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## Veterinary Team Interactions Part One: The Practice Effect

Tierney Kinnison, BSc, MSc

The Royal Veterinary College, Hawkshead Lane, Hatfield, Hertfordshire, AL9 7TA

tkinnison@rvc.ac.uk

Stephen A May, MA VetMB PhD DVR DEO FRCVS DipECVS FHEA

The Royal Veterinary College, Hawkshead Lane, Hatfield, Hertfordshire, AL9 7TA

David Guile, Post-Graduate Teaching Certificate, MA, BA, PhD

The Institute of Education, 20 Bedford Way, London, WC1H 0AL

### **Abstract**

Veterinary practices have evolved since the era of solo practitioners working on one site. Today veterinary practices tend to include veterinary surgeons, veterinary nurses, receptionists and business managers, leading to the notion of the veterinary team and the rise of interprofessional working. In addition, practices have grown in size and frequently include several branches, creating a distributed team. Research regarding veterinary teamwork is lacking. This paper uses Social Network Analysis (SNA) to address this issue. SNA measures interactions between members of a network. The types of interactions in practice and the effects of practice size and location (branches) are considered. Information sharing and asking for advice are straightforward, lower order interactions. Problem solving and being influenced by another are complex, higher order interactions. Smaller practices have higher densities of interactions, implying a more cohesive team. However individuals in smaller practices still do not interact with everyone and therefore actively choose with whom to interact. Practices with little staff rotation across branches experience limited interactions across locations. The results of this study have implications for practices aiming to expand their team, either in a single site, or by acquiring more branches. Suggestions for ways to maintain and improve interactions are suggested.

## Introduction

The evolutionary change from the solo practitioner, when veterinarians were part of an emerging profession, to the team-based interprofessional veterinary practices of today has been significant. As veterinary surgeons began to treat increasing numbers of small animals, a niche opened for assistants who would care for the animals while the veterinary surgeon specialised on the diagnostic process and choice of therapies. This new role has developed significantly over the last 50 years and, in the UK especially, has led to the highly trained veterinary nurse profession. It is likely that the relationship between the two professions will have changed, and will continue to do so. It is not only the veterinary surgeon - veterinary nurse working relationship that may evolve. Numerous other groups are now involved in day-to-day veterinary based work, including technicians, practice managers, receptionists, physiotherapists, farriers, equine dentists and more. The factors leading to a rise in veterinary interprofessional working, and the resulting potential for evolving relationships between the groups, has been described in more detail by the authors elsewhere (Kinnison and others 2014).

In addition to team composition changes, the owner of the practice is also changing. Sole principals and partnerships have slightly declined from 2006 to 2010 and limited corporations and corporate concerns have increased (Robertson-Smith and others 2010). It is anticipated that the trend has continued since 2010. Veterinary practices are also expanding with, for example, the mean number of veterinary surgeons per practice increasing from 3.0 in 2006 (Robertson-Smith and others 2010), to 7.1 in 2014 (Buzzeo and others 2014). These trends may explain the rise in teams spread across multiple branches.

Although research regarding how veterinary teams work together is sparse, these changes are mirrored by the patterns explored in organisational literature, especially relating to healthcare. Professions are brought together in organisations in response to societal pressures such as demand for accountability (Adler and others 2008), and due to increased complexity of services, which are better provided by a group of specialised professions (Abbott 1988). With regard to any well running team, the whole may be thought to be better than the sum of the parts; as Belbin describes “no one’s perfect, but a team can be” (Mullins, 2007 p332). Patel et al. (2009) highlight the importance of individual expertise utilised collaboratively with another profession’s expertise, leading to new knowledge or decisions, which may reduce redundancy (repeating tasks), inefficiency and omissions. Utilising the right person for each task is also hypothesised to lead to more cost effective provision of care (Getz 2012). Other consequences of the professional network include satisfaction at work, diffusion of innovation and performance (Tasselli 2014).

