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***Social-Professional Networks of Health Professionals:  
A Systematic Review***

**Centre for Clinical Governance Research in Health**

**Australian Institute of Health Innovation**



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2. Cunningham, F.C., Ranmuthugala, G., Plumb, J., Georgiou, A., Marks, D., Westbrook, J.I and Braithwaite, J., Australian Institute of Health Innovation, University of New South Wales.

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## **Executive Summary**

This monograph reports on a systematic review of the health literature on social-professional networks of health professionals, especially in relation to studies with relevance to quality and safety of care. An introduction is provided on the history and development of research on social and organisational networks in the social sciences, and on a number of the theories and propositions that have emerged from this research. Information is provided on social network analysis and the measures that are used in this methodology. The importance of examining networks from both a structural analytical perspective and a governance perspective is highlighted. The report describes the development of clinical and health networks in the health sector and related research.

Proceeding with reviewing the literature on social networks of health professionals, the report describes the literature review process. The search was conducted over the period January 1995 to December 2009 on five electronic databases (MEDLINE, CINAHL, Embase, Web of Science and Business Source Premier). Details are provided of the search strategy, the inclusion strategy, and the search terms. A total of 40 distinct empirical studies were identified in the search. The paper presents an analysis and synthesis of these studies.

The key topics addressed in these papers were (1) the influence of information sources on the awareness and adoption of a new technology or innovation; (2) the communication and exchange of patient clinical and other information between practitioners or organisations; (3) understanding the structural relationships and social context of professionals or organisations or between organisations; (4) advice seeking patterns of health practitioners; (5) information / knowledge exchange between health practitioners; and (6) identification of opinion leaders.

A majority of studies used social network analysis to assist in understanding structural relationships in networks. Such studies demonstrate the application of social network analysis and its associated methodologies and theoretical perspectives to investigating and evaluating the different levels of social and professional networks in the health sector. Most of the studies were undertaken in the United States, and the extent of transferability of the study findings to other settings is not clear. There is therefore a strong case for replication of studies that have findings of interest in other countries. Additional empirical research on networks of health professionals should be directed at exploring both social network structural characteristics and network governance (including facilitation and leadership), in relation to quality of care and safety, and effectiveness and sustainability. Although a small number of studies examined aspects of health professional networks relevant to quality of care and safety, and some studies addressed issues of effectiveness and sustainability, there is a need for further rigorous research.

## 1. Introduction

This monograph presents a detailed analysis of social network research published in the health care literature, and relating to social networks of health professionals (or, social-professional networks). An introduction is provided on the history and development of research on social and organisational networks, and on the tools of social network analysis. Proceeding with reviewing the literature on social networks of health professionals, the report identifies the themes in the literature and provides an overview of the issues. The details of the review process are provided, followed by a description of the methods used, content and systematic analyses of the literature, a discussion of the findings, and a conclusion.

The report has been completed as part of the Centre for Clinical Governance Research in Health's program of research. The research program is outlined in the Centre's web site: <http://www.med.unsw.edu.au/medweb.nsf/page/ClinGov>About>. In particular, this work forms part of the Australian Research Council Discovery Project, *Evaluating Communities of Practice and Social-Professional Networks: The Development, Design, Testing, Refinement, Simulation and Application of an Evaluation Framework*, ARC DP0986493.

## 2. Concept and Definition of Network, Social Network, Social Capital

*Network* is a word used extensively in health care research and in health services delivery. It is used as a synonym for *partnership*, *collaboration*, *alliance* and *group*. Alternatively, it is used more specifically to describe the relationships between people, groups or organisations. A key feature of networks is repeated and enduring exchange relationships between the actors in the network (Podolny and Page 2003). Social network analysis can measure these structural relationships empirically. It is the structure of the network and how the structural properties affect behaviour that is informative, not simply the characteristics of the network members (Hawe, Webster, and Shiell 2004).

A *social network* is a 'set of people or groups of people, "actors" ... with some pattern of interactions or "ties" between them ... [e.g.,] friendships among a group of individuals, business relationships between companies' (Newman, Watts, and Strogatz 2002: p. 2566). Commencing in the social sciences, there is a long history of examining social networks through network analysis techniques. In one sense, as described by Braithwaite and colleagues (2009b), communities of practice and social networks are two sides of the same coin, with communities of practice having a greater emphasis on learning or knowledge processes, epitomised by Wenger (1998), while social network researchers focus on structural and relationship properties (Freeman 2004; Scott 1991, 2000; Wasserman and Faust 1994). Social network theory sheds light on the fundamental social philosophical problem of how autonomous individuals can create enduring, functioning societies (Borgatti et al. 2009). Network theory also proffers explanations for a plethora of social phenomena, from individual creativity to corporate profitability.

