diverse as government documents, television shows or magazine articles. It was first described by Braun and Clarke (2006) as a stand alone method of analysis, rather than simply a component part of a larger method. Since then it has been widely employed in health service research (Braun and Clarke, 2014).

Other forms of qualitative analysis such as grounded theory and content analysis were considered in this study, but rejected in favour of thematic analysis, for its theoretical flexibility, and ability to provide a deep, rich and detailed assessment of data (Braun and Clarke, 2006). One of the criticisms of TA is that it is not a robust method of analysis, and does little more than provide a descriptive account of the data (Braun and Clarke, 2014) . However, TA can be applied within different theoretical frameworks, to provide descriptive analysis which range from superficial to deeper meaning, depending on its application and the researchers paradigm. As such, it is a method which is well suited to a mixed methods project which rejects dualism and is not fervently tied to any extreme theoretical stance.

Thematic analysis was used primarily in this project to explore and identify the causes of error in veterinary practice. In doing so, it was applied within a contextualist framework, which recognises that the data both reflects the participants own perceptions of reality and the shaping effect that environmental factors have on those perceptions. In a discussion of the causes of error, this enabled the researcher to access both the cause as stated or perceived by an individual and to probe the potentially deeper implications behind such statements. This approach facilitated a richer level of understanding than would have been gained from a more 'realist' method such as content analysis, without the theoretical constraints imposed by a grounded theory technique, which seeks to generate *theory* from data, rather than simply enhance *understanding*.

3.6.2. Quantitative technique

Factor Analysis (FA)

Factor Analysis is a commonly employed statistical technique used to simplify large sets of data (Kline, 2014). It seeks to reduce a large matrix of variables down to a more compact

'solution', where a smaller number of 'factors' explain the variance in the larger data set. This is achieved by measuring and comparing the correlations between pairs of variables – ie the degree to which the two agree or overlap, to create a correlation matrix of the entire data set. Factor analysis then determines the smallest number of factors which account for the majority of the variance within the data. The variables then cluster or 'load' onto these different factors. A factor has therefore been described as a construct 'operationally defined by its factor loadings', the factor loadings being the correlation of the variables with the factor (Kline, 2014).

This mathematical factor model is then translated into an interpretable solution; one which makes logical sense. The groups of variables which cluster onto individual factors are examined for themes which describe their general appearance, and this is used to 'label' the factor with a sensible description. The factors therefore represent descriptive components of the greater phenomenon, and together provide a comprehensive account of its make - up. As such, it is a mathematical method of defining and simplifying complex ideas and phenomenon, and is a fundamental technique in the disciplines of psychology and the social sciences (Osborne and Costello, 2009). It exists in two forms, exploratory factor analysis (EFA) and confirmatory factor analysis (CFA). *Exploratory Factor Analysis* seeks to investigate new phenomenon, and discover their component constructs and dimensions. It aims to simplify complex, messy, multivariable concepts and identify the most important aspects of the construct. It has been widely used in the study of intelligence and personality, and the development of psychological tests (Kline, 2014). It is a valuable technique in fields where data are complex, and little is known about the relative importance of their constituent constructs. EFA was the technique used in this study, to investigate the previously unexplored concept of safety culture in veterinary practice. *Confirmatory Factor Analysis*, in

contrast, seeks to assess the 'fit' of data to previously defined factor frameworks. It is therefore used to 'confirm' a hypothesis of factors, determined by previous research or theory.

There are criticisms of factor analysis. It can be difficult to replicate FA results, as there are an infinite number of mathematical solutions (Fields, 2005). However, this is mitigated by techniques such as rotation, which will be discussed further in Chapter Five. A further objection is that the results of analysis rely on the quality of the input; to paraphrase, what you get out is only as good as what you put in. The technique can only extract factors from the data it is given, so the quality of the output is determined by the quality of the content supplied for analysis. For this reason it is important to sample as wide a variety of variables as possible, in order to maximise the chances of FA identifying all the constituent components of the phenomenon under study.

Other statistical tests

Cronbachs alpha (α), Independent T test, Pearson's correlation and Split plot ANOVA

These tests were used to assess the internal reliability, alternate form, test- retest reliability and construct validity of the questionnaire and intervention, developed in phases two and three of the project, see table 3.3. These tests will be discussed in further detail in the relevant chapters.

The research question	Qualitative techniques used	Quantitative techniques used
1a.What are the causes of error in veterinary practice?	**Thematic analysis** of closed claims to VDS and semi structured individual and focus group interviews.	
1b. What are the types of error in veterinary practice	**Magnitude coding** of focus group discussions and VDS claims	
2a. What is safety culture in veterinary practice		**Exploratory Factor Analysis** of VSCS survey results
2b. Can we measure safety culture in veterinary practice		Questionnaire reliability and validity assessment. **Cronbachs α , Pearson's, Independent T test**.
3. Does safety culture improve following teamwork training		VSCS questionnaire before and after compared with control group **Split plot ANOVA**

Table 3.3: An overview of the research questions and the methods employed in their investigation.

3.7 Ethics

In research, there is an implicit ethical obligation to cause no harm to the human participants of a study (Shamoo and Resnik, 2003). This research involved the collection of data from personnel employed in private veterinary practices. The subject under investigation often touched on topics which provoked a strong emotional response, or had potentially serious implications for censure from peers, discipline from employers or external litigation, both civil and professional. There were considerable time demands and financial implications for practices who participated in the study, and the researcher was granted access to a large body of confidential and highly sensitive data from the profession's largest insurance company, The Veterinary Defence Society (VDS). As such, the logistics surrounding data collection, and the ethics regarding the protection of subjects were very much at the forefront of the researchers mind when designing the study. Issues of confidentiality and anonymity, as well as those of data protection were actively considered. Further details of the relevant information and consent processes for each study within this thesis are provided in the relevant chapters.

The research was approved by the School of Veterinary Medicine and Science ethical control panel, approval number : 582 120420, and carried out in accordance with the University of Nottingham's 'Code of Research Conduct and Research Ethics' policy.

Summary

This chapter has presented the pragmatic, mixed methods strategy used to answer the research questions presented in Chapter 2. It has justified the selection of research techniques and tools and defined the researcher's own scientific paradigm, and the influence this has had on that selection. Details of each phase will be presented and developed further in the following three chapters.

Chapter 4

The Causes of Error in Veterinary Practice

4.1 Introduction

The overarching aim of this project was to improve patient safety in veterinary practice. This chapter will present the first study of the thesis: an investigation into the causes and types of veterinary error.

Error in other industries is regarded as the product of the cognitive limitations of the human mind together with the effect of the 'system'. Human error theory has been widely used in medicine to analyse and investigate the causes of mistakes, often based on Reason's swiss cheese theory and model of organisational accident causation (Taxis and Barber, 2003, Reason, 1995). 'Active failures' of individuals at the sharp end include slips and lapses, mistakes and violations, and are seen as the final step in a chain of events. They are influenced by 'latent failures' within the system, which weaken organisational defences and influence the working conditions of individuals on the front line. These include imperfect organisational processes, designs and systems which combine to place the human operator in a position where naturally occurring human error has harmful consequences (Reason, 1995).

An example of this in medicine are medication administration errors (MAEs), especially those delivered via the intravenous route (Keers et al., 2013). Human error analysis of such errors reveals that they are not just caused by one individual's act, but by a range of

organisational and management issues, including training, high workload, poor supervision, inadequate communication, distractions and interruptions, purchasing policies and design of technology of devices such as syringe drivers (Keers et al., 2013, Taxis and Barber, 2003). Investigating error within a framework such as Reason's model facilitates the identification of latent or system failures, and is a commonly accepted technique in other industries (see figure 4.1)

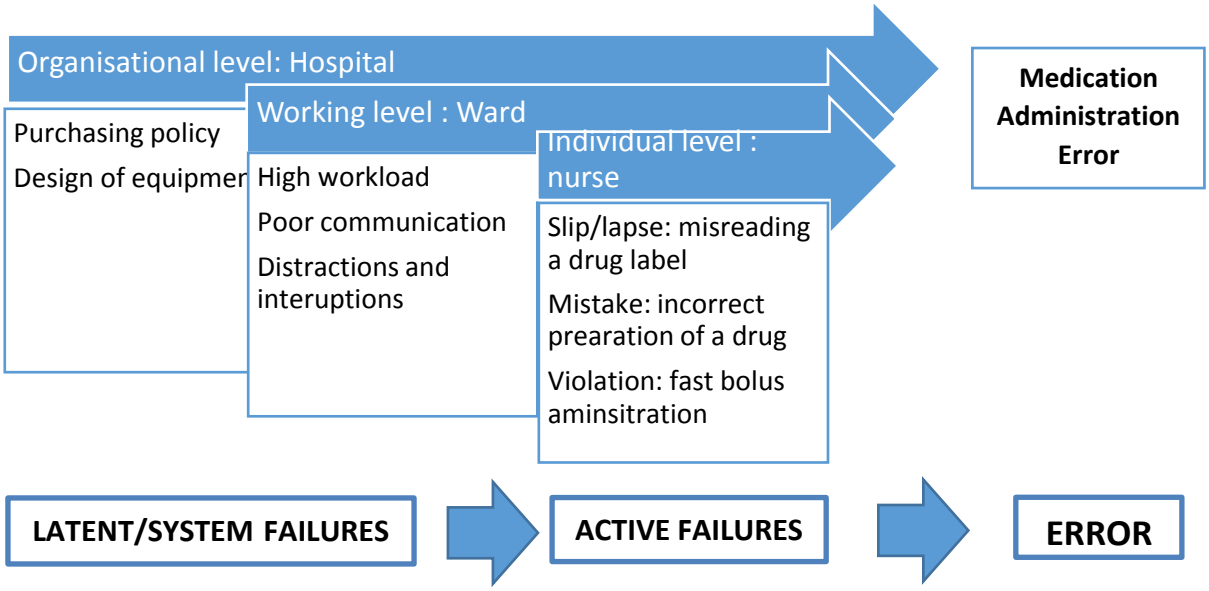


Figure 4.1 Reason's accident causation model, showing how it may be used in the analysis of MAEs. Adapted from Reason (1995).

In contrast, the investigation of veterinary error is unlikely to be so well informed, with no veterinary frameworks of error causation available. Evidence regarding the true causes of veterinary error is scant. It is an uncomfortable subject on which to dwell, with very little information available to practitioners informing them of potential causes or solutions (Tivers, 2011). The Veterinary Defence Society (VDS), the largest veterinary professional indemnity insurance provider in the UK, traditionally produces a quarterly newsletter which provides information regarding the circumstances surrounding a choice selection of errors

which result in claims. The Royal College of Veterinary Surgeons (RCVS) publishes the results of all Disciplinary Hearings, but provides no further structure to this in the form of useful feedback (Royal College of Veterinary Surgeons). In the absence of a national database, there is no formal evidence regarding the most common types of error in veterinary practice. There is also little data available from clinical audit. Rose (2016) describes the technique as being 'in its infancy in the veterinary profession', and Waine (2015) identifies significant barriers to its use in veterinary practice.

This lack of clinical audit and reporting data and formal investigative technique has implications for the veterinary organisational response to error and individual clinician's perception of the phenomenon. Medicine espouses a no blame culture. It formally accepts that the criminal prosecution of practitioners has overwhelmingly harmful effects and recognises that clinicians are often negatively affected by unexpected patient outcomes or 'second victim' syndrome (Dekker, 2007, Scott et al., 2009). A validated method of investigating adverse events (AEs) provides a pathway for clinicians to understand both their own limitations and the design of their systems, rather than simply focusing on personal 'failure'. Similar negative feelings of fear and emotional distress are reported in veterinary graduates in response to errors, including guilt, loss of self - esteem, low self - confidence, and depression (Mellanby and Herrtage, 2004). However there is little education or support provided by the profession in the aftermath of mistakes, limiting individual perceptions of how and why they occur.

Over the last 25 years, medicine has also developed evidence regarding the specific causes and types of error. Human error, rather than lack of knowledge or skill has been identified in 81% of hospital AEs with systematic failures in communication, supervision of junior staff

and the effects of inexperience recognised as important causal factors (Wilson et al., 1999, Sari et al., 2010). Poor communication alone is known to be responsible for at least 43% of adverse events (Carne et al., 2012). Medical research has also mapped the types of medical errors. Surgery is a high risk factor for mistakes with surgeons and interns the most likely clinicians to err (Thomas et al., 2000). 39.8% of AEs are linked to operations with errors in drug administration accounting for the following 15.1% AEs (de Vries et al., 2008). This pattern of error types is reflected in claims to insurance companies (Floyd 08).

The first phase of this study therefore aimed to answer the following research questions:

1: What are the causes of error in veterinary practice?

1i: What are the types of errors in veterinary practice?

1ii: What is the profession's response to error in veterinary practice?

Figure 4.2 shows how this phase of the project fits into the project overview map.

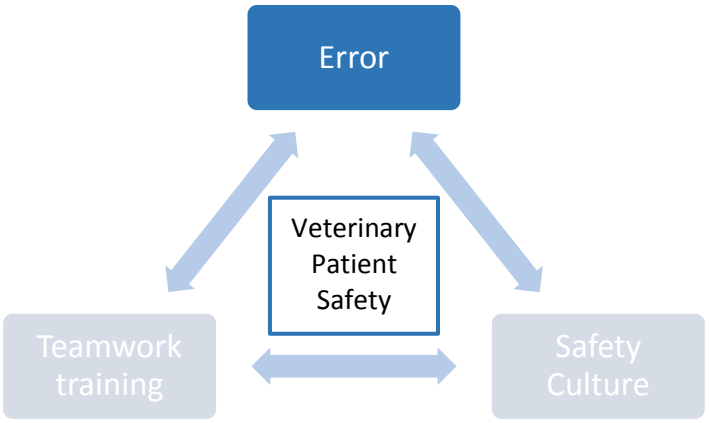


Figure 4.2 Project overview: Study one

The main aim of this phase of the study was to produce a typology of error *causation*. In addition it attempts to estimate the common *types* of error and assess the *profession's response* to veterinary error. The methodology underpinning the study will be presented. For clarity, the methods of data collection, analysis and results will be presented sequentially for each of the three aims: the causes of error, types of error and profession's response to error. The discussion of the results and limitations of the study will be presented in the final sections of the chapter.

4.2 Methodology

A qualitative methodology was adopted for the majority of this study. The main aim was not to generalise the results to the greater veterinary population, but to explore the causes of errors made by vets and nurses. This phase of the project probed a sensitive topic and investigated people's experience of events, within the context of very limited previous research. Qualitative research is best suited to exploring phenomenon where little is known, or when the subject is sensitive (Braun and Clarke, 2013) and aims to capture participants perceptions of experience, determine how meaning is formed and discover rather than test variables (Corbin and Strauss, 2008). It also allows for the fact that people's experience is shaped by their perception, and that this may differ between participants. This potential for multiple viewpoints was considered an advantage in exploring the many causes of error, and would have been constrained by more quantitative methodologies such as closed ended survey questions or quantitative data review. A small element of quantitative methodology was embedded within the overall qualitative design of the study in the assessment of the relative incidence rates of the types of errors and RCVS disciplinary hearings.

4.3 Methods

4.3.1 Data Collection

4.3.1.1 The causes of error

Veterinary Defence Society (VDS) records

The Director of Claims at the VDS was approached and asked to participate in an interview as part of the study. He was identified as a 'gatekeeper', an individual who would have an informed perspective on the causes of error in the profession, and the potential to grant the researcher access to a unique source of data. Prior to the interview the participant was given a statement detailing the remit of the study and a document requesting their consent to participate, which was signed and retained by the researcher. Following the interview, and a discussion of the project, the researcher was given access to twelve months of claims record précis, dating from January 2013 – January 2014. These consisted of short descriptions, written at the time of a claim's initiation, by the VDS claims consultants. The raw data was to be viewed by the researcher only, and no names or identifying descriptors were to be made public.

It should be noted that many claims to the VDS are motivated by a claimant's financial loss with no adverse effect on the patient. Claims also often stem from owner's unrealistic expectations or emotional distress. This is especially pertinent when an elective procedure has an unsuccessful outcome, and does not always infer that an error has been made. The VDS data should therefore be investigated with these limitations in mind. As this study aimed to identify the causes of veterinary errors which caused patient injury, inclusion criteria were defined to include only insurance claims which dealt with measures of patient

harm. Therefore, claims relating to non – harm complaints such as equine pre purchase examination disputes or certification errors, were excluded from the data set.

Focus Groups

Nine focus groups (average N per group = 8) consisting of clinical veterinary staff were organised during the spring of 2014, with the aim of discussing and exploring the causes of veterinary error. A convenience sampling and snowballing technique was used to generate participants for eight of the nine groups. Individual veterinary surgeons and nurses were contacted and invited to participate, who then invited their colleagues to attend. In seven of the eight groups there was a mix of vets and nurses, however, one group was restricted to nurses only. This was purposely to reduce the hierarchy effect potentially present in the other groups, and increase the breadth of data gathering. These groups consisted of colleagues who regularly worked together in the same practice. A purposive strategy was employed for the final group, which invited veterinary surgeons attending the annual conference of the Association of Veterinary Anaesthesia to attend a focus group as part of an afternoon conference stream. The demographics and personnel attending each focus group is shown in Table 4.1

Focus group number	Number of Vets (V) and Nurses (N)	Type of practice	Routinely worked together
Focus group 1	V=11 N=0	Small animal department of a traditional mixed practice. 1st opinion.	Yes
Focus group 2	V=4 N=3	Small animal practice. 1st opinion.	Yes
Focus group 3	V=9 N=1	Small animal practice. 1st opinion and referral hospital	Yes
Focus group 4	V=3 N=2	Small animal hospital practice. 1st opinion.	Yes
Focus group 5	V=12 N=1	Conference meeting at the Association of Veterinary Anaesthetists annual congress.	No
Focus group 6	V=3 N=2	Small animal practice. 1st opinion.	Yes
Focus group 7	V=0 N=5	Single branch of a multicentre, small animal practice. 1st opinion	Yes
Focus group 8	V=3 N=3	Small animal practice. 1st opinion.	Yes
Focus group 9	V=5 N=0	Small animal hospital practice, part of a national group. 1st opinion.	Yes

Table 4.1 Table of focus groups showing professional demographic and type of practice

Before each group, participants were given an information sheet discussing the project, and a consent form, which was signed and returned to the researcher. A copy of the information sheet and consent form can be seen in Appendix 4a. The researcher then introduced themselves, described the aim of the study and the format for the discussion. To help engender rapport and trust with the researcher, each group began with a description and discussion of a clinical mistake made by the researcher herself (CO), while working as a practicing vet. In an effort to improve confidence and encourage full disclosure around a sensitive subject, the group was reassured that the results of the discussion would be anonymised so individuals and practices could not be identified.

The participants were then asked to recall one or two incidents they had themselves experienced or directly witnessed where an error resulted in patient harm, and write a one sentence description of each incident on index cards. These were collected by the researcher, and fed back to the group for discussion. The participant whose card was selected was invited to 'tell the story' surrounding the mistake, guided by the facilitator who asked probing questions relating to the causes and prevented the focus of discussion straying to the subsequent after effects. The participants were then invited to question and comment on the facts as a group, to further elucidate or refute contributing factors. This method employs Critical Incident Technique (CIT) as a guide to the discussion (Flanagan, 1954). It is a form of incident analysis which minimises the effects of opinion and hindsight as it calls for the detailed description of a recalled event, and invites comment. The groups were run until saturation point was achieved, and were recorded and transcribed verbatim. The transcripts were then anonymised and coded so that they could not be attributed to any particular practice or group, and the code book stored separately to the transcripts themselves

4.3.1.2 The Types of error

The researcher obtained five years' worth of figures from the VDS (2009 to 2013), relating to the types or source of claims. Transcripts of the focus groups were also used to assess the types of veterinary error described by the participants.

4.3.1.3 Profession's response to error

Focus groups

The transcripts from the focus groups were used to assess the profession's response to error.

RCVS Disciplinary hearings

The RCVS is charged with investigating any complaint made about a member of the profession, and employs a strict protocol to the procedure. The records of all 34 disciplinary hearings carried out by the RCVS between January 2012 and December 2014 were downloaded from their website.

4.3.2 Data Analysis

4.3.2.1 The causes of error

The transcripts of the focus groups and precis descriptions of claims from the VDS were entered into the NVivo software programme (QSR International Pty Ltd, 2012). They were analysed as two separate groups by thematic analysis, to determine the contributing factors of veterinary error in each and enable triangulation of the results. The process was both

deductive and iterative. Some theoretical knowledge was employed, in the application of Reason's Swiss Cheese model of error and organisational accident model (Reason, 1995, Reason, 2000a). This was used to guide the assessment of the data for root causes on multiple levels, not simply the perceived failings of an individual clinician. The results were also ordered into two 'branches' of contributory factors, informed by the error literature, and relating to the human factors concepts of 'system' and 'individual' failures. However, themes were allowed to emerge from the data inductively, with no preconceived categorisation. This was to enable a true picture of veterinary error to emerge, not one which would be shaped or constrained by the findings and categories from other industries, which may or may not be applicable to the veterinary profession.

The two sets of data were then triangulated against each other. There was significant overlap between both the data sets and the two sets of coding were combined into a final typology.

4.3.2.2 The types of error

The VDS claims figures were presented pre-sorted into the categories determined by the company's own framework. Claims relating to non – harm complaints were identified and excluded from the final data set. Claims categories from which a type of error could not be confidently identified (eg 'unsatisfactory outcome') were also excluded. The remaining data was ranked in order of magnitude of the most common categories used by the company's claims consultants.

Magnitude coding (Saldaña, 2012) was applied to the focus group transcripts to assess the types of error which were most commonly discussed by the participants, and explore any themes which may emerge.

4.3.2.3 The professional response to error

In addition to coding for causes of error, a further code was created to capture comments from the focus groups which related to the attitudes of participants regarding error.

The results of the RCVS disciplinary hearings were ordered by their outcome, to assess the patterns of misdemeanours the RCVS investigate at the highest levels and asses the number and type that result in professional sanctions.

4.4 Results

4.4.1 Results: Causes of error

VDS claims themes

678 insurance claims reported between January 2013-January 2014 were examined. 156 (13%) were excluded from further analysis as they did not include an error or patient harm and were reported for financial or other dispute. A further 121 claims (24%) were excluded as they did not contain enough information to confirm a cause of error. Thematic analysis of the remaining 225 claims produced eight level one themes representing contributing factors to error. These are displayed with their definitions in table 4.2

Theme (Level 1)	Description
Cognitive	Error resulting from the limitation of psychological processes (slip, lapse, mistake)
Communication	Error due to failure of communication between significant parties. Includes written and verbal, lack of and misunderstood communication
Leadership	Error due to lack of clear leadership either with an individual or within a team
Productivity	Error made or contributed to by decisions motivated by productivity rather than best practice
Lack of technical skill	Error due to fundamental lack of knowledge or skill. Includes lack of training and practicing outside ones area of competence
Owner factors	Error contributed to or resulting from the actions of an owner
Veterinary specific	Errors caused by the specific nature of veterinary work - includes animal temperament and environmental conditions
Inadequate care	Violations - refusing to practice evidence based medicine

Table 4.2 Causes of error level one themes from VDS claims data

Focus group themes

Thematic analysis of the focus group transcripts produced eight themes shown with their definitions in table 4.3

Theme (level 1)	**Definition**
Cognitive	Error resulting from the limitations of psychological processes
Individual	Error resulting from the limitation of human performance because of personal problems – eg fatigue, stress, mental illness
Communication	Error due to failure of communication between significant parties. Includes written and verbal, lack of and misunderstood communication
Leadership	Error due to lack of clear leadership either with an individual or within a team
Design of products and equipment	Error resulting from poor human / instrument interface
Lack of technical skill	Error due to fundamental lack of knowledge or skill. Includes lack of training and practicing outside ones area of competence
Productivity	Error made or contributed to by decisions motivated by productivity rather than best practice
Veterinary specific	Errors caused by the specific nature of veterinary work - includes animal temperament and environmental conditions
Owners	Error contributed to or resulting from the actions of an owner

Table 4.3 Causes of error level one themes from focus group data

Combined typology

The two sets of results were combined to produce an overarching typology of 10 level one causes of error. The final typology is shown in figure 4.3, with causes split into active and systems 'branches'. The full typology of level one and two themes can be seen in Appendix 4b. Each theme is described in the following sections, with quotes from the focus groups or claims details used to demonstrate meaning

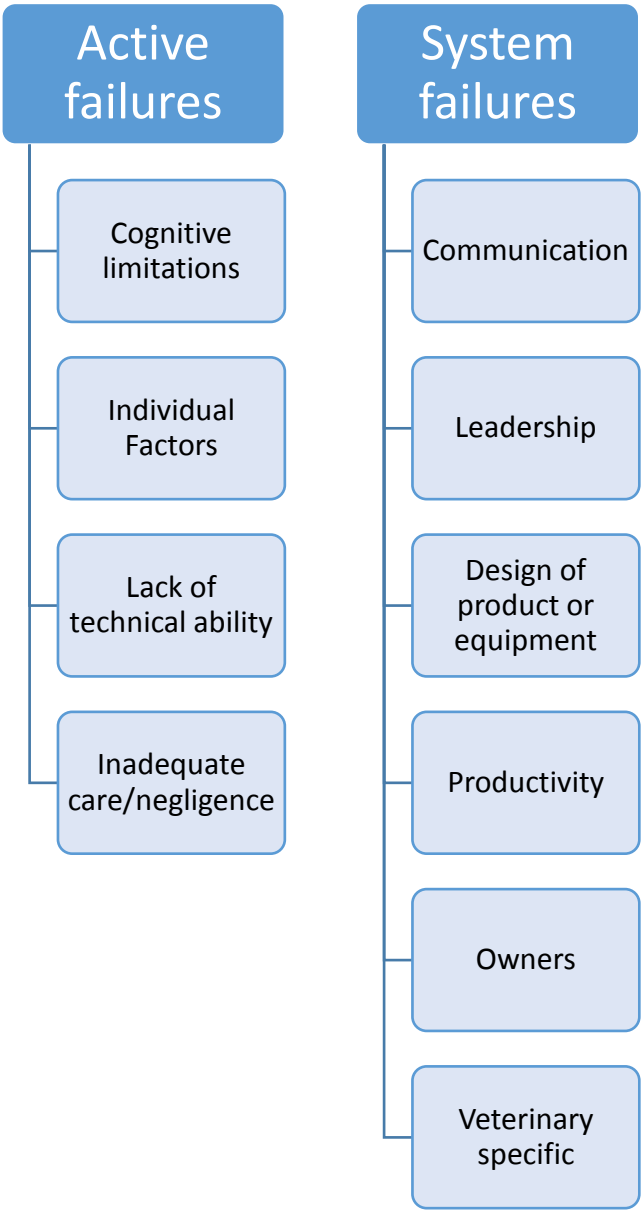


Figure 4.3 The combined typology of the causes of veterinary error

The above typology was then further organised into levels and a nested structure, see figure 4.4. This enabled a visual representation of the proximity of error to the patient, and further conceptualises the organisational error model, by showing how faults far removed from the point of care have direct consequences on patient safety. It also shows how themes such as leadership and communication can impact across a number of levels.

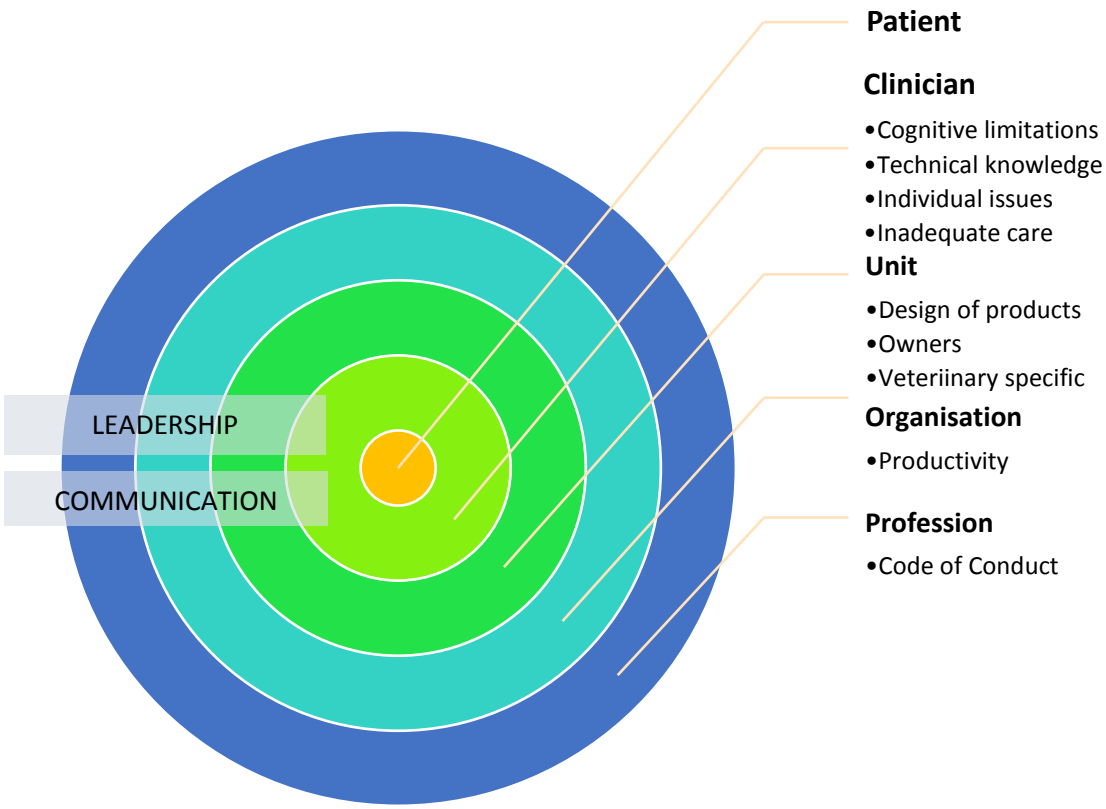
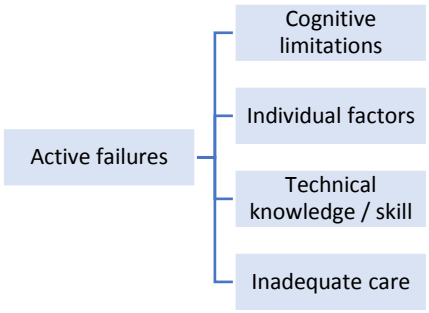


Figure 4.4 Nested structure of veterinary error showing proximity to the patient

4.4.1.1 Active Failures



'Cognitive limitations' was the code applied to descriptions of errors where a psychological limitation in the form of a slip, lapse or mistake could be identified or was implied. Slips and lapses, presenting as 'absentminded' errors, included examples such as omitting to turn on the oxygen before a procedure, or leaving a swab in an abdomen after an otherwise routine surgical procedure.

> *Nurse : You are checking it is all okay, but actually you are forgetting to check the oxygen was on*.
>
> (Focus group 5)

> ***Facilitator: Blinded a cat running on nitrous oxide without oxygen?***
>
> *Vet: without oxygen when it was in for a spay*
>
> ***Facilitator: the nitrous got turned on but the oxygen didn't?***
>
> *Vet: nitrous got on, second year trainee nurse*

Facilitator: she turned the wrong nozzle on basically

Vet: yeah yeah or she was…yeah. I can only presume she thought she was doing what she thought she was doing when she didn't

(Focus group 1)

These absentminded errors were often associated with a sense of distraction.

Nurse: I think it's when people get interrupted doing a task. You're busy doing it. Somebody says, 'Can you just do this?', and you can, so you stop what you're doing and you go there and then you forget that actually-

Facilitator: You were at that stage in your task?

Nurse: Yeah. Even if it's just holding the back of the cat for a second because it's wriggling and then you just forget that you're half-way through it.

(Focus group 7)

Overreliance on both short term and long term memory was also identified. The following extract demonstrates both: a failure to correctly retrieve a dose rate from the long term memory store, followed by an erroneous attempt to calculate a drug dose 'in their head'. This type of psychological computation relies on short term or working memory which has a limited capacity, and would have been further constrained by the fact that the participant was operating at the same time.

Vet: I was operating at the time and I for some reason thought I could remember what the mgs per kg of metacam was and obviously I couldn't. And it was when it

came in vomiting and they said 'look this metacam makes dogs vomit' and then I saw…

Facilitator: And was it definitely that you'd said the wrong dose? It wasn't a typo?

Vet: No no no. Then I realised that I'd done it wrong because I'd done it wrong in my head.

(Focus group 1)

The effects of cognitive bias, such as conformation and frequency bias, presented in the form of diagnostic tunnel vision and the temptation to jump to diagnostic conclusions. The inability to see a refractory case with fresh eyes can be a manifestation of confirmation bias, which results in the selective acceptance of evidence which supports previous conclusions and rejects that which does not 'fit' the established pattern of thought. It is implied here by the vet's persistent attempts to treat a suspected allergic skin condition, despite no improvement in clinical signs or response to treatment.

A nine year old Cocker Spaniel was presented with an infected skin condition affecting its chin, ventral throat and medial thighs in March. An underlying allergy was suspected and treatment with antibiotics and steroids instigated. Various combinations of steroids, antibiotics and ketoconazole failed to stop the condition progressing to the ears, periocular area, chest and ventrum over the next six weeks. At this point the dog was booked in for biopsies but the owner cancelled. Treatment continued without effect and two weeks later referral was arranged to [place anonymised]. Before this could take place the condition deteriorated and the skin biopsies were taken. Demodex was discovered.

(VDS precis claim)

Frequency bias is operationalised in the oft quoted maxim that 'common things are common '. While this can be a helpful guide to narrow a list of differentials, the inclination to select the 'pattern' which has been most frequently or recently used exerts a strong influence on clinical reasoning and decision making, and can result in the tendency to jump to conclusions

> *Vet : 'you can get led though a little bit … it says KC and you think 'Oh it's got…' you know, and you make it fit'*

(Focus group 3)

In older clinicians, it can present as an over reliance on mental models, to the detriment of a full investigation or consideration of all the possibilities.

> *Vet : Because I think you would be inclined to be more cautious I think if you were a, if you were a newer graduate, so if you'd been given that as a newer graduate and you don't know how often these things happen and you know it does happen you might be more inclined to check and see.*

(Focus group 2)

Mistakes, or more involved errors in decision making, presented as a limited means of self-checking in younger vets, who lack the mental map formed by experience and are therefore more inclined to select an inappropriate 'rule' for a given situation.

> *A new graduate member decided to proceed with forced traction for the calving of a 7 year old Limousin cross cow despite his findings that there was not a lot of room for*

the calf to be delivered naturally. 20 minutes later a dead calf was delivered closely followed by the uterus

(VDS precis claim)

Non cognitive factors which limited human performance included a ***lack of technical knowledge or practical ability*** or personal issues affecting individuals. These ***individual factors,*** such as self - reported fatigue or illness and the effects of stress were also shown to impair performance. Clinicians varied in their level of self - awareness to these factors, however some identified them as having a significant effect on an outcome,

C0: But what do you think made you delay?

Vet: Because I was knackered, I mean I was knackered and it was busy, and I was kind of … you know you are trying to do lots of other things…

(Focus Group 4)

Others did not appear to recognise or allow discussion of such factors, resulting in breakdowns in communication and support within the team and poor clinical results,

CO: but you were aware that she was stressed?

Nurse 1: Yes. But then that's the norm for her

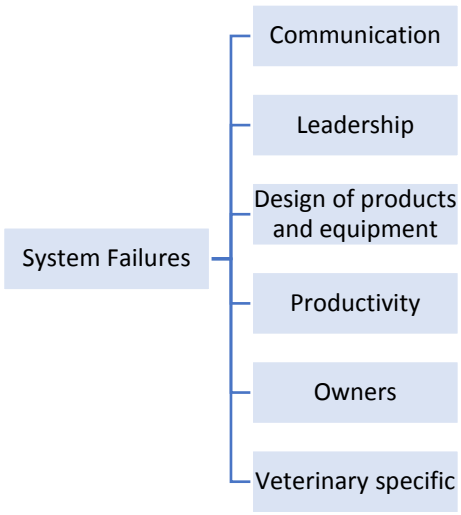
Nurse 2: she was always stressed

Nurse 1: she'd get the shakes and she would always be quiet and stressed so we'd just you know just monitor our animals and leave her to it

Reassuringly, ***inadequate care*** in the form of deliberate and intentional negligent behaviour was an uncommon finding, even among insurance record reviews which are almost universally triggered by a negative client experience.

> *a catalogue of misdemeanours including our members reluctance to use analgesia, removal of an intramedullary pin without sedation, a desire to perform canine tooth reduction surgery in a dog with a biting habit and treatment of a severely ill dog with insulin on the presumptive diagnosis of ketoacidosis following a simple olfactory detection test.*
>
> (VDS precis claim)

4.4.1.2 System failures



Failures at the organisational and professional level were identified in addition to those of the individual clinicians. These system failures are generally more removed from the point of contact with the patient, though they have direct influences on those delivering care.

Lack of leadership at multiple levels was identified as a contributing factor to many mistakes. At a local unit level, it presented as a failure to take charge of situations, or clearly allocate roles within a team.

> *Vet: We had a horse up at [place anonymised] and it was a thing where there were three people and each one thought the other person was monitoring the anaesthetic …that horse didn't get up off the table*
>
> *Nurse: I mean you still have days like that don't you where I'm like, right then, are you in charge are you?*
>
> *Vet: Yes*
>
> (Focus group 6)

Despite working in multi - professional groups, a lack of teamwork between vets and nurses was often described by participants, suggesting an underlying lack of leadership awareness or capability.

> *Nurse : staff changes down there. You don't know who people are. They don't know who you are and it's kind of … you just do it*.
>
> (Focus group 7)

Insufficient supervision of younger vets and nurses, and a perception of being 'thrown in the deep end' was common, with the resulting stress identified as being a contributing factor to mistakes

> *Nurse : working with those vets… it was just like, 'You don't realised that I'm not capable of doing this', and kind of just flung in at the deep end and you just get on with it.*
>
> (Focus group 7)

> *Vet: …. I think she [the nurse] was just thrown in at the deep end and on a night duty and me being a newish graduate was too busy doing my own thing and expecting her to have done that side of things. There goes the catastrophe really*
>
> (Focus group 1)

Failures at the level of organisational leadership, in terms of demonstrating a commitment to patient safety and quality were also identified, often secondary to the fact that those in leadership roles were too busy to dedicate time to upholding standards. Examples included both a lack of organisational awareness for the need of protocols, and a lack of ability or commitment to ensure they were in place.

Facilitator: So do you feel not backed up by the vets then in that situation?

Head nurse: I used to very much so. Very much so because if I wanted standards to keep, I felt like I was the driving force.

Facilitator: So why do you think they aren't interested in that?

Head nurse: I think that particular vet had his finger in so many pies and was pulled in so many directions. Phone calls. Other branches. Management stuff.

(Focus group 7)

Failures in leadership at the level of the profession's governing body, in the form of weak industry regulation were also identified by participants, with a sense of resignation that vets who were perceived to practice on the edges of professionalism appeared to 'get away with it'

Vet: My boss swept things like that under the carpet …… and yet he to my knowledge is still practising…. And I know that a lot of things had been brought forward against him which makes me wonder about the legislation of the whole profession sometimes

(Focus group 8)

Failures of communication presented as chaotically informal methods of communication between members of the clinical team, with over reliance on assumption and lack of formal protocols.

> ***Facilitator: so do you have quite a strict handover procedure from your night nurse to your day nurse is there a strict handover procedure?***
>
> *Nurse1: there isn't*
>
> *Vet: outpatients are a free for all aren't they. There's no strict …*
>
> *Nurse1: It's whoever's available*
>
> (Focus group 2)

The inability to speak up to senior members of staff or ask for help from colleagues was also identified as contributing to errors.

> *Vet 1 I've said to the nurses if I've gone in the room and said, 'Is everything okay? Have they done their swab count?', "No. I asked them to do the swab count and they said no they're not doing it".'*
>
> ***Facilitator: Okay. Right.***
>
> *Vet1: I think there are some nurses not even asking them to do the swab count*
>
> (Focus group 5)

Facilitator: Did you feel in a situation where you could have said to the equine surgeon, 'You're not knocking it out for ten minutes. You wait. '?

Participant: That was not an option.

(Focus group 7)

Design of products or equipment issues included similar looking bottles of drugs and names of products, often in close proximity on dispensary shelves or in prep room drawers. Unfamiliar computer systems and confusion over choices on drop down menus as well as poor design and layout of equipment were highlighted.

> *Vet: I got it anaesthetised and I was using a machine that had the American configuration of gas flow meters rather than the European. So oxygen was on the right instead of the left. There was no difference in the profile of the knobs nor was there a difference in the colour of the knobs.*

(Focus group 5)

> *Vet: I was at another practice whose computer I have to do battle with because I don't understand half of it and I hit Fuciderm instead of Fucithalmic.*
>
> ***Facilitator: Right. Is it a drop down menu?***

Vet: Yeah. It was completely my fault because all you have to do is read the screen but I hit the wrong thing typed the label and I didn't know anything more about it until one of the vets picked it up at a post op check

(Focus group 4)

This error was further compounded by the similarity in the manufacturers packaging, and proximity on the dispensary shelves

Facilitator: And is there any checking system? Did you dispense so did you hand it out?