In order for the proposed advantages of teamwork to be achieved, however, a veterinary practice must work as a unified team. This can be challenging, as a group of professionals with individual competence does not necessarily equate to group competence (Lingard 2009). The increase in interprofessional working has therefore not come without challenges. Each group is part of the 'jostle for jurisdiction' (Bechky 2003), experiencing a struggle as a collective to find their place in the world. This involves the emergence of roles and responsibilities which other members of the team can respect and trust members to undertake. Where there is confusion or great overlap in roles, insecurity and the potential for difficulties in working arise (Baxter and Brumfitt 2008). Teamwork undeniably requires communication. Team communication is a well-researched topic which has suggested links to medical errors (Lingard and others 2004; Kobayashi and others 2006; Alvarez and Coiera 2006). Different professions have different discourses and ingrained boundaries which evolve in part due to separation of training (Baxter and Brumfitt 2008), and necessitate the creation of a collaborative interprofessional discourse (Barr and others 2005).

In order to understand, and eventually improve, veterinary team working, a method is required to enable the consideration of team behaviour. Social Network Analysis (SNA) is suggested to be one such novel framework. SNA is an examination of a group, such as a veterinary practice, and is concerned with the interactions between individuals, rather than the study of individuals acting independently (Wasserman & Faust, 1994, p17). A frequent focus of SNA is on resource flow, such as information or advice. The flow of resources enables individuals to work successfully as a team and to build greater joint understanding with the consequent benefits of teamwork as identified previously. SNA has not been used to assess veterinary teamwork; however, there are examples from healthcare which have guided this paper's hypotheses and methodology.

SNA has been used to identify different types of interactions which have different levels of occurrence, or density. For example, within a hospital, interactions can include asking for advice, changing habits and sharing thoughts; these interactions have been suggested to increase in difficulty due to their decreasing densities (Wagter and others 2012). The first hypothesis of this paper is: different levels of interaction have different densities in veterinary practices.

Whether or not these interaction types occur between any two individuals is affected by several factors. One factor driving informal interactions is physical proximity, defined simply as "Individuals are more apt to interact informally if they are situated close to one another physically" (Cott, 1997 P1413). Added to distance is the issue of time and shift patterns (Cott 1997). Physical proximity can therefore be based on time or location and is likely to be affected by team size and the existence of

multiple practice branches. The second hypothesis of this paper is: interactions will be affected by practice size (Hypothesis 2a) and team locations (Hypothesis 2b).

The present paper aims to add to the literature regarding working and learning within (interprofessional) veterinary teams and arises from a large scale study. This paper focuses on the overarching analysis of the interactions within practices (Hypothesis 1) and includes analysis of the practice effects of size and physical proximity on the interactions (Hypothesis 2a and 2b). These factors are increasingly important considerations as practices expand in terms of the number of individuals they employ, the number of branches they contain and whether they are independent or part of a corporate group. In a subsequent article, the personal effects (key individuals, interprofessional relations and social factors) are the focus. Together the two articles aim to formulate a map of veterinary interactions, providing a snapshot of teamwork in modern veterinary teams.

## **Methods**

### Participants

A total of 43 veterinary practices were approached to take part in the study between October 2013 and April 2014. All practices had a multiprofessional team composition identified via their website. The practices were purposively sampled based on their location (across England), species type (small animal, equine, mixed practice), size (<10 people, 10-40 people, >40 people) and business status (independent, corporate). A mix of these characteristics was chosen to provide a representation of practices. Eleven practices, which covered all practice types, took part in the study. All individuals identified as being employed by each of the practices were targeted in the research.

### The SNA Questionnaire

The questionnaire consisted of a demographic section and a main section which asked participants to identify whether they did or did not have specific interactions with all other members of the practice team at the current point in time. The four interaction questions considered in this paper are shown in Table 1 below.

Table 1. The four interactions investigated in the SNA questionnaire.

1. Who of the following do you receive work related information from?
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2. When you feel unsure about something during your work in practice, who of the following do you ask for advice, help, explanation?
3. Who of the following significantly influences your working habits, for example through observation of their work?
4. Who do you talk to about your work activities to develop new ideas or ways to solve problems?