A review by Portes (1998) identifies Bourdieu's analysis as the first systematic treatment of the associated concept of *social capital*. Bourdieu defined the concept as the 'aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalised relationships of mutual acquaintance or recognition' (1986: p. 248). The concept evolved through further work by Coleman (1988) and was defined by Lin (1999, 2001) as a set of resources (such as access to valuable information, word-of-mouth referrals, and power) available in one's network of relationships.

Coleman (1988: p. S95) identified three forms of social capital: obligations and expectations, information channels and social norms, and described the social structural conditions under which it arises. According to Coleman, like other forms of capital, social capital is productive, making possible the achievement of objectives that would otherwise not be possible. Social capital inheres in the structure of relations between actors and among actors. It is seen by social network theorists as an attribute of an individual (e.g., Belliveau, O'Reilly, and Wade 1996; Burt 1997; Useem and Karabel 1986), or of a social unit and as more of a public good (Bourdieu 1986; Coleman 1988; Putnam 1993). Social capital is often operationalised as *network centrality*, or the number of connections between an individual and others in a network, which grants the central actor access to those individuals and their resources (Brass 1984).

A table summarising the key social network analysis terms is provided in **Appendix 1** (Table 1: Social Network Analysis: Definitions, Theories and Propositions). This table also provides associated definitions, theories and propositions.

### **3. Development of Network Research in the Social Sciences**

Social network research crosses a range of disciplines in the social, natural and physical sciences – sociology, anthropology, ethnology, social psychology, management, organisational behaviour, communications, marketing, economics, political science, human geography, epidemiology, biology, physics, mathematics, statistics, and computer science (Freeman 2004: p. 5). Over the past decade there has been an dramatic growth in network research, with the theory of networks yielding explanations for social and other phenomena across this wide variety of disciplines (Borgatti et al. 2009; Watts 2004).

There have been a number of review articles on social and organisational networks, including those by Borgatti and Foster (2003), by Brass et al. (2004) and by Provan, Fish and Sydow (2007). Provan and colleagues identified the health sector as yielding the greatest number of empirical studies on whole networks, representing 14 of the 26 studies in their review. There have also been numerous reviews of network analysis (Marsden 1990; Mitchell 1974; Wellman 1983). Considerable progress has been made in understanding what networks are, how they are structured, how they operate, and how they develop. Despite this progress, there is still a great deal not known about networks.

Freeman (2004) traces the origins of network research in the social sciences, with one of its earliest applications being the anthropological mapping of kinship relationships in Australian Aboriginal society by Warner (1937). In the 1930s, social networks were used in *sociometry* by Moreno and colleagues (1934) to examine social influence in networks of schoolgirls who ran away from a boarding school.

Social network theory advanced in the 1940s and 1950s with the use of matrix algebra and graph theory to formalise basic social-psychological concepts such as groups and social circles in network terms, permitting the objective discovery of emergent groups in network data (Luce and Perry 1949). The mathematical underpinnings to networks arose from random graph theory, famously described in the Erdős-Rényi model, following a seminal paper in 1959 (Erdős and Rényi 1959).

Other researchers, under the direction of Bavelas at the Massachusetts Institute of Technology (MIT), studied how different communication network structures affected the speed and accuracy of problem solving by the group (Bavelas 1950; Leavitt 1951). Freeman (1979) cites this as the first research application of *centrality*. This work concluded that *centrality* was related to group efficiency in problem-solving, perception of leadership and personal satisfaction of participants. Freeman's 1979 essay defined structural centrality and specified nine centrality measures, based on three conceptual foundations.<sup>1</sup> The MIT studies influenced research in fields including psychology, political science and economics. Another key influence on theoretical developments in the field was the pioneering work on network analysis by sociologists, who introduced more abstract mathematical models and theory such as biased net theory (Rapoport 1951, 1957) and graph theory (Harary, Norman, and Cartwright 1965), and other work in the 1940s and 1950s (Newman, Watts, and Strogatz 2002; Watts 2004).

In the 1950s, a paper by Pool and Kochen (1978) addressed the issue of the *small world* phenomenon – the idea that chance meetings are a clue to social structure, and their frequency an index of stratification. Their hypotheses were tested empirically by Milgram 20 years later and his concept of *six degrees of separation* became widely popularised (Milgram 1967). Other subsequent work has shown that many networks have a similar small-world property, for example, the papers by Watts and Strogatz (1998) and Buchanan (2002: p. 60). Schnettler (2009) provides a structured overview of 50 years of small-world research and summarises the empirical and theoretical progress on different facets of the small-world phenomenon.