Vet: No I just hit a button and then someone else hands it out. So certainly at (place anonymised) the receptionist knew if its Fuciderm you know there's a big label 'THIS MUST NOT GO IN EYES'. There was kind of a check in previous lives for Fuciderm not Fucithalmic

Facilitator: Why? Was that because it had happened before?

Vet: Because it's on the same shelf yeah. It sits on the shelf beside each other

(Focus group 4)

Productivity encompassed themes related to the balance between safety and the financial pressure inherent in running a viable business, combined with regulations dictated by the profession's governing body. The RCVS code states that out of hours 'staffing, facilities and arrangements should be appropriate to the likely workload of the practice. 'These should be reviewed on an ongoing basis to ensure that the 24-hour emergency cover provision remains appropriate and adequate'. This presents not insignificant difficulties for practice owners, who must balance the 'likely workload' with the costs involved with hiring staff, and the subsequent conflict of interests. Not unexpectedly, productivity often wins over safety.

Time pressure and high workloads were commonly identified, and meant established safety policies were worked around:

> *Nurse: we have a surgical checklist and we use the World Health Organisation checklist and for some reason that day it had just gone out of the window because it was too busy.*
>
> (Focus group 7)

Levels of staffing, and the provision of 24 hour care was also identified as a problem.

> *Vet:* *And out of hours, that definitely comes into play with sort of mistakes in our areas, that whole out of hours situation when it is just the two of you, and it is just ridiculous sometimes.*
>
> ***Facilitator:*** ***What, just understaffed?***
>
> *Vet:* *Oh massively, yes.*
>
> (Focus Group 4)

The ***effects of the owner*** included loss to follow up investigations and the refusal of recommended treatment options for either financial or emotional reasons. While in many cases, such issues can be mitigated by skilled client communication, in others the owners presented a very real barrier to treatment, and this contributed to errors in diagnosis or treatment.

Our Members approach to a vomiting Cockerpoo was hampered by the owners financial constraints and their repeated failure to keep appointments over a five day period. Eventually, radiographs and the dogs clinical signs suggested an urgent laparotomy was indicated and after further unnecessary prevarication from the owner, our Members finally gained consent for surgery and removed a foreign body in the early afternoon. The owners transferred the patient to [anonymised] at close of play for overnight monitoring, but the dog died two hours post-arrival

(VDS precis claim)

Veterinary specific causes of error included unique environmental conditions which affected outcomes such as operating in the less than sterile environment of a cow shed. Animal factors such as aggression or the ability to run faster than the attending veterinarian were also identified

A nervous Labrador admitted for castration remained dangerously aggressive despite dom/torb premedication and two further doses of domitor had to be administered before induction of anaesthesia could be safely achieved

(VDS precis claim)

4.4.2.Results: Types of error

VDS Figures

2238 claims figures relating to the period from January 2009 – January 2013, were ranked in order of magnitude as shown in figure 4.5.

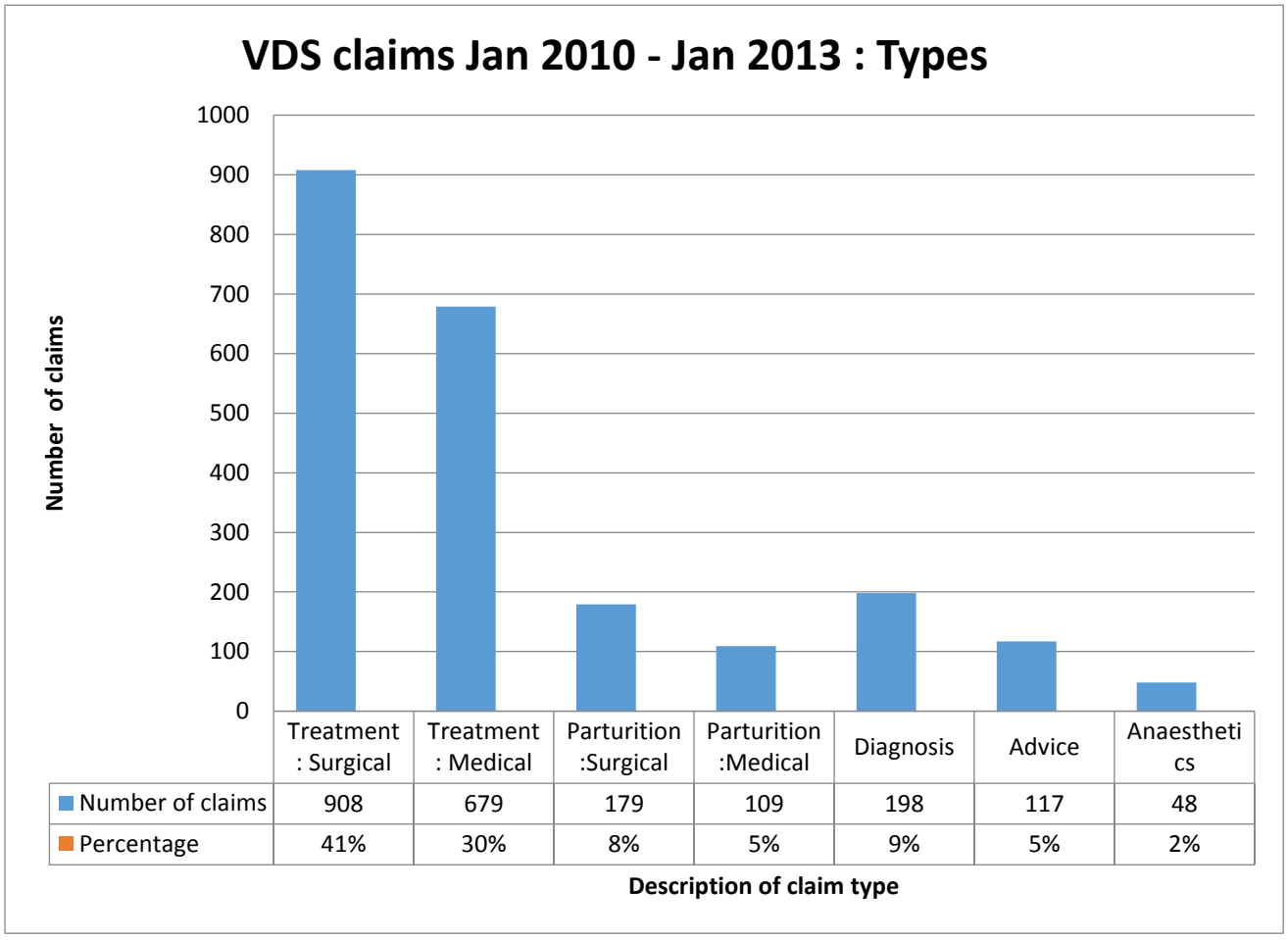


Figure 4.5 VDS claim types (2009-2013) by order of magnitude

Surgery was a consistently high risk factor for litigious complaints, accounting for 63% of parturition claims and 58% of treatment claims. The most common types of surgical claims include complications related to bitch spay operations (n=128), retained surgical items (n=76) and haemorrhage (n=67). Of medical treatment claims, errors involving drugs were common (n=152) of which incorrect choice of drug and overdose were frequently observed. Anaesthesia related claims made up only 2% (n=48) of the total records.

Focus group discussions

Errors relating to drugs, surgery and anaesthesia were the most frequently volunteered by subjects, see table 4.4. This pattern of error triangulates with both the most common types of error from claims data and the pattern of error types in the medical literature, apart from the apparent significance of anaesthesia related issues.

Type of error	Description	Number of times discussed
Drugs	Wrong drug, wrong route, wrong dose, wrong time	21
Operation / surgical error	Error involving any stage of an operation ((excluding anaesthesia)	11
Anaesthesia error	Error related to some stage of anaesthesia	10
Medical treatment error	Failure to deliver care – either as a slip /lapse oversight or a lack of technical skill or knowledge	6
Diagnostic failure	Error relating to an incorrect diagnosis	5
Patient identification	Patient received incorrect treatment of any description because they were wrongly identified	5
Aftercare error	Owner gets the aftercare wrong – failure of communication between owner and vet	2
Equipment failure	Harm to a patient arising from faulty or poorly designed equipment	1

Table 4.4 Magnitude coding of the types of error discussed across all the focus groups.

4.4.3 Results: The professional Response to error.

At the level of the individual

There was a mismatch between the causes of error discussed during the focus groups using critical incident technique, and satellite comments regarding people's *perceptions* of the causes of error. A heightened and often misplaced sense of personal responsibility was apparent when people discussed the factors which, in their view, had been the causes of mistakes. Vets consistently blamed themselves for errors, even when they had not been the person who actually committed the mistake.

> *Vet : So we are giving more responsibility in certain situations so I didn't check it. I should have checked it*
>
> (Focus group 4)

> *Vet : My fault. I didn't check really specifically the volume that had been drawn up*
>
> (Focus group 3)

The weight of this responsibility was a consistent finding. Vets often appeared to view patient safety as ultimately and solely their concern, effectively removing that responsibility from other members of staff, *and* the organisation. Not only does this undermine mutual trust and lead to poor clinical teamwork, it demands a level of personal vigilance which is unachievable.

Vet: I didn't check that's why. I expected her to do the anaesthetic and that's that

Facilitator: so again it's this clarification of roles, whose responsibility…

Vet: …(overlap) yeah I didn't even just glance over to make sure everything was switched on I just took it for granted that it would be…

CO : do you check every time now?

Vet: I don't verbalise it but I check

CO: so you don't verbalise it in that you don't ask the nurse….

Vet: …(overlap) I don't ask 'have you put everything on' I just look. Is the nitrous and oxygen on and is there halothane or isoflurane in the tech and I just visually look

CO: you just look…

Vet: and that's that. You don't need to be second, to be seen to be second guessing to trust them to do that. But it brought home to me that you're still the professional there so it might be a trainee a qualified whatever but you're still the anaesthetist and the surgeon

CO: buck stops with you?

MH: yeah absolutely.

(Focus group 1)

This suggests they put significant and unrealistic pressure on themselves, founded in a basic lack of understanding of their own limitations and an educated systems perspective. This is exemplified by the surprise apparent in the following statement, from a vet who overdosed a dog with insulin on her first day back from a 12 month maternity leave, and demonstrates the need for systems which protect both patients *and* clinicians.

> *Vet : so despite thinking I mustn't overdose this dog, I am a bit tired, I am a bit out of touch, I am going to do it right, I still did it*.
>
> (Focus group 4)

The emotional response in the aftermath of error was also discussed, with feelings of distress still recognised for a long time after a significant adverse event

> ***Facilitator: lets try this one – wrong concentration of thiopentone used and the dog died***
>
> *Vet: yeah that was…It was my wife and it scarred her, it has scarred her for life*
>
> (Focus group 1)

Fear of the consequences in the aftermath of error also emerged from the focus groups. This has potential implications for the discussion and reporting of error to both owners and colleagues.

> ***Facilitator:*** ***What's your first thought if you really make a cock up?***
>
> *Vet 1:* *How am I going tell the owner.*

Nurse 1: *And also gutted. Gutted for the animal and shit am I going to get struck off?*

Nurse 2: *Just generally mortified*

Vet 2: *You just feel really bad don't you. You know if you had a patient death or something you just feel awful*

Nurse 1: *Horrible*

Vet 1: *Awful*

Nurse 2: *Absolutely*

(Focus group 6)

At the level of the RCVS

During the period Jan 2012-Dec 2014, the RCVS heard 20 disciplinary hearings, of which only five related to incidents of patient harm and clinical error or negligence. Only a very small number of hearings resulting from clinical error, led to a vet or nurse being reprimanded (n=1) or removed from the register (n=4). See figure 4.6

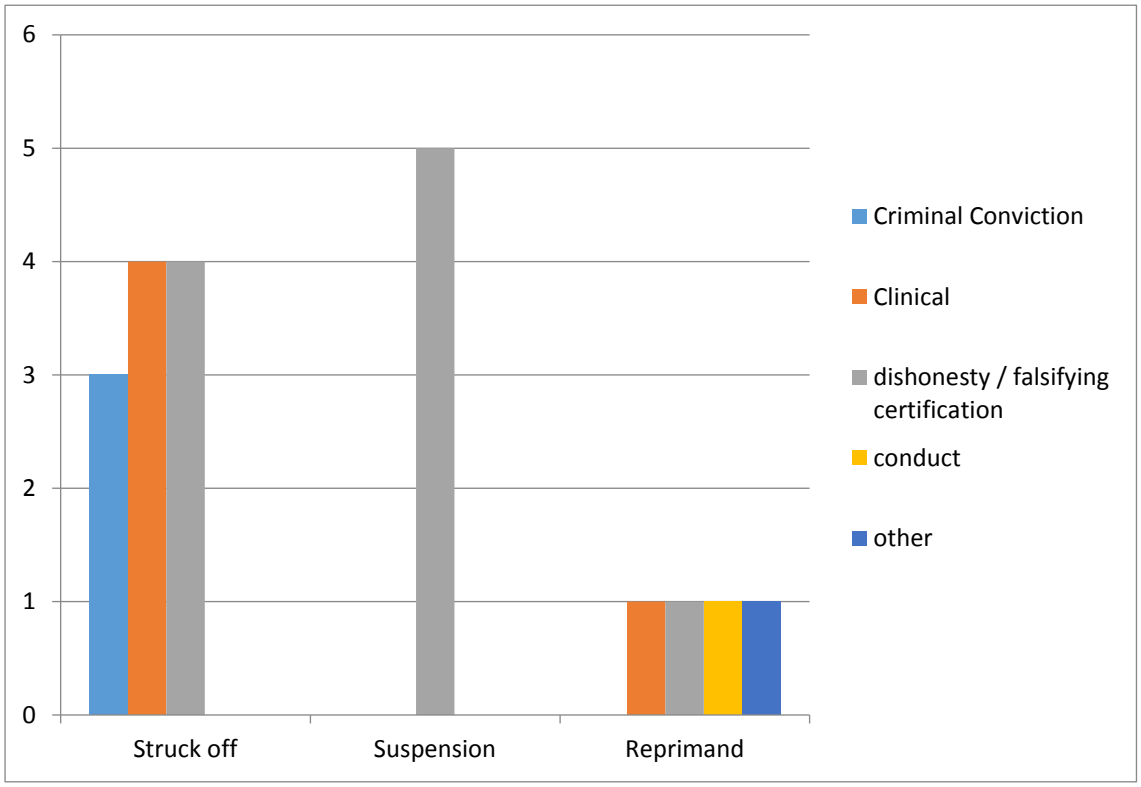


Figure 4.6 Pattern of RCVS DH results from 20 hearings Jan 2012-Dec2014

4.5 Discussion

4.5.1 The causes of veterinary error and perception of error in the profession

The aim of this phase of the research was to identify, understand and map the causes of error, specific to veterinary practice. As such, it represents the first reported research on the subject in the veterinary field, and presents an empirical typology of veterinary error informed by a human factors framework. It identifies failures at the 'sharp end' relating to the individual clinician, and those imposed by the effect of the 'system', or the organisation

in which that clinician works. It also recognises the importance of studying error in its professional context.

Although often portrayed as such by models such as Reason's swiss cheese, errors are seldom the result of an orderly, linear process of cause and effect, with a single responsible root cause. Error is a complicated, multidimensional, emotionally charged phenomenon, and as such is best investigated using a comprehensive framework to help ensure nothing is missed (Vincent et al., 2000). Frameworks of medical error causation such as the London protocol (Taylor-Adams et al., 2004) and Eindhoven PRISMA model (Van der Schaaf and Habraken, 2005) provide a structured format for root cause analysis to aid the investigation of adverse events. Models such as the Yorkshire framework (Lawton et al., 2012) help to visualise error in terms of its proximity to the patient and relate the impact of organisational decisions to the actions of those at the point of care. This can help define and conceptualise the causes of error and allow clinicians and management to recognise them. The typology presented in this project may be used to visualise veterinary error and inform its discussion, helping clinicians to see past their own perceived failings and appreciate the effects of the system. A hypothetical example of such an investigation following a retained surgical swab is provided in figure 4.7

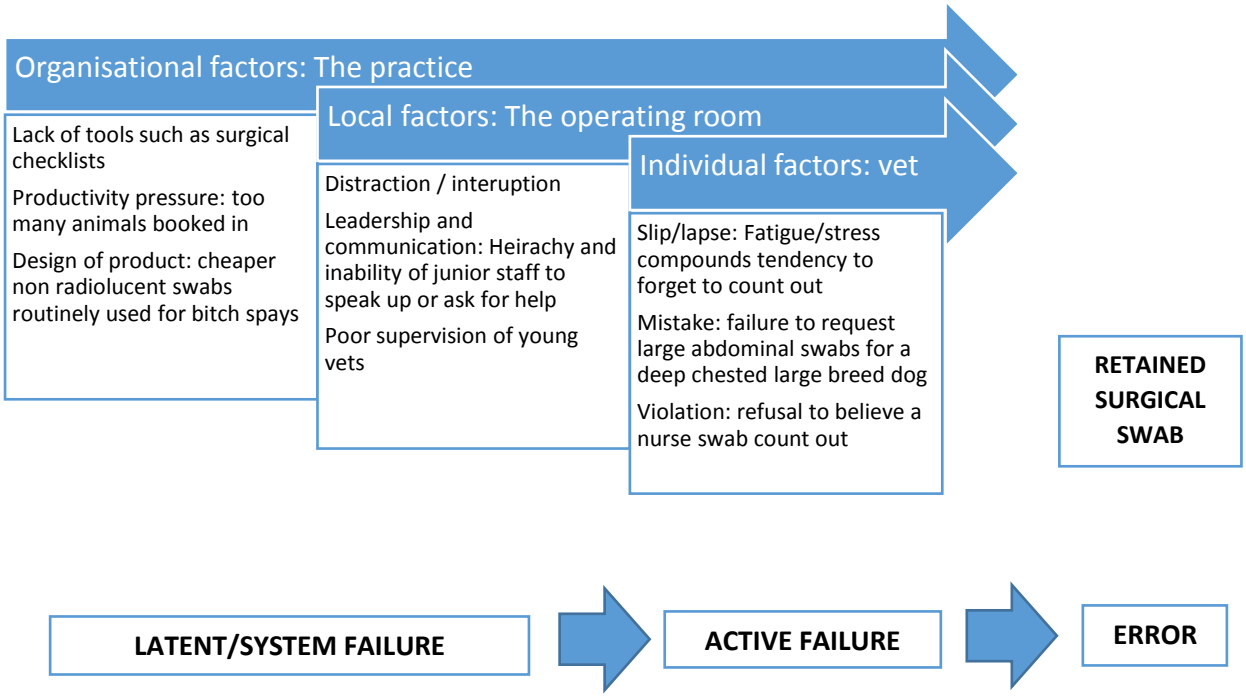


Figure 4.7 Reason's accident causation model adapted to analyse the potential contributing factors to a retained abdominal swab. Adapted from Reason (Reason, 1995)

The nested diagram (figure 4.4) further visualises errors in relation to the patient and the organisation as a whole, and may be used to envisage a unit in terms of error traps and potential. This 'unpacking' of error facilitates a more thorough understanding of its components and context, and helps inform the development of interventions which target the different 'layers', such as checklists, adverse event reporting systems and non - technical skills training programmes.

This study suggests that the causes of error in veterinary surgeons and nurses are similar to those described in other industries. This should come as no surprise. Cognitive limitations

are fundamental psychological processes which affect everyone, no matter how intelligent, committed and well trained they may be (Studdert et al., 2004). Mistakes which are often traditionally viewed as carelessness are in reality the results of these fallible cognitive processes and are to a certain degree, unconscious acts. Recognition of this in medicine has resulted in the development of tools which protect clinicians from their own limitations, such as the Safe Surgery Checklist, the use of which has the potential to reduce mortality and morbidity rates by approximately 50% (Treadwell et al., 2014). At their simplest, checklists are effective aide memoirs and 'safety nets' to reduce the fallout from slips and lapses, while treatment protocols limit mistakes due to lack of knowledge or faulty diagnostic reasoning. At their more complex, and combined with good clinical leadership, checklists promote communication and team – working. If the professions make mistakes for similar reasons, it stands to reason that interventions developed for one industry may have the potential to improve outcomes in the other, as demonstrated by the successful application of anaesthesia and surgical checklists in veterinary practice (Hofmeister et al., 2014, Bergström et al., 2016).

The effect of the system is also revealed in this typology. This perspective recognises the fact that clinicians do not make decisions in isolation and are influenced by a multitude of factors, many of which are out of their control. The actions of individuals are obviously affected by organisational issues such as time pressure, communication pathways, staffing levels, equipment availability and design. They are also affected by the more subtle, but no less dramatic effects of poor leadership and communication. Many improvements have been made in recent years in the veterinary profession, following the recognition that optimising communication between clients and vets is essential for a working relationship

(Latham and Morris, 2007). Communication is now accepted as an important veterinary skill and is often associated with the prevention of complaints (Martin, 2006). Figures from the VDS show that up to 80% of its claims relating to professional negligence include an element of communication failure (Radford et al., 2010). However, to the author's knowledge, it has not been specifically linked to errors in the veterinary literature and communication skills training has tended to focus on the relationship between the vet and the client, teaching skills such as communication in consultations, breaking bad news and dealing with angry clients (Gray et al., 2006, Radford et al., 2010, Shaw and Ihle, 2006). This study provides evidence that deficiencies in communication between members of the care team contribute to errors and poor outcomes which impact both patients and staff.

This system perspective was often absent in the focus group discussions and the sense of personal responsibility demonstrated by the focus group clinicians was notable. Many of the participants needed prompting to identify organisational issues, as they tended to focus on their own failings and seemed unwilling to distribute 'blame'. Many of these 'failings' appeared to be self - directed and internalised, rather than stemming from outside sources. Blame and shame is cited as a major reason for underreporting of errors in human medicine, limiting the opportunities for learning from errors and compounding the fear of disciplinary sanctions and the perceived response of colleagues and governing bodies (Brubacher et al., 2011, Hartnell et al., 2012, Leape, 2002). This is further compounded by the fear of legal repercussion, which provokes the practice of defensive medicine, defined as 'medical care that is primarily or solely motivated by fear of malpractice claims and not by the patient's medical condition alone'. (Floyd, 2008) 93% of medical clinicians have admitted to practicing defensive medicine. It has been estimated to increase healthcare costs by 5-9%, eroding the

trust in the doctor - patient relationship and influencing a clinicians ability to apologise in the aftermath of a mistake in case it is seen as an admission of guilt (Dove 2010).

The second victim effect of error is also now well recognised in medicine. This condition is defined as 'A health care provider involved in an unanticipated adverse patient event, medical error, and/or patient related injury who becomes victimised in the sense that the provider feels traumatised by the event. Frequently victims feel personally responsible for the unexpected patient outcomes and feel as though they have failed their patient, second guessing their clinical skills and knowledge base' (Scott et al., 2009). Sirriyeh (2010) describes clinicians suffering loss of clinical confidence and detachment from patients as well as significant mental stress, including anxiety, depression and guilt in the aftermath of adverse events. Efforts to address this in medicine include calls for an institutional support structure; first to care for the patient, second to care for the clinician, and finally to ensure organisational learning and response (Seys et al., 2013).

It is not unreasonable then to suggest that similar issues may surround the effect of error on individuals in the veterinary profession. Medical research suggests that female doctors feel the emotional effects of error longer and more deeply than male doctors (Muller and Ornstein, 2007). Veterinary practice has changed significantly in the last 15 years, with women now outnumbering men for the first time (Buzzeo et al., 2014) . Recent veterinary research suggests that female vets are more prone to the effects of workplace related stress and depression than their male counterparts (Gardner and Hini, 2006). Professional mental health and wellbeing has been recently identified as one of the key action points in the RCVS Vetfutures action report (Vet Futures Action Group, July 2016), with recent studies suggesting that the veterinary profession has an above average rate of poor mental health

and well being, especially in younger graduates (Halliwell et al., 2016). Bartram's (2009) study into work stressors in UK veterinary surgeons identified 'making professional mistakes' as one of the most significant sources of stress. The study also showed that concern about the 'possibility of client complaints or litigation' and 'unexpected outcomes' caused significantly more stress for female veterinary surgeons than males. Therefore, there is a very real possibility that second victim syndrome exists for veterinary surgeons as well as human doctors.

The RCVS holds an unusual position amongst the professions, acting as both the profession's representative and regulator. This has raised concerns relating to the effectiveness of regulating from within, and has led other professional bodies such as law and pharmacy to devolve their regulatory component from their professional society (Blass, 2010). The RCVS has reformed its disciplinary procedure in recent years to make it more transparent, faster and more efficient. Lay observers are now included in decision making throughout the disciplinary procedures and a Health Protocol was introduced in 2010 to protect professionals whose performance is impaired by mental or physical ill health (Saluja, 2011). However, fear of the institutional response to error is a major factor in medical blame and shame culture. If, as Halliwell (2016) suggests, young vets particularly view the RCVS as 'a regulator for which they have both respect and fear', similar pressures may be present in the veterinary workforce. A negative perception amongst the profession of the role and response of its regulator in the aftermath of mistakes could compound a negative culture and stifle learning. The RCVS clearly states that only 20% of reported incidents are referred to the Preliminary Investigation Committee or second stage of college investigation, and that only a very small number of those result in a Disciplinary Hearing (RCVS). This is supported by the findings in this study, which suggest that very few complaints related to

clinical aspects of the job result in discipline. However, this suggests a discrepancy between the profession's fear of the perceived response of the RCVS, and the true incidence of disciplinary sanctions. This highlights the importance of effective feedback, communication and leadership at the highest levels of the profession, in the management of error.

4.5.2 The types of veterinary error

The types of errors identified from the veterinary claims data, draw interesting parallels with the patterns of medical error types and litigation claims. Human surgery is consistently linked to a high incidence of error (Leape et al., 1991, Wilson et al., 1995) In comparison, anaesthesia related errors are responsible for only 2% of mistakes (de Vries et al., 2008). The data presented in this study represents only the type of *claim*, as determined by the claims advisor at the point of initiation. The type of *error* is therefore inferred, rather than confirmed, however, trends in claims to medical insurance companies can be seen to mirror the types of medical error (Floyd, 2008). Assuming the same is true for the veterinary profession, similar trends can be extrapolated from this data, albeit with caution. Claims to the VDS are almost always precipitated by a dissatisfied owner which potentially limits this data set to be composed of only those things of which an owner is aware, such as surgical outcomes and errors relating to dispensing of drugs. Procedures such as anaesthesia and diagnostic decision making are more 'hidden' from an owner and this may have an influence on the types of claims reported. For example, errors relating to surgery are consistently high across both the professions and their indemnifiers. This 'spike' in claims may reflect the fact that surgery is often an elective procedure where good results are 'expected' and poor results less acceptable, leading to an increased amount of litigation. The fact that veterinary

services are not free at the point of care potentially magnifies this effect, and may explain why the company receives a large number of claims relating to surgical procedures. However, surgery is also a highly complex procedure with the potential for numerous contributory factors, increasing the chances of multiple individual and system failures occurring. The surgical checklist has been developed in response to such findings, as it works at both the levels of the individual and the team.

Of the non-surgical events, errors involving drugs are most common in medicine, responsible for 15.1% of the adverse events (de Vries et al., 2008). The results from the VDS claims suggest similar findings, that adverse events involving drugs are the most common type of non surgical error.

Anaesthesia seems to account for a small proportion of both medical and veterinary insurance claims. This was not reflected however in the focus group discussions, where errors linked to anaesthesia were one of the most commonly discussed, nor by the self-report of recent graduates who identified errors linked to anaesthesia in 10% of failings (Mellanby and Herrtage, 2004). Veterinary anaesthesia research provides some rare incidence figures of anaesthetic mortality. Current estimates suggest that 0.1-0.2% of healthy and 0.5-2% of sick dogs and cats die due to anaesthesia (Brodbelt, 2009). Studies have mainly attributed the causes of death to cardiovascular and respiratory failure, but did not apply a human error framework to the analysis. However, anaesthetic overdose, poor stabilisation of patients prior to anaesthesia, problems with intubation and ventilation and procedural urgency and its associated stresses were identified as some of the possible causes and risk factors (Brodbelt, 2009). Johnston's (2002) confidential enquiry into perioperative equine fatalities (CEPEF) reported an anaesthetic death rate of 1.9% falling to

0.9% if colic surgeries were excluded. Patient age, drug choice and duration of surgery were identified as potential risk factors but the study also found that both elective and emergency procedures out of working hours carried a higher risk of death, and recognised the likely effects of clinician fatigue and understaffing (Johnston et al., 2002). These causes suggest individual and system failures, rather than simply physiological complications. It may be the case that veterinary anaesthetics are at a higher risk of operator error than is currently reflected by insurance claims. Veterinary anaesthesia is a procedure which is inherently risky, is often carried out by junior or trainee clinicians with minimal monitoring equipment, on an animal which is unable to report any errors which may occur. Future research investigating the causes of anaesthetic mortality could benefit from the use of a human error framework to identify causal factors.

A comparison of the types of error identified by magnitude coding of the focus groups and the causes of error from the groups may provide some insight into both what is happening in veterinary practice and why. Clinicians identified errors relating to drug and medication errors, surgery and anaesthesia most commonly. It is very likely that errors relating to drugs are most likely to occur due to the cognitive limitations of individuals – Reason's slips and lapses. Surgery and anaesthesia are more likely to involve breakdowns in teamwork – specifically failures of leadership and communication. Further removed causes of error such as productivity pressures in the form of understaffing, and poor design of equipment manifesting as confusing drop down computer menus for drug dispensing will further compound the problems. As a qualitative study, these findings cannot be confidently generalised to the profession as a whole, but cross referencing these causes and types of errors may highlight the most important areas on which to focus further research.

4.6 Limitations

A large body of the data collected in this study relied on vets and nurses self - reporting and recounting past errors they had made or witnessed. As Reason (1990) notes, the only difference between those involved in an error and those investigating or recalling one, is knowledge of the outcome. This is significant as it increases the risk of numerous cognitive biases. Recall and hindsight biases alter the perception of a past event due to failures of processing or memory and the influence of outcome knowledge on perception (Henriksen and Kaplan, 2003). Social desirability and attributional biases, the desire to present ones behaviour in a positive light and the need to find a reason for that behaviour in the aftermath of an event, were also possibilities (Henriksen and Dayton, 2006). Critical incident technique (CIT) was chosen as a method to reduce these effects, as participants were encouraged to discuss the facts of the case by a facilitator who had admitted to making mistakes of her own in an attempt to promote 'psychological safety' for the participants.

The recruitment of participants for the focus groups by convenience and purposive sampling limits the generalisability of these findings to the wider population. However, the aim of the study was to explore a previously under researched phenomenon, not to infer an incidence rate of veterinary error or create an exhaustive list of causes. Quality, in terms of validity and reliability is difficult to define in qualitative studies and methods of increasing quality include member checking and triangulation of findings (Tracy, 2010). Efforts to validate the findings of this study included triangulation between different data sources - the focus groups and insurance claim records - and saturation of themes from the focus groups.

One significant limitation of the study was the sampling and nature of the data informing the types of veterinary error. This was obtained from a single source as, has been discussed,

there is little clinical audit data available and no national database. It does not represent a random sample, although it will encompass almost the entirety of insurance claims against members of the veterinary profession, as the VDS is accountable for 95% of the veterinary professional indemnity market. The nature of the data also means that the type of error is inferred from the claim, and was 'pre coded' by claims consultants into the VDS's own descriptive framework. As discussed, the coding of data into a predetermined list, rather than using an iterative approach, risks 'missing' themes. It is possible therefore that other types of error exist which have not been identified in this study, and the relative incidence rate of each type should be interpreted with caution.

4.7 Conclusion

The initial phase of this study has explored the concept of veterinary error, and produced a map of its causes within the context of the profession. Veterinary error is influenced by organisational, physical and emotional factors, as well as levels of technical knowledge and skill. Many of the non-technical skills and systems factors identified as causes of mistakes in this study, are mirrored in Sammer's (2010) discussion of safety culture in the medical literature, namely leadership, teamwork, communication. Although not operationalised as a distinct theme in this study, culture is an important driver of these behaviours and therefore influences many of the causes of mistakes identified in this study.

Improving patient safety, the overall aim of the project, therefore must address all these contributing factors. This reflects the experience of other industries who have addressed

risk management and safety improvement through culture measurement and staff training. A thorough understanding of clinician's beliefs and attitudes regarding error within the context of their organisations is required to inform interventions which involve changes in behaviour. The development of interventions to mitigate veterinary error and improve patient safety, should therefore be informed not just by a typology of causes, but also an understanding of the effect of working and professional culture. Without an active effort to address positive culture change, even evidence based interventions are unlikely to fulfil their potential (Singer and Vogus, 2013). The working culture of veterinarians in relation to patient safety is an area which requires further research and this conclusion informs the subsequent two phases of this study: the development of a tool for the measurement of veterinary safety culture and an intervention to improve culture through a veterinary teamwork training programme.

Chapter 5

Safety Culture in Veterinary Practice

5.1 Introduction

Phase two of this project investigated safety culture in veterinary practice. Organisational culture has been defined as the 'shared values and beliefs which guide the behaviour of members' (Shoaf et al., 2004). Culture provides a link between an organisation's mission and frontline staff, by ensuring the company's values are reinforced through a commitment to organisational goals (Arabloo et al., 2012). In relation to patient safety, this refers to the collective perceptions of staff in relation to safe practice and delivery of care, fostered by hospital leadership. Organisations with positive, mature safety cultures are characterised by mutual trust amongst staff, effective information gathering and organisational learning, and a collective belief in the importance of safe practices (Reason, 1998). In hospitals this translates as interprofessional teamwork and the ability to speak up, effective error reporting strategies and a collective desire to provide quality care. Safety culture in medicine is therefore recognised as the driving force behind staff behaviours, and improvement practices targeting safety culture are commonly employed as a method to improve outcomes (Morello et al., 2013). However, creating or improving safety culture is a significant challenge which requires effective leadership and managerial commitment at the highest levels (Arabloo et al., 2012). In order to identify areas for improvement and benchmark performance and change, managers and leaders rely on the results of safety culture surveys. These surveys provide a snapshot of safety culture within a hospital and are often the starting point for patient safety initiatives.

However, safety culture itself is a concept which cannot be measured directly. Therefore surveys commonly assess it by tapping into staff perceptions of a number of specific, measurable domains. Together these represent the 'building blocks' of the culture concept and define and shape the construct. Many safety culture surveys have been developed in medicine, which measure different but often overlapping domains, with variable levels of reported validity and reliability (Colla et al., 2005). Accurate evaluation of an organisation requires the use of a valid measuring tool, so it is important that the choice of survey is determined by the robustness of its psychometric properties (Flin, 2007).

Phase one of this project investigated the causes of veterinary error and the response of clinicians in the aftermath of mistakes. It concluded that veterinary errors, like mistakes in all high reliability organisations, are often multifactorial and involve both system and individual failures. These findings have far reaching implications for working practices and individual behavioural change. Understanding safety culture, or the beliefs and attitudes of vets and nurses in relation to mistakes, is essential to better understand and manage that change. The outcome of phase one was a typology of error which could be used to better comprehend veterinary mistakes, and identify areas for improvement, either through a change in staff behaviours or the implementation of interventions such as surgical checklists. However, just as any attempt to mitigate errors in practice must begin with their understanding, any attempt to change clinician's behaviours in relation to error management, must begin with an understanding of their perspective.

At present there is no evidence to suggest which domains make up the heuristic of safety culture in veterinary practice and no standardised terminology on the subject (McMillan,

2014). Consequently, there is little understanding of the term in the profession, although themes related to safety culture in other industries have been identified and linked to veterinary error, such as teamwork, communication and the discussion of error and workplace stress (Bartram and Baldwin, 2005, Kinnison et al., 2015a, Mellanby and Herrtage, 2004). This lack of awareness signifies a significant gap in both research and education for the profession. It is reflected in the lack of available training and resources in concepts which influence culture, such as non technical skills and processes such as clinical audit and adverse event reporting. Figure 5.1 demonstrates how this second phase relates to the overall project.

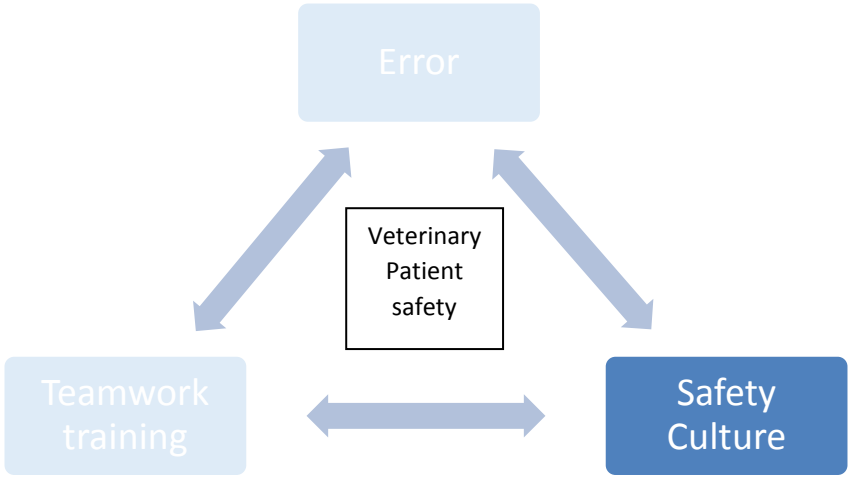


Figure 5.1 Project overview: Study two

There are no studies directly exploring safety or organisational culture in veterinary practice in the literature. As such, and in contrast to other safety critical industries, there is a limited understanding of both the concept and terminology and the constituent domains of veterinary safety culture are undefined. There are also no tools available to the profession with which to quantify or measure the concept. With this in mind, the following research question was postulated:

2: Can we measure safety culture in veterinary practice?

Phase two of this project attempts to answer these questions through the development of a safety attitudes questionnaire specifically designed for clinicians working in the veterinary profession, the Nottingham Veterinary Safety Culture Survey (NVSCS). Through this process, a working description of veterinary safety culture, and a tool with which to measure it in practice evolved.

The following sections will describe the methods used to develop a pilot survey tool and its refinement using exploratory factor analysis into the final veterinary safety culture survey. An explanation of this statistical technique will be provided in the section relating to data analysis and results. The methods and results of the initial reliability and validity assessment of the final version of the survey will then be presented, followed by a discussion of the findings.

5.2 Methods. Questionnaire design and development

Survey development is complex and time consuming, but the level of input and attention to detail in the early stages have significant effects on the quality of any results obtained from the final tool. Therefore, the design of this tool moved through various sequential stages, summarised in table 5.1 and further discussed below.

Survey stage	Comments
1.Decide the aim	Define the aim of the survey and clarify what the survey is being designed to achieve
2.Decide on the design and feasibility	Costs, time scale, format (online or paper), identify potential participants
3. Define the hypothesis and the variables to be measured	Operationalise the hypothesis by deciding which variables to measure
4. Designing the research instruments	Adapt existing survey tools and select appropriate attitude rating scales, address issues of anonymity and data protection
5. Pilot work	Test the instrument, revisit, adapt and retest
6. Design the sample	Decide on a sampling strategy, access and engage the participants. Consider and justify its representativeness
7. Doing the field work	Distribute the survey, check and follow up returns.
8. Prepare the data (pre analysis)	Enter the returned data, clean, code and prepare it for analysis

Table 5.1 Summary of the stages of survey development, adapted from Oppenheim (2000)

5.2.1 Deciding the aim

The aim of this survey was twofold. In designing a tool to measure veterinary safety culture from scratch, the major component parts of the construct would be operationalised and defined, as part of the process. As described by Nunnally (1978), a construct is 'a representation of something that does not exist as an observable dimension of behaviour'. The more abstract the construct, the more difficult it is to measure. The development of the survey would create a model of the construct which could then be shaped by descriptive language to provide a 'map' of the concept itself in the veterinary context.
The resulting survey would then provide a working measurement tool for veterinary practices, in the form of the Nottingham Veterinary Safety Culture Survey (NVSCS).

5.2.2 Deciding the design and feasibility

As an area of social science research, safety culture represents a multi-causal phenomenon (Glendon and Stanton, 2000). The design of the survey would therefore need to accommodate multiple variables which related to both the overlying concept, and also to each other.

Multivariate analysis enables the simplification of such complex interactions often presented by research into social phenomena (Fields, 2005). This type of analysis could determine the important constituents of safety culture, by accounting for the amount of variance in the concept which was determined by the variables under measurement in the survey. It could also rank those variables, so enabling the researcher to determine which were most important, and which less so (Oppenheim, 2000). Exploratory factor analysis, a

form of multivariate analysis, is a commonly used technique to discover and identify the underlying components of a concept, and the survey was designed with this method of analysis in view.

Practical considerations such as time and costs were also accounted for. The timescale for the project, from conception to final data preparation (pre analysis) was a period of 12 months. This was to allow for adequate pilot work and recruitment of participants.