The interactions were presented across the top of a table which contained a list of all members of the practice team down the left hand side in a sociocentric (whole network) roster format.

Participants were asked to tick or cross each box within the table to identify their interactions.

Participants were not directed to consider any one mode of interaction (face-to-face, telephone, email), all modes could be included.

The interactions were developed from published literature in healthcare (Cott 1997; Creswick and Westbrook 2010; Wagter and others 2012). The questionnaire was piloted with one typical veterinary practice (22 participants) and adaptations relating to presentation and wording were incorporated.

### Distribution

Each practice was visited by the senior author (TK) to distribute the paper based questionnaires and answer any questions regarding the project. The team had been advised of the visit through posters or emails and were informed that it was for a PhD regarding the veterinary team. Those members of the practice team available during the visit completed the questionnaire. These initial response rates averaged 42.5%. The remaining unanswered questionnaires were left with a representative who organised their completion and return. Final details of the practices can be seen in the Results.


Participation was voluntary as was explained within a consent paragraph on the questionnaire.

Participants could opt out at any time. The project received ethics approval from the Royal Veterinary College's Ethics and Welfare Committee, Ref: URN 2013 0086H.

### Analysis

The first stage of analysis involved creating diagrams of the networks known as sociograms using NetDraw (Borgatti 2002). Sociograms are a tool for identifying patterns in the data. Further to this several SNA calculations were employed using the SNA programme Ucinet (Borgatti and others 2001). As these are likely to be novel to many readers, they are explained in Table 2 below.

Table 2. SNA statistics and explanations.

Analysis	Description
Density	The number of ties (connections) divided by the total possible number of ties, value therefore of 0 to 1. Affected by network size as it would be less feasible for large networks to have a density score of 1 compared to small networks
Average degree (outdegree)	<p>Outdegree is the number of times information (or any resource) travels from one person to another. In the diagram, person A has said that they ask person B for information – therefore information travels from B→A, and person B has an outdegree score of one.</p>  <p>The average degree is the outdegree score across a whole network. Average degree is less influenced by network size</p>
Maximum Geodesic	A geodesic is the shortest path between any dyad (two people). The maximum geodesic within a network is the longest geodesic that exists. It indicates how easy it is to reach another individual. Values range from 1 (direct contact) upwards

## Results

Details of the 11 participating practices can be seen in Table 3. The ‘admin’ group included for example practice managers and accounts staff. The ‘other clinical’ individuals were for example kennel assistants or groomers while the ‘other non-clinical’ group consisted of builders and maintenance staff. The prevalence of multiple groups highlights the interprofessional nature of veterinary working.

Code	Type			Total Respondents (Veterinary Surgeon: Veterinary Nurse: Admin: Reception: Other Clinical: Other Non-Clinical)	Response Rate
	Species	Branches	Organisation		
1	Equine	Single	Independent	17 (8 : 4 : 4 : 3 : 0 : 0)	94.7%
2	Small	Single	Independent	14 (3 : 5 : 1 : 3 : 2 : 0)	93.3%
3	Small	Multiple	Independent	34 (10 : 16 : 4 : 2 : 2 : 0)	79.1%
4	Small	Multiple	Independent	30 (7 : 6 : 6 : 10 : 0 : 1)	76.9%
5	Mixed	Multiple	Corporate	60 (26 : 14 : 4 : 14 : 0 : 2)	83.3%
6	Mixed	Multiple	Corporate	25 (11 : 6 : 3 : 3 : 2 : 0)	78.1%
7	Small	Single	Independent	5 (3 : 4 : 1 : 0 : 0 : 0)	100%
8	Small (Referral)	Single	Independent	14 (7 : 6 : 0 : 1 : 0 : 0)	100%
9	Mixed	Multiple	Independent	47 (15 : 9 : 11 : 6 : 5 : 1)	88.7%
10	Small	Multiple	Corporate	16 (5 : 5 : 1 : 5 : 0 : 0)	100%
11	Small	Multiple	Corporate	13 (4 : 4 : 1 : 3 : 1 : 0)	100%

Table 3: Participating Practices.

