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Safety Culture: The Nottingham Veterinary Safety Culture Survey (NVSCS).

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Abstract

Safety culture is a vital concept in human healthcare because of its influence on staff behaviours in relation to patient safety. Understanding safety culture is essential to ensure the acceptance and sustainability of changes, such as the introduction of safe surgery checklists. While widely studied and assessed in human medicine there is no tool for its assessment in veterinary medicine. This paper therefore presents initial data on such an assessment: The Nottingham Veterinary Safety Culture Survey (NVSCS). 350 pilot surveys were distributed to practicing vets and nurses. The survey was also available online. 229 surveys were returned (65% response rate) and 183 completed online, resulting in 412 surveys for analysis. Four domains were identified: 1) Organisational Safety Systems and Behaviours, 2) Staff Perceptions of Management, 3) Risk Perceptions and 4) Teamwork and Communication. Initial indications of the reliability and the validity of the final survey are presented. Although early in development, the resulting 29 item NVSCS is presented as a tool for measuring safety culture in veterinary practices with implications for benchmarking, safety culture assessment and teamwork training.

Introduction

Since seminal studies in medicine identified the scale and impact of medical error, the medical profession has sought to reduce its effects through an understanding of its causation (Brennan et al., 1991). Recent studies in the veterinary literature have identified causes and types of errors in veterinary practice which mirror those in healthcare (Oxtoby et al., 2015a, Kinnison et al., 2015b). Numerous medical reports have identified safety culture as an important tool for reducing errors, due to its far reaching influence on staff behaviours and the 'improvement' of safety culture is now a key strategy to improve outcomes (Kohn et al., 2000, Pronovost and Sexton, 2005).

Culture has potent effects within an establishment. It influences the attitudes and consequently, the behaviours of the workforce, and is linked to outcomes in finance, quality and safety (Parker et al., 2006, Singer et al., 2009). Defined by Uttal (1983) as the "shared values and beliefs, that interact with a company's people, organisational structures and control systems to produce behavioural norms" it is more colloquially recognised as 'the way we do things around here' or the 'social glue' of an organisation (Choudhry et al., 2007). It is created and channelled by organisational leadership which, consciously or

unconsciously, gives guidance to behaviours which the organisation values and rewards (Dov, 2008).

Safety culture is a component of organisational culture, and has been identified as a predictive measure of safety outcomes across industries (Dov, 2008, Ginsburg et al., 2014). The Safety Attitudes Questionnaire (SAQ) and Hospital Survey of Patient Safety (HSOPS), are the most commonly used tools to assess safety culture in medicine (Halligan 2011). These attitude questionnaires attempt to 'tap in' to the beliefs and perceptions of medical staff and positive results are linked to reduced levels of adverse events, satisfaction levels of patients and their families, and safety behaviours of staff (Sorra and Dyer, 2010, Mardon et al., 2010).

Surveys measure multiple domains which together make up the concept of safety culture and these differ between instruments. Flin's (2006) comparison of 12 survey instruments identified 73 different subdomains which condense into ten major themes (Figure 1). As can be seen from figure 1, there is a significant degree of overlap in the domains between surveys and any new measure would be expected to mirror similar themes. However, it is likely that safety culture is subtly different depending on the setting, and therefore surveys cannot be directly transferred for use across industries. Many have been developed for human healthcare with differing degrees of psychometric quality (Scott et al., 2003). Both 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.

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

Figure 1. Comparison of the domains of safety climate between literature review (Flin et al., 2006), SAQ (Sexton et al., 2006) and HSOPS (Sorra and Dyer, 2010).

Practical applications

Safety climate questionnaires are useful predictive instruments, highlighting defects in a system before it fails, rather than relying on retrospective feedback data such as mortality and morbidity rates (Flin et al., 2000). They are used in medicine to assess the impact of staff training, as a tool to benchmark performance within and across hospitals and to detect areas for further training and resource allocation. Evidence linking safety culture to outcomes is growing (Singer et al., 2009, Korner et al., 2015). Positive SAQ results have been associated with reductions in length of stay, decreased medical errors, lower bloodstream infection rates and lower ventilator associated pneumonia rates (Colla et al., 2005) and

Dixon Woods'(2014) multicentre multifaceted study linked inverse levels of mortality to supportive and positive organisational values.