5.2.3 Defining the hypothesis and variables to be measured

It was hypothesised that veterinary safety culture would mirror the traits of safety culture in other industries, most pertinently medical safety culture, and could therefore be measured by similar means. As a concept which was ill defined and unexplored in the veterinary context, it was important to ensure that as many areas of relevance were included in the initial survey items, so as not to unintentionally exclude any relevant concepts. Although there was no previous research available specific to the veterinary profession, there was a significant body of research regarding safety culture in other industries. Flin (2006) refers to considerable overlap between the domains or constituents of safety culture across industries, and these domains were extrapolated for the development of this survey. Two well established measures of medical safety culture, the Safety Attitudes Questionnaire (SAQ) and Hospital Survey of Patient Safety (HSOPS) were used as templates to generate an initial pool of survey questions or 'items' (Sexton et al., 2006, Sorra and Dyer, 2010). A copy of the SAQ and HSOPS surveys can be found in Appendix 5a. This was further supplemented

by questions which were generated from discussions and findings from the first phase of the study. This enabled the generation of a set of presumptive variables or subdomains which would be measured by sets of relevant statements or 'items'. Together these were hypothesised to make up the construct of veterinary safety culture, forming a conceptual sketch or model of the construct. This presumptive set of subdomains is listed in table 5.2, for comparison with those from the medical models.

SAQ survey subdomains	HOSPS survey subdomains	NVSCS hypothesised subdomains
Teamwork	Teamwork across units	Teamwork
Job satisfaction	Teamwork within units	Leadership (immediate)
Perception of management	Management support	Leadership (organisational)
Safety climate (Org commitment)	Supervisor expectations and actions	Safety vs productivity
Working conditions	Staffing	Personal attributes
Stress recognition	Non punitive response	Non punitive response
	Communication and openness	Event reporting and discussion
	Feedback and communication re error	Hierarchy and speaking up
	Frequency of event reporting	Communication
	Handoff and transition	Attitudes to error
	Organisational learning	Causes and organisational learning
	Overall perceptions of PS	

Table 5.2 Summary of the variables or subdomains of safety culture measured by the SAQ and HOSPS and the hypothesised subdomains of the NVSCS (Sexton et al., 2006, Sorra and Dyer, 2010).

5.2.4 Designing the research instrument

Attitude statements.

The items in the questionnaire take the form of attitude statements. The study of attitudes is complex and beyond the scope of this project. Suffice to say, attitudes may be described as the tendency of a participant to respond in a certain manner when presented with a situation. They are composed of logical, rationalised beliefs together with feelings or emotions and can lead to the expression of certain behaviours (Oppenheim, 2000). Attitude questionnaires attempt to 'tap in' to these beliefs in the hope that they may enable the prediction or understanding of behaviour in relation to a certain construct, in this case safety culture. Attitude statements are therefore defined as 'a single sentence that expresses a point of view, a belief, a preference, a judgement, an emotional feeling, a position for or against something' (Oppenheim, 2000)

Well written attitude statements should provoke strong responses from participants, using words which reflect their own terminology. Rather than being formally written, they should make use of the vocabulary from investigative interviews and focus groups to maximise understanding for the recipients (Edwards, 1983). This strategy was employed in generating statements for the NVSCS. For example, the item

' If something goes wrong at this practice *my boss just sweeps it under the carpet*'

includes a colloquialism used in the focus groups from phase one which captures the sense of the statement, and transmits that understanding to others. General rules such as

avoiding lengthy, double barrelled, or double negative statements also apply. For example, 'I feel guilty if I make a mistake' is a better constructed statement than 'I feel guilty and ashamed if I make a mistake'. The first refers to one emotion; the second statement combines two feelings which may not apply together to all recipients, potentially creating a statement which is impossible to answer.

A deductive approach was used to generate the items in the NVSCS, as there was a significant body of research relating to safety culture, and sufficient theory to apply this to the veterinary context (Hinkin, 1998). All the items from both the SAQ and HSOPS surveys were pooled. The wording of the statements was amended to suit the target audience of veterinary clinicians and irrelevant items excluded. For example, an original statement such as 'High levels of workload are common in this operating room' was changed to 'High levels of workload are common in this practice'. 46 items were generated from the interview and focus groups in phase one. These statements were pooled together with the items retained from the medical questionnaires to produce a list 133 items. These statements were organised into the eleven hypothesised subdomains shown in table 5.2. The full list of statements is available in Appendix 5b.

The sets of statements were scanned to ensure a degree of balance in the final tool, so that each possible subdomain had a representative set of items. As attitudes are particularly sensitive to question wording, it was essential that there were multiple items relating to each subdomain, rather than a single statement. This increases the reliability of the response and therefore measurement, as the combination of items minimises inherent bias

or anomalous results caused by the misinterpretation of a single statement (Gliem and Gliem, 2003).

The pool of items was then edited, so that each suspected subdomain contained between three and nine statements, resulting in a pilot survey of 57 attitude statements (see table 5.4). A free text box was included to enable an element of qualitative data collection, and to provide the opportunity for people to identify aspects which were not addressed by the list of items.

PROPOSED DOMAINS AND THEIR DESCRIPTIONS	NUMBER OF ITEMS
Causes of error and organisational learning *Perceptions of the causes of error and efforts of the organisation to prevent mistakes*	4
Attitudes to error *Acceptance that error occurs, feelings associated with it and the perception of personal responsibility/lack of systems perspective*	4
Event reporting and discussion *Attitudes of staff to the reporting of errors and response of the organisation to discussion of mistakes*	3
Non punitive response to error *Staff perceptions of the consequences of error at unit and professional levels*	4
Hierarchy and speaking up *Feelings related to the 'superiority 'and the role of the vet compared to the nurse. Perceived ability of subordinates to question the actions of those above them and cross professional lines*	5

Safety vs productivity *The impact of financial viability, pressures of small business and the influence the need to make money has on safety practices*	7
Personal attributes and resources *The recognition of one's limitations and their impact and the effect of stress.*	9
Teamwork *The perception of the current level of teamwork within the clinical team*	8
Communication *Perceived success and reliability of communication within the team*	4
Leadership – immediate boss *Impressions of the leadership of the clinical unit*	4
Leadership – organisational *Front line workers perceptions of practice management / owner commitment to safety*	5

Table 5.3 The proposed domains of safety culture in the veterinary profession, adapted from the domains of HSOPS, SAQ and Flin (2006)

A combination of both positive and negative worded statements was included in the pool. This technique helps to maintain the interest of the reader, ensuring they pay attention to the questions and minimises the incidence of acquiescent response bias or the tendency to agree with all statements automatically (Rattray and Jones, 2007). However, there is some debate over whether including such items can have a adverse effect on the final psychometric qualities of a measure (Hinkin, 1998). Certainly, negatively worded statements must be carefully handled and interpreted in later analyses.

Finally, a pool of demographic measures was created, informed by the pattern of demographics employed by the SAQ and HSOPS surveys, and standard measures from The Office for National Statistics. Table 5.4 shows those included in the pilot questionnaire, the full pool is available in Appendix 5c.

Item	Possible answers
How long have you worked at this practice	<1y, 1-5,6-10,11-15,16-20, 21y or more
What is your current job title	Intern, assistant, senior assistant, clinical director, salaried partner, partner / owner, trainee nurse, qualified nurse, head nurse, care assistant, other
How many years have you been qualified or training	<6m, 6-12m, 1-2y, 3-4y, 5-10y, 11-20y, 21+y
What is your current work pattern	Full time / Part time
Are you male or female	M / F
Please provide the postcode of the practice where you currently work. (This is used to group together results from the same practice, NOT to identify individuals)	Free text entry box

Table 5.4 Table showing the demographic questions in the VSCS

Attitude Scales

The measurement of attitude relies on the process of transforming a person's emotional and cognitive response to a statement into a figure which 'quantifies' the attitude and essentially, enables statistical analysis (Payne and Payne, 2004). Such measures must be reliable, producing the same results over time and in different conditions, and must demonstrate validity; that they measure the subject that they pertain to measure (Oppenheim, 2000).

Many ‘scales’ of attitude measurement, have been developed in an attempt to quantify such phenomena, and which produce different types of data. Therefore the choice of scale should reflect the aim of the questionnaire and the element it is measuring. Frequency scales can be used when it is important to judge how often a particular event occurs. Thurstone scales rely on a panel of judges to rank statements relating to a concept in order from favourable to unfavourable along a linear scale, which then forms the basis of a scoring system. The statements are then given numerical values and participants are asked to agree or disagree with the list of items. The resulting score represents the strength of their attitude towards the concept under investigation (Bowling, 2014).

The Likert Scale (Likert, 1932) was the scale of choice in the development of the NVSCS. Relatively quick to develop, it is a method widely used in healthcare, sociology, psychology and education (Rattray and Jones, 2007, Bowling, 2014, Norman, 2010). In addition, the statements from the SAQ and HSOPS surveys were already presented in Likert form. Unlike Thurstone scales, Likert scales rely on the *participants* to place themselves on a continuum of agreement with a given attitude statement.

Each statement from the pool of items was linked to a Likert scale, divided into five ratings, which ranged from strongly disagree to strongly agree, and included a neutral midpoint. Each level of agreement was assigned a score from 1-5 with 1 being strongly disagree and 5 being strongly agree. An example is given below:

1. **It is difficult to discuss errors in this practice.** **(Likert score)**
    - Strongly agree (5)
    - Agree (4)
    - Neither (3)
    - Disagree (2)
    - Strongly disagree (1)

Despite the scale being divided into five 'units', this does not infer that each division is of equal value, despite the visual temptation to believe so. For example, the difference in the strength of feeling between 'Agree' and 'Strongly agree' cannot be assumed to be equal to that between 'Neither' and 'Agree'. However, the scale does allow for the ordering of people's attitudes, without comment on how relative they are to each other (Bowling, 2014, Jamieson, 2004).

5.2.5 Pilot work

Initially, all 57 statements were piloted on two participants who had no veterinary experience to determine if the wording and language used in each statement was clear and understood. Participants were invited to comment or ask questions about statements they did not understand or found difficult to answer, and the items were amended accordingly. The entire draft survey, consisting of all 57 statements and 10 demographic measures, was then pilot tested on vets (n=8) and nurses (n=4), to assess its usability. Again, discussions regarding the meaning of statements or ease of answering led to amendments of the text,

which became less frequent and more superficial over the course of the testing. A copy of the pilot survey is available in Appendix 5d.

5.2.6 Designing the sample

Confidentiality

All participants were assured, on the front page of the survey, that their answers would be confidential. A copy of this information sheet is available in Appendix 5e. They were not assured anonymity, despite the potential for this to improve both the response rate and quality. True anonymity can be difficult to achieve, especially when online data collection methods are employed (Lefever et al., 2007). It was also important that participants who worked at the same practice could be identified and grouped together for analysis. Culture is a local phenomenon, and for the results to be meaningful, the survey asked participants to provide the postcode of where they worked, as a means of extracting individual practice data from within the larger data set. This in turn presented potential issues with smaller practice units, as identifying individuals became a possibility. For this reason, anonymity was not specifically assured.

Response rate

Designing a successful questionnaire includes a consideration of the best way to maximise response rates. This essentially involves attracting participant's attention with the subject matter, harnessing their cooperation and motivating them to spend time to answer the questions. Many factors have been found to influence response rates, varying from the type of envelopes used in mail surveys, how much publicity a survey is afforded and whether

incentives are offered to participants on completion (Edwards et al., 2002). Table 5.5 shows a selection of strategies employed to improve response rates and their relevance to this study (Oppenheim, 2000).

Strategy	Comments
Publicity	Limited resources meant there was no opportunity to publicise the survey to the profession through advertising. However, presentations at veterinary conferences and scientific meetings helped raise awareness and motivate people to participate.
Incentives	Incentives were not offered due to limited resources.
Confidentiality / anonymity	Confidentiality was highlighted, but anonymity was not assured.
Appearance	The professional survey building website Surveymonkey was used to develop the survey which ensured it was presented attractively and that the technological aspects worked well.
Length	The pilot form of the survey was long. This is unavoidable with a pilot measure, and increases the chances that participants will abandon the survey before it is complete.

The topic	Patient safety is a 'new' topic in the veterinary profession. The information page at the beginning of the survey attempted to explain the importance of the concept and reassure clinicians who may have fearful of exposing their mistakes
Rapport	Many of the surveys were completed face to face in practice groups after a discussion of the subject with the researcher. This was an effort to engage and reassure clinicians to encourage their participation.
Return envelopes	Any mailed paper surveys were always accompanied by a self -addressed envelope.
Advance warning	Practices were contacted in advance, the purpose of the survey explained and a day arranged for the researcher to meet staff.

Table 5.5 Common strategies for maximising survey response rates and their relevance to this project. Adapted from (Oppenheim, 2000)

In the case of this study, the data was to be used specifically for the process of exploratory factor analysis (EFA) to identify the subdomains of veterinary safety culture. Sample size is regarded as the most important aspect of ensuring the statistical tests would be robust and valid, and therefore a critical number of 300 responses was required (Ferguson and Cox, 1993).

Sampling method

A convenience sampling and snowballing technique was used to generate participants, followed by a mixed mode strategy for the survey's completion, utilising postal, online and group administration methods. This technique enabled the researcher to explain about the project and purpose of the survey, provide reassurance regarding confidentiality and to invite any questions from participants. In many cases, it also ensured a response, as the researcher collected the completed surveys in person, on the day.

5.2.7 Field work

Distribution of the survey began on 1st January 2015 and continued until 31st May 2015. Initially, individual participants who had been involved with phase one of the project were approached to fill in the survey and distribute it throughout their organisations. This was often run as a 'lunch and learn' continuing professional development (CPD) session, with a pre - arranged date and time for the researcher to be present, and for staff to be released from work in order to complete the survey. The project was also presented at the summer meetings of two national surgical associations, The Association of Veterinary Soft Tissue Surgeons (AVSTS) and The British Veterinary Orthopaedic Association (BVOA). Hard copy

surveys and a link to the online version were distributed to attendees, with an invitation for them to forward the link to their colleagues. Participants who had attended the focus group at the Association of Veterinary Anaesthetists conference during part one of the study, were contacted via email and invited to complete the survey. The snowballing technique was also employed online, using Facebook to engage the researcher's own network of veterinary colleagues, and invite them to both complete the survey online and forward the link to their associates. All those sent an invitation to complete the survey online, were sent a reminder 2 weeks after the initial contact to maximise responses. In total, 350 paper copies of the survey were distributed to 14 individual veterinary practices and the two regional meetings between February and April 2015. The online survey was opened on 1st January 2015 and closed on 31st May 2015. Table 5.6 gives an overview of the participants and their description.

Participants	Description
Practice A	Charity small animal hospital
Practice B	Charity small animal hospital
Practice C	Small animal first opinion practice.
Practice D	Small animal hospital
Practice E	Small animal hospital and farm animal practice
Practice F	Small animal hospital
Practice G	Small animal hospital and referral centre
Practice H	Small animal hospital
Practice I	Small animal and equine first opinion practice
Practice J	First opinion and referral equine practice
Practice K	First opinion and referral equine practice
Practice L	Small animal referral hospital
Practice M	Small animal first opinion practice
Conference	Association of Veterinary Soft Tissue Surgeons annual conference
Conference	British Orthopaedic Veterinary Association annual conference
Facebook	Individual vets in practice
Association of Veterinary Anaesthetists	Association of Veterinary Anaesthetists focus group follow up.

Table 5.6 Overview of the survey participants

5.3 Results

This section will describe the preparation and analysis of the pilot survey response data. There were multiple steps in this process and an outline is presented in figure 5.2. Each stage will be discussed in more detail in the following section

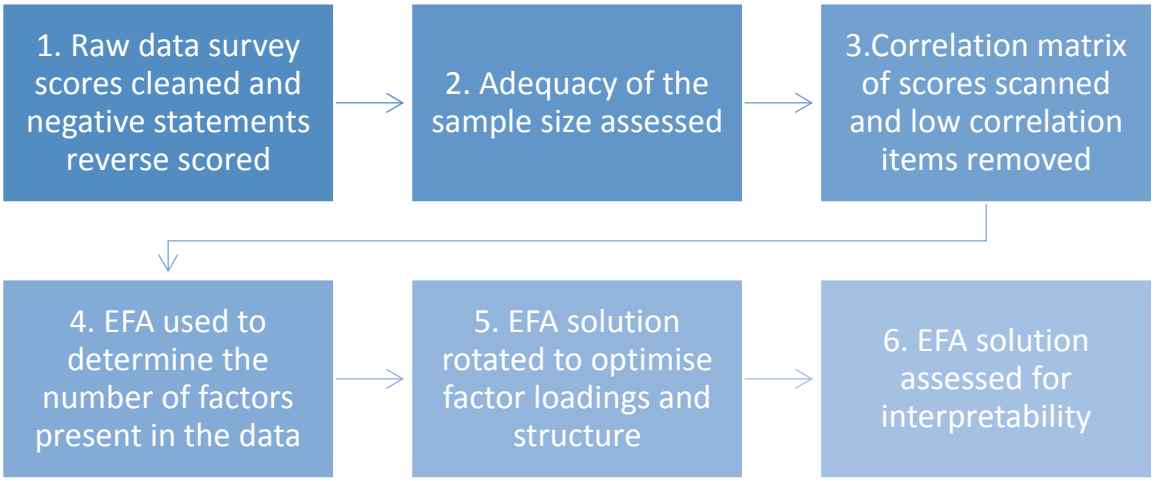


Figure 5.2 Steps in the preparation and analysis of the raw pilot survey data.

5.3.1 Data preparation

229 paper copies were returned, a response rate of 65% and 183 online surveys were completed, resulting in 412 surveys for analysis. Data from the 229 hard copy questionnaires was entered by hand into the SPSS statistical software package (IBM corp, 2013). Data from the 183 online surveys was exported from Surveymonkey (Palo Alto) and merged directly with the SPSS data file to create a set of 412 results. The data was then cleaned for anomalous entries. Missing entries were assigned a score of 99, to enable the statistical programme to distinguish them as such. The Likert scales were coded numerically as follows:

1=Strongly disagree, 2= Disagree, 3= Neither, 4= Agree, 5= Strongly agree.

Reverse scoring

Items which had been negatively worded were reverse scored at this stage. Each subdomain was composed of a set of items, and within each set there was a mix of positively and negatively worded statements. Those scores on statements with which an agreement indicated a *negative* attitude, were reversed as follows:

1=Strongly agree, 2=Agree, 3=Neither, 4=Disagree, 5=Strongly disagree.

For example, strong agreement with the item 'I am sometimes intimidated by a member of my team' suggests a poor teamwork environment with negative connotations for patient safety and safety culture. The numerical sum of the scores for each subdomain should reflect the positivity of the participant's attitude regarding that subdomain, with higher values signifying more positive attitudes. By reversing the magnitude of scoring for negative items this is reflected in the combined score for that subdomain.

Reverse scoring has implications for future statistical analysis. It has significant effects on the determination of Chronbach's alpha, so a careful record of the questions which had been reversed was maintained.

5.3.2 Assessing the adequacy of the sample size

Sample size is of critical importance in establishing a stable and valid factor structure. Sample size for EFA is controversial, with anecdotal recommendations in the literature suggesting 'rules of thumb' such as 5 participants per measured variable and a total sample never less than 100 (Gorsuch, 1983) or a ratio of 10 participants per survey item (Nunnally, 1978). However, Fabrigar and Fields suggest that an estimate of sample size is better determined by assessing the factor loadings and communalities (Fabrigar and Wegener, 2011, Fields, 2005). Some authors also recommend the use of power calculations to assess the minimum sample size needed to achieve an acceptable level of 'fit' for the theoretical model which EFA constructs (MacCallum et al., 1996).

In this case, 412 surveys had been returned for analysis which satisfied the recommendation of Fields (2005) and Fergusson and Cox (1993), that a minimum sample of 300 is required for EFA. In addition, the Kaiser-Meyer-Olkin measure of sampling adequacy was assessed (table 5.7). Values closer to 1.0 indicate a compact pattern of correlations within the data matrix, suggesting that factor analysis is an appropriate method to apply to the data. Values <0.5 indicate that more data is needed as there is a spread of patterns in the available data which is unlikely to coalesce into meaningful structure. This sample suggested factor analysis was a valid technique, with a value of 0.886 (Fields, 2005).

Kaiser – Meyer – Olkin measure of sampling adequacy	0.886

Table 5.7 The Kaiser-Meyer-Olkin measure of sampling adequacy

5.3.3 Assessing the correlation matrix

The correlation matrix for the entire data set was visually scanned for low correlations. Items which did not correlate strongly with any other items were assumed to be unrelated to any underlying common factors and were not likely to be related to the overall construct of safety culture. Similarly, those items which correlated with only one other item were likely to be less reliable measures of a subdomain, as at least three items are required to 'measure' a subdomain. Items which showed low affinity for any other items in the matrix, assessed by correlation coefficients of <0.3, or those which correlated with only one other item were excluded from the pool (Fields, 2005). This process occurred in phases, with a new correlation matrix generated after each phase, and fewer items excluded each time. The final stable matrix consisted of data from 412 completed surveys, composed of 29 items all with multiple correlations >0.3. This resulted in the exclusion of 28 items.

Table 5.8 shows the items which were discarded and those retained for factor analysis. The superscript 'r' denotes those items that were reverse scored.

Retained items	Excluded items
We have procedures and systems in place to prevent errors happening in this practice	I feel guilty if I make a mistake
Mistakes have led to positive change at this practice	ʳ Mistakes do not matter so long as no patient gets seriously hurt
ʳ It is difficult to discuss errors in this practice	ʳ I have made errors which have harmed patients
ʳ If we make a mistake my boss just sweeps it under the carpet and does not address it unless he/she is forced to	ʳ The vet doing the procedure is always ultimately responsible for the safe treatment of the animal
We normally discuss our mistakes informally amongst the team	ʳ Mistakes have happened in the past because I forgot to check everything properly
ʳ If I make a mistake I worry I will get into trouble with my boss	I do not forget the mistakes I have made, and this stops me making the same mistake again
I feel my boss supports me if I make a mistake at this practice	ʳ If I make a mistake I worry that the owner will report me to the Royal College of Veterinary Surgeons
I always feel able to question the decisions or actions of someone with more authority	ʳ the Royal College of Veterinary Surgeons punishes vets and nurses who make mistakes
I would always speak up if I perceived a problem with patient safety during a procedure	The veterinary surgeon should always be in charge of the team during a procedure
It is easy for personnel here to ask questions if there is something they do not understand	ʳHigh levels of workload are common in this practice

ʳ I am sometimes intimidated by another member of the team	ʳ We use too many locum staff than is good for patient safety in this practice
The level of staffing in this practice is always sufficient to handle the number of patients	ʳWe use too many part time staff than is good for patient safety in this practice
Patient safety is never compromised to get more work done	I am more likely to make errors in tense or hostile situations
When my workload becomes excessive, my performance is impaired	ʳ A truly professional person can leave personal problems behind when they are at work
I am less effective at work when I am fatigued	ʳ I sometimes feel 'burned out' by my work
I have the support I need from other personnel to care for my patients to the best of my ability	People who are careful and measured are less likely to make mistakes
Nurse input is well received at this practice	I am too busy to fill in paperwork like anaesthetic and surgical checklists
In this unit, people treat each other with respect	Checklists would be more useful for younger vets and nurses than more experienced clinicians
This practice is a good place to work	Female vets seem to get more stressed than male vets
At present, there is good cooperation between reception and clinical staff	You have to be very confident in yourself to be a good surgeon
At present there is good cooperation between vets and nurses	It is easier working with people I know because I am used to how they do things

ʳ Important information is often lost at shift change or patient transfer	We often share roles in the prep room to help each other out, especially when it is busy
ʳ Communication breakdowns which lead to errors or confusion are common	ʳ Because we work together all the time, standardised communication methods are less necessary in this practice
ʳ Information is sometimes lost at handover between part time workers at this practice	I am always clear about my roles and responsibilities at every stage of a procedure
Inexperienced vets and nurses are adequately supervised and supported even at busy times.	ʳ When we are really busy we try to work faster, even if it means taking short cuts
I respect my boss	ʳ The management often doesn't know about mistakes that we make
ʳ I am scared of my boss	ʳ The management seem to care much more about patient safety after something has gone wrong
We are given formal feedback about errors that happen in this practice / group of practices	The management feels that patient safety is more important than keeping busy
The management regularly discusses the results of clinical audit with the team in this practice.	

Table 5.8 Items retained for factor analysis and items excluded due to low correlations. Reverse scored items are shown by the superscript 'r

5.3.4 Exploratory Factor Analysis (EFA)

As described in Chapter three, Exploratory Factor Analysis (EFA) was the method of choice to analyse the pilot survey data. This is a commonly used statistical technique in psychology and social science but it is unusual in the veterinary literature. Therefore a description of the method will be presented in more detail here. For clarity, a definition of commonly used terms is provided in table 5.9

Phrase or term	**Definition**
The *construct*	The overarching phenomenon of *safety culture* which is measured by the NVSCS.
The *subdomains* or *variables*	The *factors* which makes up the construct of safety culture. The cumulative score of these subdomains makes up the total score for the questionnaire. Higher scores indicate a positive attitude and more mature safety culture.
The *items*	The *attitude statements* making up the questionnaire, which 'tap in' to the subdomains. The cumulative score of related groups of items is the 'measure' of that subdomain.
Factor loading	The *correlation of an item with a factor*
Eigenvalue	The *sum of the squares of the factor loadings*. Essentially, the eigenvalues for each item will show the *proportion of variance accounted for in that item by each factor.*
Case	The *set of results* obtained from a participants questionnaire.

Table 5.9 Glossary of commonly used terms in this section

General comments on factor analysis

Factor analysis gives information regarding the number and type of subdomains within an area of interest and identifies the measures which are most effective at 'tapping in' to those subdomains. It is a useful tool to determine the dimensions of a new measurement scale by assessing how a total pool of individual measures correlate to form subdomains, and how many subdomains make up the construct. It also enables the assessment of the psychometric values of individual items. An item which loads strongly on a specific factor is likely to reflect the same subdomain as the other items which also load on that factor. For example, an item such as 'At present there is good cooperation between vets and nurses' may load strongly to Factor A (Teamwork) and weakly to Factor C (Risk perception). The other items loading to Factor A also mirror this pattern, suggesting they all measure the same subdomain. Items which load weakly on a factor whose other items are strongly loaded are, in contrast, unlikely to be measuring the same underlying subdomain. Therefore, subscales, or subdomains can be created by grouping together those items with the strongest loadings to individual factors. Items influenced by multiple factors can be omitted as they are likely to be poor measures of any one subdomain (Fabrigar and Wegener, 2011)

Factor analysis was used in this study to determine the number of subdomains making up the construct of veterinary safety culture, assessed by the items in the NVSCS. The subdomains are presumed to be responsible for the patterns of correlations between items, and are extracted as 'factors'. These factors are then assessed in turn, for the strength and influence they exert on each item. This is termed the factor loading, and is a measure of the strength of the correlation between the item, and the factor itself. This method of analysis is

based on the common factor model, which assumes that correlations between items are accounted for by a *common* factor which influences their behaviour. For example, the two statements 'People here treat each other with respect', and 'There is good cooperation between vets and nurses' correlate because they are both influenced by the common factor 'Teamwork'.

The number of factors to extract

Factor analysis was used to find a 'best fit' common factor model within this correlation matrix of 29 items. It is accepted that no model will have a perfect fit to any data set, especially in sociological phenomena. These complex constructs are likely to be influenced by numerous non linear factors which are inevitably not accounted for. Also, numerous less significant common factors must be excluded if the ultimate aim is to reduce the number of subdomains, in order to simplify the concept. No mathematical model can account for this inevitable surplus and the influence of unknown non linear factors, but the aim of factor analysis is to develop a model which best fits as much of the data as possible. In deciding the correct number of factors to extract, four criteria can be used to guide the selection of the simplest model (Fabrigar and Wegener, 2011)

1. The model reasonably accounts for the correlations between measured variables
2. A model with one fewer factors is worse
3. A model with one more factor is no better
4. All factors are interpretable and can be related to theoretical concepts regarding the overall construct.

Eigenvalues

Eigenvalues are used to decide how many factors to extract from the data. They are the sum of the square roots of the factor loadings of each factor, the factor loadings being the correlations of the items with the factor. These values indicate the proportion of variance in a measured item, which is accounted for by each of the common factors. The larger the eigenvalue displayed by an item for a factor, the more variance is explained by that factor (Kline, 2014). Eigen values determine the relative importance of each factor. They are used to rank the major factors, and identify those that have the most influence on the construct, and those which are minor enough to be discounted.

The following procedures were used to guide the researcher's decision on how many factors to extract from the data.

- **Eigen values greater than 1 rule (Kaiser criterion)**

This is the default setting on many statistical computer programmes, including SPSS, however it is a weak method of factor determination which often overestimates the number of common factors. It should be used in consideration with other methods (Fields, 2005, Kline, 2014, Fabrigar and Wegener, 2011)

- **Scree Test**

This plots the eigenvalues of the factors in descending magnitude. In theory this enables a visual assessment to determine the cut off point between the *major* common factors and less relevant ones, as those which are present before the first inflexion of the scree line. It has been shown to reliably predict the correct number of factors in artificially produced

matrices (Kline, 2014). This method involves a degree of subjectivity however, and scree plots can often give equivocal results. Again, it is advisable to use them in conjunction with other methods.

- **Parallel analysis**

This technique aims to compare the correlation matrix generated by the data, with a matrix of randomly generated figures. The random matrix is created to have the same number of variables or items and an identical sample size, or number of cases. Theoretically, the eigenvalues generated from a data set made up of meaningful correlating measures, will be greater than those which are generated by the parallel data set, where correlations arise by chance alone. The number of factors to extract is therefore indicated by selecting the factors in the real data set which have eigenvalues greater than those in the parallel set (O'Connor, 2000)

Initial factor structure

Exploratory Factor Analysis (EFA) was conducted on the 29 items. Cases which contained missing entries identified by the code '99', were excluded listwise and completely removed from the analysis, resulting in a dataset with 378 cases. This is recommended when sample size allows, and a data set of this size was more than sufficient for reliable factor analysis without the need to introduce error in the form of substituting values for missing data (Fields, 2005). Initial analysis using the default Kaiser's criterion of one as a cut off measure, suggested seven factors were present. The scree plot was equivocal however, with inflexions at two, five and eight suggesting one, four or seven factors, see figure 5.3.

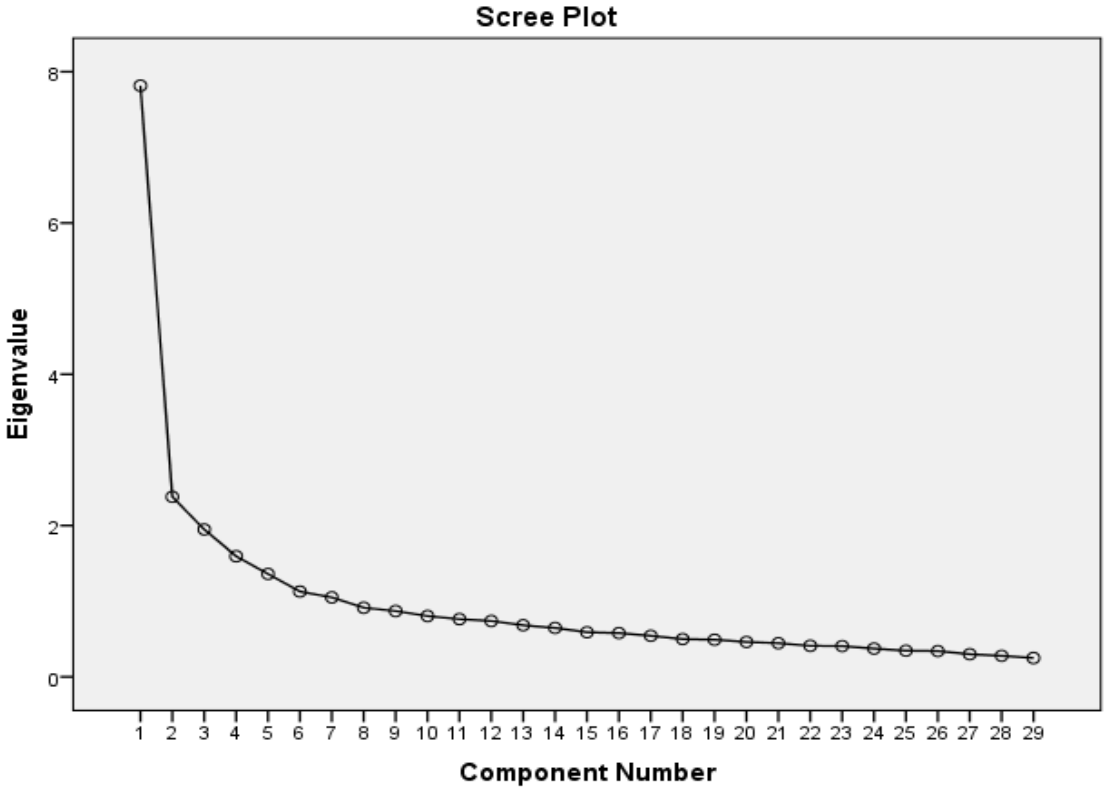


Figure 5.3 Scree plot of initial analysis showing inflexions at 2, 5 and 8

As discussed above, Kaiser's rule is known to overestimate the number of factors, and this seven factor model resulted in one subdomain which was comprised of less than three items, suggesting overfactoring.

Parallel analysis is one of the most reliable methods of estimating factor extraction (Fabrigar and Wegener, 2011). Parallel analysis of the data using O'Connors matrix is displayed in table 5.10, suggesting a four factor structure (O'Connor, 2000).

Factor number	Random data Eigenvalues		Original Eigenvalues
	Means	**95th percentile**	
Factor 1	1.553593	1.637482	**7.815**
Factor 2	1.469133	1.525113	**2.380**
Factor 3	1.414544	1.460855	**1.949**
Factor 4	1.367033	1.411850	**1.594**
Factor 5	1.319419	1.360465	1.360
Factor 6	1.276921	1.316055	1.128

Table 5.10 Parallel analysis of 378 cases, 29 variables (items), 100 datasets. Original eigenvalues of greater value than the parallel eigenvalues are in bold. Factors 7-29 are presumed to be minor and are not displayed

The scree plot also indicated that a four factor model was a legitimate assumption and therefore, SPSS was programmed to extract a four factor model from the data for rotation.

Rotation

Rotation is a mathematical method by which the *best fit* of the final factor structure model can be determined. Factors can exist in any dimension, producing an infinite number of final structure solutions. One of the criticisms of factor analysis is that this infinity of solutions, makes it inherently difficult to reproduce results from a myriad of possible structures. If a factor structure is stable, it should be reproducible. Rotation aims to alter the 'fit' of the factor structure so that 'simple structure' is maximised. Essentially, it tries to maximise the chances that 'each factor has a few high loadings with the rest of the loadings being zero or close to zero' (Kline, 2014). This simple structure has the advantage of being easier to

interpret, as each factor has only a few high loadings and no cross loadings. It is also more likely to be reproducible.

Final rotated factor structure

The four factor, 29 item model was rotated using oblique rotation, to maximise the loadings of the items on the four factors and strive to achieve a best fit simple structure. The results of the four factor rotation are shown in table 5.11. Despite rotation, two items loaded onto more than one factor above the selected level of 0.3. These were retained in the final survey structure as, when included in the factor to which they showed their highest loading, they were conceptually related to the other items on that factor and to the description of the factor itself. As an early measure, it would be expected that the structure of the factors may alter slightly as the tool is developed over time, and the decision to retain these items could potentially be reviewed in future refinement of the tool, such as confirmatory factor analysis. The eigenvalues in the rotated solution are greater as they account for more variance in the items loading on the factor, than those in the un-rotated solution, and together account for 47.371% of the variance in the sample.

Factor	Initial eigenvalues			Rotated eigenvalues. (Sums of squared loadings)
	Total	**% of variance**	**Cumulative percentage**	**Total**
1	7.815	26.949	26.949	5.485
2	2.380	8.205	35.155	4.453
3	1.949	6.720	41.875	2.571
4	1.594	5.496	47.371	5.251

Table 5.11 Table showing eigenvalues before and after oblique (oblimin) rotation.

The following table demonstrates the item loadings on each of the four factors (table 5.12).

Item	Factor 1	Factor 2	Factor 3	Factor 4
At present there is good cooperation between vets and nurses at this practice	**.814**	-.010	-.081	-.120
In this practice people treat each other with respect	**.661**	-.209	-.018	.061
Nurse input well received at this practice	**.669**	-.045	-.079	.113
At present there is good cooperation between reception and clinical staff at this practice	**.711**	.106	.028	-.113
This practice is a good place to work	**.594**	-.137	.000	.212
I have the support I need from other personnel to care for my patients to the best of my ability	**.509**	-.121	.129	.160
Communication breakdowns which lead to errors are common	**.446**	.025	.221	.185
It is easy for personnel to ask questions if there is something they do not understand	**.352**	-.249	-.044	.281
I am scared of my boss	.145	**-.785**	.017	-.057
If I make a mistake I worry that I will get into trouble with my boss	-.001	**-.756**	-.071	-.064
I always feel able to question the decisions or actions of someone with more authority	-.032	**-.638**	.132	.097

I feel my boss supports me if I make a mistake at this practice	.228	**-.565**	-.140	.249
I am sometimes intimidated by another member of my team	.064	**-.629**	.238	-.105
I respect my boss	.379	**-.422**	-.166	.194
I would always speak up if I perceived a problem with patient safety during a procedure	-.186	**-.472**	.109	.267
The level of staffing is always sufficient to handle the number of patients	.237	**-.347**	.285	-.078
When my workload becomes excessive my performance is impaired	-.102	-.137	**.755**	-.031
I am less effective at work when I am fatigued	-.077	-.148	**.731**	-.043
Patient safety is never compromised to get more work done	.076	-.136	**.495**	.188
Important information is often lost at shift change or patient transfer	.372	.207	**.417**	.143
Information is sometimes lost at handover between part time workers at this practice	.264	.259	**.359**	.057
We are given formal feedback about errors which happen in this practice / group of practices	-.053	.149	.067	**.757**
Mistakes have led to positive change at this practice	-.044	-.097	-.118	**.723**
The management regularly discusses the results of clinical audit with the team in this practice	-.008	.041	.143	**.651**
We have procedures and systems in place to prevent errors happening in this practice	.028	.038	.055	**.655**

If we make a mistake my boss just sweeps it under the carpet and does not address it unless he/she is forced to	.183	-.234	-.102	**.570**
It is difficult to discuss errors at this practice	.248	-.198	-.035	**.474**
We discuss our mistakes informally amongst the team	.059	-1.22	-.297	**.434**
Inexperienced vets and nurses are adequately supervised and supported even at busy times	.187	.083	.311	**.408**
Eigenvalues (after rotation)	7.815	2.380	1.949	1.594
% variance	26.949	8.205	6.720	5.496
Cumulative variance	26.949	35.154	41.874	47.371

Table 5.12 Pattern matrix for 4 factors, 29 items N=378

Interpretability of solution

The final criterion for determining the number of factors to extract is whether the solution is logically interpretable. When naming a common factor, each measure or item which loads onto that factor must hypothetically relate to the resulting subdomain. It does not make conceptual sense to include any item which does not load highly on that factor. Equally, a common factor which has no substantial loadings or only a single loading is unreliable, hard to interpret and probably the result of extracting too many factors. If it is a major common factor, it should influence and therefore load more than one item in a data set. This four factor structure delineates four subdomains of safety culture, measured by theoretically linked items that cluster together comfortably. Titles that describe each group of items are logically iterated and describe the subdomain effectively.

In addition, the model was run specifying both a three and five factor structure to compare the results, and ensure neither displayed a 'better' alternative. The pattern matrixes for both models are available in appendix 5f. Neither demonstrated a model which fitted the data more efficiently, further confirming a four factor structure for the construct of safety culture in veterinary practice as described below:

Factor 1. Organisational safety systems and behaviours:

Staff perception of management commitment to patient safety, through their response to errors and their prevention

- We are given formal feedback of errors which happen in this practice / group of practices
- Mistakes have led to positive change at this practice

- The management regularly discusses the results of clinical audit with the team in this practice
- We have procedures and systems in place to prevent errors happening in this practice
- If we make a mistake my boss just sweeps it under the carpet and does not address it unless he/she is forced to
- It is difficult to discuss errors in this practice
- We normally discuss mistakes informally amongst the team
- Inexperienced vets and nurses are adequately supervised and supported even at busy times

Factor 2. Staff perception of management:

Frontline staff's trust of management and seniors and the effect of hierarchy.

- I am scared of my boss
- If I make a mistake I worry that I will get into trouble with my boss
- I always feel able to question the decisions or actions of someone with more authority
- I feel my boss supports me if I make a mistake at this practice
- I am sometimes intimidated by another member of my team
- I respect my boss
- I would always speak up if I perceived a problem with patient safety during a procedure
- The level of staffing in this practice is always sufficient to handle the number of patients

Factor 3. Risk perceptions:

Frontline staffs acknowledgement of individual and organisational risk factors which affect patient safety

- When my workload becomes excessive my performance is impaired

- I am less effective at work when I am fatigued
- Patient Safety is never compromised to get more work done
- Important information is often lost at shift change or patient transfer
- Information is sometimes lost at handover between part time workers in this practice

Factor 4. Teamwork and communication:

Staff perceptions of teamwork and communication within clinical units

- At present there is good cooperation between vets and nurses
- People treat each other with respect
- Nurse input well received in this practice
- At present, there is good cooperation reception and clinical staff
- This practice is a good place to work
- I have the support from other personnel to care for my patients to the best of my ability
- Communication breakdowns common
- It is easy for personnel here to ask questions if there is something they do not understand

5.4. Assessing the reliability and validity of the final 29 item 4 factor survey

Once the final structure of the survey had been established, its reliability and validity were assessed. Reliability infers that a measure is consistent and stable over time (Golafshani, 2003). This is commonly assessed by measures such as alternate form and test-retest reliability. The internal reliability of the measure is also assessed, by assessing the reliability of each of the subscales within a multidimensional measure individually.