Hypothesis 1: Different levels of interaction have different densities in veterinary practices.

The four main interactions have different numbers of ties, densities and average degrees, known as cohesion scores. Table 4 demonstrates the average cohesion results for the participating practices.

The Standard Deviation shows the difference between the practices, due largely to their size.

Table 4. Average scores of number of ties, density and average degree for the 11 practices according to interaction type. Standard Deviation (SD) is also reported

	Number of Ties (SD)	Density (SD)	Average Degree (SD)
Information	515.09 (571.73)	0.58 (0.18)	13.69 (6.37)
Advice	353.45 (366.94)	0.47 (0.20)	10.07 (3.56)
Problem Solve	242.18 (252.01)	0.31 (0.13)	6.79 (2.34)
Influence Change	195.55 (192.52)	0.27 (0.13)	5.66 (1.70)

Receiving information and receiving advice have the highest densities, with a problem solving and being influenced by another having lower densities. This pattern across the interactions remains the same for every practice despite their size, supporting Hypothesis 1. The average degree shows, for example, that on average almost 14 people ask an individual for information, whereas only five to six



are influenced by any one individual. Clearly individuals differ in these scores and this is explored in the personal effects paper in this series.

The pattern of densities across interactions can be clearly seen in sociograms. The sociograms of one practice (Code 6) are shown as an exemplar in Figure 1. Each dot is termed a node and represents a respondent. The nodes are shaped for the profession of the respondent. The lines are termed arcs and show the direction of the interaction.