Veterinary Model

There is no published research on this subject relating to veterinary practice. However, concepts which influence patient safety have been identified in the veterinary literature, which mirror many of the domains of safety culture identified by Flin (Flin et al., 2006, Flin et al., 2000). These include the contribution of stress and poor clinical outcomes to burnout in young vets (Bartram et al., 2009) lack of supervision of younger clinicians (Mellanby and Herrtage, 2004), organisational factors (Oxtoby et al., 2015b), a fear of speaking up and poor communication (Kinnison et al., 2015a). At present, there is no evidence to describe the factors which define safety culture in veterinary practice. There are no validated, reliable survey tools specific to the profession with which to measure the construct, in contrast to many other safety critical, high reliability industries.

Study Aims

The aims of this study are:

1. To identify the factors or domains which make up the construct of safety culture in veterinary practice in the UK
2. To develop an instrument to measure the safety culture in veterinary practices in the UK : Nottingham The Veterinary Safety Culture Survey (NVSCS)

Method : Factor analysis and survey structure

Two tools developed for use in the closely related discipline of medicine, the SAQ and HSOPS, were used to create a 'pool' of Likert scale statements which were adapted for relevance to the veterinary profession. Statements irrelevant to the veterinary setting were removed and item wording was amended to suit the new target population. Themes which had arisen from a previous qualitative study investigating veterinary error (Oxtoby et al., 2015a) were used to generate further statements unique to the veterinary setting creating a pool of 133 items. Guided by the literature, the statements were sorted into groups with similar themes by the primary researcher (CO), to form a set of 11 domains which were postulated to describe the concept of veterinary safety culture. See figure 2

DOMAIN	Number of statements
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 worker's perceptions of practice management's commitment to safety	**5**

Figure 2 : Presumptive domains of veterinary safety culture.

The statements were then edited, so that each domain contained between three and nine items. This was to maximise the reliability of each domain, as the combined score of multiple items is a more reliable method of assessing attitudes, than an individual's response to a single item (Gliem and Gliem, 2003). The statements were chosen to try and maintain a balance of positive and negative wording in each domain. This resulted in a tool with 57 statements. One free text box item was included to gather qualitative data. Ten items were included as demographic measures (see figure 3).

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

Figure 3: Demographic items in the NVSCS.

The survey was presented using Survey Monkey (Palo Alto). It was piloted with practicing vets and nurses, ranging in degrees of seniority to include junior, senior and head nurses, and junior, senior assistant vets and one clinical director, from six different practices until minimal changes to question wordings were deemed necessary (n vets= 8, n nurses= 4).

A convenience sampling and snowballing technique was used to generate subjects to receive the final version of the survey. The survey was distributed in both paper and online formats. 350 paper copies were distributed to 14 veterinary practices and the spring meetings of the Association of Veterinary Soft Tissue Surgeons and the British Veterinary Orthopedic Association, between February and April 2015. The online survey was opened on 1st January 2015 and closed on 31st May 2015. No incentives were offered to complete the survey. Ethical approval for the study was granted by the University of Nottingham, School of Veterinary Medicine and Science ethics committee, approval number 582 120420.

Method : Reliability and Validity

As a final step, an assessment of the survey's reliability and validity was carried out on the final form of the survey after factor analysis and refinement of the pilot survey.

Internal reliability was assessed using Cronbachs alpha. To see if scores differed by presentation format (paper vs online), the mean scores were compared using an independent T test.

Survey validity was assessed by comparing the domains in a well validated measure of safety culture, the SAQ, with those in the final form of the NVSCS. This is a measure of medical safety culture, and was not adapted for a veterinary context, but it was judged to be easily interpreted by practitioners in the absence of any veterinary specific alternative. The subdomains of both surveys overlap sufficiently for comparison. Convergent validity would be indicated by strong correlations between related domains and weakly correlating domains would demonstrate divergent validity. An online version of the NVSCS was combined with an original copy of the SAQ. An online link to this survey was emailed to all the contacts in the 14 hospitals who had participated in the original pilot survey. It was also sent out to all final year veterinary students at the University of Nottingham. The link was

left open for two weeks in July 2016 and validity was assessed by comparing the results of the separate domains of the final NVSCS with those of the medical SAQ using Pearson's correlation.

Results: Factor analysis and survey structure

229 paper copies of the pilot survey were returned for analysis, a response rate of 65%. 183 online surveys were completed, resulting in a total of 412 surveys for analysis.

Data preparation.

The Likert scales were coded numerically as follows: 1=Strongly disagree, 2= Disagree, 3= Neither, 4= Agree, 5= Strongly agree. Negatively worded items were reverse scored so that their valence matched the positively worded items. Missing entries were assigned the code 99. The data set was visually scanned and cleaned for anomalous numbers or missing entries.