Validity is the ability of an instrument to measure that which it pertains to measure (Rattray and Jones, 2007). In the case of this safety attitude survey, it is the degree to which the tool can accurately measure the construct of veterinary safety culture. Several levels of validity can be considered when assessing an instrument: face, content and construct validity. Face validity is the most superficial form of validity assigned to a measure and relates simply to the superficial presentation and relevance of the survey (Litwin, 1995). Content validity is not assessed statistically. Rather, it relates to the assessment of a measure by the subjective opinion of informed personnel (Litwin, 1995). Construct validity is the most robust form of validity, and can be described as convergent or discriminant. Convergent validity assesses the level of correlation between the results of the new measure with those from an established tool which measures the same construct. Discriminant validity uses the same technique, but tests the new measure against constructs thought to be unrelated. In this case low correlations are expected.

5.4.1 Methods

Reliability: Internal reliability

The survey scores for the 29 items selected for the final form of the NVSCS was extracted from the original data set and entered into SPSS. The items were sorted and grouped into their subdomain sets and Chronbach's alpha was calculated for each to produce a set of 4 alpha values, one for each subdomain. To further assess the internal reliability of each subdomain, scale if item deleted assessments were conducted for each set of items.

Reliability: Alternate form reliability

Response scores from the online version and hard copy editions of the pilot NVSCS data set were compared. The original cleaned and reverse scored data set of 378 cases and 57 items was exported to excel. The 29 items making up the four subdomains were extracted. Participant's scores were summed to create a data set of four scores for each participant, one for each subdomain and the data split into online (n=180) and paper copy (n=193) entries. Missing entries were assigned the score 99 and missing data were excluded listwise. This new data set was imported to SPSS and an independent T test used to compare the means of the scores on each subdomain.

Validity: Face and content validity

Face and content validity were assessed by the reaction of participants to the survey, a comparison with the domains of safety culture in the literature and similar survey tools and the opinion of a non veterinary expert in safety culture from the aviation industry.

Validity: Construct validity

In the absence of another validated measure of veterinary safety culture, the SAQ (short form) was selected as a tool against which the NVSCS could be assessed for construct validity. This is a highly validated, widely used measure of medical safety culture (Taylor and Pandian, 2013). It is also quick and easy to complete and two of its subdomains overlap strongly with the subdomains of the NVSCS (Table 5.13). As such, it is a suitable instrument to compare the relevant subdomain scores for both convergent and divergent validity.

SAQ	NVSCS
Teamwork climate	Teamwork and communication
Perceptions of management	Staff perceptions of management
Stress recognition	Risk perception
Safety climate	Organisational safety systems and behaviours

Table 5.13 Subdomains of the SAQ as compared with subdomains of the NVSCS

An online version of the final form NVSCS combined with items from the SAQ, was written up in SurveyMonkey. The 5 point Likert scale used in the SAQ was assigned numerical scores as follows:

Disagree strongly = 1, Disagree slightly = 2, Neutral = 3, agree slightly= 4, Agree strongly = 5.

The online link to this survey was emailed to all contacts who had participated in the first two phases of the study. In addition it was distributed to final year veterinary students at the University of Nottingham and a request for participants sent out on the researcher's Twitter account. The survey was left open online for 2 weeks.

The data was exported from survey monkey as an excel file. Cases with missing entries were excluded listwise, resulting in a total data set of n= 41. Negatively worded items from both the SAQ and NVSCS were reverse coded. The scores for each subdomain were then summed to produce two sets of four subdomain scores, one set from each questionnaire. The

summed scores were imported to SPSS, and Pearson's correlation used to assess the degree of similarity between the SAQ and NVSCS results for each subdomain.

5.4.2 Results

Reliability: Internal reliability

The results of Chronbach alpha for each of the four subdomains of the NVSCS are displayed in table 5.14. Tables 5.15 – 5.18 display the scale if item deleted values for each subdomain.

Chronbachs alpha values			
Factor 1 Organisational safety systems and behaviours	**Factor 2 Staff perceptions of management**	**Factor 3 Risk perception**	**Factor 4 Teamwork and communication**
.794	0.805	0.592	0.794

Table 5.14 Chronbach alpha values for each subdomain of the NVSCS

Factor 1: Organisational safety systems and behaviours (α = 0.794 n = 8)	**Scale if item deleted value**
Mistakes have led to positive change at this practice	.767
We are given formal feedback of errors which happen in this practice / group of practices	.767
We have procedures and systems in place to prevent errors happening in this practice	.775
The management regularly discusses the results of clinical audit with the team in this practice	.770
If we make a mistake my boss just sweeps it under the carpet and does not address it unless he/she is forced to	.753
It is difficult to discuss errors in this practice	.760
We normally discuss mistakes informally amongst the team	.792
Inexperienced vets and nurses are adequately supervised and supported even at busy times	.785

Table 5.15 Factor 1 scale if items deleted value

Factor 2: Staff perceptions of management (α= 0.805 n = 8)	**Scale if item deleted value**
I am scared of my boss	.749
If I make a mistake I worry that I will get into trouble with my boss	.778
I always feel able to question the decisions or actions of someone with more authority	.780
I feel my boss supports me if I make a mistake at this practice	.766
I am sometimes intimidated by another member of my team	.792
I respect my boss	.783
I would always speak up if I perceived a problem with patient safety during a procedure	.804
The level of staffing in this practice is always sufficient to handle the number of patients	.807

Table 5.16 Factor 2 scale if items deleted values

Factor 3: Risk perception (α = 0.592 n= 5)	**Scale if item deleted value**
Important information is often lost at shift change or patient transfer	.495
Information is sometimes lost at handover between part time workers in this practice	.568
Patient Safety is never compromised to get more work done	.553
When my workload becomes excessive my performance is impaired	.519
I am less effective at work when I am fatigued	.547

Table 5.17 Factor 3 scale if items deleted value

Factor 4: Teamwork and communication (α = 0.828 n = 8)	**Scale if item deleted value**
At present there is good cooperation between vets and nurses	.802
People treat each other with respect	.792
nurse input well received	.800
At present, there is good cooperation reception and clinical staff	.823
This practice is a good place to work	.796
I have the support from other personnel to care for my patients to the best of my ability	.805
Communication breakdowns are common	.829
It is easy for personnel here to ask questions if there is something they do not understand	.817

Table 5.18 Factor 4 scale if items deleted values

Reliability: Alternate Form reliability

Alternate form reliability was assessed to strengthen the reliability assessment of the NVSCS. The results are displayed in table 5.19.

Subdomain (Factor)	**N: Hard copies** **N: Online copies**	**Sig (2 tailed)** **p<0.05**	**Mean: Hard copy** **Mean: Online copy**	**SD: Hard copy** **SD: Online copy**
Factor 1	183 167	0.341	29.40 28.49	10.95 5.860
Factor 2	189 171	0.267	28.73 30.16	11.638 12.718
Factor 3	188 171	0.185	13.87 13.05	7.556 2.978
Factor 4	190 172	0.097	30.82 32.02	4.523 8.757

Figure 5.19 Table of Independent T test values. P<0.05

The four subdomains showed no statistically significant difference in the mean scores between questionnaires in an online format and those in a paper copy format.

Validity: Face and content validity

In the author's opinion, the face validity of the NVSCS is good. The questions appear clear and unambiguous and are relevant to the construct of safety culture. In addition, the response of both specialist and non - specialist (ie non veterinary) individuals to the pilot form of the survey indicates agreement with this assessment.

As a new tool to examine safety culture, a novel and previously undefined concept in the profession, conducting a formal review for content validity would have posed some challenges. It is difficult to ask individuals to rate an item's relevance in relation to a concept of which they have little formal knowledge. The tool was therefore assessed by a specialist in aviation safety culture, who agreed that it appeared to comprehensively cover the general aspects of safety culture, without comment on its more specialist veterinary aspects. Strong evidence for content validity is also provided by comparison with the literature. The subdomains which have emerged in this tool are similar to those present in longstanding surveys used in medicine, and those identified by Flin's (2000) over - arching review of safety culture subdomains. In addition, the tool was well accepted by participants, all of whom were practicing clinicians who generally identified with the statements and the concept.

Validity: Construct Validity

50 replies were gathered online over the two weeks. 9 surveys were excluded listwise due to missing data. The results of Pearson's test to assess the degree of correlation between scores for each subdomain are shown in table 5.20

Factor / subdomain	**NVSCS Factor 1** Organisational safety systems and behaviours	**NVSCS Factor 2** Staff perceptions of management	**NVSCS Factor 3** Risk perception	**NVSCS Factor 4** Teamwork and Communication
SAQ Teamwork climate				
Pearson Correlation	.613	.642	-.194	**.865**
Sig (2 tailed)	.000	.000	.225	**.000**
SAQ Perceptions of management				
Pearson Correlation	.642	.611	-.001	.615
Sig (2 tailed)	0.00	0.00	.995	.000
SAQ Safety climate				
Pearson Correlation	**.791**	.687	.068	.703
Sig (2 tailed)	**.000**	.000	.675	.000
SAQ Stress recognition				
Pearson Correlation	-.298	-.303	**.490**	-.226
Sig (2 tailed)	.000	.054	**.001**	.156
SAQ Job satisfaction				
Pearson Correlation	.525	.597	-.073	.783
Sig (2 tailed)	.000	.000	.650	.000
SAQ Work conditions				
Pearson Correlation	.556	.524	.111	.766
Sig (2 tailed)	.000	.000	.490	.000

Figure 5.20 Validity data. N=41. P<0.01 (2 tailed)

Factors 1 (.791), 3 (.490) and 4 (.865) on the NVSCS show high correlations with related subdomains of the SAQ suggesting good convergent validity. Discriminant validity is good for factor 3, as the subdomain does not correlate well with any other domains of the SAQ.

Factors 1 and 4 show less robust discriminant validity as their correlations are relatively strong across a number of other SAQ domains. Factor 2 on the NVSCS does not demonstrate convincing validity of either sort, as it shows a similar strength of correlation to five of the six SAQ domains.

5.5 Discussion

This aims of this phase of the project were to investigate and describe the concept of safety culture in the veterinary profession and to create a reliable, validated tool for its measurement. In a veterinary context, safety culture could be defined as the shared attitudes and beliefs of practice staff which shape their perceptions of risk and their behaviours in relation to patient safety. The development of the NVSCS informs a more detailed definition, by identifying and describing the component domains of veterinary safety culture namely, organisational safety systems and behaviours, perceptions of management, risk perception and teamwork and communication, at a local level. Each of these domains will now be discussed in more detail.

Organisational safety systems and behaviours. A cornerstone of safety culture is the reporting and discussion of adverse events and a non-punitive organisational response to mistakes (Hutchinson et al., 2009). The visible commitment of the organisation to patient safety, through the encouragement of event reporting and provision of timely, constructive feedback is critical to the development of a mature safety culture (Halligan and Zecevic, 2011). This is identified in the NVSCS by items which relate to the open discussion of error, and the potential to learn from mistakes through local and organisational feedback.

Organisational efforts to develop protective tools and processes at all levels of the organisation, must be guided by a systems perspective which recognises the limitations the environment place on individuals. This is further reinforced by an organisation's transparent response to errors, and its efforts to create a culture of learning, rather than one of blame and shame (Mahajan, 2010). If done successfully, this contributes to the development of mutual trust within a team, one of the three facilitators essential for teamwork, which is itself linked to positive culture (Salas et al., 2005).

Perceptions of management. The perceptions of management, generated by the observed behaviours of senior personnel, are critical in engendering a culture of trust and support in an organisation. Interestingly, this is represented by the item 'The level of staffing in this practice is always sufficient to handle the number of patients'. Frontline workers will judge their seniors by their actions. The demands on staff which can result from understaffing, especially out of hours, are highly visible and are compounded by the fact that they often occur during already antisocial working hours. This could potentially have a significant and emotive impact on staff's impressions of the management's commitment to providing safe, quality care.

The negative effects of traditional hierarchy can have significant effects on the ability to speak up and question senior clinicians. However, it is often essential to patient safety and a naturally occurring back up behaviour in highly evolved teams where flattening of clinical hierarchy results in freedom of communication (Salas et al., 2005). However recent research has shown that traditional clinical structures exist in veterinary practice, with subsequent implications for speaking up. Clinicians have described 'bullying cultures' and a lack of support for young graduates (Kinnison et al., 2015b, Buzzeo et al., 2014). These issues are

addressed by NVSCS items relating to 'questioning the decisions or actions of someone with more authority', always feeling able to 'speak up' and feeling 'intimidated' by another team member.

Leadership, and its direct influence on safety culture, has been identified as a critical factor in the major health scandals of the last 20 years (Kennedy et al., 2000, Francis, Kirkup, 2015). Clinical leadership from the level of the 'board to the ward ' has direct effects on the culture and clinical outcomes of a practice (Korner et al., 2015, Hackett et al., 1999) and patients receive better care from teams which are well led (Ham, 2014). Clinical leadership in the veterinary profession is under researched. Senior clinicians in veterinary leadership roles are often left to 'learn on the job' with no support or formal knowledge of the skills required to lead a team. The emerging structure of corporate veterinary practice has resulted in a generation of vets in 'middle management' roles. These are often relatively inexperienced clinicians who find themselves positioned somewhere between the frontline and a far removed head office. There is also very little available training in leadership skills, despite 'better practice management' being identified by clinicians themselves, as an area for improvement in the RCVS's 2014 survey of the profession (Buzzeo et al., 2014). By identifying staff attitudes to 'the boss', through survey items such as 'I respect my boss' or 'I am scared of my boss', the direct link between leadership at many levels and staff perceptions can be identified and assessed.

Perceptions of risk. Before the emergence of human factors in medicine, surgeons had unrealistic expectations of their ability to work unaffected by factors such as fatigue and stress. Early safety culture surveys found that up to 70% of surgeons believed that fatigue did not affect their performance (Sexton et al., 2000). Human factors research and

education has driven medical personnel to be more aware of their personal limitations, with the development of tools such as HALT (Hungry Angry Late and Tired) and IMSAFE (Illness, Medication, Stress, Alcohol, Fatigue, Eating and Elimination) (Watters and Truskett, 2013 Graves et al., 2010). Similar stressors exist in the veterinary profession, which demands long working days, often including antisocial hours. 90% of veterinary surgeons also state that they find the job stressful, citing high demands and client expectations. (Buzzeo et al., 2014). However, there is limited acceptance at present of the direct impact such factors have on vets ability to perform at work, with knock on implications for behaviours which are deemed acceptable. The risk perceptions factor of the NVSCS identifies both personal and system risk factors which impact on patient safety, assessing the effect of high workload and fatigue, and identifying handovers of patient care as an error trap.

These factors are further complicated in veterinary medicine by overlying financial implications. These provoke the inevitable trade - off between safety and productivity which other industries, and increasingly healthcare, are forced to confront. Industries such as offshore oil and gas attempt to minimise this by setting down strict regulations for accepted standards and build designs which reduce the risk of failure to a minimum. These industries have embraced human factors principles for decades and consequently recognise the threat of human risk at every stage in the design of processes and equipment.

Teamwork and communication. Teamwork is closely linked to safety culture and outcomes in medicine (Korner et al., 2015). Recent research into veterinary team dynamics suggests that vets and nurses tend to work in professional silos, limiting the interprofessional flow of information (Kinnison et al., 2015c). 52-70% of adverse events in medicine have been linked to poor teamwork or communication and 24% of malpractice claims are linked to

communications breakdowns (Weaver et al., 2014). Failures of teamwork and communication have been linked to adverse events in veterinary practice (Kinnison et al., 2015a). Interprofessional tensions are common, as demonstrated by the RCVS survey finding that 33% of veterinary nurses feel there is a lack of respect for their profession from vets or management and 54% feel undervalued in practice (Williams and Robinson, 2014). Items relating to the relationships between nurses, vets and receptionists within a practice attempt to assess those interprofessional tensions.

Recognition that "A group of experts does not constitute an expert team" has led to the development of postgraduate training in medicine and an increased focus on interprofessional working (Burke, 2004). Teamwork training is viewed as essential to improve safety and quality, and has been associated with improved clinical performance, organisational efficiency and culture and improved patient outcomes (Salas and Rosen, 2013, Weaver et al., 2013). Dixon Woods found improved levels of teamwork and happier staff in hospitals which reported a positive supportive culture (Dixon-Woods et al., 2014). The NVSCS assess similar dimensions through items relating to mutual 'respect', 'support' and the assessment that 'this practice is a good place to work'. Improvements in teamwork through training foster improvements in culture, which in turn leads to improved outcomes for patients, staff engagement and retention (Korner et al., 2015). Recent research has highlighted the benefits of a combined approach using teamwork training and quality improvement initiatives to influence safety culture (Robertson et al., 2015).

Safety culture is an all-encompassing term which describes a vastly complex, intangible, poorly understood phenomenon. The results of this study enable veterinary practitioners to 'un – pack' the concept and relate it to tangible, accessible ideas such as the effects of

hierarchy or fatigue on performance. It is hoped that each subdomain can be more easily understood and acted upon than the concept of safety culture alone. Evidence based medicine is highly valued in the veterinary profession, and the NVSCS tool provides a means to gather evidence for a concept which has a direct effect on the attitudes and behaviours of staff and in turn influences their ability to deliver care. Safety assessment surveys in medicine are used to 1) diagnose safety culture, 2) evaluate interventions, 3) benchmark hospitals and 4) fulfil regulatory directives (Nieva and Sorra, 2003). It is hoped that the NVSCS may be used in veterinary practice for similar means. The tool may be used to 'score' safety culture and stimulate discussion in practices. It can also be used to raise awareness of issues regarding teamwork and communication, attitudes to error and the system response of the organisation. On a more unit based level it can be used to benchmark units within a larger hospital, or branches within a single organisation, to assess strengths and weaknesses within a team, guide training initiatives and provides a pre and post training measure. This information will be critical to practices which are trying to effect changes regarding patient safety, and to ensure the success and sustainability of quality improvements.

It should be remembered however, that surveys such as the NVSCS are not the only form of measurement and that qualitative methods are also valuable to inform a picture of any unit's safety culture. Traditionally the 'soft skills' have been viewed with suspicion and mild contempt by many practitioners, often poorly understood and dismissed as 'the fluffy stuff'. Yule (2006) observes that these 'tacit skills are not easy to identify as they form the basis of expertise and are difficult to verbalise". It is therefore arguably easier to learn, teach and assess a technical skill or physiological concept, than it is to attain non - technical expertise. First generation Crew Resource Management trainees in aviation dismissed the programme

as ‘charm school’ and viewed it as an effort to manipulate their personalities (Helmreich et al., 1999). In a profession which values traditional quantitative methods of scientific enquiry, the ability to formalise and quantify an aspect of an otherwise intangible concept is valuable. However, clinicians and managers should resist the temptation to place too much emphasis on the results of culture surveys alone. As Parker (2006) points out, ‘measures of safety culture yielding one overall index or score, provide at best a crude indication of a complex phenomenon’. Such surveys can however give valuable information about the measurable aspects of such a concept, but if used in isolation risk oversimplifying its subtlety, depth and nuance. As such, they should be used in combination with assessments of audit, document analysis and interviews to triangulate results (Choudhry et al., 2007).

The reliability and validity of such measures are essential to enable confidence in their results (Rattray and Jones, 2007). When they have the potential to dictate changes in policy or resource allocation, the credibility of the survey is even more important. The results of this study suggest very good internal reliability of the NVSCS. Factors one, two and four, show excellent internal reliability. Cronbach alpha values are affected by the number of items present in a scale which may explain why factor three had a lower α value of 0.592 . However, values above 0.5 are deemed acceptable, especially in measures in early stage development such as the NVSCS (Fields, 2005, Bowling, 2014). The alternate form reliability is also encouraging, indicating that the survey remains a stable measure, regardless of the format used to gather information. The results of the construct validity study are also encouraging. Culture surveys traditionally develop over many years, and as a tool in the early stages of development, further refinement and validation would be desirable. Future assessment of convergent and divergent validity could include the measurement of

correlations between NVSCS scores and related outcome measures such as staff engagement or patient safety indicator data.

Phase two of this project has attempted to relate the attitudes and beliefs of veterinary practitioners to the causes of veterinary error investigated in phase one. The two are intrinsically related, and the understanding of both is essential for development and implementation of interventions which aim to improve patient safety and decrease mistakes. Phase three of this PhD is informed directly by these previous two projects, in the development of a non technical skills training programme for veterinary practitioners. This aims to improve patient safety by influencing both practice safety culture and the non technical skills of staff.

5.6 Limitations

One of the notable limitations of this study is the use of Likert scales in the development of the survey and the subsequent application of parametric statistical tests. Likert scales present data in ordinal form, which traditionally requires the use of non parametric tests which do not use the mean as a measure of central tendency. The use of parametric tests to analyse ordinal data is controversial, although researchers commonly use tests such as principle component analysis and factor analysis in the analysis of data from Likert scales. In doing so, they assume equal measures between scale ratings and essentially treat the data as interval, rather than ordinal. This has been and remains to be a contentious issue. As Jamieson (2004) points out, 'If the wrong statistical technique is used, the researcher increases the chance of coming to the wrong conclusion about the significance (or

otherwise) of his research'. Parametric methods of analysis are extremely common however, with the justification that sample size and distribution are more important factors in the decision over which statistical test to apply (Knapp, 1990) . Others argue that the robustness of parametric tests overcomes the need to adhere to traditional 'rules', and that, if those rules were to be indiscriminately applied, 'we can effectively trash about 75% of our research on education, health status and quality of life assessment ' (Norman, 2010). As Jamieson (2004) again points out, 'such issues as mean, standard deviation and parametric statistics should be considered in the design phase and must be addressed by the authors'. The limitations of Likert scales are therefore noted in the development and design of this survey. Notably, careful consideration was paid to sample size, in an effort to ensure reliable and valid results.

The sampling technique used to generate participants for the study introduced an inevitable element of bias. As discussed in chapter three, convenience sampling is an unusual method in quantitative research, and is more commonly applied to qualitative studies. The gold standard sampling method would be the random selection of names from the RCVS veterinary and veterinary nurse registers, however this was deemed unlikely to be successful. Response rates to cold call surveys are notoriously low (VanGeest et al., 2007, Asch et al., 1997). In addition, the NVSCS targets practitioners who work in extremely busy environments, under constant time pressure, and probes a sensitive subject of which they have little prior knowledge or understanding. Non response to postal surveys reduces the sample size and introduces non response bias into the data(Cook et al., 2009). It was felt that a method which enabled the establishment of a degree of trust and rapport with the researcher, would improve the chances of not only increasing response rates but also

ensuring more truthful answers to the questions. Fabrigar (2011) points out that in relation to factor analysis, the sampling technique is less important so long as it is not directly related to the construct of interest. Efforts were made to include a cross section of the profession with first opinion, referral, large and small practices included in the study. As safety culture is a wide and diverse phenomenon, present to varying degrees in every practice, it was felt unlikely that sampling a more truly random selection of vets and nurses would necessarily generate 'better' results. For the purposes of the study, the need to obtain the critical number of responses (n=300) to ensure successful statistical analysis also informed the selection of sampling technique.

The effect of participant biases was an important consideration in developing the statements for the survey. Non response bias is the degree of bias introduced by participants self - selecting not to complete a questionnaire (Cook et al., 2009). This can be simply a disinclination to participate in the study, or may reflect deeper sociodemographic reasons, in which case the response population will be skewed. Attempts to minimise this included making the instrument as short as possible and carefully considering its method of distribution. Social desirability bias reflects people's tendency to over emphasise their agreement with statements which show them in a more acceptable social light (Krumpal, 2013). It is implicit in all forms of questioning, but is especially pertinent when that questioning involves the exploration of particularly sensitive topics such as patient harm and professional error. It is natural for people to wish to appear 'better' than they may be in realty, but this bias is compounded in this study by the strong emotional response associated with error. Feelings of guilt, shame and fear, as well as the desire to appear socially and professionally acceptable will inevitably influence participant's answers. In an

attempt to minimise this, issues of confidentiality, anonymity and data protection were particularly carefully considered in the study design. Other methods of eliminating social desirability bias include the use of forced choice type scales, or the elimination of items which correlate highly with an external measurement of social desirability, before the data analysis phase (Ferguson and Cox, 1993).

Analysis of the construct validity of the survey was also limited by a lack of comparable veterinary measure. The SAQ, along with the HSOPS survey was used to provide questions for the original pool of items in the pilot NVSCS. This potentially increases the likelihood of convergent validity between the two measures as elements of one were incorporated in the other, albeit significantly altered. The construct validity results should therefore be interpreted with caution.

Chapter 6

Teamwork Training and Veterinary Safety Culture

6.1 Introduction

Phases one and two of this project established the causes of error in veterinary practice, and developed a tool for the measurement of veterinary safety culture to aid in the management of staff behaviours relating to patient safety. The final phase of this PhD involved the design of an intervention with the aim of improving safety culture in practices and as a result, improving outcomes. This was inspired by the findings from the initial phases and the overall project aim of improving patient safety in veterinary practice.

Safety culture is recognised in other industries as being fundamental to performance (Frankel et al., 2003). In medicine, positive safety culture is associated with enhanced patient safety and targeting culture change as a means to improve performance is a key strategy to improve outcomes in hospitals (Morello et al., 2013).

Morello's (2013) review of interventions to improve safety culture found that leadership walk rounds and multifaceted unit based strategies were the most effective methods of increasing culture survey scores. Leadership walk rounds aim to increase awareness of safety for clinicians by educating staff about patient safety concepts and prioritising the subject for senior leaders, who in turn obtain and act on information they elicit from frontline staff (Frankel et al., 2003). Multifaceted unit based strategies include initiatives

such as CUSP, a stepwise programme which aims to impact safety culture by empowering staff to take responsibility within their unit by providing education, tools and organisational resources (Pronovost et al., 2005). Other methods of manipulating culture include structured educational programmes, team based strategies such as TeamSTEPPS and simulation based training (Morello et al., 2013).

Team performance is equally recognised in medicine as being essential to the provision of safe patient care (Manser, 2009). Failures in clinical leadership have been highlighted in the reports following clinical negligence at Bristol, Alder Hey and Maidstone and Tunbridge Wells Trusts (Warren and Carnall, 2010). The links between culture and leadership are well established, and it has been highlighted as an essential component of quality of care in a recent Department of Health report (Darzi, 2008). Communication failures are recognised as contributory factors in up to 70% of errors in healthcare (Leonard et al., 2004) and poor communication increases the risk of error tenfold (Riley et al., 2011). Doctors and nurses are often trained in different styles of communication (Haig et al., 2006), however the process of providing medical care is inherently interdisciplinary and poor coordination amongst carers detrimentally affects patient care (Manser, 2009).

Team based training strategies are employed in efforts to enhance coordination amongst caregivers *and* improve culture. The rationale for interprofessional education is that learning together enhances working together, through a team based collaborative approach. Thistlethwaite (2012) warns however that simply gathering different professional groups in the same room is not sufficient. Training must be interactive to be effective. TeamSTEPPS is an evidence based teamwork system designed to develop a culture of safety through

training teamwork skills. It has been shown to decrease the number of errors attributed to communication failures, improve staff perceptions of role clarity, leadership and communication within a team and improve observed staff teamwork behaviours (Deering et al., 2011, Mayer et al., 2011).

Simulation is also considered a highly effective method of delivering training for both technical and non technical expertise (Rosen et al., 2012). It is commonly associated with two educational theories: constructivism, in which the subject learns through experience, reflection and application of new concepts, and behaviourism, which involves repeated, deliberate practice. The constructivist theory, represented by Kolb's (2014) experiential learning model also informs the concept of learning styles. Individuals vary in the manner by which they approach a learning opportunity, and an understanding and appreciation of this can have an effect on their performance and the achievement of learning objectives (Cassidy, 2004). There are now many models of learning style, but simulation may offer the opportunity to address multiple styles, successfully engaging all members of a cohort (Hellaby, 2013). It is a successful method of interdisciplinary training and is used both within and outside medicine to effectively deliver teamwork training (Aggarwal et al., 2010).

One of the most important aspects of any training initiative is the degree to which learning can be transferred to the workplace, to ultimately affect outcomes. This is represented by Kirkpatrick's (1975) hierarchy of evaluation (see figure 6.1)

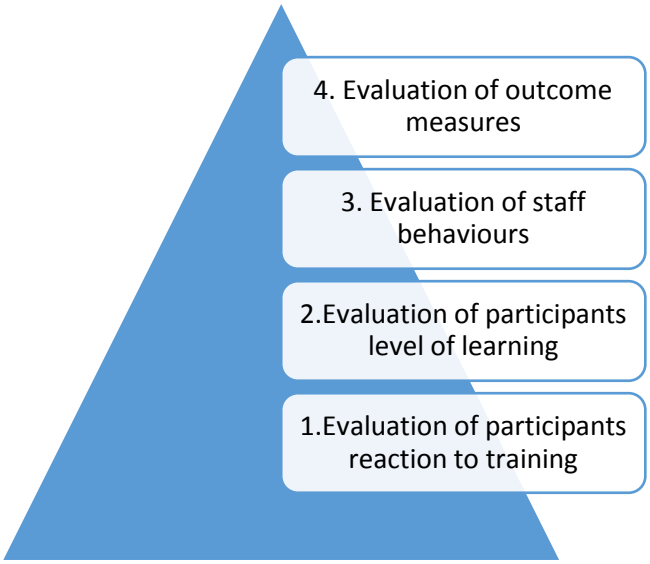


Figure 6.1 Kirkpatrick's hierarchy of evaluation, adapted from (Swanwick, 2011).

Importantly, evidence is emerging which suggests that simulation training can be successful at ensuring learning at the highest level of Kirkpatrick's model (Boet et al., 2014). Improved obstetric outcomes have been demonstrated by Draycott (2008) after the implementation of interprofessional simulation training, and Steinemann's (2011) study comparing clinical outcomes pre and post simulation training found a 76% improvement in task completion and 16% reduction in resuscitation times in trauma resuscitations. It has also been linked to improved perinatal outcomes when used in combination with a didactic delivery of TeamSTEPPS (Mayer et al., 2011).

The use of simulation training in veterinary education to deliver non – technical skills is rare. Unfortunately, there is very limited simulation equipment available to veterinary educators and no equivalent of the high fidelity sim patient or 'manikin'. At present, the most comparable 'patient' is Toronto University's prototype high fidelity canine patient simulator, designed for the teaching of veterinary students (Fletcher et al., 2012). In a study of

undergraduate education using this sim dog, 98.5 % of students agreed that the simulator produced an engaging learning environment, and commonly commented that it allowed them to practice teamwork and communication skills more effectively than paper based or problem solving activities. The benefits of applying the theoretical principles of teamwork in a simulated environment, would appear to be equally relevant to a veterinary context, enabling engagement with both constructivist and behaviourist models of learning.

The final phase of this project involved the design of an interprofessional educational intervention. Based on the TeamSTEPPS curriculum and incorporating some elements of simulation, the aim was to improve safety culture in veterinary practice by exploiting the relationship between safety culture and teamwork training. 'VetTeams' was developed as a veterinary teamwork training workshop based on the principles of Salas's teamwork model and the medical TeamSTEPPS curriculum (Salas et al., 2005, King et al., 2008). The Nottingham Veterinary Safety Culture Survey (NVSCS) developed in phase two was used as a measure of safety culture. Figure 6.2 shows how this phase of the project relates to the whole.

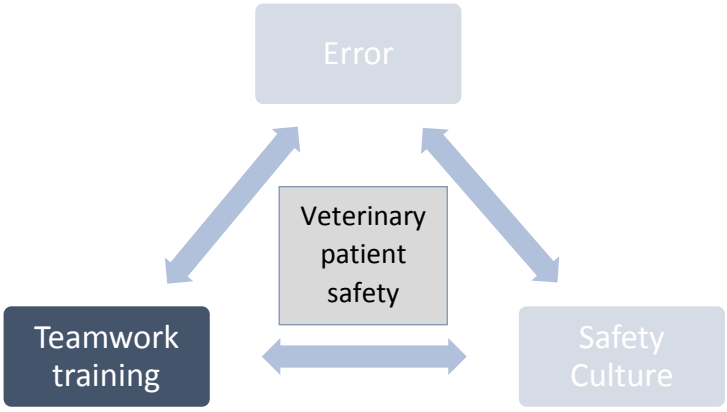


Figure 6.2 Project overview: Phase 3

This chapter will describe the development of the VetTeams curriculum, the implementation and results of the workshop on the safety culture of a pilot group of veterinary hospitals. It will also describe a further assessment of the usefulness of the NVSCS by demonstrating its test – retest reliability. This third phase of this project therefore aims to answer the following research questions:

3: Can we improve veterinary safety culture through teamwork training?

3i: Does the NVSCS show reliability as a measure of safety culture over time?

6.2 Methods

6.2.1 Designing the VetTeams workshop

Defining the aim

A training needs analysis is recommended before the development of any new educational curriculum (Brown, 2002). Phase one of the project served as such, in the case of the VetTeams workshop. The ultimate aim of the intervention was the mitigation of veterinary error and improvement in patient safety. The causes of error identified in the initial study provided evidence of a lack of understanding regarding personal limitations and a lack of education and competence in non - technical skills. These findings were indications of training needs, as well as evidence for the veterinary error typology presented in chapter four. In addition to their use to explore and map the causes of error, the focus groups from phase one could be considered as 'professional conversations', a method which is emerging as a useful tool for assessing educational needs (McKimm and Swanwick, 2013)

The analysis of errors in the focus group conversations, also acted as a framework for reflective thinking and discussion, by employing the technique of significant event analysis (Branch, 2005). Reflective practice is an essential attribute of the competent health professional, as it allows clinicians to learn from experiences, and relate those experiences to their core professional beliefs and values. It also promotes the linking of experiences, to expand and improve an individual's knowledge web, and potentially enhances their self - awareness and therefore their ability to self-regulate (Mann et al., 2009). In this case it enabled clinicians to identify areas where lack of both technical and non-technical knowledge or ability, resulted in patient harm, and to review their own behaviours and decisions. In addition, the qualitative analysis of VDS claims exposed similar gaps in professional competence and education, providing a triangulating viewpoint on errors and their causes, and the subsequent professional training requirements.

In order to 'pitch' the workshop at the correct level for successful learning, some estimation of clinician's existing level of knowledge was required. The competency model (Miller, 1990) is a commonly used framework to visualise learners positions on the educational paradigm, ranging from a state of knowledge to one of integrated expertise, see figure 6.3. Similarly, the conscious competency or Johari model demonstrates individual's awareness of their level of expertise ranging from the unconsciously incompetent to the consciously competent (Luft and Ingham, 1961).

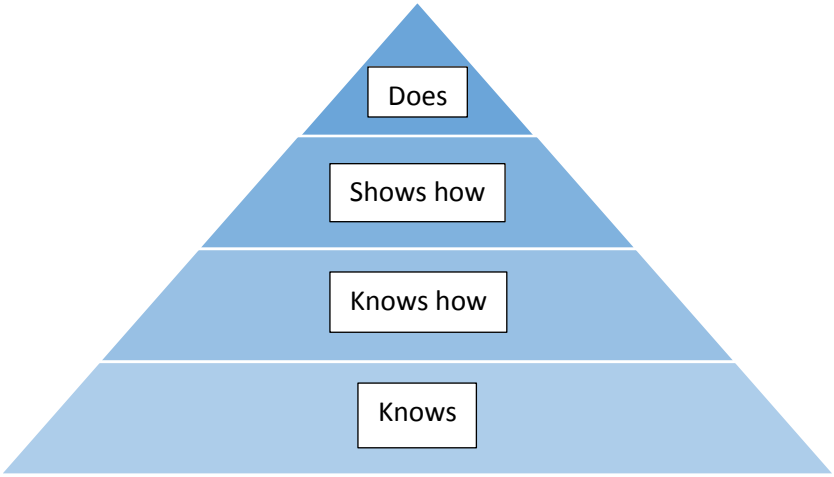


Figure 6.3 The competency model**,** adapted from (Miller, 1990)

In relation to patient safety and the causes of veterinary error, it is likely that veterinary surgeons and nurses are diffusely spread across these frameworks, depending on their experience of practice and level of personal interest in the subject. However, both the paucity of veterinary literature and the results of the phase one focus group discussions suggest that many clinicians would be positioned towards the lower levels, with little formal education in relation to both their personal limitations and variable proficiency in non-technical skills. It was assumed that very few would exhibit unconscious competence in these areas. This observation therefore informed the overall aim of the workshop, defined as:

'To introduce the importance and relevance of non-technical skills and teamwork in the clinical workplace, and their relationship to safety culture, patient safety and quality of care '

Defining the Learning Objectives

Learning objectives define the observable, measurable behaviours expected in participants who have undergone a learning process and aid the development of a curriculum (Harden, 2002). The formal assessment of non-technical skills however is not simple (Yule et al., 2006). Technical knowledge is commonly assessed through traditional examinations and practical expertise through OSCE type examinations, but behaviours such as leadership and teamwork are difficult to formally and consistently grade. Observational methods of assessment have been developed, such as Anaesthetists Non Technical Skills (ANTS) and Non Technical Skills for Surgeons (NOTSS), but none exist specific to veterinary clinicians (Flin et al., 2010, Yule et al., 2008). The learning objectives for VetTeams were designed therefore to shape the curriculum, rather than inform any formal assessment, and are as follows:

By the end of the session, participants should be able to:

- *Identify and describe the key components of teamwork, and its relevance to patient safety*
- *Identify behaviours which facilitate good teamwork*
- *Utilise specific tools to promote behaviours relating to team leadership : Brief, Debrief*
- *Identify the barriers to teamwork*

Learning objectives are the building blocks of a teaching programme (McKimm, 2003). They often originate as general competencies, defined by regulating bodies and developed into actionable curricula by Universities at undergraduate level and postgraduate CPD training.

In the veterinary profession, such competencies are shaped by the RCVS Day One and Year One Competencies, themselves informed by the Code of Professional Conduct. The VetTeams workshop goals were initially inspired by the overall aim of the project and the findings of the training needs assessment. However, they are reflected in the relevant competencies of the RCVS code and Professional Development Phase (PDP) of postgraduate training. The PDP aims to bridge the gap between day one competency and the development of professional competence, by ensuring the latter is 'further developed in a structured manner during the first year or so in clinical practice, until a recently qualified vet can perform confidently as a fully-effective professional in the work place' (RCVS, 2016). Table 6.1 shows how the VetTeams learning objectives align with the relevant competencies specified by the RCVS, for Day One, Year One (PDP) and the overarching Veterinary Code of Conduct

VetTeams Learning Objectives	Year One Competencies	Day One Competencies	Code of Professional Conduct
Identify and describe the key components of teamwork, *and its relevance* to patient safety	Underpinning knowledge: Principles of effective interpersonal interaction, including communication, leadership, management and team working.	Underpinning knowledge: Principles of effective interpersonal interaction, including communication, leadership, management and team working.	Veterinary surgeons and veterinary nurses should regularly review work within the team, to ensure the health and welfare of patients; and, ensure that processes are in place to enable changes in practice when indicated. Veterinary surgeons and veterinary nurses in leadership roles should lead on clinical governance. They should enable and encourage staff to raise concerns and should act on concerns brought to their attention.
Identify behaviours which facilitate good teamwork	Work effectively as a member of a multi-disciplinary team in the delivery of services.	Work effectively as a member of a multi-disciplinary team in the delivery of services.	17.3 Veterinary surgeons and veterinary nurses should communicate with colleagues

			and others within the organisation or practice, to coordinate the care of patients and the delivery of veterinary services.
Utilise specific tools to promote behaviours relating to team leadership : Brief, Debrief and Step	Understand and apply principles of clinical governance.	Understand and apply principles of clinical governance.	Veterinary surgeons must work together and with others in the veterinary team and business, to co-ordinate the care of animals and the delivery of services.
Identify the barriers to teamwork			

Table 6.1 Alignment of the VetTeams learning objective with relevant professional competencies and the Code

The learning objectives for this workshop were developed to target both the cognitive and affective domains as set out in Bloom's (1956) taxonomy. This educational theory presents the three domains of learning: Cognitive, Psychomotor, and Affective, otherwise known as 'Knowledge Skills and Attitudes' (KSAs). As an intervention whose aim was to 'teach' non-technical, somewhat abstract skills and improve safety culture within the team, VetTeams was an attempt to not only deliver theoretical knowledge (the cognitive domain) but also to change attitudes or the students emotional response to that knowledge, and influence their subsequent behaviour (the attitudinal domain), see table 6.2. These objectives were to be achieved by the design of the curriculum.

