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 practising vets and nurses. The survey was also available online. 229 surveys were returned (65 per cent 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.

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 and others 1991). Recent studies in the veterinary literature have identified causes and types of errors in veterinary practice which mirror those in healthcare (Kinnison and others 2015a, Oxtoby and others 2015). 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 and others 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 and others 2006, Singer and others 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 and others 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 and others 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 and Zecevic 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 (Mardon and others 2010, Sorra and Dyer 2010).

Surveys measure multiple domains which together make up the concept of safety culture and these differ between instruments. Flin and others’ (2006) comparison of 12 survey instruments identified 75 different subdomains which condense into 10 major themes (Fig 1). As can be seen from Fig 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 and others 2003). Both Flin and others (2006) and Rattray and Jones (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.

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 and others 2000). They are used in medicine to assess the impact of staff training, as a tool to benchmark performance

C. Oxtoby, L. Mossop, K. White, E. Ferguson

Safety culture: the Nottingham Veterinary Safety Culture Survey (NVSCS)

doi: 10.1136/vr.104215
Veterinary Record | May 13, 2017

**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 and others 2015) 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 Fig 2).

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 2005). 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 Fig 3).

The survey was presented using Survey Monkey (Palo Alto). It was piloted with practising vets and nurses, ranges 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. In total, 350 paper copies were distributed to 14 veterinary 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. In total, 350 paper copies were distributed to 14 veterinary practices until minimal changes to question wordings were deemed necessary (n vets=8, n nurses=4).

**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 Cronbach’s α. 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

In total, 229 paper copies of the pilot survey were returned for analysis, a response rate of 65 per cent. And 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**

Twenty-eight statements were removed from the data set after screening for low correlations with each other (<0.3) as items which are measures of the same construct are expected to correlate with each other (Fields 2005). Principal axis factoring was conducted on the remaining 29 items with oblique (oblimin) rotation. Initial analysis retained seven factors using Kaiser’s criterion of one 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 four-factor solution was retained, which explained 47.37 per cent of the variance and produced an interpretable solution presented in Fig 4.

The results of the factor analysis are summarised in Fig 5. The statistical results are available in full in online supplementary appendix 1.

| Factor 1 | Items |
|----------|-------|
| Organisational safety systems and behaviours | We are given formal feedback of errors which happen in this practice/group of practices |
| Staff perceptions of management's commitment to patient safety, through their response to errors and their prevention | 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 | Items |
|----------|-------|
| Staff perceptions of management | I am scared of my boss |
| Frontline staff’s trust of management and seniors and the effects of hierarchy | 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 |

**FIG 4: Factor structure describing the domains of veterinary safety culture and their related items**

*Veterinary Record | May 13, 2017*
Results: reliability and validity
Fifty 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 v online) are displayed in Figs 6 and 7.

Data analysis: construct validity
Of the 50 NVSCS/SAQ surveys completed online, 9 were excluded listwise for analysis due to missing data, resulting in 41 surveys for analysis. The results are displayed in Fig 8.

Factors 1 (0.791), 3 (0.490) and 4 (0.865) 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 and others 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.
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 and others 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 and others 2000, Francis 2013, Kirkup 2015). Clinical leadership from the ‘board to the ward’ has direct effects on the culture and clinical outcomes of a practice (Hackett and others 1999, Korner and others 2015). 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 and others 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 and others 2015b). Clinical leadership in the veterinary profession is under-researched, and there is little training available at both undergraduate and postgraduate levels despite ‘better practice management’ being identified by clinicians as an area for improvement.

**FIG 6: Cronbach’s α values to determine the internal reliability of the Nottingham Veterinary Safety Culture Survey**

**FIG 7: Independent t-test values to determine the alternate form reliability of the Nottingham Veterinary Safety Culture Survey**

**FIG 8: Pearson’s correlation to determine the convergent and discriminant validity of the Nottingham Veterinary Safety Culture Survey (NVSCS). SAQ, Safety Attitudes Questionnaire**
in the Royal College of Veterinary Surgeons’ (RCVS’s) 2014 survey of the profession (Buzzo and others 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 per cent of surgeons stating that fatigue did not affect their performance (Sexton and others 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) (Graves and others 2010, Watters and Trustekk 2013). Similar stressors exist in the veterinary profession, with 90 per cent 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 (Buzzo and others 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 and others 2015b). In total, 52–70 per cent of adverse events in medicine have been linked to poor teamwork or communication and 24 per cent of medical malpractice claims are linked to communication breakdowns (Weaver and others 2014). Failures of teamwork and communication have also been linked to adverse events in veterinary practice (Kinnison and others 2015a, Oxtoby and others, 2015) while figures from the Veterinary Defence Society suggest that communication failure is a factor in 50 per cent of claims relating to professional negligence (Radford and others 2010). Recognition that ‘a group of experts does not constitute an expert team’ has led to the development of postgraduate training in medicine (Burke and others 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 2015, Weaver and others 2013). Dixon-Woods found improved levels of teamwork and happier staff in hospitals which reported a positive supportive culture (Dixon-Woods and others 2014). In comparison, the RCVS survey found that 53 per cent of veterinary nurses felt there was a lack of respect for their profession from vets or management and 54 per cent felt undervalued (Williams and Robinson 2014). Improvements in teamwork through training foster improvements in culture, 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 pretraining and posttraining 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.

**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 pretraining and posttraining 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.

**References**

BARRAT, D. J., YADEGARFAR, G. & BALDWIN, D. S. (2009) Psychosocial working conditions and work-related stressors among UK veterinary surgeons. *Occupational Medicine* 59, 334–341.

BRENNAN, T. A., LEAPE, L. L., LAIRD, N. M., HEBERT, L., LOCALIO, A. R., LAWThERS, A. G., NEWHOUSE, J. P., WEILER, F. C. & HIATT, H. H. (1991) Incidence of Adverse Events and Negligence in Hospitalized Patients. *New England Journal of Medicine* 324, 370–376.

BUrKE, C. S., SALAs, E., WILSON-DonNELLY, K. & PRIEST, H. (2004) How to turn a team of experts into an expert medical team: guidance from the aviation and military communities. *Quality and Safety in Health Care* 13(Suppl 1), i96–i104.