Data analysis: **Factor Structure**

28 statements were removed from the data set after screening for low correlations with eachother (<0.3) as items which are measures of the same construct are expected to correlate with each other (Fields, 2005). Principal Axis Factoring (PAF) was conducted on the remaining 29 items with oblique (oblimin) rotation. Initial analysis retained 7 factors using Kaiser's criterion of 1 as a cut off measure. However this method is known to overestimate the number of factors(Fabrigar and Wegener, 2011). Parallel analysis (O'Connor, 2000), a more reliable method for identifying the number of factors to extract, suggested a four factor solution. Therefore, a 4 factor solution was retained which explained 47.37% of the variance and produced an interpretable solution presented in figure 4.

Factor	**Items**
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 perceptions of management *Frontline staff's trust of management and seniors and the effects 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 who work in this practice treat each other with respect Nurse input is well received in this practice At present, there is good cooperation between 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 are common It is easy for personnel here to ask questions if there is something they do not understand

Figure 4 : Factor structure describing the domains of veterinary safety culture, and their related items

The results of the Factor Analysis are summarised in figure 5. The statistical results are available in full, in Appendix 1.

Statistical analysis	Factor 1	Factor 2	Factor 3	Factor 4
Eigenvalues (after rotation)	7.815	2.380	1.949	1.594
% variance	26.949	8.205	6.720	5.496

Figure 5. Summary statistics of the NVSCS showing Eigenvalues (*the proportion of variance accounted for in an item by each factor)* % variance (*the measure of variance accounted for by that factor*).

Results: Reliability and validity

50 combined final form NVSCS and SAQ online surveys were completed. All 50 surveys were completed by final year vet students.

Data analysis: Reliability

The results of internal reliability and across methods (paper vs online) are displayed in figures 6 and 7.

Cronbachs alpha values			
Factor 1 Organisational safety systems and behaviours	**Factor 2 Staff perceptions of management**	**Factor 3 Risk perception**	**Factor 4 Teamwork and communication**
.828	.805	.592	.794

Figure 6: Cronbach alpha values to determine the internal reliability of the NVSCS

Subdomain (Factor)	N: Hard copies N: Online copies	Mean: Hard copy Mean: Online copy	SD: Hard copy SD: Online copy	Sig (2 tailed) p<0.05
Factor 1	183 167	29.40 28.49	10.95 5.860	.341
Factor 2	189 171	28.73 30.16	11.638 12.718	.267
Factor 3	188 171	13.87 13.05	7.556 2.978	.185
Factor 4	190 172	30.82 32.02	4.523 8.757	.097

Figure 7: Independent T test values to determine the alternate form reliability of the NVSCS

Data analysis: Construct validity

Of the 50 NVSCS/SAQ surveys completed online, nine were excluded listwise for analysis due to missing data resulting in 41 surveys for analysis. The results are displayed in table 8.

Factor / subdomain	NVSCS Factor 1:Organisational safety systems and behaviours	NVSCS Factor 2: Staff perceptions of management	NVSCS Factor3: 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)	.000	.000	.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 8: Pearson correlation to determine the convergent and discriminant validity of the NVSCS

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.

Discussion

The first aim of this study was to identify the factors which make up the construct of safety culture in UK Veterinary practice. The four emergent factors help describe the construct and shape its understanding, by representing its measurable aspects.

Factor 1. Organisational safety systems and behaviours

A cornerstone of safety culture is the reporting of adverse events and organisational response to mistakes (Hutchinson et al., 2009). Visible commitment by the organisation to patient safety, by encouraging reporting and providing timely, constructive feedback is critical to the development of a mature safety culture (Halligan and Zecevic, 2011). This is further reinforced by an organisation's transparent response to errors, in its efforts to develop protective tools and processes at all levels of the organisation, guided by a systems perspective. The open discussion of error has implications for both individual and organisational learning (Mahajan, 2010) and can contribute to the development of mutual trust within a team, essential for teamwork and linked to culture (Salas et al., 2005).