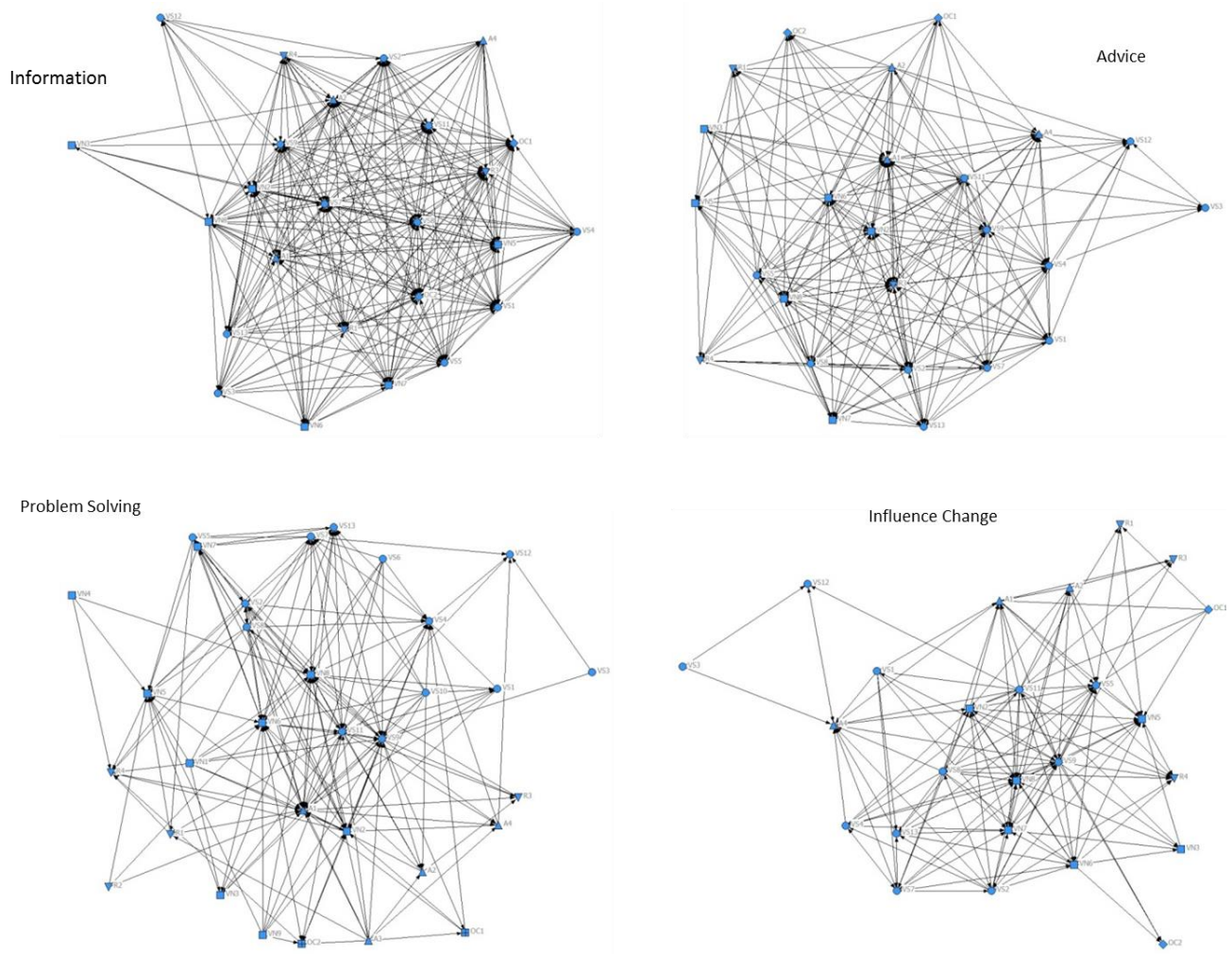


Figure 1: Sociograms of the four main interactions for practice code 6. Node shape key: circle—veterinary surgeon, square—veterinary nurse, up triangle—office/administration, down triangle—receptionist, diamond—other clinical

Hypothesis 2a - Interactions will be affected by practice size.

The size of the practice has an effect on the cohesion statistics which supports Hypothesis 2a. Table 5 demonstrates the cohesion scores according to practice size.

Table 5. Cohesion scores ranked according to practice size (largest to smallest). Ave Deg stands for Average Degree (outdegree). Max Geo stands for maximum geodesic

		Information				Advice				Problem Solve				Influence Change			
Practice Code	Size	No. of Ties	Density	Ave Deg	Max Geo	No. of Ties	Density	Ave Deg	Max Geo	No. of Ties	Density	Ave Deg	Max Geo	No. of Ties	Density	Ave Deg	Max Geo
5	60	1891	0.37	26.24	3	1188	0.23	16.50	4	854	0.17	11.86	4	660	0.13	9.17	5
9	47	1204	0.44	22.72	4	907	0.33	17.11	3	524	0.19	9.89	5	400	0.15	7.55	5
3	34	585	0.32	13.61	3	378	0.21	8.79	5	320	0.18	7.44	5	234	0.13	5.44	6
4	30	664	0.45	17.03	3	389	0.26	9.97	4	307	0.21	7.87	4	281	0.19	7.21	4
6	25	489	0.49	15.28	3	314	0.32	9.81	4	206	0.21	6.44	4	184	0.19	5.75	7
1	19	257	0.75	13.53	2	167	0.49	8.79	5	101	0.30	5.32	4	88	0.26	4.63	4
10	16	150	0.63	9.38	3	148	0.62	9.25	2	90	0.38	5.63	3	68	0.28	4.25	4
8	14	123	0.68	8.79	2	125	0.69	8.93	2	74	0.41	5.29	3	70	0.39	5.00	3
2	14	125	0.60	8.33	3	127	0.61	8.47	4	87	0.41	5.80	4	85	0.41	5.67	4
11	13	136	0.87	10.46	2	103	0.66	7.92	2	71	0.46	5.46	5	53	0.34	4.08	5
7	8	42	0.75	5.25	4	42	0.75	5.25	2	30	0.54	3.75	3	28	0.50	3.50	3

The number of ties and average degree decrease with decreasing practice size for all four interactions. In total there are fewer interactions in small practices. The density however tends to increase. Smaller practices are therefore more connected than larger practices. There are exceptions to these trends, for example practice Code 3 has a lower than expected density for the information interaction which may be in part due to limited interactions across branches of the practice as explored in the Discussion. The maximum geodesic does not show a clear pattern across practices of different size for any interaction.