VetTeams learning objectives	**Position in Blooms taxonomy**
Identify and describe the key components of teamwork, *and its relevance* to patient safety	*Cognitive*: Learners were expected to recall and understand the key components of Salas's teamwork model *Attitudinal*: Value the benefit of the teamwork concept
Utilise specific tools to promote behaviours relating to team leadership	*Cognitive*: Recalls, understands and applies the tools in daily practice *Attitudinal*: Values the tool and what it can achieve and changes their observed behaviour by using the tools in daily practice
Identify behaviours which facilitate good teamwork	*Cognitive*: Recall and understand the relevant behaviours, apply that knowledge to their own behaviours and in judging the behaviours of others

	Attitudinal: Recognising and responding to the behaviours of others and themselves, and engaging with the process of practicing 'good' team working skills. Eg: consciously using closed loop communication methods.
Identify barriers to teamwork	*Cognitive*: Recall and understand the relevant behaviours, apply that knowledge to their own behaviours and in judging the behaviours of others *Attitudinal*: Recognising and responding to the behaviours of others and themselves, and actively attempting to avoid 'bad' team working skills. Eg: consciously avoiding behaviours such as eye rolling which show disrespect and undermine mutual trust.

Figure 6.4: The cognitive and attitudinal targets of the VetTeams learning objectives

Designing the curriculum

The curriculum shapes the learning objectives in terms of specific knowledge, skills and attitudes and the format of delivery and assessment. It enables the allocation of resources and provides the details of the framework in which learning can occur (Swanwick, 2011). Curriculums often exist on two levels, one formal, the other hidden. The formal curriculum mirrors that which is delivered, the hidden curriculum describes the unspoken aims and objectives of the organisation delivering the training (Hafferty and Franks, 1994). These are not explicitly stated, but in this case, reflected the beliefs and attitudes of the researcher, and ultimately, the relevant principles of practice defined by the RCVS code of conduct, namely Professional competence, Honesty and integrity and Professional accountability.

Methods of curriculum delivery range from objective led, to experiential learning where objectives are broader and less prescriptive. Bligh's (2001) PRISMS model of learning provides a useful framework for evaluating the design of a curriculum. This framework suggests that educational strategies should be Practice Based, Relevant, Interprofessional, Short, Multisite and Symbiotic. Experiential learning is now popular, especially in medicine and the advent of simulation training facilitates many of the objectives of the PRISM model (Swanwick, 2011). This form of learning is also commonly used in undergraduate veterinary training, with Extra Mural Studies (EMS) or 'seeing practice' an important aspect of training. The VetTeams workshop was in part inspired by forms of simulation training, and designed towards this experiential learning format Table 6.3 shows how the VetTeams curriculum sits on the PRISM model.

PRISM model	VetTeams
Practice based and linked with professional development	Non - technical skills enable the delivery of technical skills and move clinicians up the professional expertise model
Relevant to students and communities	VetTeams skills are used every day, all the time. They are essential skills and competencies
Interprofessional, interdisciplinary	VetTeams training is designed for interdisciplinary practice teams who work together regularly
Shorter courses taught in smaller units	The two hour timeframe enables it to be 'fitted in' to the day without the need to close the business
Multisite locations	Delivered onsite at the practice's own premises
Symbiotic (organic whole)	VetTeams has the potential to be part of a larger modular programme of teamwork and non technical skills training similar to TeamSTEPPS.

Table 6.3 The VetTeams curriculum and the PRISM model. Adapted from (Bligh et al., 2001)

Teaching methods

Adult learning models recognise that learning is active and influenced by experience and reflection (Taylor and Hamdy, 2013, McKimm and Swanwick, 2013). As such, the VetTeams curriculum was designed to encourage active participation from the learners and set within the context of familiar working practices. Veterinary CPD is often delivered in a traditional didactic style, but the format of a small group workshop provided the opportunity to design a much more dynamic type of learning environment. The subjects covered can be difficult to describe and pin down succinctly, so the format shaped itself as a group discussion, grounded in theory and led by the researcher who acted as a facilitator. It was thought that this would be more engaging and more constructive than simply presenting the theoretical concepts in a traditional instructive style. As topics often described as 'soft skills', it was also important that learners were able to associate the learning objectives with real clinical scenarios, and for them to appreciate the direct effect that such skills can have on outcomes. Although there was likely to be an overt awareness of the importance of skills such as teamwork and communication amongst the participants, it was judged that there was unlikely to be much depth or formal knowledge. The curriculum was therefore designed to instruct learners in the theory underpinning such skills and draw on learners own experience and knowledge from the clinical setting and the inclusion of a clinical vignette. This provided an opportunity for constructive and facilitated reflective thinking, within the framework of the workshop.

Content

The content of the workshop was inspired by the TeamSTEPPS education programme developed by the Agency for Healthcare Research and Quality (AHRQ) in the USA (King et

al., 2008). Developed as a syllabus for teaching the theoretical aspects of teamwork to clinicians in practical applicable ways, its learning objectives mirror those defined for the VetTeams workshop. The researcher undertook the TeamSTEPPS online training course and qualified as a Master Trainer in the programme. 'Tools' developed for use in the hospital setting were adapted and integrated into the veterinary workshop, and used to link the theoretical principles of teamwork to its practical application in a veterinary context.

The TeamSTEPPS curriculum is comprised of 7 modules as shown in table 6.4

Module	Description	Available Tools
1	Introduction	
2	Team Structure	
3	Communication	SBAR Callout Check Back Handoff
4	Leading Teams	Brief Debrief Huddle
5	Situation Monitoring	STEP IMSAFE (HALT)
6	Mutual Support	Two Challenge rule Feedback Task Assistance CUS DESC

Table 6.4 TeamSTEPPS modules and Tools (King et al., 2008)

These modules were mapped onto the causes of error identified in phase one of the study. The domains of teamwork, leadership and communication showed obvious overlap, and the teamwork and leadership modules were selected for the final curriculum. Teamwork was viewed as a fundamental topic on which to base the subsequent discussions. Leadership is closely associated with the development of organisational culture in the literature and had recently been highlighted by the RCVS VetFutures report as one of the six key targets for the profession in the future (Schein, 2010, RCVS, 2015). A discussion of checklists was included at the request of the charity hospital group, as they had recently implemented the use of a surgical checklist with varying degrees of success. This was included in the curriculum as an opportunity to provide a fresh perspective on teamwork practices. Discussing the tool in terms of its influence on the team was an opportunity to describe veterinary teamwork from a separate but clinically relevant angle.

The TeamSTEPPS programme also includes elements of change management principles, in recognition of the importance of sustaining the attitudinal and behavioural shifts which the initiative aims to achieve. Elements of this were also included in the workshop, in part to make learners aware of the need to structure sustainment and also to help them to do so. The groups were invited to fill in self - addressed postcards, answering the following questions:

What will you change at work following this workshop?

When will you do it?

These postcards, together with the results of the group discussion about the BRIEF tool were fed back to each hospital 2 weeks after the training day, in an effort to sustain interest and momentum in any changes the team tried to make following the workshop.

The VetTeams workshop curriculum

An outline of the workshop curriculum is provided here.

- *Pre workshop exercise (two weeks before)*
  Participants complete the Nottingham Veterinary Safety Culture Survey (NVSCS 1).

- *Introduction*
  The researcher introduces herself and the workshop in the context of the PhD project.
  Teamwork exercise: The group is divided into two and each half provided with materials to make paper chains. After brief instructions, the groups are given five minutes to create the longest chain they can.

- *Facilitated discussion in two groups, using post it notes to write one word responses to the following questions:*
  What is teamwork? What do we mean by it? Using the paper chains exercise, reflect on the skills and behaviours you used to successfully build the paper chain
  What are the key components?
  What behaviours facilitate it?
  What behaviours inhibit it?
  The facilitator then collects the notes and uses the participant's ideas to 'build' a model of teamwork through group discussion and comment. This model is then mapped onto the theoretical Salas model of teamwork and compared

- *The importance of teamwork*

  Didactic session discussing patient safety and team-working evidence, its relationship to quality of care and safety culture

- *Focus on leadership*

  Facilitated discussion of the following:

  What does a good leader do?

  What behaviours or skills does a good leader exhibit?

  Relate these skills back to the Teamwork model

- *BRIEF and DEBRIEF*

  Introduce the BRIEF and DEBRIEF tools and relate them to the previous discussion on leadership.

- *Group exercise*

  Group reads together a vignette describing a clinical scenario of poor teamwork
  Facilitated discussion of the vignette to identify behaviours responsible for poor teamwork and suggest causes for those behaviours and ways they may be avoided or mitigated.
  Discuss how a BRIEF could have helped and the points people would have raised if they were running one for this scenario

- *Group exercise*

  Facilitator guides the group to design a BRIEF checklist for their unit
  When? Who? What?

- *Facilitated group discussion on surgical checklists*

  What do you like about checklists?
  What do you not like about them?
  Facilitator presents a slide with some basic facts on checklists and their effect on team communication. Relate back to the original Sala teamwork model.

- *Group change management exercise.*

Developing the clinical scenario vignette

The learning outcomes for the scenario were determined from the overall curriculum. They encompassed the general outcomes of recognising good and bad teamwork behaviours, and also allowed participants to apply knowledge from the session in a clinical context. The aim of the vignette exercise was therefore:

To apply the theoretical concepts of teamwork, leadership and situational awareness to a 'real' clinical scenario and demonstrate the direct effects of those non technical skills on outcomes.

The specific learning objectives were:

By the end of the exercise participants will be able to:

Identify behaviours which relate to poor teamwork and directly relate these to outcomes for the patient

Identify specific areas for improvement in leadership and teamwork

Suggest and apply tools to improve teamwork to this scenario

Reflect on the application of those tools to their own experience in practice

The scenario was assessed using a review framework adapted from Kim (2006) (see table 6.5). The scenario is available in full in Appendix 6a.

Framework	VetTeams scenario
Structure : relevance and authenticity	
Level of the learner?	Range of levels expected in the groups but few expected to have high levels of detailed knowledge
Goals and Objectives	• Identify behaviours which relate to poor teamwork and directly relate these to outcomes for the patient • Identify specific areas for improvement in leadership and situational awareness • Suggest and apply tools to improve teamwork to this scenario • Apply those tools to their own situations in practice
Scenario setting	General practice of a similar level to that experienced by the learning cohort.
What are the sources for the scenario and will learners find them authentic?	Scenario written by a practicing first opinion vet (CO) from their own experience, peer reviewed to ensure authenticity and accuracy.
What nuances / complexities are present-do they match the level of the learner?	Multiple failures in teamwork or examples of poor teamworking behaviour are distributed throughout the scenario, some more subtle than others to account for the variety of levels of knowledge and awareness
What gaps in realism do learners need to overcome	None. The scenario is written and presented as a case review : a highly realistic and plausible account of a 'real' case

Process : engagement and level of challenge	
How does the learner know what to do and how do they interact with each other?	Learners are directed to discuss the scenario as a group, facilitated and led by the researcher in the form of a debrief.
How do their actions change the outcome of the scenario	Learners are encouraged to suggest ways in which team members in the scenario may have altered the outcome by altering their behaviours
What do learners need to do that they haven't already done?	Apply the vocabulary and knowledge from the theoretical models previously discussed to a clinical scenario and relate those skills to patient (and clinician) outcome
Outcomes : educational design	
How can the learner be evaluated?	No formal evaluation was planned. Methods of evaluation could include subsequent assessment in the workplace using tools such as NOTECHS, and auditing the use of the Brief and Debrief tools
How does scenario link to debriefing and reflection?	Feedback occurs in a debrief fashion as a group discussion led and guided by the facilitator/researcher. Learners are encouraged to relate the concepts to their own practice and discuss examples where similar issues have arisen in their work environments, or where the tools may be helpful to them in practice.
How does it link to prior knowledge and the curriculum?	The scenario is designed to encourage learners to *apply* the theoretical knowledge presented earlier in the workshop, and conceptualise it in a real world situation.

Table 6.5 Review of the scenario using the framework adapted from Kim (2006)

6.2.2 Study design and data collection

A controlled before and after strategy was used to design this study (see figure 6.4), which would act as a pilot to investigate the possibility of expanding such a training scheme to a wider population.

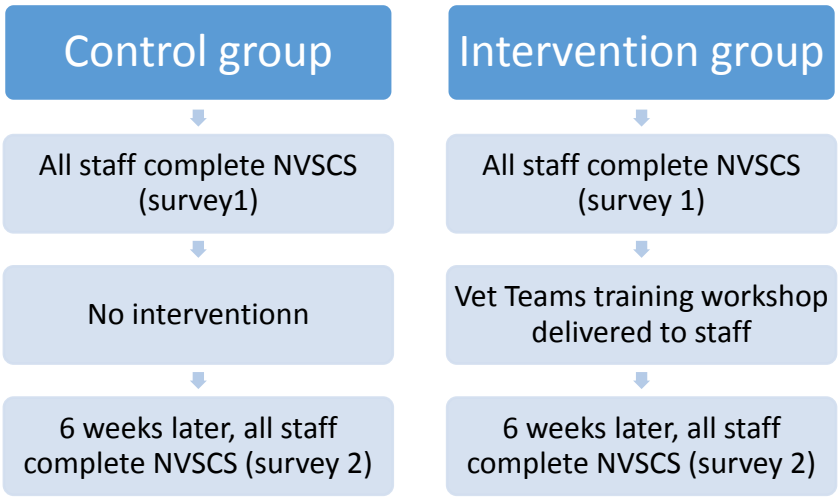


Figure 6.4 Overview of the study design

Cluster sampling within a convenience framework was used to generate subjects for the project. Through contacts made during phase one, a proposal was made to a large charity group of veterinary hospitals. The Principle of Regional Veterinary Services (Midlands area) had been involved with the focus groups in phase one of the study, and was willing for hospitals in his area to participate in the teamwork training phase. This group of practices provided an interesting and useful model. As a group of hospitals run by an umbrella administration, it could be assumed that each would have similar working methods and protocols. Each hospital was comparable in terms of size, staffing structure, management support and clinical caseload. As members of the same organisation, they could also be

assumed to have similar working cultures, or at least a common set of values and single organisational vision. As such, they represented as standardised a set of practices as it was likely to be found in the UK veterinary industry. The proposed VetTeams intervention also coincided with recent efforts within the organisation to improve patient safety and quality of care through the introduction of a surgical checklist.

The researcher was given access to six hospitals in the midlands area of the UK. Three were to be used as a control group, and three were to receive the VetTeams intervention. In addition a large independent referral hospital on the South Coast was invited to join the study after one of their veterinary surgeons expressed an interest following their involvement with phase two of the study via the Association of Veterinary Soft Tissue Surgeons (AVSTS). This hospital was also to receive the intervention.

The Nottingham Veterinary Safety Culture Survey (NVSCS) developed in phase two, was used as a pre and post training measure to assess how the workshop affected safety culture in the four intervention hospitals over a six week period, compared to the three hospitals where no training occurred. All clinical staff in each hospital, including all vets, nurses and care / kennel assistants were to undertake the survey. As only seven hospitals were to take part in the project, an incentive was included to try and enhance response rates and maximise sample sizes. All completed questionnaires from each hospital were to be entered into draws for £20 Amazon vouchers.

The NVSCS in its final form consisted of the 29 items finalised in phase two and nine demographic items. These had been adapted slightly from the pilot survey to better ensure

anonymity. For example, the subdivisions of head nurse, trainee nurse etc. were removed so as to decrease the possibility of identifying individuals. A final item was also added to allow surveys to be paired for later analysis, in the form of a unique identifying number. This was generated for each subject by combining the last 2 digits of their birth year, with their parent's house number and the first two letters of that parent's street address.

An overview of participants and data collection procedure is shown in table 6.6

Veterinary Hospital	Time = 0	Time = 6 weeks
Control Group Hospital A Hospital B Hospital C	NVSCS Survey 1	NVSCS Survey 2
Intervention Group Hospital D Hospital E Hospital F Hospital G	NVSCS Survey 1	NVSCS Survey 2 + VetTeams participant feedback form

Table 6.6 Table showing participants and data gathering methods**.**

Control group

The Senior Veterinary Surgeon (SVS) at each hospital was contacted, the project explained and any questions or queries satisfied. The SVS then emailed a copy of an information sheet for staff to all members of clinical staff within their hospital, together with an online link to the NVSCS. The information sheet is available in appendix 6b. The survey was left open for 5

days, and reminder emails were sent out to all participants, via the SVS, 36 hours before the online link was closed.

Intervention group

The SVSs and the contact vet at the independent hospital were approached, the project explained, and a time arranged for the VetTeams training to be delivered. The workshop was designed to fit a two hour time slot, and was run at the convenience of each individual hospital. The contact vet was asked to email a copy of the information sheet for staff to all members of clinical staff within their hospital with the online link to the NVSCS, as for the control group. They were then asked to invite 8-10 clinical staff across a range of professions and experience, to include vets, nurses and care assistants, to take part in the workshop. Each participant was sent an information sheet informing them of the aims of the project and the content and learning objectives of the workshop. This information sheet is available in appendix 6c. On the prearranged day, the researcher delivered the VetTeams workshop and the participants were asked to fill in a student evaluation form to gauge their opinion of the training, available in appendix 6d. This was developed from a standard student evaluation questionnaire and used Likert type responses to rank students satisfaction with different elements of the workshop.

To provide a form of feedback to the hospital after the session, the contact vet was sent a PDF and Powerpoint copy of the survey results, and a short explanatory report the week following the workshop.

All the hospitals (control and intervention) were contacted again six weeks later to arrange completion of the second survey. As before, this was achieved via the contact vets, who sent a second information sheet and reminders to all participants, each with a second online link to the survey, see appendix 6e. The hospitals were also sent bags of sweets, each carrying a sticker with the online link to the survey, as a further physical reminder in an effort to increase response rates. One hospital requested paper copies rather than an online version. These were posted out with a stamped addressed envelope for their return.

6.3 Data analysis

Three sets of data were generated from this phase of the study. Two related to the VetTeams intervention: the student evaluation of the workshop and the effect of the training on hospital safety culture scores. The third data set related to further reliability analysis of the NVSCS. Figure 6.5 shows an overview of the data sets, their collection and method of statistical analysis. In all statistical analysis a P value of ≤ 0.05 was assumed to be significant, unless otherwise stated.

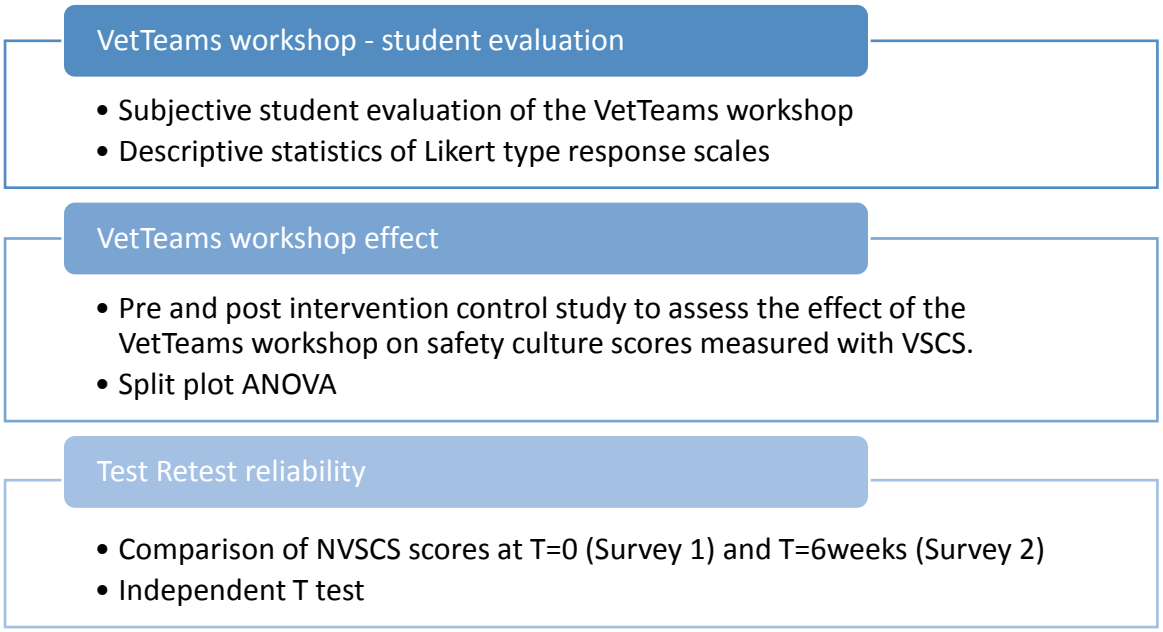


Figure 6.5. Data sets generated and the statistical tests applied in their analysis**.**

6.3.1 Student evaluation

The scores from the student evaluation forms were entered into SPSS by hand and descriptive statistics were used to analyse the data.

6.3.2 VetTeams workshop effect

The results of both the NVSCS surveys from each of the seven hospitals were exported from survey monkey into Excel. They were grouped by postcode, and then by survey (1 or 2), resulting in a data set made up of 14 blocks of data, two for each hospital.

The NVSCS items were sorted and grouped together into the subdomains or factors, identified in phase two: Organisational safety systems and behaviours, Staff perceptions of management, Risk perceptions and Teamwork and communication. The negatively worded items were reverse scored and each set of factor scores was summed for each individual.

This created a second data set of a summative score for each of the four NVSCS factors and a total survey score for each participant (made up of the summed subdomain scores). Missing data was assigned the score 100. This allowed single factors containing a missing value to be easily detected, and excluded from the final analysis, without needing to exclude the entire set of scores for that individual. Finally the scores were paired using the individual unique codes, resulting in a final data set of four matched survey one and survey two values for each participant. The survey was positively scored so higher scores indicated a 'better' score, or more positive attitude

A split plot ANOVA was used to compare the changes in scores for each of the four factors of the NVSCS over time (within group effect) and between the control and intervention hospitals (between groups effect).

6.3.3 Test Retest reliability

Test Retest reliability of the NVSCS was assessed by comparing the results of paired surveys from the control hospital group. These groups were not subjected to any intervention, and as such their safety culture would be expected to remain relatively stable over the six weeks between survey points. Pearsons correlation was used to assess the similarity or degree of correlation between the results for each subdomain in the two sets of surveys.

Bland Altman plots were also produced from the data to assess the agreement between the measured values of the first and second surveys.

6.4 Results.

44 Student evaluation forms were completed. 121 surveys were completed for Survey 1 (response rate 65%) and 72 surveys completed for Survey 2 (response rate 39%). See figure 6.6 for a more detailed breakdown of the participant demographics by hospital and staff groups.

Hospital	**Number of staff** **V=Vet** **VN=Vet Nurse** **VCA= Veterinary Care Assistant**	**Number of Survey 1 completed**	**Number of Survey 2 completed**	**Response rate %** **S1** **S2**
Control group				
A	V=8 VN=9 VCA=11 Total staff = 28	15	21	54 75
B	V=6 VN=9 VCA=5 Total staff = 20	12	18	60 90
C	V=11 VN=13 VCA=11 Total staff = 35	21	6	60 17
Intervention group				
D	V=5 VN=8 VCA=4 Total staff = 17	6	4	35 24
E	V=12 VN=10 VCA=5 Total staff= 27	25	0	93 0
F	V=11 VN=10 VCA=6 Total staff = 27	14	15	52 56
G	V=13 VN=14 VCA=6 Total staff = 33	28	8	85 24
Sum Totals	**Total staff 187**	**121**	**72**	**65** **39**

Figure 6.6: Participant demographics for each hospital and response rates (%) to Surveys 1 and 2

6.4.1 The VetTeams workshop: student evaluation

VetTeams workshop student evaluation

- Subjective student evaluation of the VetTeams workshop by participants
- Descriptive statistics of Likert type resonse scales

44 student evaluation forms were completed. The responses were scored so that high scores reflected a positive response and low scores a negative response. The VetTeams workshop was generally very well received by staff at all 4 hospitals, as represented by the results in figure 6.7.

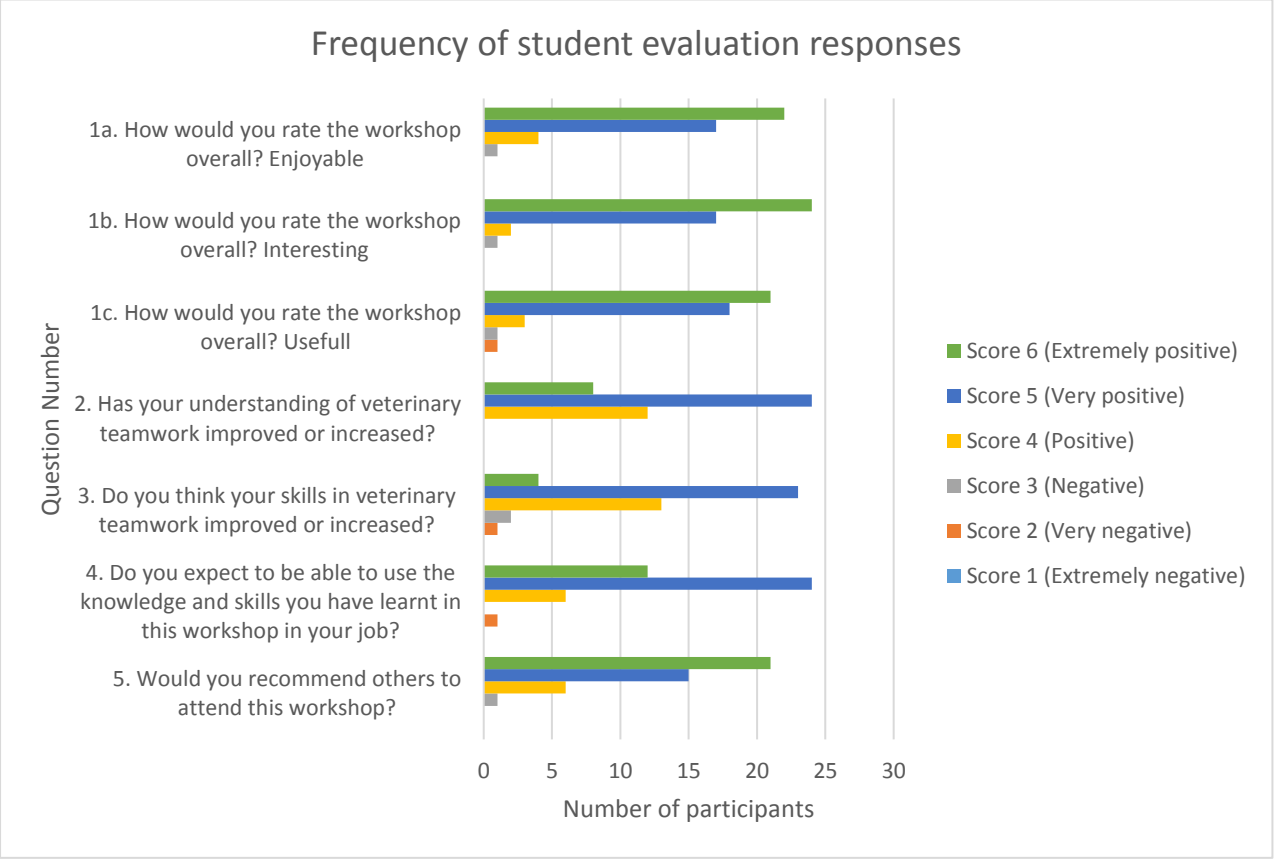


Figure 6.7 Student evaluation of VetTeams workshop

Students rated the course highly enjoyable (Mdn 5.5), interesting (Mdn 6.0) and useful (Mdn 5.0). Participants self - assessment of their learning (Mdn 5, SD 0.878) and the potential application of that learning in their subsequent work (Mdn 5, SD 0.799) was also positive (see table 6.8).

Question	Median (Mdn)	Mode
1.How would you rate the workshop overall?		
1a.Enjoyable	5.50	6
1b. Interesting	6.0	6
1c. Useful	5.0	6
2. To what extent has your understanding of veterinary teamwork improved or increased as a result of the workshop?	5.0	6
3. To what extent do you think your skills in veterinary teamwork improved or increased as a result of the workshop?	5.0	5
4. Do you expect to be able to use the knowledge and skills you have learnt in this workshop in your job?	5.0	5
5. To what extent would you recommend others to attend this workshop?	6.0	6

Table 6.8: Descriptive statistics of student evaluation scores

6.4.2 The VetTeams workshop: Effect on NVSCS scores

VetTeams worskhop effect on NVSCS score

- *Data set*: Paired NVSCS scores for each subdomain at T0 and T1 from control and intervention group hospitals
- *Data analysis*: Split plot ANOVA

Overall, there was a trend of increases in NVSCS scores for Factor 2 (Staff perception of management), Factor 3 (Risk perception) and Factor 4 (Teamwork and Communication) in both the control and intervention groups. However, the effect of group (ie control or intervention hospital) was not significant. The NVSCS scores decreased for Factor 1 (Organisational safety systems and behaviours), though again the effect of group was not statistically significant. This suggests that the VetTeams workshop made no significant difference to safety culture. The results are presented in figures 6.8-6.11 for each of factors 1-4 of the NVSC

Factor 1 : Organisational safety systems and behaviours

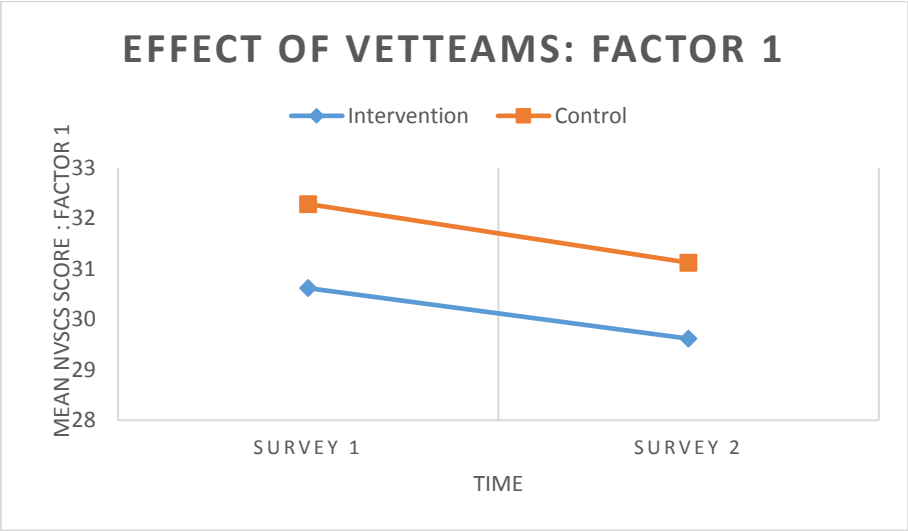


Figure 6.8 Effect of VetTeams on mean NVSCS scores: Factor 1

There was a non significant effect of group on staff perceptions of organisational safety systems and behaviour. F(1,36) = 0.27, p=0.86

Factor 2 : Staff perceptions of management

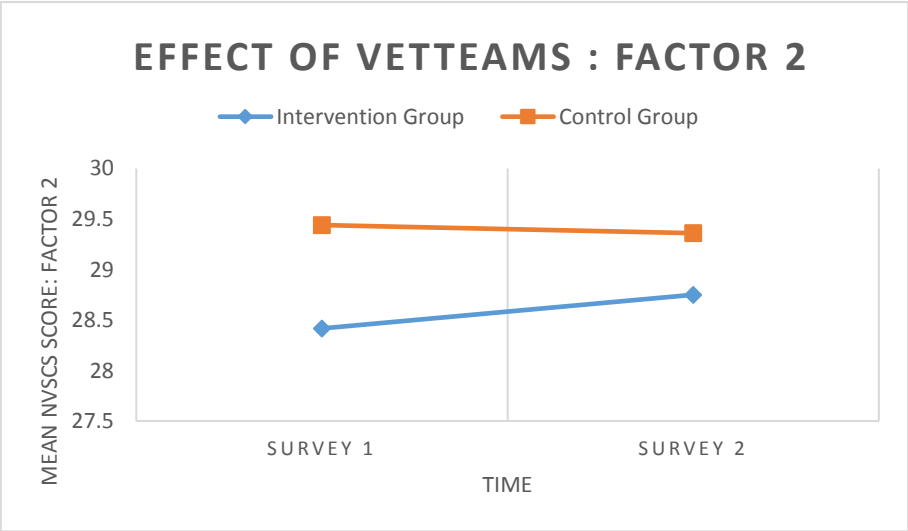


Figure 6.9 Effect of VetTeams on mean NVSCS scores: Factor 2

There was a non significant effect of group on staff perceptions of management.

F (1,35) = 0.156, p= 0.695

Factor 3 : Risk perceptions

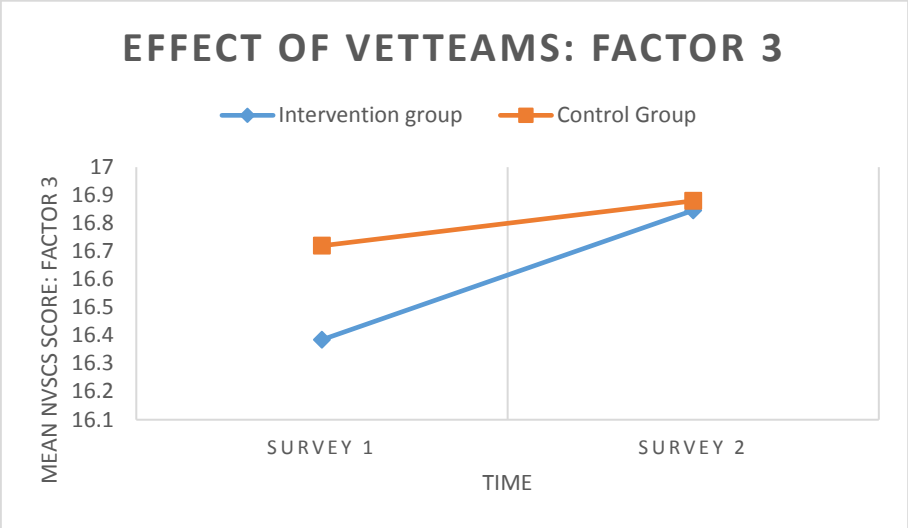


Figure 6.10 Effect of VetTeams on mean NVSCS scores: Factor 3

There was a non significant effect of group on risk perceptions. F(1,36) =0.199 ,

Factor 4: Teamwork and Communication

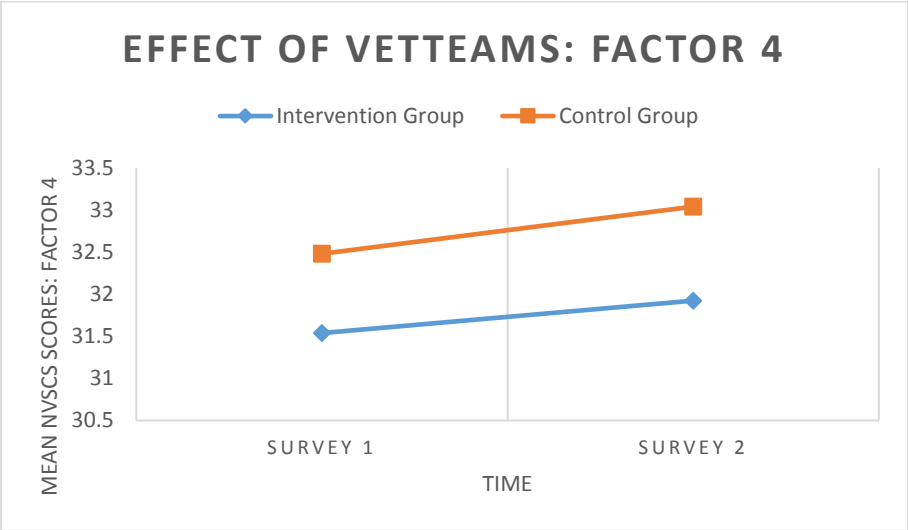


Figure 6.11 Effect of VetTeams on mean NVSCS scores: Factor 4

There was a non significant effect of group on teamwork and communications.

F(1,36) = 0.021, p=0.886

To limit any potential bias in the data set caused by the inclusion of the self selected hospital in the intervention group, the data analysis was repeated, excluding the results of that hospital. The results were broadly similar. The trends within the data were similar for Factors 1 and 3 but the results were still non significant. The full results are available in Appendix 6f.

6.4.3. Test Retest reliability

VSCS Test - Retest reliability

- *Data set*: Paired NVSCS scores (S1 and S2) from control group hospitals
- *Data analysis*: Pearson's correlation coefficient

23 paired surveys (survey 1 and survey 2) were extracted from the data set of the control hospitals A, B and C. Surveys with missing data from more than one subdomain were excluded from the analysis (n=3) resulting in 20 paired surveys for analysis. Each factor was analysed separately, and missing data was excluded listwise for each factor. The results are displayed below in table 6.12.

Subdomain	**Pearsons (r)**	**Mean: survey 1** **Mean: survey 2**	**SD: Survey 1** **SD: Survey 2**
Factor 1 (n=39) Organisational safety systems and behaviours	0.731 p≤ 0.01	31.59 30.54	3.393 4.096
Factor 2 (n=38) Staff perceptions of management	0.778 p≤ 0.01	29.11 29.08	4.549 4.239
Factor 3 (n=39) Risk perception	0.360 p≤ 0.05	16.62 16.87	1.830 1.539
Factor 4 (n=39) Teamwork and communication	0.832 p≤ 0.01	32.46 32.23	3.698 4.189

Table 6.12 Test - Retest reliability results

Pearson's correlation coefficient (r) indicated a strong degree of correlation (>0.7) between T=0 and T=1 scores for three of the four subdomains (Factor 1, 2 and 4). There was a significant correlation between the scores for Factor 3, but it was not as strong (0.3). This suggests there was no significant difference between scores on the first and second survey within the control group of hospitals, suggesting that the NVSCS instrument is reliable and stable over time.

Bland-Altman analysis of each of the four factors further confirmed that there was no significant difference between the mean NVSCS scores on survey 1 and survey 2. The plots and regression coefficient for each of Factor 1-4 factor are displayed below in figures 6.13-6.16.