Factor 2. Staff perception of management

The perceptions of management, through the behaviours of senior personnel, are critical in engendering a culture of trust and support in an organisation. 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). In short, patients receive better standards of care from teams which are well led (Ham, 2014). The ability to speak up and question even senior clinicians in a team is an essential component of patient safety and a naturally occurring back up behaviour in teams which are highly evolved (Salas et al., 2005). Flattening of clinical hierarchy and the resulting freedom of communication is a feature of highly functioning teams, however recent research has shown that traditional hierarchies exist in veterinary practice, with subsequent implications for speaking up (Kinnison et al., 2015c). Clinical leadership in the veterinary profession is under researched, and there is little training available at both under and post graduate levels, despite 'better practice management' being identified by clinicians as an area for improvement in the RCVS's 2014 survey of the profession (Buzzeo et al., 2014). Senior clinicians in veterinary leadership roles are often left to 'learn on the job' with no support or education in the skills required to lead a team. This is in direct contrast to the emphasis placed on leadership training in medicine.

Factor 3. Risk perceptions

In the early development of similar surveys in medicine, surgeons had unrealistic expectations of their ability to work unaffected by factors such as fatigue and stress, with

70% of surgeons stating 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 use of tools and mnemonics 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, with 90% of veterinary surgeons stating they find the job stressful, citing high demands and client expectations. They also identified bullying cultures in practice and a lack of support for young graduates (Buzzeo et al., 2014). These factors are further complicated in veterinary medicine by overlying financial implications, which affect practice owner's perspectives, and represent the trade - off between safety and productivity that other industries, and increasingly healthcare, are forced to confront. However, there is limited understanding at present of the direct impact such factors have on our ability to perform at work, with knock on implications for behaviours which are deemed acceptable.

Factor 4. Teamwork and communication

Teamwork is closely linked to safety culture and outcomes in medicine. There is an increased focus on interprofessional working, a concept which has been recently highlighted in research on veterinary team dynamics, which 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 medical malpractice claims are linked to communication breakdowns (Weaver et al., 2014). Failures of teamwork and communication have also been linked to adverse events in veterinary practice (Kinnison et al., 2015a, Oxtoby et al., 2015b) while figures from the Veterinary Defence Society suggest that communication failure is a factor in 80% of claims relating to professional negligence (Radford et al., 2010). Recognition that "A group of experts does not constitute an expert team" has led to the development of postgraduate training in medicine (Burke et al., 2004). Teamwork training is viewed as a valuable method 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). In comparison, the RCVS survey found that 33% of veterinary nurses felt there was a lack of respect for their profession from vets or management and 54% felt undervalued (Williams and Robinson, 2014). 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).

The second aim of the study was the development of an instrument capable of measuring safety culture. Similar surveys in medicine are used to gather information on which to base decisions regarding allocation of funds, staffing or training. Although in an early stage of development, the NVSCS has good initial measures of reliability and validity. It is hoped that further research and development will improve the measure by repeating these assessments with larger sample sizes, and assessing test-retest reliability.

Limitations

A limitation of this study was the potential bias induced by the sampling strategy. This was in part dictated by the need to generate a sufficient quantity of responses for the factor analysis. A minimum sample size of 300 was required (Ferguson and Cox, 1993). Response rates to cold call surveys are notoriously low and it was felt that the chances of recruiting enough participants would be improved with the chosen strategy.

The use of students in the validation of the final NVSCS was carefully considered. As this data was only used to compare participant's responses between the SAQ and NVSCS, and not to assess the concept of veterinary safety culture, it was felt that using final year veterinary students was acceptable. Students were not included in the data set for the original pilot survey, as they would have had limited experience of veterinary practice and culture, and would therefore have introduced significant bias to the data.

The effect of participant biases such as self - selection and social desirability bias must also be considered. Efforts to minimise this included careful statement wording, keeping the survey as short as possible, and ensuring participant's confidentiality.

One notable limitation of the study is the use of Likert scores in the survey and subsequent application of parametric statistical tests to the results. Likert scales present data in ordinal form, but this method assumes equal measures between scale ratings, treating the data as interval, rather than ordinal. This is recognised as a controversial but common practice (Jamieson, 2004) but the limitations of the method are acknowledged in the development of this survey.

Conclusion

This research presents initial efforts to explore the concept of safety culture in the veterinary profession and create a reliable, validated tool for its measurement. Evidence based medicine is highly valued in our 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 which directly influence their ability to deliver care. It is hoped, that it may be used to assess the safety culture within practices, to raise awareness of issues such as teamwork and communication, attitudes to error and the system response of the organisation. On a more unit based level it can help benchmark branches or units, assess strengths and weaknesses within a team, guide training initiatives and act as a pre and post training

measure. This information will be critical to practices which are trying to effect change, and implement quality improvement tools such as safe surgery checklists, to ensure success and sustainability.

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