Hypothesis 2b - Interactions will be affected by team locations.

Four of the 11 practices were single site practices. All other practices had between two and five branches. In all cases there were identifiable main branches and satellite branches.

The sociograms of three practices (Codes 3, 4 and 9) highlighted a limited flow of resources between some of their branches. Interactions are therefore affected by the location of the team as suggested in Hypothesis 2b. The most extreme example was for Practice Code 9 which had two branches 13.9 miles apart. The sociogram for the advice interaction of Practice Code 9 is shown in Figure 2. The colour of the nodes depicts the branch the individual worked in.

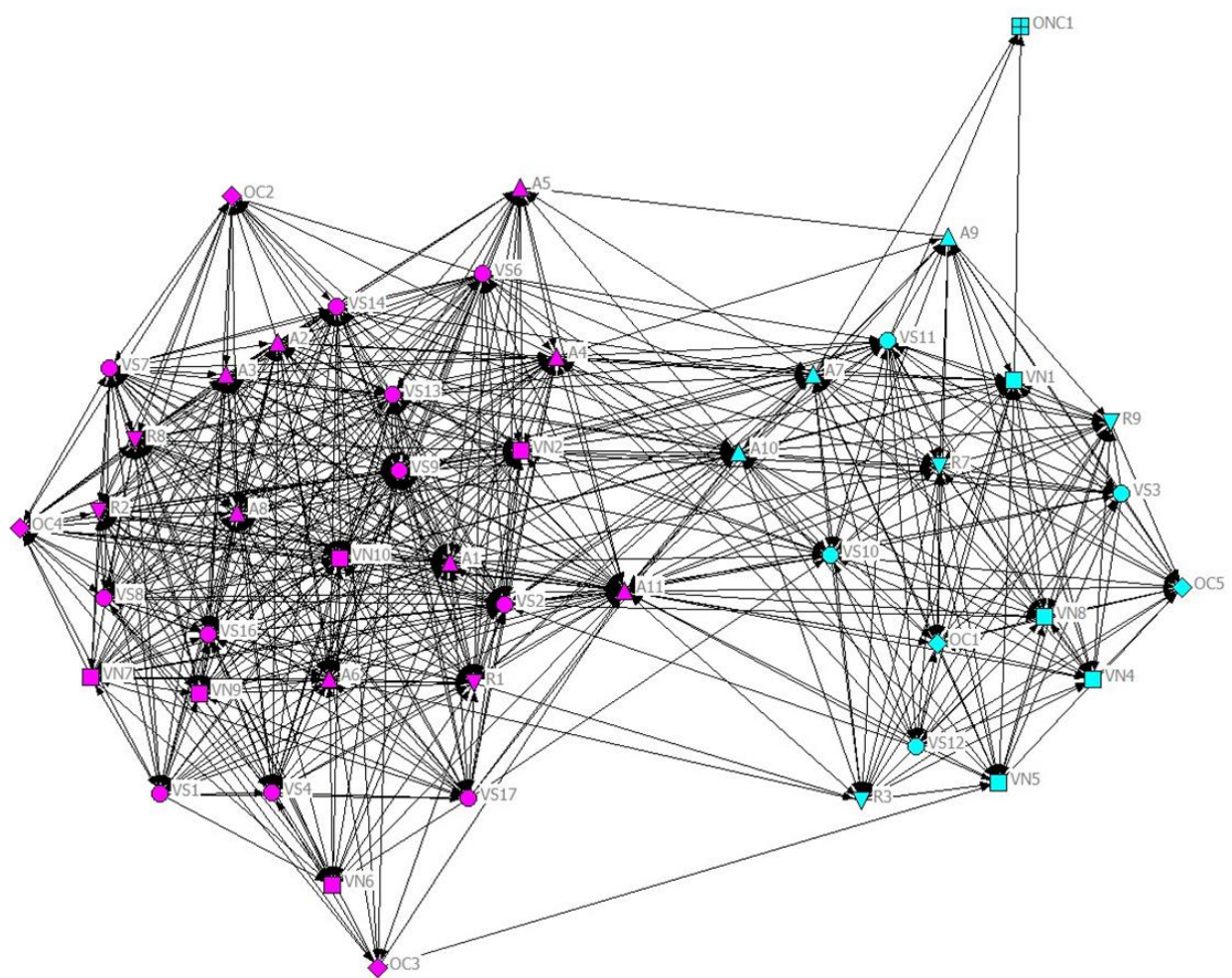


Figure 2. The branch divide in asking for advice of Practice Code 9.

**Discussion**

SNA has enabled interactions within veterinary practices to be mapped, beginning the process of understanding veterinary teamwork. Our research shows that information receiving and asking for

advice could be considered more straightforward, lower order, interactions due to higher densities. Problem solving and being influenced by another's actions could be considered more complex, higher order, interactions due to lower densities. Similar results have been previously identified in hospitals (Wagter and others 2012).

The size of the practice affects the interactions. The number of ties decreases with decreasing practice size. This is to be expected as within networks of fewer people, there are fewer opportunities for ties. The density of ties increases with decreasing practice size. This is due to the fact that while the total number of ties decreases, the number of possible ties decreases further. A smaller network is therefore more connected than a larger network and resources flow more easily. Smaller teams have also been suggested to function better than larger teams in primary and community care (Xyrichis and Lowton 2008). This is relevant for practices aiming to increasing in size.

To explore the effect of team size in more depth, the average degree was calculated. It depicts the average number of respondents who identify each individual (outdegree). It can be used to compare networks as it should not be as affected by network size as other indices, as in any given circumstance there is a limit to the number of people with whom you can interact. However the size of the participating practices falls below the value where it is possible to have interactions with everyone for some interactions. As practice Code 5 shows, it is possible to have an outdegree of over 26 for information. Several practices are smaller than this and therefore cannot have scores as high as Code 5. This makes comparing these networks challenging and is why average results