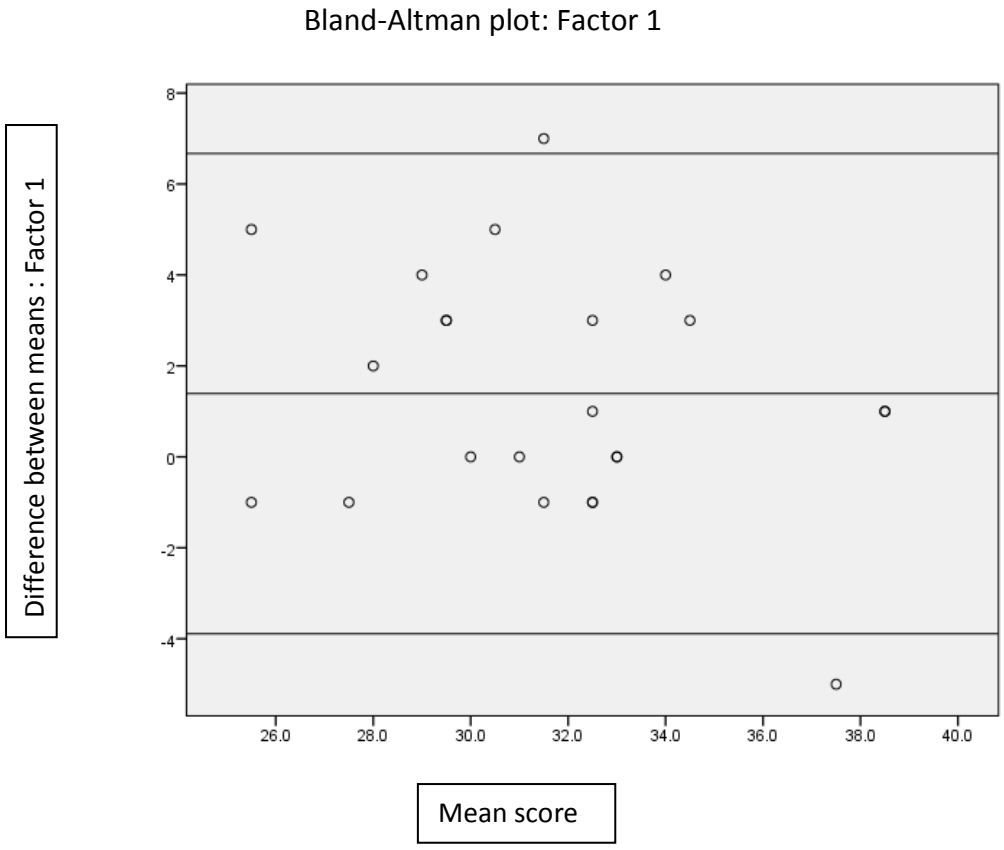


Figure 6.13: Bland-Altman plot showing Mean Difference line and 95% confidence interval lines
Regression coefficient : t= -1.219, p=0.236

Bland-Altman plot: Factor 2

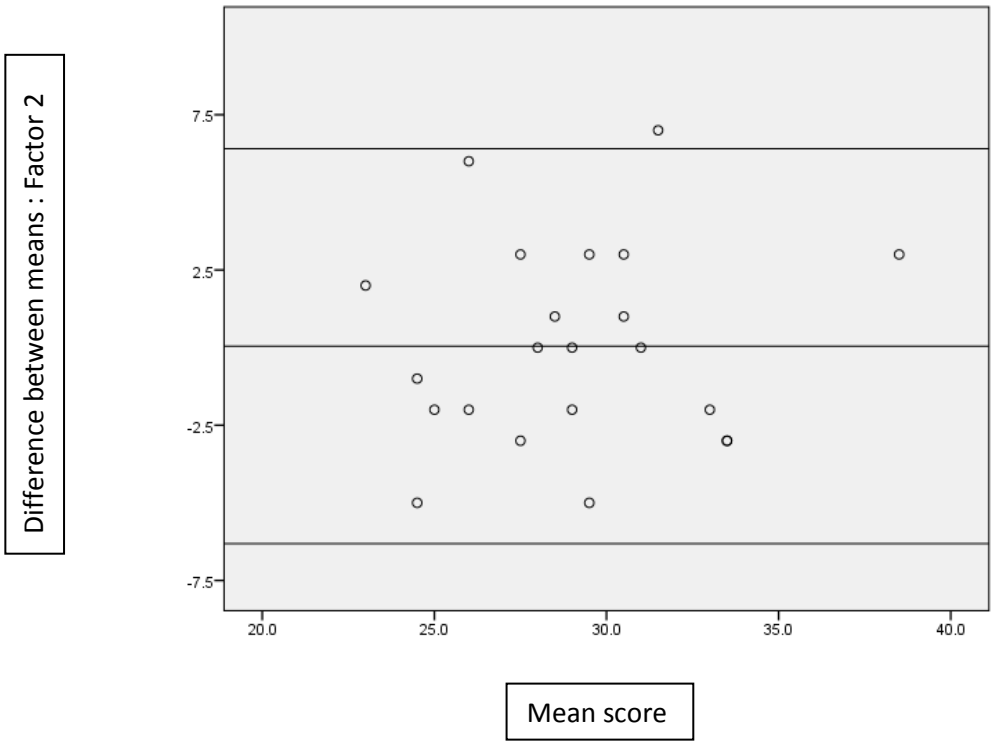


Figure 6.14: Bland-Altman plot showing Mean Difference line and 95% confidence interval lines
Regression coefficient : t= 0.480, p=0.637

Bland-Altman plot: Factor 3

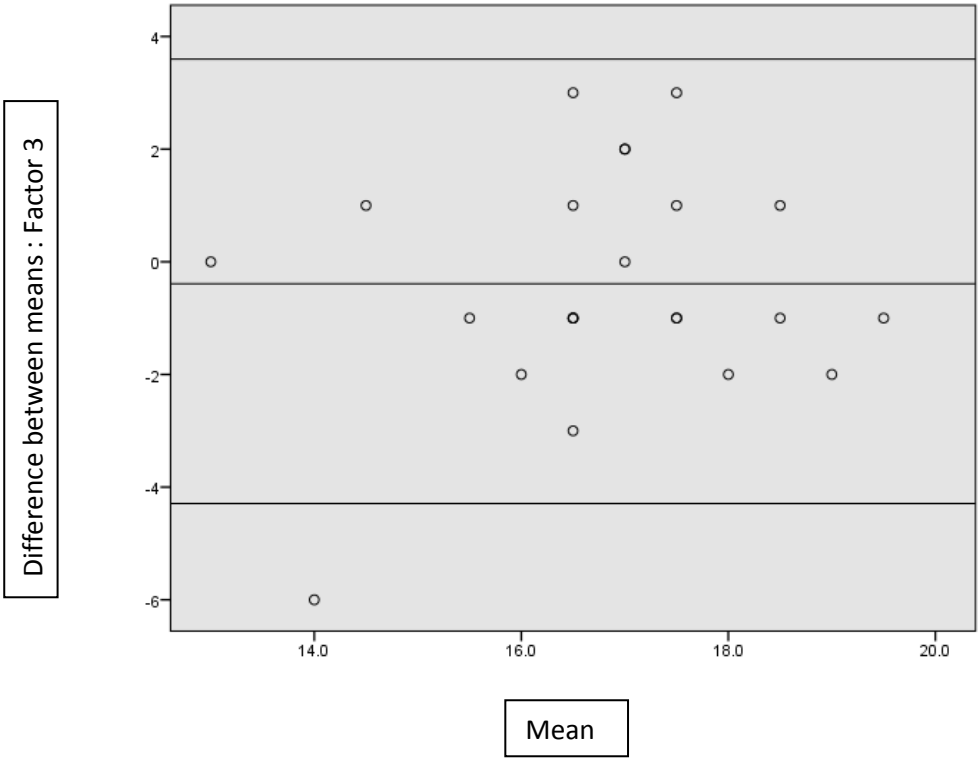


Figure 6.15: Bland-Altman plot showing Mean Difference line and 95% confidence interval lines
Regression coefficient : t= 0.723, p=0.477

Bland-Altman plot: Factor 4

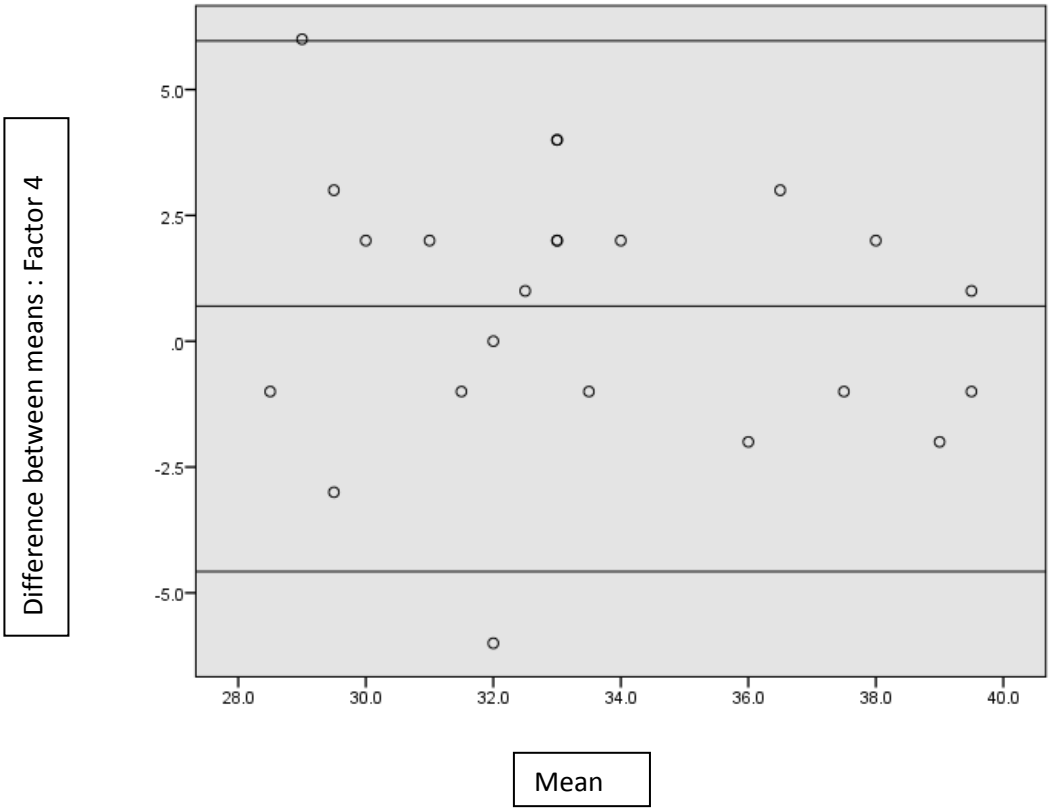


Figure 6.16: Bland-Altman plot showing Mean Difference line and 95% confidence interval lines
Regression coefficient : t= -0.715, p=0.482

6.6 Discussion

The final aim of this project was to develop an intervention which could reduce errors and improve outcomes in veterinary practice through training in non technical skills and subsequent improvements in safety culture. Identified as critical to the causes of error in phase one and as important components of veterinary safety culture in phase two, the non technical skills are vital to the delivery of safe care, and yet are largely overlooked by the profession. VetTeams was developed as a novel, interactive, relevant training package which could be conveniently fitted into a normal working day and which trained practice teams together.

The effect of VetTeams on individuals.

The VetTeams curriculum was generally very well received. The use of active learning and multiple teaching strategies has been shown to be a more effective way to deliver learning to adults and appeared to work well with this cohort of students (Robertson 10). Learners engaged with the process and appeared to enjoy the small group interactive format, as demonstrated by the positive responses on the student assessment survey. As expected, there was a marked degree of variation in knowledge between the groups, with some teams finding it easier to define the roles of teamwork and leadership more easily than others. This reflected the varying levels of awareness and exposure of different members of the profession to the formal recognition of non - technical skills.

Team training programmes in medicine vary greatly in design and length, and there is no 'gold standard' format, with 'team training' encompassing a variety of methods including

assertiveness training, cross training, error management and guided team self - correction (Weaver et al., 2014). TeamSTEPPS is an example of an evidence based, comprehensive modular and flexible programme which has been adapted in the medical field to suit the target population (Robertson et al., 2010). As a relatively novel form of veterinary CPD, the similar concept, format and timescale of VetTeams was successful, with a majority of participants indicating that they felt their skills had improved or agreeing that they would recommend it to a colleague. However these results only satisfy the two lower levels of the Kirkpatrick hierarchy. Level one corresponds to simply participation by learners, and two to the reaction or satisfaction they demonstrate. Levels three, four and five, indicating that learning has occurred, behaviours in the workplace have changed and outcomes have improved, are not assessed objectively by these figures. In reality, it is often difficult to assess the transfer of learning at these levels and many medical research studies do not achieve it (Buljac-Samardzic et al., 2010). This study did not include formal assessment, however the VetTeams participants consistently applied the principles of teamwork and leadership to the clinical vignette, suggesting some impact at level three of the framework. One of the charity hospitals also reported the sustained use of the BRIEF tool suggesting some change in staff behaviours as a result of the education.

The effect of VetTeams on practice safety culture.

Studies in medicine have shown that interprofessional training can improve working culture and patient satisfaction (Campbell 01), decrease errors (Morey 09) and improve the knowledge and skills of staff (Young 05). Despite its obvious benefits, interprofessional training is rare in veterinary medicine. VetTeams provided the opportunity for different professional groups to train together, not simply be present in the same room. The interactive 'paper chain' exercise at the beginning of this workshop was designed to

encourage the small mixed groups to interact, employ teamwork skills and reflect on those skills in the following facilitated discussion. Although not statistically significant, it is encouraging that the culture survey results show an improvement in the domains of teamwork and communication, risk perception and staff perception of management following the workshop. The exception to this positive trend is the finding that attitudes to organisational safety attitudes and behaviours showed a negative trend in both the control and intervention hospitals. This could have been an effect of the NVSCS itself, as it is acknowledged that culture surveys can act as interventions in themselves (Nieva and Sorra, 2003). The act of participating in the survey may have raised awareness and stimulated discussion and staff assessment of their organisation's approach to patient safety, in this case with negative consequences. It is important therefore that the effect of the NVSCS is considered, as simply the act of using the tool can have consequences which organisations may need to manage.

There are many stakeholders involved in postgraduate training and continuing professional development (CPD). In addition to those attending the course, their direct employers must grant the budget, time allocation and post- educational support. As such, their perception of and involvement in an intervention such as VetTeams is critical. Although the trend in three of the four domains of safety culture was positive in this study it was not statistically significant and the intervention may have had greater success if it had more pronounced support of management. Buy in and support from the senior leaders in a hospital is essential for patient safety initiatives to succeed and be sustained (Ginsburg et al., 2010). This pilot project did not achieve that level of backing in many cases. While the senior contact at the charity hospital group was keen to support and encourage the intervention, he was a

remote ‘central office management’ figure in the six local hospitals. Enthusiasm for the project amongst those local leaders, the Senior Veterinary Surgeons (SVSs), was varied. Some saw potential benefits and used the intervention to try and springboard changes within their hospitals, others tolerated it good naturedly but appeared unlikely to carry suggestions forward, or became distracted by more pressing matters. For example, in one hospital a new computer system was installed four weeks after the intervention causing enormous stress and extra work for the staff, side-lining any attempts to continue with the BRIEF tool.

Qualitative research in medicine has highlighted some of the barriers to implementing teamwork training and culture change initiatives. Benning’s (2011) large scale intervention to improve patient safety by, amongst other things, improving culture found gaps between management and frontline engagement, ward practices and practice change. They concluded that “one of the major lessons learnt was the scale of resources and organisational support required to make patient safety initiatives work”. Ensuring senior clinicians were engaged in the process and encouraging local ownership were seen as two methods to improve this. Such research demonstrates the importance of planning, preparation and commitment from senior staff to ensure the success of any veterinary patient safety initiative. Improvements in a practice’s safety culture are likely to be slow and difficult, multifactorial and non linear. It is improbable that the VetTeams workshop can change safety culture on its own and as such the failure of this study to show a statistically significant improvement in safety culture scores is not surprising. A two hour educational intervention was always unlikely to initiate dramatic change, but the results imply it may

have a place as part of a larger scheme incorporating other drivers of change such as benchmarking, audit and senior strategic leadership

Rouse (2011) states that Kirkpatrick identifies four conditions necessary for change A person must have a desire to change, the knowledge to do so, a supportive work environment and a reward for changing. Vet Teams may provide for the first two of these conditions, practice managers and owners must be engaged to provide the final two. The workshop may therefore have a value as part of a more comprehensive patient safety and quality improvement initiative in a practice. The ambition to improve culture is probably more realistically achieved through the concept of continuous improvement, characterised by small incremental gains. This is represented by review cycles such as Plan Do Study Act (PDSA), a methodology used by the NHS to facilitate organisational change (Benning et al., 2011). Tools such as this need to be developed to support senior veterinary managers and practice owners in implementing and sustaining the changes associated with patient safety initiatives.

Moving forward, there is much potential to expand and improve VetTeams, in the form of a workshop more tailored to individual practices. For the purposes of this study, each hospital was presented with the same workshop, which focussed on skills predetermined by the researcher. In practice, the delivery of the intervention could be more bespoke. Programmes such as CUSP and TeamSTEPPS in medicine encourages clinicians to identify issues and problems as a first step, before a training programme begins (Pronovost et al., 2005). This acts as a training needs analysis and allows the unit to select the most appropriate educational module to target its perceived problem. The VetTeams curriculum

could be expanded in a 'toolkit' style to cover more aspects of non - technical skills and teamwork and include tools adapted or created for use in the veterinary context. Practices should also identify their own concerns, either through pre workshop meetings or analysis of the results from a practice NVSCS. This could increase the engagement of practitioners, as the workshop could then address concerns they have identified themselves, making it more relevant and encouraging 'buy in' from frontline clinicians. It is also well recognised in medicine that the effects of training decay over time and some studies have suggested the value of 'boosting' initiatives with follow up activities to sustain changes (Steinert et al., 2012). This may also merit consideration in the design of future educational programmes

The NVSCS

An added outcome of this study was the practical application of the NVSCS, and further evidence of its reliability as a measuring instrument. As a tool for practice the NVSCS appears to function practically well. The final 29 item version was well accepted by veterinary clinicians. It was quick and easy to complete, the statements appeared to be well understood and the results were received positively by senior personnel and management.

Test retest reliability is an assessment of the stability and reliability of a measure over time (Rattray and Jones, 2007). A common measure of reliability, it is especially important regarding tools which are to be used to assess anticipated changes to a construct, such as the development of safety culture in practice. For there to be confidence in the tool's ability to detect change in the object of its measurement, it is essential that it is itself stable over time. The subdomains of organisational safety systems, staff perception of management and teamwork and communication show strong evidence of such reliability. The subdomain

of risk perception showed slightly weaker reliability, although it was still statistically significant. It is virtually impossible to control for all the confounding variables which may impact staff perception of safety culture. It may be that some external variable affected people's perceptions of personal risk perception in the time frame of the study, or possibly the domain is more subjective than the others and more prone to fluctuations.

The NVSCS successfully highlighted areas of practice for discussion or development which could improve safety critical processes such as methods of communication and difficulties with adverse event reporting and discussion. From its limited use in the seven hospitals in this pilot project, it appears to be a workable benchmarking tool, giving reliable results over time and effectively measuring the construct of veterinary safety culture. Importantly, it breaks down a complex concept and describes the key components in actionable concepts for the attention of management and senior staff.

6.5 Limitations

Bias, introduced by the method of sampling participants, may limit the results of this study. The use of cluster sampling within a convenience framework inevitably restricts the generalisability of the results, as the data has not been gathered from a truly random sample of the population. There is also the possibility of self - selection bias in the inclusion of the south coast practice which volunteered to take part. However, there were significant issues regarding the logistics of delivering training to a wide group of practices, and the

diversity of veterinary practice would have limited the comparability of a control group in a truly random sample. It was deemed unreasonable and unrealistic to expect clinicians to stay behind after work to participate in a research study, and a lunch hour was both too short, and too unreliable, to use for the planned workshop. The study therefore relied on the willingness of practice owners to release clinical staff 'en bloc' from their jobs. Taking these factors into account, it was considered a robust enough sampling strategy for a pilot study, while acknowledging its limitations.

This study attempted to assess outcomes in the form of changes in culture score pre and post intervention. It is extremely difficult to design a study which accounts for all possible variables in the messy real life of medical or veterinary practice. Attributing a causal link between the teamwork training and hypothesised improvement in NVSCS scores would be difficult at best, and the study may have benefitted from including some lower level assessments. Such measures could have evaluated the success of the workshop in terms of whether learning had occurred through a formal assessment (Kirkpatrick level 3) or whether behaviours had changed through observational studies (Kirkpatrick level 4). The inclusion of some form of student assessment to 'test' whether learning had occurred was considered but not included in the final design. Clinicians took part in the workshop out of goodwill, and it was felt that subjecting them to a 'test' could cause anxiety which may affect people's decision to participate and detract from the time allowed for the intervention itself. Several studies in medicine have assessed the effect of team training at levels such as teamwork processes, clinical processes and clinical outcomes in addition to staff attitudes. The 'measurement' of behaviour changes may have been possible by, for example, recording the number of times a brief was used in the 6 weeks following the intervention. However, this would have involved a significant commitment from the SVS and

it was felt that this was beyond the scope of this project. A noteworthy advantage of the study was the use of a culture survey with proven reliability and validity in the form of the NVSCS.

One significant limitation of this study is the lack of qualitative methods employed to investigate the student evaluation of VetTeams and the organisational effect of the intervention. Safety culture is a complex and multifactorial phenomenon, and is probably best assessed by multiple methods rather than a single quantitative measure such as the NVSCS. In order to understand the results in greater depth and context, focus groups or interviews with clinicians and managers, and the inclusion of a free text box on the student evaluation form would be a useful addition to future studies.

Chapter 7

Discussion and recommendations

Three separate studies have been conducted within this thesis to investigate the improvement of patient safety in veterinary practice. These studies present evidence describing the causes of veterinary error, the development of a tool for the measurement of veterinary safety culture, and a proposed patient safety intervention in the form of a veterinary teamwork training workshop. This final chapter will begin with a brief summary of each of the three core studies and go on to discuss the ways these findings relate to the broad aim of the thesis. It will present four main themes to guide improvements in veterinary patient safety supported by the research findings, together with specific recommendations and proposals for their development.

This will be followed by a discussion of the factors which may drive the uptake of patient safety initiatives in the industry. Finally it will submit suggestions for further research and address the limitations of the work.

7.1 Summary of the three studies

7.1.1 Study One: The causes and types of veterinary error

The first study in the thesis investigated the causes and types of error in veterinary practice. It identified cognitive limitations in individuals and system failures including poor communication, leadership, product design and productivity pressure as causes of error.

Surgery was identified as a significant risk factor for complaints, and by inference, errors. It became clear during the data gathering and analysis, that a human factors approach to errors was important, involving both an individual and systems perspective. It also appeared that this perspective was lacking in many frontline clinicians, who saw errors as the responsibility of individuals and lacked this 'bigger picture' perspective. Pronovost (2010) refers to similar qualities in human surgeons, describing this sense of personal responsibility as 'what is so great and so myopic about medicine'. Both human medics and vets advocate strongly for their patients, and yet they lack the knowledge and training to apply that advocacy in the correct context, directing their efforts at themselves rather than their systems. This phase of the research identified specific dimensions of both veterinary practice and individual clinicians which contribute to error and could therefore be a target for improvements.

7.1.2 Study Two: The development of the Nottingham Veterinary Safety Culture survey (NVSCS)

The second study examined the concept of safety culture in veterinary practice and designed a tool for its measurement. It identified four domains of safety culture in the veterinary profession: 1. Organisational safety systems and behaviours, 2. Staff perceptions of management, 3. Risk perceptions and 4. Teamwork and communication. These findings are triangulated by similar domains in the medical and safety literature. Patient safety improvements in medicine rely heavily on culture change, and the uptake of even irrefutably effective interventions such as the Safe Surgery Checklist succeed or fail depending on the attitudes and behaviours of healthcare staff (Haynes et al., 2015). The

NVSCS is presented as the only reported reliable and validated tool available to assess safety culture in veterinary practice. It may be used to raise awareness of safety critical attitudes and behaviours, benchmark practices internally or externally, track change over time or assess the response to safety interventions.

7.1.3 Study Three: The development of VetTeams – a veterinary teamwork training workshop

The final phase of the project involved the development of VetTeams, an interprofessional teamwork training workshop, inspired by the TeamSTEPPS curriculum (King et al., 2008). The two hour workshop focussed on exploring the themes of teamwork and leadership, and their relationship to the use of surgical checklists in practice. The aim of the workshop was twofold: 1) to achieve the specific learning outcomes and 2) to positively influence the practice safety culture. Learning outcomes were achieved at Kirkpatrick levels 1 and 2, and staff response to the workshop was overwhelmingly positive. The effect on safety culture was not statistically significant, however the workshop represents a positive first step in the potential development of a larger training curriculum for veterinary practices.

7.2 Recommendations for veterinary practice

The following section will outline four main themes which have emerged from the research and which relate to the overall aim of the thesis: the improvement of veterinary patient safety. The studies have effectively served as a needs analysis for the profession and the following themes have been generated by viewing the results of the research and applying

the experience of other industries, most notably medicine, to similar issues. While solutions cannot always be directly applied, the underlying principles are often transferrable and these have inspired the themes presented in this chapter. Each will be discussed in turn, with specific recommendations for further development suggested. An outline of these themes and their related recommendations is presented in figure 7.1

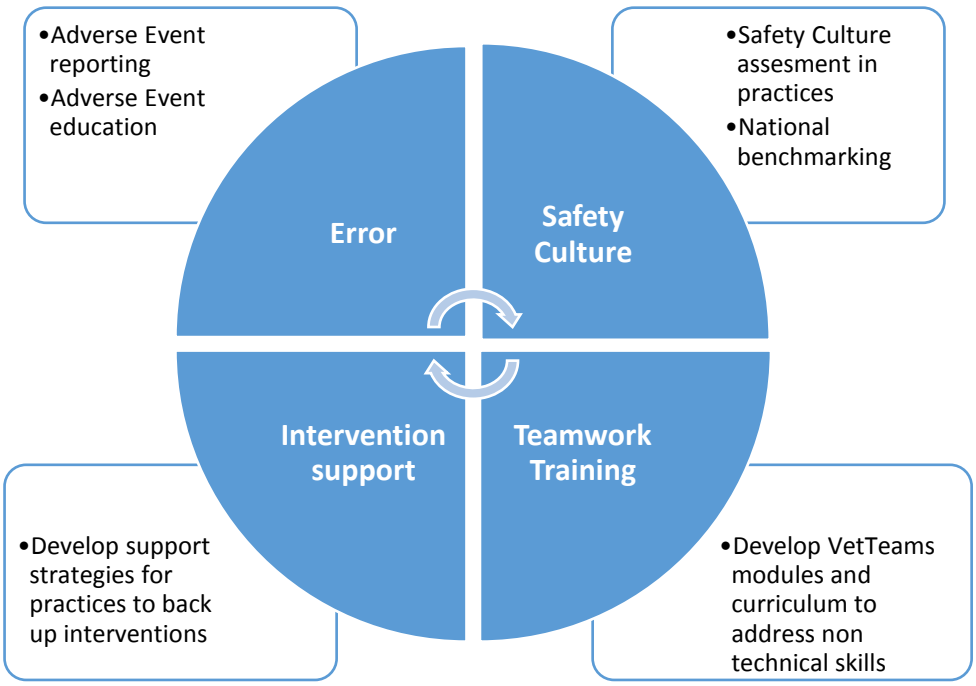
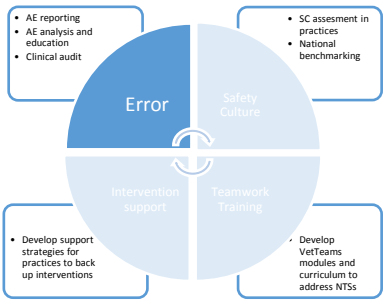


Figure 7.1 Themes and recommendations to improve patient safety in veterinary practice

7.2.1 Theme One

Improve the understanding of veterinary error



One of the initiatives most consistently identified as a high priority for improving patient safety is the development of patient safety reporting systems (Panesar et al., 2009). Adverse event reporting represents an effort to understand, track and prevent error on three levels: 1) to identify the types and causes of safety issues, 2) to communicate the most important risks to healthcare providers and 3) to inform the development of practical solutions to mitigate harm. This study attempted to identify the causes and types of veterinary errors and developed a solution in the form of a workshop inspired by those findings. However, this could be developed further. The first phase of this PhD study provides the beginnings of a framework for categorising adverse events in veterinary practice, and lays the foundations for a similar analysis of veterinary patient safety incidents. At present there is no national data base for veterinary adverse event reporting. The results of this study suggest that the causes of error in veterinary practice are similar to those in medicine, with system failures and poor non - technical skills significant factors. The profession has no means of assessing the causes, frequency or severity of incidents, or providing feedback to its members.

Learning from other industries, effective reporting systems rely on confidentiality, feedback and practical recommendations to improve local processes (Barach and Small, 2000). They also contribute to three of Reason's essential components of a positive safety culture: a culture which is reporting, learning, just and flexible (Reason, 2000a).

The National Reporting and Learning Service (NRLS) set up by the National Patient Safety Agency (NPSA) generates approximately 250,000 voluntary patient safety reports each quarter, and is now one of the largest reporting systems in the world (Cook and Scobie, 2009). Reports to the NRLS are made through a web based open access system or, more commonly, via its interface with an organisation's own commercial risk management software (Catchpole et al., 2008). The system is voluntary and reporting is anonymous, in recognition of one of the most significant barriers to incident reporting - fear of the consequences in terms of public and professional censure (Mahajan, 2010). Similar expressions of a fear of the consequences of error was highlighted in this and other veterinary studies (Hartnack et al., 2013), and may have similar effects on the reporting of veterinary error.

Adverse event reports are analysed via stratified sampling of recurring types of error and free text mining for specific topics. This allows the most frequently occurring or most severe forms of incident to be given priority. More detailed analysis of the free text description of the incident is then undertaken by coding the text for key words which highlight factors responsible for the incident (Cook and Scobie, 2009).

Feedback to frontline staff is achieved by the publication of quarterly data summary reports and individual organisation reports showing rates of reporting benchmarked against similar organisations. 'Rapid response' reports are also published which address specific issues, providing contextual detail from the reporting system and advice on implementing recommended actions to prevent their recurrence (Panesar et al., 2009).

Reporting systems are limited by numerous factors. The rate of reporting is often low, with potentially only 1 in 5 incidents reported (Taylor et al., 2004). Reports are often made by

nurses rather than consultants, effectively skewing the database and are subject to hindsight bias and oversimplification of a complex chain of events (Panesar et al., 2009, Catchpole et al., 2008). Analysis of incidents can be compromised by a lack of detail in the text and because the reports are anonymised, the inability to return to the author to ask for more information. There is also no universally accepted taxonomy or analysis framework (Runciman et al., 2006). However, despite these limitations, the NRLS represents a data gathering and analysis system which exists to learn from past harms and mitigate future error, rather than assigning blame, and could be used as a model to inspire a similar system for the veterinary profession.

Other methods of detecting adverse events include traditional retrospective record reviews, structured record review using systematic search strategies such as the IHI's Global Trigger Tool (Classen et al., 2011) and active surveillance of existing databases such as administrative claims or clinical records. This is especially useful in the detection of adverse drug events (ADEs), and there are numerous examples of systems developed to do so in healthcare (Huang et al., 2014). Other active systems have been developed which detect 'triggers' in electronic clinical records such as abnormal laboratory values, high risk medications or those used as antidotes (Szekendi et al., 2006). The IHI' 'Global Trigger Tool'With the increase in computerised records in veterinary practice and the evolution of collaborative research projects such as VetCompass, there may be opportunities to develop similar methods of surveillance in the veterinary industry.

Recommendation 1

- **Development of a Veterinary Adverse Event reporting system**

Figure 7.2 shows a suggested framework for an adverse event reporting form for small animal veterinary practice which could be adapted for equine practice. The aims of such a system would include:

1) Evaluate the nature of adverse events in practice
2) Measure which are the most frequent adverse events
3) Evaluate which are the most serious adverse events ie which cause most patient harm and owner complaints
4) Evaluate the common contributing factors to inform recommendations

Adverse event reporting form
Q1 Please enter your practice code
Q2 Please describe what happened. Please include any contributing factors leading up to the event, as well as the actual incident (free text)
Q3 Please enter the date on which the event occurred
Q4 Please enter the location in which the incident occurred
Q5 Please categorise the patient safety incident
Q6 Using the following grading, please indicate the degree of harm to the patient: No harm, Low harm, Moderate harm, Severe harm, Death
Q7 Please enter the patient species:
Q8 Was the owner informed and what was the result?
Q9 Please indicate your staff group

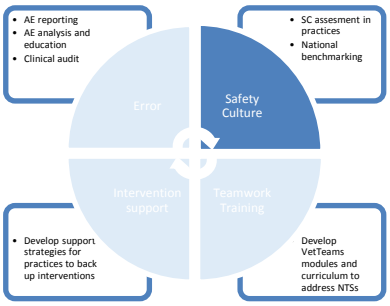
Figure 7.2 The suggested structure of a small animal adverse event reporting form. Adapted from a patient safety incident report form (NHS England).

Any adverse event reporting system is only as good as the data that feeds it, therefore it is important to win hearts and minds, as well as simply providing a reporting 'vehicle'. Hartnell (2012) identifies three strategies to enhance data reporting in medical staff, 'reducing reporter burden, closing the communication gap and educating for success'.

These suggestions should be integrated into the design of a veterinary reporting system. Reporting should be quick and easy for staff. The above framework is short and concise and could be easily adapted to a digital format for use on a tablet or smart phone to make reporting as easy and convenient as possible. Educational initiatives aimed at explaining the aims and the benefits of reporting, as well as what and how to report should be developed and publicised alongside the actual mechanical system. As the research in study one of this thesis suggested, clinicians are often blind to the contributing effects of the system, limiting the potential depth and quality of any reports they make. Educating clinicians in human factors and a systems approach to error would potentially improve the quality of reporting.

Possibly one of the most important aspects of encouraging reporting is the provision of useful timely feedback. Clinicians need to feel that their report makes a difference, in terms of practical advice and solutions, and this feedback must be delivered back to the front line not just to a level of management and oversight, to ensure continued compliance. A reporting system would ideally be introduced as part of a quality and safety initiative which encompasses a commitment to continuous improvement and effort to improve safety culture by the practice leadership.

7.2.2 Theme Two: Engage safety culture



The promotion of safety in many safety critical industries commonly employs three approaches: managing 'hardware', ensuring best practice, and managing people (Parker, 2009). For example, improvements in driving safety rely on technological developments such as airbags and ABS while best practice informs the setting of speed limits and the rules of the Highway Code. Comparable people management relies on education strategies designed to alter attitudes, such as speed awareness and 'Don't drink and drive' campaigns. In human healthcare, hardware improvements are represented by examples such as computerised records and the redesign of catheter ports to prevent misconnections. Best practice is evident in NICE treatment protocols and evidence based public health. People management is, in part, achieved through assessment and manipulation of safety culture, through the use of culture surveys such as HSOPS and SAQ, and training programmes such as TeamSTEPPS and NHS Scotland's Flying Start initiative (Flying Start NHS, King et al., 2008).

Safety and quality could potentially be improved in veterinary practice by similar means. The development of more ergonomically designed equipment and drugs with fewer side effects represent improvements in 'hardware'. The rise of evidence based medicine in the form of resources such as BestBets for Vets (Dean et al., 2015) to inform treatment guidelines helps guide and ensure 'best practice'. It is hoped, that the development of the

NVSCS will enable managers to investigate both their systems and the attitudes of their employees, and provide an evidence base from which to inspire behavioural change.

Recognised or not, safety culture exists in every veterinary organisation on multiple levels. It is likely to vary within subsets of workers within a practice and is not fixed. As Parker (2006) points out, safety culture is not a dichotomy – something which organisations either do, or do not have. It develops with an organisation and exists in varying stages in maturity. This is represented by Westrum's (2004) model of the levels of safety culture, see table 7.1

Pathological	**Bureaucratic**	**Generative**
Information is hidden	Information may be ignored	Information is actively sought
Messengers are "shot"	Messengers are tolerated	Messengers are trained
Responsibilities are shirked	Responsibility is compartmentalised	Responsibilities are shared
Bridging is discouraged	Bridging is allowed but neglected	Bridging is rewarded
Failure is covered up	Organisation is just and merciful	Failure causes inquiry
New ideas are actively crushed	New ideas create problems	New ideas are welcomed

Table 7.1 The levels of safety culture. Adapted from Westrum (1996)

Further developed by Reason (2016) to include reactive and proactive culture types, this model is as applicable to veterinary practice as to the industrial organisations for which it was first designed. These 'ladders' of safety culture describe a developmental model which advances through stages of maturity from the pathological to the generative.

The act of conducting a safety culture assessment in a practice has the knock on effect of raising awareness amongst staff about the existence and importance of safety culture. By extension, this may precipitate staff to question and re - evaluate both their own actions, and the actions of management and practice leadership in the light of patient safety and the combined effect on patient outcomes. Well explained and organised safety culture assessments can highlight the commitment of management to safety and patient outcomes and help create a set of common organisational goals. For this reason, safety culture assessment is often used to launch an organisational patient safety initiative which aims to improve safety culture and move an organisation up the 'culture ladder' (Nieva and Sorra, 2003). By raising awareness of the concept, safety culture surveys such as the NVSCS can therefore act as interventions in themselves to improve safety culture through increasing awareness of problems and the possibility of solutions.

In addition to snapshot measures such as the NVSCS, it may be helpful for veterinary practices to attempt to place themselves at a point along this continuum, both in terms of assessing their current position, and visualising where they would like to be. The 'nested' model of veterinary error developed in phase one of the project helps to visualise how safety culture cuts across all layers of the organisation and affects safety on multiple levels (see figure 7.3)

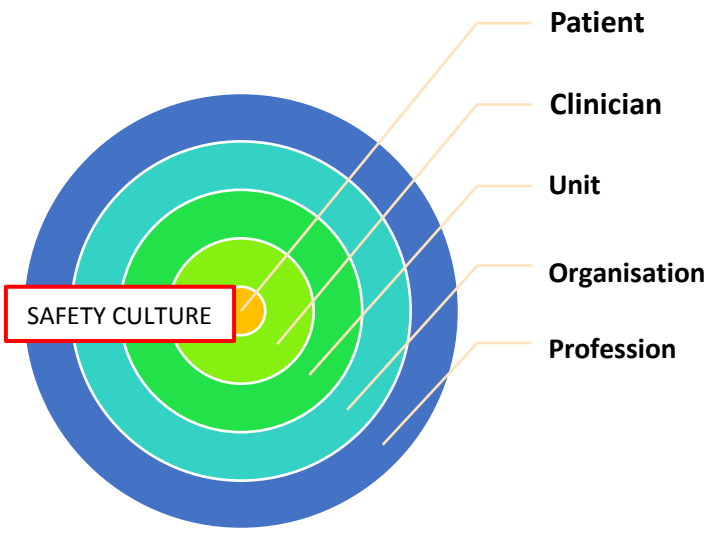


Figure 7.3: The nested diagram of veterinary error showing safety culture active at all levels

Recommendation 2a

- **Safety culture practice assessment**

Veterinary practices should take active measures to promote their safety culture, through annual measurement using the NVSCS. This would enable them to identify areas for improvement in each of the four domains and therefore target their resources more efficiently. An example of this is given below (see table 7.2). These action points were drawn from an informal report prepared for one of the hospitals in phase three of this study. It was written to provide the hospital with some feedback as thanks for their participation, and shows an example of the areas which an organisation may identify and attempt to change, by taking the NVSCS. Annual repeated use would show if and how the problems identified have been improved or have shifted. The full report is available in Appendix 7a.

Survey domain	Recommended action
Organisational Safety Systems	1. Assess practice communication and handover systems and protocols 2. Develop regular (monthly Mortality and Morbidity meetings using a framework to identify system contributions to error) 3. Assess reporting and feedback systems in the hospital regarding errors and mistakes
Perception of seniors / management	1. Foster mutual trust through open discussion of error led by practice leadership 2. Educate staff as to the shared responsibility of patient safety through senior leadership initiatives such as communication tools CUS and assertive statements. Reward efforts to promote safety from junior staff
Risk Factors	1. Evaluate staffing levels 2. Track workload to identify patterns in business and adjust staffing levels accordingly
Teamwork	None required

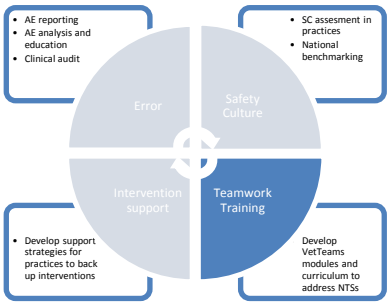
Table 7.2 Safety Culture Survey, Hospital 1 – Summary Report. 3rd March 2016. 21 responses

Recommendation 2b

- **National benchmarking system**

Practices should be encouraged to provide a national database with their annual safety culture scores. Practices would remain anonymous, but could benefit from being able to benchmark themselves against similar practices in terms of size or geography, on each of the four domains of safety, to identify areas where they could improve. Practices with consistently high scores could be invited by the database organisers to share best practice. Such a database could also facilitate further development and assessment of the psychometric properties of the survey through analysis of a larger data set and techniques such as confirmatory factor analysis to re asses and refine the factor structure.

7.2.3 Theme Three: Teamwork training



Deficiencies in *some* non technical skills have been identified in veterinary medicine. The importance of veterinary communication skills is now well recognized. Business skills have also been highlighted as an important gap in veterinary undergraduate training with studies in the UK and USA identifying a lack of basic knowledge, skills and attitudes (Brown and Silverman, 1999, Cron et al., 2000). However, interprofessional communication and

teamwork training is still undervalued (Kinnison et al., 2015a). Findings from stage one of this study identified failures in the teamwork skills of communication and leadership as causal factors of veterinary error. However, there is no equivalent to a TeamSTEPPS or NHS Leadership Academy for the veterinary profession (NHS Leadership Academy).

Communication skills training in medicine goes beyond developing the relationship with the patient and delivering bad news. Handover has been identified as a critical feature of keeping patients safe with poor performance caused by a lack of formal training and systems (Manser and Foster, 2011). A lack of consistent practices, limited use of protocols and absence of best practice guidelines have been identified as contributing to interrupting the flow and consistency of patient care (Clark et al., 2009). Educational strategies targeting handoff have been developed such as the PACT and HELiCs projects and specific tools such as handover prompt cards developed (Clark et al., 2009, Iedema et al., 2009).

The NHS Leadership academy offers stages of training recognizing the need for leaders at multiple levels – from the board to the ward. Basic courses cover skills such as giving and receiving feedback, adaptive leadership and the healthcare leadership model, while more advanced courses cover governance, strategy, policy and systems leadership (NHS Leadership Academy). Online programs such as the Institute for Healthcare Improvement's (IHI) International Leadership Development Program for Physicians include topics such as leadership and managing change, as well as patient safety and engagement and quality improvement strategies (Harvard T.H.Chan). The studies within this thesis have identified a need for similar resources in the veterinary profession.

Recommendation 3

- Develop VetTeams modules to cover a broader range of non technical knowledge and skills in greater depth.

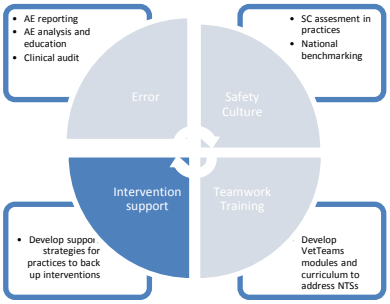
VetTeams teamwork training could act initially as an educational intervention which raises awareness and moves people along the conscious competency model (Luft and Ingham, 1961). Training programmes such as VetTeams may help veterinary staff to become more aware of their levels of non technical skills and the potential for their development (conscious incompetence), and move individuals along this continuum as they advance to the levels of conscious and unconscious competence. Linking the importance and relevance of these non technical skills to their day to day actions and patient outcomes, increases their significance, engages professional values and helps to satisfy the requirements of adult learning

The original VetTeams curriculum was limited by time and resources. However it has the potential to be developed and expanded to include the areas of communication, leadership, situation monitoring and mutual support covered in the original TeamSTEPPS curriculum. A summary of the modules comprising a potential VetTeams curriculum is presented in table 7.3

Module	Suggested content
Introduction to patient safety	Human factors in medical error, Reason's Swiss Cheese, the limitations of individuals and importance of a system approach
Teamwork in veterinary practice	Introduction to the definition of teamwork, Salas model. Relevance to error and the use of tools such as surgical checklists
Communication	Barriers to communication, define 'good' communication *Communication tools* : SBAR and Handoff
Situational awareness	Define situation awareness and shared mental models and discuss their effect on teamwork Barriers to situation awareness *Tools and facilitators* : communication, STEP
Mutual support	Introduce mutual support and mutual monitoring concepts Discuss conflict resolution *Tools and facilitators*: Feedback, assertive statements, CUS, DESC
Leadership	Discuss the skills and behaviours of good leaders relating to previous modules *Tools and facilitators* : BRIEF, DEBRIEF

Table 7.3 Summary of a potential VetTeams curriculum. Adapted from (King et al., 2008)

7.2.4 Theme Four: Supporting initiatives with change management strategies



It is inevitable that any effort to improve patient safety will require changes in attitudes and beliefs which manifest as changes in behavior and working practices. Organizational change is notoriously difficult, as recognized by Galvin (2005) who notes that improvement must be measured in decades not years. As such, successful organizational applications of patient safety initiatives rely heavily on planned, staged, implementation strategies (McCulloch, 2016). Examples of programs which include change management techniques include the Team Strategies and Tools to Enhance Performance and Patient Safety (TeamSTEPPS) initiative and the Comprehensive Unit-Based Safety Program (CUSP) (Pronovost et al., 2005, Sheppard et al., 2013). The failure of VetTeams to have a significant impact on practice culture scores in this study may be partly due to insufficient structured change management.

The delivery system of the TeamSTEPPS educational program employs Kotter's change management principles to embed, spread and sustain the program objectives using a three stage model as shown in table 7.4 (Kotter and Rathgeber, 2006).

Phase of training	Description
Phase 1. Assessment – Set the Stage	Determine the readiness of the organization for embracing a TeamSTEPPS initiative. Identify a change team who undertake a training needs analysis of the organization, including a HSOPS culture survey
Phase 2. Planning, training and implementation – Decide what to do and make it happen	Change team participate in an intensive train the trainer program, and develop a customized 'Implementation and Action plan'. This can range from implementation of the TeamSTEPPS curriculum across the organization, to introduction of specific tools and strategies within single units.
Phase 3. Sustainment – Make it stick	The goal of this phase is to sustain and spread innovations. The change team facilitate this through coaching, monitoring and feedback to continually reinforce the project

Table 7.4 The TeamSTEPPS three stage model for implementation and sustainment.

Adapted from King (2008)

The CUSP program originated as eight steps created to 'impact safety climate by empowering staff to assume responsibility for safety in their environment' (Pronovost et al., 2005). This was achieved through a structured approach to culture change, by the formation of a 'unit improvement team' consisting of a physician, nurse and senior executive, and targeted at the unit level within a hospital (see table 7.5)

Step	Description
Step 1 Culture survey	All staff undertake a voluntary safety culture assessment, to assess frontline attitudes to management and organizational commitment to safety, and better understand the environment in which they deliver care.
Step 2 Educate staff	40 minute presentation on the science of safety, highlighting the effect of systems on adverse events and highlighting the importance of teamwork and a no blame approach
Step 3 Identify staff concerns	Frontline staff complete a 'Safety assessment' which aims to identify safety concerns and suggestions for improvement
Step 4 Executive adopts a unit	Unit team meets with a senior executive to discuss the results of the safety assessment and the plan for moving forward. Monthly meetings are scheduled
Step 5 : Implement improvements	Frontline staff select initiatives they feel are most crucial and are given time and resources to implement them
Step 6 Document results	Staff are encouraged to define outcome measures for success and document their efforts so they are visual and available to all
Step 7 Share stories	Success stories are published and shared by means of a Safety Tales form
Step 8 Repeat survey	Culture surveys are repeated annually to assess the overall impact of the CUSP program on organizational safety climate

Table 7.5 The CUSP framework. Adapted from Pronovost (2005)

Since its inception, CUSP has been developed into a simpler six stage model and made available in a web based form (Pronovost et al., 2006). eCUSP is now an internet based project management tool which facilitates creation, planning and support for patient safety initiatives.

The principles employed by these two extensive improvement programs could be extended to the veterinary profession, and encompass the use of elements presented in this thesis. Both TeamSTEPPS and CUSP use a safety culture survey as a baseline measurement, to determine the impact of the intervention and provide background organizational information which can help plan the implementation strategy. The NVSCS presented in Chapter five is an equivalent measure developed for the veterinary profession, and would be well suited to play a similar role in a tailored improvement program. Its validity and reliability support its use to gather information and ensure its suitability as a pre and post measure of change. The VetTeams curriculum presented in Chapter six could be extended as a training methodology to create a comprehensive yet flexible program which can be tailored to individual practice needs.

Recommendation 4

- Develop project management and change support strategies for veterinary practices.

Table 7.6 shows a suggested outline for an educational initiative tailored to issues identified by the NVSCS, with provision for continued support and sustainment of initiatives.

Step	Description
Step 1	NVSCS
Step 2	General educational initiative explaining systems and their effect, the causes of veterinary error, recognition of self - limitations and the effect on second victims
Step 3	Practice Needs Assessment: Identify concerns and use the error framework from chapter four to analyze past incidents.
Step 4	Identify local champion(s). Work with management to identify and prioritize areas for intervention / training
Step 5	Implement the relevant component of the VetTeams workshop, define outcome measures and plan follow up meetings. For example, if poor communication is identified in the practice needs assessment, the workshop could be tailored to include communication tools and strategies such as SBAR and CUS, or the development of a structured handover protocol.
Step 6	Reward improvement: Make outcome data visible, use feedback, share success stories and reward individuals and departments for success.
Step 7	Repeat NVSCS annually to track influence on practice safety culture and identify new areas to target

Table 7.6 Proposed outline of a patient safety implementation and sustainment program for veterinary practice

These recommendations all potentially involve significant organisational change which can be ‘a massive task’ (McCulloch, 2016). Patient safety is in its infancy in the veterinary profession, therefore the following section identifies the potential drivers of such change in the veterinary industry

7.3 Drivers of change in Veterinary Patient Safety

7.3.1 Professional values

The professionalism movement in medicine has actively engaged in the study and definition of the inherent values and attributes of medical professionals, in order to guide the behaviours of its members and to teach and asses its students (Mossop, 2012b). This focus accepts that there is more to being a good doctor than technical knowledge and practical competence, a concept which is being recognised through parallel developments in veterinary professionalism. Professional values are important drivers of behaviour. Improvements and advances in domains other than safety, hinge on the inherent desire of professionals to improve in the pursuit of excellence (Carroll and Quijada, 2004). In the case of veterinary patient safety, it may be that these values are disengaged, due to the profession’s lack of evidence suggesting the need for improvement. The IOM report of 2000 made uncomfortable reading for medical clinicians, but it was essential to enlighten them as to the degree of the problem, and motivate their professionalism in the form of a desire to improve (Kohn et al., 2000). Perhaps, in a similar way, the veterinary profession needs to be presented with evidence that it may not be as good as it would like to be, to be able to begin the journey of improvement. Reason (Reason, 2000b) acknowledged that

organisational safety culture becomes profoundly important when accident rates 'bottom out', or become so low as to be 'invisible'. Lee (1998) observes that at this point it is imperative to address workers minds and hearts; to engage professionals with not only factual data such as incident report rates and the details of root cause analysis, but also to harness the emotional influence of professional attributes and values.

Engaging values is therefore a cornerstone for success, as these deeply held beliefs affect behaviours and ultimately performance. Patient safety initiatives naturally engage with the veterinary professional values espoused by the RCVS code, namely, professional competence, honesty and integrity, independence and impartiality, client confidentiality and trust and professional accountability (The Royal College of Veterinary Surgeons). Mossop's (2012a) definition of veterinary professionalism, includes characteristics such as honesty, altruism, personal values and empathy, characteristics repeatedly demonstrated by practicing clinicians in the focus groups during phase one of this study. Framing these values in the context of patient safety improvements has the potential to engage the profession at the individual level, and stimulate demand for relevant research and CPD.

7.3.2 Regulators

The drive to improve patient safety in human medicine was undoubtedly triggered by the Brennen and Leape incidence of harm study (Brennan et al., 1991) and subsequent Institute of Medicine (IOM) report (Kohn et al., 2000). The public concern and political fallout it triggered acted as a catalyst for change, sustained by the subsequent research and body of evidence it generated (Stelfox et al., 2006). There is unlikely to be such a dramatic institutional call for patient safety initiatives in the veterinary field. In addition to the total

lack of similar incidence data, in many ways it is not in the profession's business interests to suggest to the public that veterinary care is anything less than safe and efficient. In this cynical age, owners display a remarkable degree of trust by handing over their pet to the care of a veterinary team, often with no tangible assessment of its quality beyond their relationship with individual clinicians and a general respect for the profession (Blass, 2010). Clients believe that 'bad' vets are dealt with by litigation and the regulatory power of the RCVS. As such, there is no drive to improve from the veterinary equivalent of human patients – the animal owners, the patients themselves being unable to voice their opinions.

The profession's regulating body, the RCVS, does not advertise patient safety as an organizational goal. Although 'animal safety' appears in the code of professional conduct, it is limited to the context of clinical governance and not promoted as a driver of policy. In contrast to healthcare institutions such as the National Health Service (NHS), who promote patent safety as one of their major goals or visions (NHS choices), it is not explicitly mentioned in the recent RCVS VetFutures report (Vet Futures Action Group, July 2016). This working document is the result of a years consultation, and presents the vision of the College for the future of the profession. It sets out six aims, none of which relate directly to improving quality of care. This is perhaps an opportunity lost. Three of the aims, to 'provide exceptional leadership, to be a leading force for animal welfare and to ensure confident, resilient, healthy and well supported members of the profession', have definite roots in the patient safety movement. They could be effectively operationalized through safety initiatives such as non technical skills training, safety culture assessment and second victim support to resonate with practicing vets and nurses, increasing their relevance to day to day practices, and therefore their uptake. This study has shown however fear of sanctions and a

potential misperception amongst members of the profession of the response of the RCVS to errors, may have a damaging effect on the College's ability to lead such initiatives.

In reality, and in contrast to the governmental oversight of healthcare organizations, the RCVS has limited influence and power beyond sanctions on individuals, and is unable to mandate policy in private practices. The omission of patient safety from a document such as VetFutures reflects the paucity of research regarding the topic specific to the veterinary profession and a degree of professional insularity.

7.3.3 Professional indemnity insurance

Professional indemnity insurers such as the Veterinary Defense Society (VDS) may have a role to play in driving patient safety improvements. There is little evidence that litigation related to malpractice deters unsafe practices or improves patient safety in human medicine (Pawlson and O'Kane, 2004). In fact, the pursuit of an individual to prove negligence and subsequent bestowment of blame, is behavior exactly counter - productive to managing error and preventing its recurrence. It does little to reduce costs to insurance companies in the form of pay outs and results in increases in premiums for clinicians (Wu et al., 2013). As this thesis and numerous other studies have shown, errors are usually caused by a combination of events, and often involve failures of the system rather than, or in addition to, an individual's mistake. Subsequent fear of litigation promotes the practice of defensive medicine, which in turn, increases healthcare costs to consumers.

However, some medical insurance companies have embraced the concept of patient safety as a form of 'proactive risk management' (Pawlson and O'Kane, 2004). Much as medicine

has shifted away from the reactive treatment of acute conditions and where possible, takes a more preventative approach to injury and disease, some medical insurance companies take a proactive approach to both the avoidance and mitigation of errors in their members. This is achieved through a combination of a data driven assessment of errors employing a system perspective, and the application of this information to identify the causes of patient harm and litigation. This information is then developed into tools which are fed back to organizations to mitigate future errors, improving patient safety and reducing claims. An example of such a company is the Colorado Physicians Insurance Company (COPIC) based in Denver USA.

COPIC aims to 'reduce patient harm and physician's liability risk, and provide clinicians with effective tools to enhance the quality of practice' (Copic, 2016). This is achieved through the following methods, summarized in table 7.

Method	*Description*
Incident reporting to reduce recurrence of errors	Physicians are actively encouraged to report incidents and near misses which are coded into the insurance database. COPIC then uses the data to analyze incidents and uses this information to inform organizations about how to strengthen their error defenses.
Systems assessment and feedback	Member organizations are regularly assessed from a systems perspective using a combination of surveys and onsite visits by nurses trained to identify risk factors for patient safety. This assessment is informed by the information in the COPIC data base of reported incidents. Practice principles are informed of the results of the survey and visitation, and recommendations are made to improve systems and reduce risk. The practice is also provided with links to 'tool kits' and other educational programs to help improve patient safety standards and care quality.
Rewarding results	COPIC provides incentives for clinicians and practices which adopt recommended practices. Individuals and practices accrue points for attending educational programs, adhering to recommended practices or implementing recommendations from the systems assessment. Their malpractice premiums are subsequently linked to these actions, and baseline results of the practice survey. Those hospitals which make efforts to improve safety, improve quality and subsequently reduce claims are rewarded with lower premiums.

Actions for persistent offenders	In addition, organizations or individuals who are consistently identified as repeat offenders are monitored and offered extra help in the form of repeat surveys and assessment. If the problem appears to be related to an individual, they can be directed to other forms of help such as retraining for clinical skills, or counselling services for those with mental health or addiction issues. For those who refuse to change, the last resort is the withdrawal of insurance.

Table 7.7 Summary of the proactive risk management strategies employed by COPIC. Adapted from Pawlson (2004)

A similar approach to patient safety may be possible in the veterinary insurance industry. The VDS at present commands trust and respect amongst the profession, and is viewed by many in the profession as being the people who are 'on your side' in the event of a mistake. It is a mutual insurance company, run by vets, for vets, and is in an ideal position to understand the challenges and realities of practice. In the absence of any other provider of risk management strategies and systems assessment, such a service would potentially reward the company, its members, and ultimately benefit both clients and their pets.

7.3.4 Pet Insurance

Another possible source of quality assurance and improvement stems from market forces. Again, in medicine, this drive has been harnessed by initiatives such as the Leapfrog group, a collaboration of large employers and public purchasers of healthcare insurance in the USA. This group believes in the power of transparency, information flow and reward based incentives to drive quality and efficiency, and applies these beliefs to healthcare. They attempt to use market forces such as public disclosure of performance measures, rewards for those who supply better care and informed consumers who make their choices based on quality and value, to drive improvements (Galvin et al., 2005). The group invites hospitals to voluntarily undertake a survey which assesses the institution's progress in implementing evidence based safety initiatives such as computerized physician order entry systems (CPOE), ICU staffing and evidence based hospital referral. The results of the survey initiate the incentive and reward system – either through influencing consumers on their choice of hospital, or paying providers according to performance measures.

This model may be relevant to recent changes in the UK veterinary pet insurance market. In 2014, pet insurance companies paid out £602 million in claims, or £1.65 million a day, an increase of 15% on the previous year. Insurance premiums for owners have increased in suit, from 577 million in 2010 to 895 million in 2015, an increase of over 50% (Adam Bernstein, 2016). Pet insurance is a risky and expensive business. One potential cause of this increase in claims costs is an increase in veterinary fees, due in turn to an increase in the availability of complex care. Insurance underwriters have responded by commenting that 'the rising costs of veterinary care are threatening the sustainability of pet insurance'.

In 2015, the Royal Sun Alliance (RSA) group, which underwrites policy for Tesco, MoreThan, Marks and Spencer, John Lewis, Argos and Homebase launched its 'preferred referral practice network' (Veterinary Record, 2015). This attempt by the underwriters to control costs, incentivizes the referral of pets to approved practices by imposing a surcharge on owners who choose to refer their animal to a practice not on the list. This represents a radical change in the structure of UK pet insurance, and its relationship with private practices, and demonstrates the potential of market powers to influence policy in the veterinary industry. Much as Leapfrog recognizes that quality and efficiency are the gold standards for the selection of healthcare products for its members, similar recognition and incentives from pet insurance providers could do much to influence quality and patient safety in veterinary practices. The selection of veterinary practices on measures of quality and systems assessment would not only drive up standards, but protect insurers from the costs of rework or expenses incurred as the result of errors.

7.3.5 The Business case for safety

The majority of veterinary practices are run as businesses and are therefore subject to the pressures that any firm must face. Veterinarians must therefore consider the business aspects of practice, as well as delivering high quality clinical standards, to be financially viable (Bachynsky et al., 2013). This inevitably leads to the trade- off between productivity and safety as experienced by many other industries and identified in phase one of this study. Issues such as appropriate levels of staffing and provision of out of hours care were highlighted in the focus groups as contributing factors in errors and are good examples of decisions and policies which affect both patient safety and practice turnover. Veterinary practices are continually under pressure from regulations in the form of the RCVS's Code of Professional Conduct and increasingly competitive market forces, while maintaining a responsibility to their employees, clients and patients.

Some institutions within healthcare have highlighted safety's relationship with quality and efficiency and advocate safety initiatives as not only valuable in their own right but a method to improve services and reduce costs. The Virginia Mason Institute in Seattle has embraced this ideal through the development of an institutional wide 'way of doing things' which targets culture change through Lean project management techniques (Weber, 2006). The Virginia Mason Production System, is based on the principles of the Toyota Production System (Nelson-Peterson and Leppa, 2007), a set of management techniques and technical processes which aim to strip out waste and ensure consistency, increasing quality for the consumer. Translated to healthcare, this equates to reducing errors and rework, improving quality of care and patient satisfaction (Eaton, 2013). Virginia Mason initially employed Lean techniques as a response to falling income and financial pressure. They engaged with

stakeholders such as large companies with significant healthcare purchasing power, to define quality as patient satisfaction, the practice of evidence based care, rapid access to care, patient's rapid return to functioning and cost (Blackmore et al., 2011). They used this definition to define value care streams for common conditions, improving the quality of care for patients, reducing costs for themselves and their stakeholders. They now boast increased revenues, improved quality of care indicators and improved patient and job satisfaction ratings (Weber, 2006).

Lean thinking has been successfully applied to numerous healthcare settings, and Virginia Mason has recently been engaged by the NHS in a trial with five UK hospitals to implement the technique in UK healthcare (NHS Trust Development Authority, 2015). Mazzocato's (2010) review of Lean methods in healthcare concluded that the process has shown positive results in improvements in quality, access, efficiency and reduced mortality. As small businesses, this model of reducing costs while improving efficiency and customer satisfaction could appeal to many veterinary practice owners. It is possible, that Lean methods applied within the context of quality and safety could both improve practice systems leading to fewer mistakes and reduce costs from unnecessary steps and rework, strengthening the business case for an active patient safety policy. Studies in medicine suggest that the use of this combined approach of efficiency and patient safety initiatives is a more effective means of ensuring change and improved outcomes, appealing to both the heart and mind of the profession (Robertson et al., 2015).

7.3.6. The Patient at the centre approach

Including the person undergoing treatment as an active member of the team is a strong principle in medical patient safety drives (Kitson et al., 2013). Considering the patient as a dynamic member within the chain of care delivery, rather than a passive receiver, is a shift change in attitude, and places a not insignificant amount of responsibility on the patient and their relatives to ensure safe treatment. This is encouraged by campaigns aimed at encouraging patients to speak up, such as 'It's OK to ask' aprons as part of the 'clean**your**hands' initiative to reduce infection rates in hospitals (Pittet et al., 2011). It represents an extension of Reason's essential components of a safe culture model, where safety is the responsibility of everyone, within a culture of trust which allows all to speak up (Reason, 2000a). Considering the client as an integral part of the veterinary care team, rather than a person whose sole job is to carry out instructions handed out by the vet, may represent a similar change in attitude and practice. While it may be natural to present an air of all - encompassing expertise, being open and honest with clients about the possibility of error and their role in preventing it may help reduce mistakes. Training staff to educate owners in procedures such as medication checking and administration may not only help to mitigate prescribing errors, but increase communication and foster trust between practices and their clients. Transparency and communication with patients has been seen as a vital component of mitigating malpractice claims in human healthcare. The main drivers of such claims, rather than being a wish to blame and persecute individual clinicians, are a need to understand what has happened, to know that it will not happen to someone else, and a belief that caregivers are accountable (Boothman et al., 2009). It may be that similar sentiments are experienced by veterinary plaintiffs. If so, extending the remit of teamwork

to include the animal's owner has the potential to both reduce errors and the fallout in their aftermath.

7.4 Further research

This final section suggests areas for further research that the findings of this study have highlighted.

7.4.1 The development of veterinary checklists

Some veterinary practices are using surgical checklists – mostly adapted versions of the WHO Safe Surgery Checklist. There is currently no research to infer the suitability of this tool, or guide the adaptations which may make it suitable for veterinary practice. There is also no research in the veterinary field regarding successful implementation and auditing of the tool. Such a project would be a valuable addition to the veterinary patient safety literature.

7.4.2 The development of interventions to reduce medical adverse events

Adverse events involving drugs are the second most common type of error in medicine (de Vries et al., 2008). The findings of phase one of this study suggest that errors involving drugs are also a significant problem in veterinary work. Further work to understand the etiology of adverse drug events and develop interventions to mitigate them would be valuable

7.4.3 The role of error in professional mental health and the development of second victim support structures.

Clinicians often feel emotional and mental distress in the aftermath of errors. The potential relationship this has with stress and subsequent mental health in the profession should be explored. The role of gender may also be significant in such a study. In the absence of systems thinking, it is very possible that poor outcomes are viewed as personal failings and this may have a profoundly negative effect on the individual. More research is needed to investigate the effect of error on individuals and develop essential support systems to deal with the potential second victim effects of error in veterinary clinicians.

7.5 Conclusions

Vincent (2016) states that "Twenty-five years ago the field of patient safety, apart from a number of early pioneers, did not exist and the lack of research and attention to medical accidents could reasonably be described as negligent". It may be that this statement is relevant to the veterinary profession today. Clinical audit, quality of care indicators and proactive risk management strategies are rare or non existent. There is virtually no research to inform the profession of where it is at present, or where it should strive to be. In the absence of evidence to the contrary, it is easier, cheaper, more comfortable and more convenient to assume that everything is just fine.

Those who work in the profession however know that this is not always the case. While recognizing the quality, conscientiousness and absolute dedication of the overwhelming majority of the profession, this thesis has demonstrated gaps in knowledge and skills which can have a profound influence on the quality of veterinary care and patient outcomes.

The NVSCS survey and VetTeams training workshop, together with the framework for assessing and learning from error presented in this thesis comprise the basic elements of a quality improvement program for veterinary practice. However there is no quick fix. Patient safety in the profession should be a permanent underpinning strategy rather than a short term goal. Like other high reliability organizations, improvement should be viewed as a cycle of continuous improvement, rather than a succession of 'patient safety projects' such as the implementation of a checklist or reporting system. The concepts of patient safety are interdependent and reliant on one another: improvements rely on data, data relies on reporting which in turn is dependent on a culture of trust and understanding. Such a culture

is defined by its leadership, which is essential to drive change and implement improvements.

The veterinary profession is populated by people who are highly trained, highly skilled and who care passionately about their patients and their clients. This thesis presents evidence and recommendations for improving the systems in which they work to improve their ability to reliably, consistently and safely deliver the care they strive to provide.

Appendices

Appendix 4a

Information Sheet

My name is Catherine Oxtoby. I qualified from Bristol vet school in 2000 and have worked in equine and small animal practice for 13 years. I am currently undertaking a PhD in Patient Safety at the University Of Nottingham

Patient safety and quality of care has been a topic of huge concern and research in the field of human medicine for the past 25 years and yet there is virtually no reference to the subject in the veterinary literature.

The aim of this study is to explore the concept of patient safety in veterinary practice today by increasing our understanding of the causes and types of error. Drawing on my own experience over the past 12 years the fact that errors occur is undeniable. As such I am interested in practitioners' experience of mistakes and errors in practice, their views and opinions of such events. In developing our understanding of the causes of error we hope to be able to reduce the incidence of adverse effects in practice, with potential benefits to the patients, their owners and the practitioners themselves.

This will be a mixed methods study with data collected from in depth interviews, group interviews and surveys of veterinary general practitioners, specialists and nurses, paraprofessionals and owners.

Please be assured, the results of the focus groups will be strictly confidential. I appreciate that this is a potentially sensitive subject and the names of any individuals or organisations will not be made public. A copy of the transcript will be available if requested, as will the results and report on the findings.

Please do not hesitate to contact me if you have any questions, or have anything you wish to discuss.

Catherine Oxtoby BVSc MRCVS

University of Nottingham. SVMS.

Consent form

Title of the study: PhD study in Patient safety in Veterinary Practice

Researchers:

Catherine Oxtoby BVSc MRCVS svxco1@nottingham.ac.uk

Supervisors : Professor Liz Mossop

Professor Kate White

Professor Eamonn Fergusson

Purpose of the study:

The aim of this study is to explore the concept of patient safety in veterinary practice today by increasing our understanding of the incidence, types and causes of error.

We hope to be able to reduce the incidence of adverse effects in practice, by understanding the background and root causes of mistakes, resulting in benefits to the patients, their owners and the practitioners themselves.

This study will use qualitative methods with data collected from semi structured questions in a focus group or interview.

Consent:

This consent form is a formal way of indicating that you agree to participate in this study and that you understand that any information collected by the researchers:

- will be used for a research study
- may be written in a report for publication
- may be presented at research conferences or meetings
- will be anonymised and treated confidentially
- will only be accessed by research colleagues or examiners
- that you can request to see a copy/summary of the completed study
- that you can request to see any information written down/kept during the process of data collection.
- The researchers have explained that any comments you make will be anonymous so that in the final study write up, it will not be possible to identify you

	please tick
I understand that participation in this study is voluntary and that I may leave the study at any time (without needing to provide reasons for doing so)	
I agree that information I give during the study can be used in a report, a published paper or a conference or meeting presentation.	
I understand that the study is being conducted for the purposes of research.	
I understand that I can request to see a summary of the findings, and I can also request to see any notes made during the process of my data collection.	

If you have any queries regarding this study, please speak to the researcher directly or contact them via e-mail or phone (details above).

Please advise us here if you would like to receive a summary of the study results, and indicate how you would like to be contacted

…….

Participant
Name:..... Signature:.....

Researcher
Name:..... Signature:.....

Date:.....

Thank you very much for participating in this study.

Appendix 4b

Causes of veterinary error– Level one and two codes

Level one codes	Level two codes
Cognitive	Absent minded mistake (slip or lapse) Inexperience Over reliance on experience Reliance on long term memory Reliance on working memory Distraction from environmental factors Distraction from colleagues or owners Tunnel vision Diagnosis based on insufficient information Mistake (application of an incorrect plan)
Individual	Stress Personal Problems (fatigue, illness)
Lack of technical ability	Lack of training Lack of competence Lack of technical knowledge Lack of practical ability
Inadequate care / Negligence	
Communication	Failure to listen to a junior colleague Misleading information from owner Failure to confirm a team member had completed a task Misunderstanding due to failed communication (written of verbal) Lack of communication between team members Lack of communication between vet and owner Lack of communication between vet and laboratory Failure to ask for help from colleagues Failure to speak up to a senior member of staff Poor handover communication between staff
Leadership	Lack of governing body regulation Lack of planning Lack of assertiveness with owner or colleague Fear of criticism from colleagues Poor teamwork Lack of clearly allocated roles and team structure

	Lack of supervision and support Lack of team protocols Safety protocols ignored
Design of products	Similar named items Proximity on a shelf / storage Similar looking items Same name, different concentrations (drugs) Layout of the room Unfamiliar computer systems Computer dropdown menus
Productivity	Lack of staffing Time pressure Safety not the primary focus Unfamiliar layout of equipment Practice financial constraints Trying to save money for the client Lack of suitable equipment Lack of 24 hour supervision
Owner factors	Owner refuses or delays treatment for financial reasons Owner non compliance Owner gives misleading information Owner refuses treatment or delays diagnosis for reasons other than financial
Veterinary specific	Animal temperament factors Environmental factors

Appendix 5a

SAQ and HSOPS forms

Safety Attitudes: Frontline Perspectives from this Patient Care Area

I work in the (clinical area or patient care area where you typically spend your time): This is in the Department of: Please complete this survey with respect to your experiences in this clinical area.

- Use number 2 pencil only.
- Erase cleanly any mark you wish to change.

Correct Mark ● Incorrect Marks ✓ ✗ ◒ ⊖

Please answer the following items with respect to your specific unit or clinical area.
Choose your responses using the scale below:

A	B	C	D	E	X
Disagree Strongly	Disagree Slightly	Neutral	Agree Slightly	Agree Strongly	Not Applicable

Not Applicable
Agree Strongly
Agree Slightly
Neutral
Disagree Slightly
Disagree Strongly

1. Nurse input is well received in this clinical area.
2. In this clinical area, it is difficult to speak up if I perceive a problem with patient care.
3. Disagreements in this clinical area are resolved appropriately (i.e., not *who* is right, but *what* is best for the patient).
4. I have the support I need from other personnel to care for patients.
5. It is easy for personnel here to ask questions when there is something that they do not understand.
6. The physicians and nurses here work together as a well-coordinated team.
7. I would feel safe being treated here as a patient.
8. Medical errors are handled appropriately in this clinical area.
9. I know the proper channels to direct questions regarding patient safety in this clinical area.
10. I receive appropriate feedback about my performance.
11. In this clinical area, it is difficult to discuss errors.
12. I am encouraged by my colleagues to report any patient safety concerns I may have.
13. The culture in this clinical area makes it easy to learn from the errors of others.
14. My suggestions about safety would be acted upon if I expressed them to management.
15. I like my job.
16. Working here is like being part of a large family.
17. This is a good place to work.
18. I am proud to work in this clinical area.
19. Morale in this clinical area is high.
20. When my workload becomes excessive, my performance is impaired.
21. I am less effective at work when fatigued.
22. I am more likely to make errors in tense or hostile situations.
23. Fatigue impairs my performance during emergency situations (e.g. emergency resuscitation, seizure).
24. Management supports my daily efforts: Unit Mgt ⊖⊖⊖⊖⊖ Hosp Mgt ⊖⊖⊖⊖⊖
25. Management doesn't knowingly compromise pt safety: Unit Mgt ⊖⊖⊖⊖⊖ Hosp Mgt ⊖⊖⊖⊖⊖
26. Management is doing a good job: Unit Mgt ⊖⊖⊖⊖⊖ Hosp Mgt ⊖⊖⊖⊖⊖
27. Problem personnel are dealt with constructively by our: Unit Mgt ⊖⊖⊖⊖⊖ Hosp Mgt ⊖⊖⊖⊖⊖
28. I get adequate, timely info about events that might affect my work, from: Unit Mgt ⊖⊖⊖⊖⊖ Hosp Mgt ⊖⊖⊖⊖⊖
29. The levels of staffing in this clinical area are sufficient to handle the number of patients.
30. This hospital does a good job of training new personnel.
31. All the necessary information for diagnostic and therapeutic decisions is routinely available to me.
32. Trainees in my discipline are adequately supervised.
33. I experience good collaboration with nurses in this clinical area.
34. I experience good collaboration with staff physicians in this clinical area.
35. I experience good collaboration with pharmacists in this clinical area.
36. Communication breakdowns that lead to delays in delivery of care are common.

BACKGROUND INFORMATION

Have you completed this survey before? ○ Yes ○ No ○ Don't Know Today's Date (month/year):_____

Position: (mark only one)

- ○ Attending/Staff Physician
- ○ Fellow Physician
- ○ Resident Physician
- ○ Physician Assistant/Nurse Practitioner
- ○ Nurse Manager/Charge Nurse
- ○ Registered Nurse
- ○ Pharmacist
- ○ Therapist (RT, PT, OT, Speech)
- ○ Clinical Social Worker
- ○ Dietician/Nutritionist
- ○ Clinical Support (CMA, EMT, Nurses Aide, etc.)
- ○ Technologist/Technician (e.g., Surg., Lab, Rad.)
- ○ Admin Support (Clerk/Secretary/Receptionist)
- ○ Environmental Support (Housekeeper)
- ○ Other Manager (e.g., Clinic Manager)
- ○ Other:_____

Mark your gender: ○ Male ○ Female Primarily ○ Adult ○ Peds ○ Both

Years in specialty: ○ Less than 6 months ○ 6 to 11 mo. ○ 1 to 2 yrs ○ 3 to 4 yrs ○ 5 to 10 yrs ○ 11 to 20 yrs ○ 21 or more

Thank you for completing the survey - your time and participation are greatly appreciated.

PLEASE DO NOT WRITE IN THIS AREA

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Hospital Survey on Patient Safety

Instructions

This survey asks for your opinions about patient safety issues, medical error, and event reporting in your hospital and will take about 10 to 15 minutes to complete.

If you do not wish to answer a question, or if a question does not apply to you, you may leave your answer blank.

- *An "event" is defined as any type of error, mistake, incident, accident, or deviation, regardless of whether or not it results in patient harm.*
- *"Patient safety" is defined as the avoidance and prevention of patient injuries or adverse events resulting from the processes of health care delivery.*

SECTION A: Your Work Area/Unit

In this survey, think of your "unit" as the work area, department, or clinical area of the hospital where you spend *most* of your work time or provide *most* of your clinical services.

What is your primary work area or unit in this hospital? Select ONE answer.

- ☐ a. Many different hospital units/No specific unit
- ☐ b. Medicine (non-surgical)
- ☐ c. Surgery
- ☐ d. Obstetrics
- ☐ e. Pediatrics
- ☐ f. Emergency department
- ☐ g. Intensive care unit (any type)
- ☐ h. Psychiatry/mental health
- ☐ i. Rehabilitation
- ☐ j. Pharmacy
- ☐ k. Laboratory
- ☐ l. Radiology
- ☐ m. Anesthesiology
- ☐ n. Other, please specify: _____

Please indicate your agreement or disagreement with the following statements about your work area/unit.

Think about your hospital work area/unit...	Strongly Disagree ▼	Disagree ▼	Neither ▼	Agree ▼	Strongly Agree ▼
1. People support one another in this unit	☐1	☐2	☐3	☐4	☐5
2. We have enough staff to handle the workload	☐1	☐2	☐3	☐4	☐5
3. When a lot of work needs to be done quickly, we work together as a team to get the work done	☐1	☐2	☐3	☐4	☐5
4. In this unit, people treat each other with respect	☐1	☐2	☐3	☐4	☐5
5. Staff in this unit work longer hours than is best for patient care	☐1	☐2	☐3	☐4	☐5

SECTION A: Your Work Area/Unit (continued)

Think about your hospital work area/unit…	Strongly Disagree ▼	Disagree ▼	Neither ▼	Agree ▼	Strongly Agree ▼
6. We are actively doing things to improve patient safety	☐1	☐2	☐3	☐4	☐5
7. We use more agency/temporary staff than is best for patient care	☐1	☐2	☐3	☐4	☐5
8. Staff feel like their mistakes are held against them	☐1	☐2	☐3	☐4	☐5
9. Mistakes have led to positive changes here	☐1	☐2	☐3	☐4	☐5
10. It is just by chance that more serious mistakes don't happen around here	☐1	☐2	☐3	☐4	☐5
11. When one area in this unit gets really busy, others help out	☐1	☐2	☐3	☐4	☐5
12. When an event is reported, it feels like the person is being written up, not the problem	☐1	☐2	☐3	☐4	☐5
13. After we make changes to improve patient safety, we evaluate their effectiveness	☐1	☐2	☐3	☐4	☐5
14. We work in "crisis mode" trying to do too much, too quickly	☐1	☐2	☐3	☐4	☐5
15. Patient safety is never sacrificed to get more work done	☐1	☐2	☐3	☐4	☐5
16. Staff worry that mistakes they make are kept in their personnel file	☐1	☐2	☐3	☐4	☐5
17. We have patient safety problems in this unit	☐1	☐2	☐3	☐4	☐5
18. Our procedures and systems are good at preventing errors from happening	☐1	☐2	☐3	☐4	☐5

SECTION B: Your Supervisor/Manager

Please indicate your agreement or disagreement with the following statements about your immediate supervisor/manager or person to whom you directly report.

	Strongly Disagree ▼	Disagree ▼	Neither ▼	Agree ▼	Strongly Agree ▼
1. My supervisor/manager says a good word when he/she sees a job done according to established patient safety procedures	☐1	☐2	☐3	☐4	☐5
2. My supervisor/manager seriously considers staff suggestions for improving patient safety	☐1	☐2	☐3	☐4	☐5
3. Whenever pressure builds up, my supervisor/manager wants us to work faster, even if it means taking shortcuts	☐1	☐2	☐3	☐4	☐5
4. My supervisor/manager overlooks patient safety problems that happen over and over	☐1	☐2	☐3	☐4	☐5

SECTION C: Communications

How often do the following things happen in your work area/unit?

Think about your hospital work area/unit…	Never	Rarely	Some-times	Most of the time	Always
1. We are given feedback about changes put into place based on event reports	☐1	☐2	☐3	☐4	☐5
2. Staff will freely speak up if they see something that may negatively affect patient care	☐1	☐2	☐3	☐4	☐5
3. We are informed about errors that happen in this unit	☐1	☐2	☐3	☐4	☐5
4. Staff feel free to question the decisions or actions of those with more authority	☐1	☐2	☐3	☐4	☐5
5. In this unit, we discuss ways to prevent errors from happening again	☐1	☐2	☐3	☐4	☐5
6. Staff are afraid to ask questions when something does not seem right	☐1	☐2	☐3	☐4	☐5

SECTION D: Frequency of Events Reported

In your hospital work area/unit, when the following mistakes happen, *how often are they reported?*

	Never	Rarely	Some-times	Most of the time	Always
1. When a mistake is made, but is *caught and corrected before affecting the patient*, how often is this reported?	☐1	☐2	☐3	☐4	☐5
2. When a mistake is made, but has *no potential to harm the patient*, how often is this reported?	☐1	☐2	☐3	☐4	☐5
3. When a mistake is made that *could harm the patient*, but does not, how often is this reported?	☐1	☐2	☐3	☐4	☐5

SECTION E: Patient Safety Grade

Please give your work area/unit in this hospital an overall grade on patient safety.

☐	☐	☐	☐	☐
A Excellent	B Very Good	C Acceptable	D Poor	E Failing

SECTION F: Your Hospital

Please indicate your agreement or disagreement with the following statements about your hospital.

Think about your hospital…	Strongly Disagree	Disagree	Neither	Agree	Strongly Agree
1. Hospital management provides a work climate that promotes patient safety	☐1	☐2	☐3	☐4	☐5
2. Hospital units do not coordinate well with each other	☐1	☐2	☐3	☐4	☐5
3. Things "fall between the cracks" when transferring patients from one unit to another	☐1	☐2	☐3	☐4	☐5
4. There is good cooperation among hospital units that need to work together	☐1	☐2	☐3	☐4	☐5

SECTION F: Your Hospital (continued)

Think about your hospital...	Strongly Disagree ▼	Disagree ▼	Neither ▼	Agree ▼	Strongly Agree ▼
5. Important patient care information is often lost during shift changes	☐1	☐2	☐3	☐4	☐5
6. It is often unpleasant to work with staff from other hospital units	☐1	☐2	☐3	☐4	☐5
7. Problems often occur in the exchange of information across hospital units	☐1	☐2	☐3	☐4	☐5
8. The actions of hospital management show that patient safety is a top priority	☐1	☐2	☐3	☐4	☐5
9. Hospital management seems interested in patient safety only after an adverse event happens	☐1	☐2	☐3	☐4	☐5
10. Hospital units work well together to provide the best care for patients	☐1	☐2	☐3	☐4	☐5
11. Shift changes are problematic for patients in this hospital	☐1	☐2	☐3	☐4	☐5

SECTION G: Number of Events Reported

In the past 12 months, how many event reports have you filled out and submitted?

- ☐ a. No event reports
- ☐ b. 1 to 2 event reports
- ☐ c. 3 to 5 event reports
- ☐ d. 6 to 10 event reports
- ☐ e. 11 to 20 event reports
- ☐ f. 21 event reports or more

SECTION H: Background Information

This information will help in the analysis of the survey results.

1. How long have you worked in this hospital?

- ☐ a. Less than 1 year
- ☐ b. 1 to 5 years
- ☐ c. 6 to 10 years
- ☐ d. 11 to 15 years
- ☐ e. 16 to 20 years
- ☐ f. 21 years or more

2. How long have you worked in your current hospital work area/unit?

- ☐ a. Less than 1 year
- ☐ b. 1 to 5 years
- ☐ c. 6 to 10 years
- ☐ d. 11 to 15 years
- ☐ e. 16 to 20 years
- ☐ f. 21 years or more

3. Typically, how many hours per week do you work in this hospital?

- ☐ a. Less than 20 hours per week
- ☐ b. 20 to 39 hours per week
- ☐ c. 40 to 59 hours per week
- ☐ d. 60 to 79 hours per week
- ☐ e. 80 to 99 hours per week
- ☐ f. 100 hours per week or more

SECTION H: Background Information (continued)

4. What is your staff position in this hospital? Select ONE answer that best describes your staff position.

- ☐ a. Registered Nurse
- ☐ b. Physician Assistant/Nurse Practitioner
- ☐ c. LVN/LPN
- ☐ d. Patient Care Asst/Hospital Aide/Care Partner
- ☐ e. Attending/Staff Physician
- ☐ f. Resident Physician/Physician in Training
- ☐ g. Pharmacist
- ☐ h. Dietician
- ☐ i. Unit Assistant/Clerk/Secretary
- ☐ j. Respiratory Therapist
- ☐ k. Physical, Occupational, or Speech Therapist
- ☐ l. Technician (e.g., EKG, Lab, Radiology)
- ☐ m. Administration/Management
- ☐ n. Other, please specify:

5. In your staff position, do you typically have direct interaction or contact with patients?

- ☐ a. YES, I typically have direct interaction or contact with patients.
- ☐ b. NO, I typically do NOT have direct interaction or contact with patients.