are provided. The problem solving and influence interactions demonstrate, however, that even when there is the opportunity for the smaller practices to have similar results to the larger practices, they do not; instead their average degrees remain smaller. Practice size appears therefore to have a genuine effect, for some interactions at least. Even when it is possible to maintain interactions with more people, participants in small practices do not. Instead, individuals choose with whom to interact. Understanding the reasons for these choices requires further research and is explored in Part Two of this series.

The notion that size matters for communication in veterinary practices has implications for practices which are expanding. Dense networks are ideal for the transmission of ideas and to enable all members of the team to work in similar ways using best practices (Tasselli 2014). Large practices with lower densities may experience challenges. Efforts should be made in order to allow resources to continue to flow around larger networks. For example, team meetings have been identified as a means to increase interprofessional communication and reduce misconceptions about roles (Xyrichis and Lowton 2008). Staff databases can prove beneficial (Cross and Parker 2004) and could include

details on individual expertise, such as small animal surgery or computers, as well as some personal details. To share information, memos and emails may be useful; while to disseminate innovative ideas, targeting people with many connections would be most influential (West and others 1999; Anderson 2002).

It is important to note that a higher density does not unequivocally imply a 'better' transfer of resources. In high density networks there may be redundant ties whereby an individual is connected to two people who have the same information. Therefore the same information could be obtained by maintaining just one of those ties (Burt 1992). Hence, a network with a lower density may be more efficient and equally effective. Networks with low densities – but which include individuals who link separate subgroups – are therefore useful for the transfer of novel resources while networks with high densities are useful for maintaining group cultural norms and allow the same information to spread quickly (Adler and Kwon 2002). The density of information flow within the current veterinary practices (average 58%) and low maximum geodesics can be considered beneficial as the whole team is able to 'work from the same page'. At the other extreme, the lower density of influencing behaviour fits with the density theory as only novel behaviours need to flow through the network, although the higher maximum geodesics suggest it may be unlikely a new behaviour will spread across the whole network quickly.

Physical proximity has been hypothesised as having an influence on interactions (Wagter and others 2012). In line with this, the current study demonstrated the effect of separate branches on overall practice integration. Some teams managed to interact across branches while others experienced 'structural holes' (Burt 1992) around the branches, indicated by fewer interactions and gaps in the sociograms. Reasons for this do not seem to be purely geographical. The most extreme example has only two branches relatively close together (Practice Code 9). The majority of individuals working within this practice do not work across branches. It could be suggested that there is a lack of boundary spanners or brokers (Akkerman and Bakker 2011); people who are forced to, or choose to, work across a boundary (be it physical or cultural). This is an issue which is considered more extensively in Part Two of this series regarding personal effects on interactions. Each branch may run very successfully independently, however, this potentially contradicts one of the proposed advantages of the changing veterinary field - whereby corporates are replacing small scale private practices: that of gaining best practice through sharing experience across a wider network of individuals. Rotation of junior doctors in hospital departments has been suggested to allow access to non-redundant knowledge and makes them "'custodians' of most of the knowledge passing within the department" (Tasselli 2015 page 22). Branch rotation is therefore suggested as a means of

understanding differences and sharing best practice. Ultimately an ideal model of processes could be agreed upon, ensuring branch uniformity which regulates team roles and client experience.

This study aimed to create a map of interactions based on a representation of practices in England. This was achieved through the inclusion of pet and large animal practices, practices of different size and location and practices with different management structures. The small scale means that the study does not profess that the results are generalisable to every veterinary practice. It does however provide theoretical propositions (Yin 2009) suggesting that in similar situations, similar results can be anticipated.

SNA is an excellent methodology for mapping interactions within networks. It does however have some limitations. SNA using a roster format enforces a limit on the participants involved, in this case, practices' 'employees'. Although the questionnaire did ask for 'extended team members' from outside the practice, little data of these types were received. This may suggest limited activity outside of the practice, or a limitation of the questionnaire. Missing data have been suggested to have effects on SNA due to the nature of studying interactions. The authors compared the results of their statistics with missing data removed and included and noted no difference in the pattern of results. Further, response rates from all practices were comparable to other reports and were higher (minimum in this study of 76.9%) than the suggested acceptable rates of over 70% for many indices in an assessment of missing data by Kossinets (2006). This led the authors to include all available data in the analysis. This may however underestimate trends through the inclusion of individuals with missing ties. The results are also self-reported. While anonymity was assured, it is possible participants overestimated their interactions to portray their importance to the group. The similarity in overall patterns of interactions within practices and the clarity of the sociograms, however, suggests that these results are valid. Subsequent observational based SNA have been conducted by TK to assess the self-awareness of interactions and this has revealed that reported results were very similar to observed results (unpublished data). As suggested in previous SNA studies, the quantitative nature of questionnaire based SNA has limitations. It may map the interactions, but concurrent qualitative methods would produce a fuller understanding of the interactions. Current research by the authors is seeking to address this issue through undertaking in-depth case studies.

This paper has provided a starting point for the quantitative consideration of team working within veterinary practices. It has portrayed a comparison of interactions within veterinary teams and has considered the effects of practice size and physical location. Increasing practice size and the inclusion of multiple branches may cause challenges for maintaining communication across the whole of the team. This is important for practices coping with change and making decisions

regarding their future growth. Methods to maintain and improve interactions between team members should be considered and involve a move from the informal to the formal, including team meetings, modes of information dissemination, rotation of staff and uniform practice protocols across branches (Greiner 1998). In the following paper in this series, the personal effects, including interprofessional interactions, are considered.

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