6. How long have you worked in your current specialty or profession?

- ☐ a. Less than 1 year
- ☐ b. 1 to 5 years
- ☐ c. 6 to 10 years
- ☐ d. 11 to 15 years
- ☐ e. 16 to 20 years
- ☐ f. 21 years or more

SECTION I: Your Comments

Please feel free to write any comments about patient safety, error, or event reporting in your hospital.

THANK YOU FOR COMPLETING THIS SURVEY.

Appendix 5b

Original pool of items, sorted into presumed domains **(*Questions evolved from focus groups)**

Attitude to error / organisational learning
We actively do things to improve patient safety and prevent mistakes
Mistakes have led to positive change here
If we make changes to improve patient safety, we formally evaluate the results
*If I have made a mistake which caused my patients harm in the past, I will never forget and make the same mistake again

Acceptance that it happens / perceptions of PS
I have made errors which have potential to harm patients
I have seen others make errors which have potential to harm patients
It is just by chance that more serious mistakes don't happen here
We have good procedures and systems to prevent errors happening.
Mistakes often happen because someone was being careless
*Errors are inevitable - there's only so much you can do to stop them happening – it doesn't really matter as long as nothing gets seriously hurt
*Patients are biological systems – sometimes things go wrong which is not someone's fault.
*Surgery and anaesthesia are inherently risky procedures – sometimes things go wrong.
*Reminding people to take care will help stop mistakes from happening
* I would feel happy and confident that my animal was safe when being treated in this practice

Consequences / non-punitive response to error
Staff feel that their mistakes are held against them
*If I make a mistake I worry that I will get into trouble with my boss / the RCVS / be sued
*I feel guilty and ashamed if I make a mistake
*I learn from my mistakes
*The RCVS punishes vets who make mistakes

Event reporting and discussion
It is difficult to discuss errors in this practice.
I am encouraged by my colleagues to discuss any errors that are made
If an event is reported people feel that their errors are being recorded rather than the problem itself
If a mistake is made but is caught and corrected before it reaches the patient, how often is this reported?
How many reports have you made using this system in the last 12 months?
* I would welcome a formal reporting system for mistakes if it was anonymous and made a difference – ie helped prevent mistakes from happening.
*I am unlikely to admit a mistake has been made to a client if I can get away with it so long as it does not further harm my patient
*There is a formal system in place in this practice for reporting errors
*Do you feel such a reporting system makes any difference to the way your practice works?
*So long as it makes no difference to my patient, I often do not discuss an error with an owner as I feel it is in no one's best interests and will only cause trouble

Teamwork

Inter team – Think about the branch where you work and the team of people you work with most of the time.

People support one another in this practice
When a lot of work needs to be done quickly we work together as a team to get the work done
In this practice people treat each other with respect
Practice administration supports my daily efforts
This practice is a good place to work
This practice deals constructively with problem employees
I have the support I need from other personnel to care for my patients
During emergencies I can predict what other personnel are going to do next
Morale is high in this practice
Nurse input is well received in this practice
There is good cooperation between units that need to work together (eg between reception and clinical staff)
All the personnel here take responsibility for patient safety
I know the first and last names of everyone I worked with on my last shift
Medical equipment here is adequate
Working in this practice is like being part of a big family

Intra team – Think about how your branch works with other work units – eg other branches, practices or external laboratories

Branches of this practice do not coordinate well with one another
Things fall between the cracks when transferring patients from one branch to another, or between this practice and an ooh provider
*The vets and nurses here work well together as part of a coordinated team
*It is easier working with people I know because I am used to how they work
*I can often predict what my colleagues will do in most situations
*It is often unpleasant to work with staff from other branches

Communication

Hierarchy and speaking up
Staff will speak up freely if they see something that may negatively affect patient care
Staff feel free to question the decisions or actions of those with more authority
Staff are afraid to ask questions when something does not seem quite right
It is difficult to speak up if I perceive a problem with patient care during a procedure
It is easy for personnel here to ask questions if there is something they do not understand.
I am frequently unable to voice disagreement with other members of staff

Formal communication

Important information is often lost at shift change or patient transfer
I know the proper channels to direct questions related to patient safety in this practice
Important issues are communicated at shift change
Communication breakdowns which lead to errors are common
Shift changes are problematic for patients at this practice
Information is often lost at handover between part time workers in this practice
Briefing all personnel involved in a procedure (eg an operation) is important for patient safety
Briefings are common in this practice
*Problems often occur in information exchange between practice branches or between this practice and the OOH service provider

*I don't need lots of formal communications with my colleagues because we work together all the time

Feedback from management
We are given feedback about changes put into place as a result of errors and mistakes
We are informed about errors that happen in this practice / group of practices
I receive appropriate feedback about my performance
I am provided with adequate timely information about events in the practice that might affect my work

Leadership
Perception of immediate bosses regard of safety - think about the boss of your clinical team
Trainee vets and nurses are adequately supervised at all times
I am sometimes intimidated by another member of my team
When pressure builds up my boss wants us to work faster, even if it means taking shortcuts
My senior colleagues / boss overlook patient safety problems that happen over and over
Disagreements in this practice are resolved appropriately – eg not who is right but what is best for the patient
Personnel frequently 'work around' or disregard established practice protocols or treatment guidelines
I respect my boss
I am scared of my boss
This practice does a good job at training new personnel
I receive appropriate feedback about my performance
Think about the organisation and its values: perceptions of senior management
The organisation provides clinical guidelines and evidence based practice protocols which enhance patient safety
The boss / management seems to care much more about patient safety after something has gone wrong
The actions of practice management / bosses show that patient safety is a top priority
The management / administration in this practice do a good job
My senior colleagues / boss says a good word when he/she sees a job done to established practice protocols
My senior colleagues/ boss seriously considers staff suggestions for improving patient safety
Practice management / bosses provide a work culture that promotes patient safety
*The veterinary surgeon should be formally in charge of staff during every procedure
*My role and responsibilities are clearly defined at every stage of a procedure…..
*If I am doing an unfamiliar procedure (non-emergency) I always plan what I want to do beforehand

Leadership of owners
*It is important to make sure an owner to has confidence in my ability
*It is important to maintain a confident professional air to an owner at all times
*I sometimes feel under pressure from owners to go against my clinical judgement

Safety vs productivity
High levels of workload are common in this practice
The level of staffing in this practice is sufficient to handle the number of patients
Staff work longer hours than is good for patient care
I feel I am working too hard at my job
Patient safety is never sacrificed to get more work done
We use too many temporary staff than is best for patient care in this practice

We use too many part time staff than is best for patient safety in this practice
We often work in crisis mode trying to get too much done too quickly
The pressure of keeping busy is more important than making sure patient safety is always a top priority

Personal attributes / risk perception? / personal resources - stress
Fatigue impairs my performance even during emergency situations
When my workload becomes excessive my performance is impaired
I am less effective at work when I am fatigued
I am more likely to make errors in tense or hostile situations
Stress from personal problems adversely affects my performance
I feel fatigued when I get up in the morning and have to face another day at work
I feel burned out by my work
I feel frustrated by my job
*I always come to work intending to do my best for my patients and clients
*People who are meticulous and measured are less likely to make mistakes
*I dislike having standard operating procedures (SOPs) for clinical scenarios
*I do not use SOPs
*I do not know if my practice has SOPs for clinical scenarios
*I like to make my own decisions about my treatment of clinical cases
*I am too busy to fill in more paperwork like checklists
*Experienced vets do not need surgical checklists as much as younger vets
*Surgical checklists are a good idea for younger vets
*More experienced vets are more likely to cut corners than young vets
*I never come to work feeling that I don't care if I make a mistake today
*More experienced vets are sometimes less meticulous / careful/ a bit slack….
*A truly professional person can leave their personal problems behind when working

Interesting statements from discussions….but no obvious fit in any domain…
*I like my job
*This practice is a good place to work
*I am proud to work at this practice
*Confident people make better surgeons
*Women can be as technically competent as men but don't make as good surgeons as men
*Female vets don't handle stress as well as male vets

*Total N=47
Total N=134

Appendix 5c

Original pool of demographic items

How long have you worked at this practice?

<1y, 1-5,6-10,11-15,16-20, 21y or more

What is your current job title?

Intern, assistant, senior assistant, clinical director, salried partner, partner / owner, trainee nurse, qualified nurse, head nirse, care assistant, other

How many years have you been qualified or training?

<6m, 6-12m, 1-2y, 3-4y, 5-10y, 11-20y, 21+y

What is your current work pattern?

FT / PT

Are you male or female?

M / F

Please provide the postcode of the practice where you currently work. (This is used to group together results from the same practice, NOT to identify individuals)

Free entry box

What is your age?

16-20,21-30,31-40,41-50,51-60,61-70

What is your ethnic group?

White, mixed multiple ethnic groups, Asian / Asian British, black/African/Caribbean/black British, other ethnic group

What best describes your normal working hours?

Days and evenings with OOH, Days and evenings with no OOH, nights / emergency work, other

Which of the following best describes the type of practice where you work?

Mixed, small animal, equine, farm animal, referral, other

Appendix 5d

Original pilot version of the NVSCS

Thank you for completing this questionnaire

My name is Catherine Oxtoby, I am a second year PhD student at Nottingham University School of Veterinary Medicine and Science investigating medical error in veterinary practice. This survey is designed to explore your attitudes and beliefs regarding mistakes made by vets and nurses which result in patient harm.

There are no right or wrong answers - we are interested in your opinions. For the purpose of the questionnaire, patient safety refers to the safety of the animal and an error or mistake refers to an action which results in some degree of patient harm.

The questionnaire is ABSOLUTELY CONFIDENTIAL. Information identifying the respondent will not be disclosed under any circumstances. It should take 1015 minutes to complete.

Participation is entirely voluntary and there is no obligation to take part. The study has been approved by Nottingham University School of Veterinary Medicine and Science's ethics committee.

By completing this questionnaire you agree that the information collected :

WILL BE TREATED CONFIDENTIALLY

will be used for a research study and only accessed by research colleagues and examiners

may be written in a report for publication

may be presented at research conferences or meetings

You can request to see a copy or summary of the completed study and see any information kept during the process of the study. Any further information can be obtained by contacting Catherine Oxtoby

Thank you again for your time.

Catherine Oxtoby,

2nd year PhD student,(svxco1@nottingham.ac.uk)

Project supervisors:

Dr Liz Mossop, Associate professor of Veterinary Education, University of Nottingham SVMS

Professor Eamonn Ferguson, Professor of Health Psychology

Mrs Kate White, Associate Professor in Veterinary Anaesthesia

SECTION A : OPINIONS ABOUT ERROR

1. I feel guilty if I make a mistake

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

2. Mistakes do not really matter as long as no patient gets seriously hurt

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

3. I have made errors which have harmed patients

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

4. The vet doing the procedure is always ultimately responsible for the safe treatment of the animal

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

5. Mistakes have happened in the past because I forgot to check everything properly

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

6. I do not forget the mistakes I have made, and this stops me making the same mistake again

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

7. We have procedures and systems in place to prevent errors happening in this practice

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

8. Mistakes have led to positive change at this practice

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

9. It is difficult to discuss errors in this practice

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

10. If we make a mistake my boss just sweeps it under the carpet and does not address it unless he/she is forced to

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree
- I am the boss!

11. We normally discuss our mistakes informally amongst the team

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

12. If I make a mistake I worry I will get into trouble with my boss

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

I am the boss!

13. If I make a mistake I worry that the owner will report me to the Royal College of Veterinary Surgeons

0 Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

14. The Royal College of Veterinary Surgeons punishes vets and nurses who make mistakes

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

15. I feel my boss supports me if I make a mistake at this practice

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

I am the boss!

16. I always feel able to question the decisions or actions of someone with more authority

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

17. I would always speak up if I perceived a problem with patient safety during a procedure

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

18. It is easy for personnel here to ask questions if there is something they do not understand

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

19. The veterinary surgeon should always be in charge of the team during a procedure

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

20. I am sometimes intimidated by another member of my team

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

21. High levels of workload are common in this practice

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

22. The level of staffing in this practice is always sufficient to handle the number of patients

0 Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

23. Patient safety is never compromised to get more work done

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

24. We use too many locum staff than is good for patient safety in this practice

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

25. We use too many part time staff than is good for patient safety in this practice

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

26. When my workload becomes excessive my performance is impaired

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

27. I am less effective at work when I am fatigued

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

28. I am more likely to make errors in tense or hostile situations

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

29. A truly professional person can leave personal problems behind when they are at work

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

30. I sometimes feel 'burned out' by my work

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

31. People who are careful and measured are less likely to make mistakes

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

32. I am too busy to fill in paperwork like anaesthetic and surgical checklists

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

33. Checklists would be more useful for younger vets and nurses than more experienced clinicians

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

34. Female vets seem to get more stressed than male vets

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

35. You have to be very confident in yourself to be a good surgeon

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

SECTION B: YOUR WORK AREA / UNIT

Think about the unit where you work and the team of people you work with most of the time, including vets, nurses and support staff

Please indicate your agreement or disagreement with the following statements about your work area/unit.

36. I have the support I need from other personnel to care for my patients to the best of my ability

- ❍ Strongly Disagree
- ❍ Disagree
- ❍ Neither
- ❍ Agree
- ❍ Strongly Agree

37. Nurse input is well received in this practice

- ❍ Strongly Disagree
- ❍ Disagree
- ❍ Neither
- ❍ Agree
- ❍ Strongly Agree

38. It is easier working with people I know because I am used to how they do things

- ❍ Strongly Disagree
- ❍ Disagree
- ❍ Neither
- ❍ Agree
- ❍ Strongly Agree

39. In this unit, people treat each other with respect.

- ❍ Strongly Disagree
- ❍ Disagree
- ❍ Neither
- ❍ Agree
- ❍ Strongly Agree

40. We often share roles in the prep room to help each other out, especially when it is busy.

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

41. This practice is a good place to work

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

42. At present, there is good cooperation between reception and clinical staff

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

43. At present, there is good cooperation between vets and nurses

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

44. Important information is often lost at shift change or patient transfer

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

45. Communication breakdowns which lead to errors or confusion are common

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

46. Because we work together all the time, standardised communication methods are less necessary in this practice

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

47. Information is sometimes lost at handover between part time workers at this practice

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

48. Inexperienced vets and nurses are adequately supervised and supported even at busy times

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

49. I am always clear about my roles and responsibilities at every stage of a procedure

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

50. When we are really busy we try to work faster, even if it means taking shortcuts

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

51. I respect my boss

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

I am the boss!

52. I am scared of my boss

Strongly Disagree

Disagree

Neither

Agree

Strongly Agree

I am the boss!

SECTION C: YOUR COMPANY / ORGANISATION

Think about the company and its values, rather than your immediate boss and the unit where you work.

53. The management often don't know about mistakes that we make

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

54. The management seem to care much more about patient safety after something has gone wrong

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

55. The management feels that patient safety is more important than keeping busy

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

56. We are given formal feedback about errors which happen in this practice / group of practices

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

57. The management regularly discuss the results of clinical audit with the team in this practice

- Strongly Disagree
- Disagree
- Neither
- Agree
- Strongly Agree

SECTION D: Your Comments

58. Please feel free to write any comments about patient safety, error, or event reporting in your practice.

SECTION E: Background Information

This information will help in the analysis of the survey results. It will not be used to identify individuals.

59. How long have you worked in this practice?

- ❍ Less than 1 year
- ❍ 1 to 5 years
- ❍ 6 to 10 years
- ❍ 11 to 15 years
- ❍ 16 to 20 years
- ❍ 21 years or more

60. What is your current job title?

- O Intern
- O Assistant
- O Senior Assistant
- O Clinical Director
- O Salaried Partner
- O Partner/Owner
- O Trainee Nurse
- O Qualified Nurse
- O Head Nurse
- O Care Assistant
- 0 Other

61. How many years have you been qualified or training?

- ❍ Less than 6 months
- ❍ 6 months - 12 months
- ❍ 12 years
- ❍ 34 years
- ❍ 510 years
- ❍ 1120 years
- ❍ 21+ years

62. What is your current work pattern

- ❍ Full time
- ❍ Part time

63. Are you male or female?

- ❍ Male
- ❍ Female

64. What is your age?

- 0 1620
- 0 2130
- 0 3140
- 0 4150
- 0 5160
- 0 6170

65. What is your ethnic group?

- White
- Mixed/Multiple ethnic groups
- Asian/Asian British
- Black/African/Caribbean/Black British
- Other ethnic group

66. What best describes your normal working hours?

- Days and evenings with out of hours
- Days and evenings with no out of hours
- Nights / emergency work only
- Other

67. Which of the following best describes the type of practice where you work?

- 0 Mixed
- 0 Small animal
- O Equine
- 0 Farm animal
- 0 Referral
- 0 Other

68. Please provide the postcode of the practice where you currently work (This is used to group together results from the same practice, NOT to identify individuals)

Appendix 5e

Information sheet for survey participants

Dear colleague,

Please find below a link to a survey investigating patient safety in veterinary practices. It is part of a PhD project supervised by Nottingham University School of Veterinary Medicine and Science, investigating medical error in the profession.

Patient safety is a recognised problem in human medicine. 1 in 10 visits to hospital result in a mistake and an estimated 98000 people a year die as a result of doctor's or nurse's errors. Research in medicine and other safety critical industries recognises that poor communication, human factors limitations and problems within the organisation's systems contribute to mistakes. Clinical leadership, reporting and safety cultures are important factors in their prevention. There is no research on this subject specific to the veterinary profession.

This survey asks questions relating to the above issues, in order to explore the safety culture - or 'the way we do things round here' in veterinary practices. It is relevant for any clinical member of staff and the results can be used to target training and resources, measure improvement and guide the development of clinical quality and safety programmes which will contribute to gold standards of care.

www.surveymonkey.com/r/VetSCS

Thank you for your time and help.

If you have any questions please contact Catherine Oxtoby BVSc MRCVS
svxco1@nottingham.ac.uk

Appendix 5f

Pattern matrix for three and five factor safety culture models

Three factors, 29 items. Values <0.25 suppressed

Pattern Matrix

	Component		
	1	2	3
given formal feedback of errors	.617		
positive change	.566		-.329
management discusses clinical audit	.568		
procedures and systems in place	.580		
boss sweeps it under the carpet	.631	-.251	
difficult to discuss errors	.599		
discuss mistakes informally	.389		-.381
inexperienced well supervised	.528		
I am scared of my boss		-.781	
worry re trouble with the boss		-.756	
able to question one with more authority		-.651	
boss supports me	.377	-.565	
intimidated by other team member		-.631	.273
I respect my boss	.462	-.407	
always speak up		-.496	
level of staffing sufficient		-.338	.347
ex workload impairs performance			.673
less effective when fatigued			.641
PS never compromised	.281		.418
info lost at shift change / handover	.462		.424
info lost at handover between part timers	.286		.368
good co-op vets and nurses	.559		
good co-op reception and clinical	.495		
people treat each other with respect	.589		
nurse input well received	.639		
good place to work	.667		
support from other personnel	.561		
comm breakdowns common	.538		
easy to ask questions	.519		
management feels PS more imp than busy	.434		

Five factors, 29 items (Values <0.25 suppressed)

Pattern Matrix

	Component				
	1	2	3	4	5
given formal feedback of errors				.754	
positive change				.703	
management discusses clinical audit				.627	
procedures and systems in place				.637	
boss sweeps it under the carpet				.541	
difficult to discuss errors	.253			.442	
discuss mistakes informally			-.392	.372	
inexperienced well supervised				.337	.492
I am scared of my boss		-.827			
worry re trouble with the boss		-.807			
able to question one with more authority		-.640			
boss supports me		-.581			
intimidated by other team member		-.638			
I respect my boss	.340	-.434			
always speak up		-.423		.309	
level of staffing sufficient		-.425			.362
ex workload impairs performance			.803		
less effective when fatigued			.803		
PS never compromised			.294		.411
info lost at shift change / handover					.780
info lost at handover between part timers					.684
good co-op vets and nurses	.852				
good co-op reception and clinical	.658				
people treat each other with respect	.732				
nurse input well received	.743				
good place to work	.662				
support from other personnel	.498				
comm breakdowns common					.636
easy to ask questions	.396			.263	
management feels PS more imp than busy	.258				

Appendix 6a

VetTeams clinical scenario

It is 5.00 pm, and a whelping bitch has just been admitted during evening consultations for c section. The owner is well known to the practice. She's demanding and emotional, and the dog is a valuable breeding bitch, but also beloved family pet. The dog is distressed and panting with a green lochia discharge. The vet 'out the back' is about to go home. She is 1 year qualified, so generally considers herself competent and confident, but she has never done a c section before. She was on call last night and has had a busy day, so she is tired, hungry and now very fed up that she will be late to leave. However, everyone else is fully booked consulting and the vet on call doesn't take over till 6.30pm so she has no option. **HALT** . **Lack of self awareness, under stress which will reduce her ability to perform . Her colleagues are probably similar**.

She finds a senior nurse to help her, starts iv fluids and gives pre op analgesia with a dose of metacam. The admit form and paperwork is still in reception with the client so she asks the nurse to write it down somewhere, knocks the dog out leaving the nurse to monitor the GA, prep and scrub the dog, and goes to scrub herself. **Somewhere – not specific, not closed loop. Lack of system and poor HF – relies on short term memory in a stressed and busy environment.**

The senior nurse calls a junior nurse to take over the GA, while she clips, scrubs and shouts at people generally to get towels and hotties ready for the puppies. **Nurse also tired and hungry. Selects the nearest available person not necessarily the best one for the job**. The junior nurse doing the GA is worried. She hasn't done many emergency GAs before and is a bit overwhelmed but she feels she should be able to cope and doesn't want to ask her boss for help in case she loses face or gets snapped at. **Fear of criticism from colleagues. Not asking for help**. But the dog has had no routine pre-med and the anaesthetic is not smooth. There are lots of people running about and the atmosphere is busy and a bit stressed. **No one offers to help – all just doing their thing and not monitoring each other or noticing her stress. Poor supervision of inexperienced**.

The vet is ready, **No communication with the nurse re status of patient,** so they move the dog to theatre which further upsets the anaesthetic. Again the nurse feels under pressure to just get on with it, even though she'd like to say wait and let the dog settle. **Not speaking up to superiors** Instead she looks to see if it has had any analgesia. There is nothing marked on the forms which have found their way through from reception, so she asks generally, whether she should give some pain relief. The vet is concentrating on sorting her kit and doesn't hear, **HF** the nurse is busy setting up and forgets that metacam was given earlier **HF**. She had not written it down immediately as the correct paperwork was not with the dog but she intended to fill it in later. **Nurse normally gives the analgesia with a routine pre med.** She replies with a general yes , so the junior nurse administers a second shot of metacam.

The C section not straightforward. The bitch is overweight, and the uterus is bruised and friable, oozes blood when touched, and tears when first puppy is brought out. The vet is worried about blood loss and gets stressed. She goes v quiet, concentrating on what she's trying to do. **Effects of stress -> decreases communication, loses sit awareness and narrows focus** She soon gets frustrated, as she is pulling out puppies faster than there are spare people there to take them from

her. **Lack of shared mental model – the team is now reactive rather than proactive. No time to assign roles**. The senior nurse starts calling for help from the kennel nurse, vet student and schoolie (who has no concept of sterile technique). **People are used to being pigeon holed in their tasks eg 'the kennel nurse' and don't offer help as they don't see it as 'their' job.** The vet gets snappy and asks 'someone' to go get the boss to help her. **Who is the busiest person in the room?**

The boss comes in five minutes later (He was doing a PTS on a bonded clients dog so couldn't just walk out) by which time the nurses are worried, as the puppies are not responding well. The senior nurse sends a junior nurse to get the crash box, but she doesn't know where it is as its hardly ever used and has to be told**. Lack of mental model and resource allocation** The boss looks in the abdomen, takes in the number of people in the room and decides there are more than enough pairs of hands present. He tells the assistant she needs to spay the dog as the uterus is so discoloured and friable but that she'd better let the owner know. **Failure of senior leadership to gather information and support staff. No attempt to gain situational awareness**. Then he goes back to his fully booked evening surgery, stressed because he is now running really late. **Communication and Role allocation Reception is totally out of the loop so has no idea about what's unfolding and keeps booking in clients and doesn't explain to existing ones why there is a delay**. The assistant de-scrubs, phones the owner, rescrubs after a difficult conversation and proceeds to spay the dog successfully.

Everyone relaxes as she starts to close the abdomen. The dog's colour is good though she takes a long time to come round as she is very cold as she is soaked from the fluids used to flush the abdomen. The puppies are slow but alive. The anaesthetic nurse is filling in the form for kennels and asks the vet when to start oral metacam as 'she had a shot when she was asleep'. Only then does the vet realise that there has been a drug overdose. She is angry with the nurses for not checking with her or making sure it was written down when she specifically asked for it to be. She knows the owner will not be understanding**. Blame culture and poor response to an honest mistake**

The bitch goes home late that night with her puppies at the insistence of the owner who is experienced in caring for dogs who've had c sections. She comes in for a post op check 2 days later, but is dull and depressed with abdominal pain and a temperature of 103.8. X rays reveal the swab left behind in the abdomen…..

Appendix 6b

Information sheet for participants, survey 1.



VETERINARY SAFETY CULTURE SURVEY

https://www.surveymonkey.co.uk/r/VetSCS2

Thank you for agreeing to fill in this survey and helping with this research project.

My name is Catherine Oxtoby – I am a practicing vet and a third year PhD student at Nottingham Veterinary School. The aim of the PhD is to investigate the causes of error in veterinary medicine and develop 'tools' to reduce mistakes in practice.

This survey has been developed from similar questionnaires used routinely in human hospitals, which ask questions about the beliefs and attitudes of staff regarding patient safety. This includes views on practice management, teamwork and communication and the causes of mistakes.

The survey is almost ready for use in practices, where I hope it will help identify areas for training, and development of better working systems to increase quality of care. As part of its development, I need to assess how answers to the questions change over time. You have been asked to fill in the survey now, and will be sent it again in 6-8 weeks. It should take you less than five minutes – don't overthink it!

The survey is **completely confidential**. Some of the questions are potentially sensitive, but there are no questions which ask for your identity as it is important you feel able to answer as honestly as possible. At the end of the survey you are asked to enter an identifying code. This is so I can match the 1st and 2nd surveys for comparison without needing to know your name or any other identifying details. To do this write the last 2 digits of the year you were born, the house number of your parents and first 2 letters of that parents street name. So, for example, my unique code would be 761CH.

Your participation in this is very much appreciated. I know how busy life in practice is and really value your help and input.

If you have any questions, please get in touch : svxco1@nottingham.ac.uk

Catherine Oxtoby BVSc MRCVS

Appendix 6c

Information for participants in the VetTeams workshop

TEAMWORK TRAINING WORKSHOP

Thank you for agreeing to participate in this workshop. It is the final part of a PhD run through Nottingham Veterinary School, investigating the causes of error in veterinary medicine and developing 'tools' to reduce mistakes in practice.

Poor teamwork – specifically failures in communication between healthcare professionals and clinical leadership, have been a significant finding of the study so far. Similar problems have been identified in medicine and are recognised as leading causes of error. Training for healthcare teams is now an important part of medical education, but there is little available in our profession.

The aim of this workshop is to discuss the importance of teamwork in relation to patient safety and quality of care, and develop behaviours which promote good team working.

By the end of the session, you should be able to:

Identify and describe the key components of teamwork *and its relevance* to patient safety
Identify behaviours which facilitate good teamwork
Use specific tools to promote behaviours relating to teamwork
Identify the barriers to teamwork

The workshop is designed to be informal and very interactive – it is not a lecture! As such please come prepared to get involved . We will be discussing the issues as a group. Everyone's opinion is important and very welcome.

A few weeks before the workshop you will be asked to complete the Veterinary Safety Culture Survey. It should take you less than five minutes – don't overthink it! The survey has been developed as part of the PhD project, from similar questionnaires routinely used in medical hospitals. It is used to assess attitudes to aspects of patient safety and highlight areas for training and improvement. You will be given the survey to fill in again, 8 weeks after the workshop. This second survey is important for two reasons – to assess the impact of the training workshop, and to allow me to further validate the survey as a tool which can then be used across the profession.

Your participation in this is very much appreciated. I know how busy life in practice is and really value your help and input. I hope you find it useful and a little bit different to normal CPD…

If you have any questions before the session please get in touch : svxco1@nottingham.ac.uk

Catherine Oxtoby BVSc MRCVS

Appendix 6d

Student evaluation form

1. How would you rate the workshop overall?

Very enjoyable	***6***	***5***	***4***	***3***	***2***	***1***	***Not enjoyable***
Very interesting	***6***	***5***	***4***	***3***	***2***	***1***	***Of little interest***
Very useful	***6***	***5***	***4***	***3***	***2***	***1***	***Little use***

2. To what extent has your understanding of veterinary teamwork improved or increased as a result of the workshop?

A lot	***6***	***5***	***4***	***3***	***2***	***1***	***Little***

3. To what extent do you think your skills in veterinary teamwork improved or increased as a result of the workshop?

A lot	***6***	***5***	***4***	***3***	***2***	***1***	***Little***

4. Do you expect to be able to use the knowledge and skills you have learnt in this workshop in your job

Definitely	***6***	***5***	***4***	***3***	***2***	***1***	***Not at all***

5. To what extent would you recommend others to attend this workshop?

Fully	***6***	***5***	***4***	***3***	***2***	***1***	***Not at all***

Appendix 6e

Information for participants, survey 2.

VETERINARY SAFETY CULTURE SURVEY

https://www.surveymonkey.co.uk/r/VetSCS2

ROUND TWO (then I'll leave you alone!)

Deadline WEDNESDAY June 29th

Remember the safety culture survey you filled in 6 weeks ago as part of a PhD project from Nottingham University Veterinary School?

Please please please can you take 5 minutes to repeat the survey now – copy and paste the above link to your browser or control and click over the link. This second run is extremely important for the project. We are looking at how the survey results change over time, so need the second survey to compare with the first.

Please don't forget to enter your ID code in the last question so we can pair your surveys together. (The last 2 digits of the year you were born, the house number of your parents and first 2 letters of that parent's street name. So, for example, my unique code would be 761CH.)

The results will help us understand how to improve the delivery of quality care to patients and help reduce the chances of vets and nurses making mistakes.

It takes 5 minutes to complete.

It is completely confidential.

This is the last time you will be asked to fill it in!

Your help is really appreciated. The views of busy practitioners on the front lines which reflect the realities of veterinary work are vital to the success of the study, so THANK YOU so much for your help.

If you have any questions, please get in touch : svxco1@nottingham.ac.uk

Appendix 6f

Split plot ANOVA results excluding the data from the self selected Hospital G.

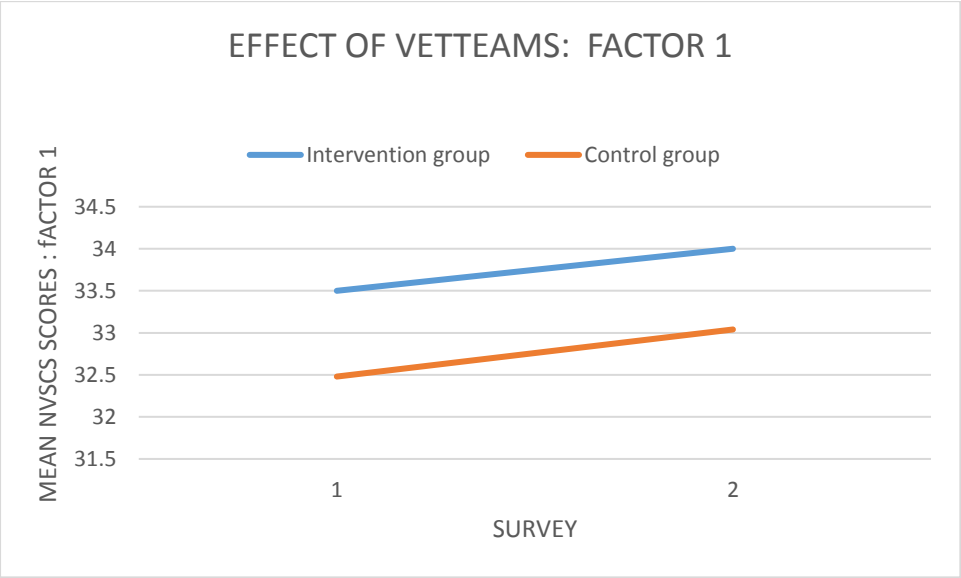
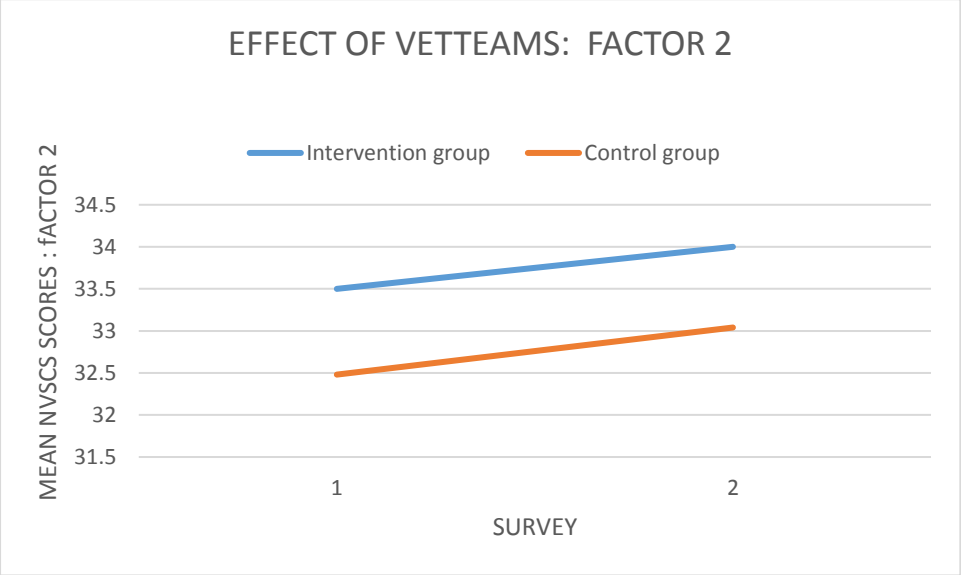


Figure 6f.1: the effect of vet teams on mean NVSCS scores : Factor 1

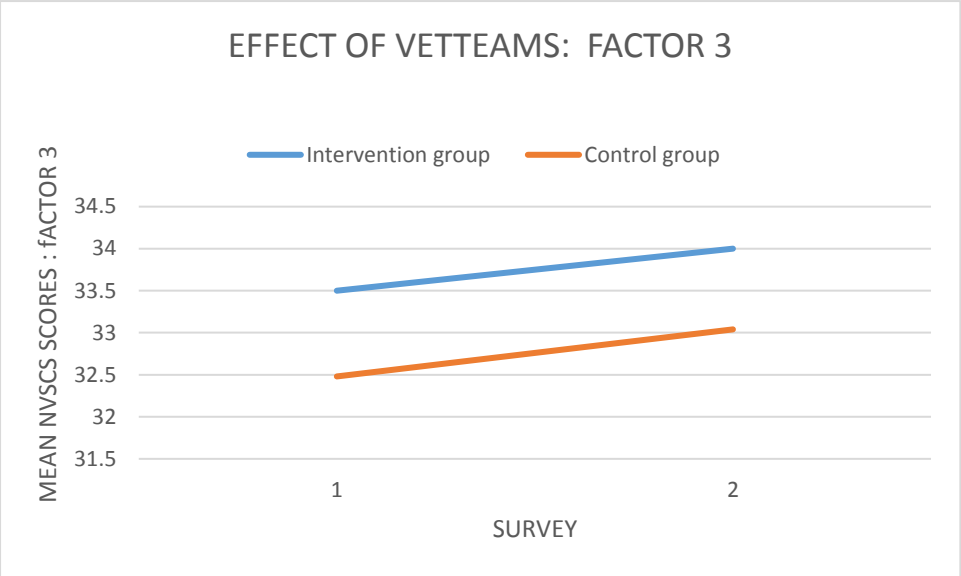
Non significant effect of group on staff perceptions of organizational safety systems and behavior (Factor 1)

F(1,29) = 0.00. p=0.96



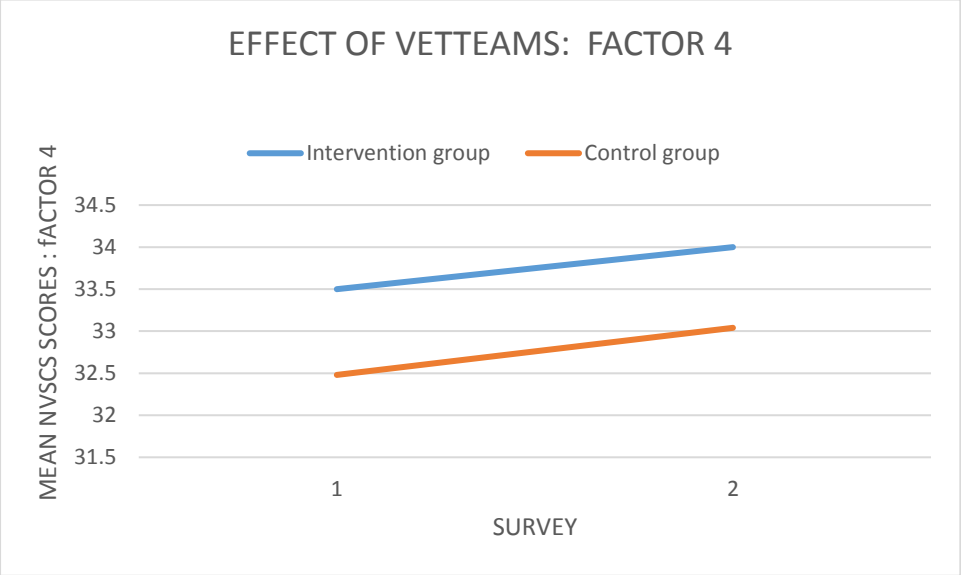
Non significant effect of group on staff perceptions of management (Factor 2)

F(1,28) = 0.097. p=0.758



Non significant effect of group on risk perceptions (Factor 3)

F(1,29) = 3.77. p=0.062



Non significant effect of group on staff perceptions of teamwork and communication (Factor 4)

F(1,29) = 0.001. p=0.973

Appendix 7a

Hospital 1 Safety Culture Survey Report. 3rd March 2016

There were 29 responses and the survey generally demonstrated a very positive safety culture.

Points to note:

Organisational safety systems

~18% disagreed with the statement 'we receive formal feedback about errors' and ~ 60% agreed that errors are discussed informally amongst the team. While this latter statement is encouraging in that it suggests a level of mutual trust and support within the clinical team, it has implications for organisational learning. Such discussions are a valuable source of feedback for an organisation and this suggests a lack of either a formal or effective reporting systems in the hospital. Such a system is a rich source of data which can inform improvements and is a valuable tool to enable learning from mistakes which may occur.

Perception of seniors / management

Generally this was very positive. 90% of respondents agree with the statement 'I respect my boss', no one agrees with the statement ' I am scared of my boss' and no one disagrees with ' I feel my boss supports me'.

However, 35% disagree that they 'feel able to question someone with more authority' and 25% agree that they feel intimidated by another staff member. While the vast majority (92%) agree that they would 'always speak up if they had a concern about patient safety', this statement is undermined by the previous findings. The effects of hierarchy can have negative impacts on patient safety and staff should be reassured and empowered to speak up regardless of rank. Tools such as assertive statements, a two challenge rule and CUS (I'm concerned, I'm uncomfortable, Stop!) can help support people who feel less able to speak up as they are agreed upon by the team before a conflict occurs and are recognised as efforts to protect the patient rather than a personal disagreement.

Risk Factors

14-18% agree with the statements that information is lost at shift changeover and between part time workers. This suggests that looking at the hospital's communication and handover systems or protocols could be beneficial. Handoff is a major source of error and there are tools available to improve the quality and structure of handovers.

46% disagree with the statement that Patient Safety is never compromised to get more work done and this is reflected in some of the statements which suggest that staffing levels are often tight and can not always cope with the level of work. This can reflect badly on more senior levels of management within the organisation, as it may cause front line workers to question the management's commitment to safety, if they feel it is not an organisational priority.

Teamwork

Again, this was generally extremely positive. 92% agreed that nurse input was well received, and that vets and nurses cooperate (this was answered similarly by both vets and nurses). 76% agree that relationships with reception are good and 74% that people treat each other with respect. 89% agree that it is a good place to work.

30% agree that 'communication breakdowns are common' which reflects the previous findings and again suggests that the practice communication *systems* could be reviewed as the levels of cooperation and trust within the team appear to be high.

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