Network analysis was also used in the 1950s by sociologists (Fischer 1948; Hollingshead 1949) to study the changing social fabric of cities. Similarly, social science research today is exploring the structure of internet and web-based virtual communities (Barabási 2009; Wellman et al. 1996). Through the 1950s and 1960s, anthropologists applied network-based explanations to a range of outcomes, from seeing societies as networks of relationships (Barnes 1954; Nadel 1957), to applying mathematical models to examine kinship systems (White 1963; Boyd 1969), to understanding the role-relationships in families (Bott 1957). The term 'social network' is credited to Barnes (1954), as used in his study of a Norwegian island parish.

Sociologists took the lead in social network research in the 1970s. Lorrain and White (1971) built their approach around the concept of role, seeing the occupants of each role in a network as being

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<sup>1</sup> 'Three [centrality measures] are based on degrees of points and are indexes of communication activity. Three are based on the betweenness of points and are indexes of potential for control of communication. And three are based on closeness and are indexes either of independence or efficiency.' (Freeman 1979: p. 237)

structurally equivalent to one another, and proposing that an algebraic approach be used as an alternative to the limitations of graph theory. Granovetter (1973) explored the power of *weak ties* that, on the one hand lack intimacy, but on the other hand facilitate the diffusion of influence and information and provide opportunities for mobility. By 1978, a specific journal named *Social Networks* was established to provide a common forum and a medium for the rapid and systematic exchange of ideas about social networks (Freeman, Mitchell, and Ziegler 1978).

Tolerance against failures and errors is an important feature of many complex networked systems. However research by Centola (2009) has shown that scale-free networks are much less robust than exponential networks for the spread of complex contagions (such as social movements, collective behaviours, and cultural and social norms). This work highlights the value of more homogeneously distributed social networks for the robust transmission of collective behaviour.

According to Dunbar (Dunbar 1993; Dunbar 1996), and supported in more recent work by Hill and Dunbar (2003), the typical size of a social network in contemporary Western society (the number of friends or meaningful relationships humans can have) is restricted to around 150 people, the *Dunbar Number*, due to the possible limits in the capacity of the human communication channel.<sup>2</sup> Further, Raafat and colleagues (2009: p. 424) point out that the shape of the network and its number of connections is crucial for the diffusion of information and for herding behaviour: 'Diffusion theory explores social networks and their role in influencing the spread of new ideas and practices. How do authority figures or "hubs" transmit their information in the more spatial-based transmission models?'

The link between social networks and health status has recently been studied by a number of authors, thus creating a link to the original work by Durkheim on social integration and suicide (1897). Berkman and colleagues (2000) provide an overview of this body of literature and present a conceptual model of how social networks affect health. They argue (p. 846) that network structure and function influence social and interpersonal behaviour through four primary pathways: (1) provision of social support; (2) social influence; (3) social engagement and attachment; and (4) access to resources and material goods. The work by Rook (1990) on conflicts and stress shows that not all relationships are positive in valence, and that social relationships may impact powerfully on health through acts of abuse, violence and trauma. A comprehensive review of social network models from the perspective of understanding health behaviours is provided by Valente (2010).

Watts (2004) provides an overview of the impact of the rapidly growing availability of inexpensive yet powerful computers and large-scale electronic datasets on the study of networks and networked systems. The substantial progress on a number of previously intractable research problems, and the

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<sup>2</sup> Dunbar (1993: pp. 681-694) used a *neocortex ratio* to examine the relationship between neocortex size and group size in nonhuman primates and found that these measures were reasonable predictors of group size. He then used a regression equation to predict a group size for humans of 147.8. Dunbar compared this figure with census data on intermediate level groups in tribal societies from a range of ethnographic studies where the average size of the intermediate level groups for those societies for which accurate census data were available was 148.4.

introduction of new techniques has been termed *the new science of networks* (Buchanan 2002; Barabási 2002; Newman 2003; Watts 2003). Research over the last decade has demonstrated that ‘many real networks, independent of their age, function, and scope, converge to similar architectures, a universality that has allowed researchers from different disciplines to embrace network theory as a common paradigm’ (Barabási 2009: p. 412).

While summarising the current field of research on networks, Provan, Fish and Sydow (2007: p. 481), highlight the need to study networks and their performance from two perspectives – *structure*, using social network analysis, and *governance*:

Although great strides have been made, a shared language with definite, concrete meanings in the study of networks has not been developed. In particular, it seems indispensable to distinguish between networks as a perspective (often using social network analysis as a methodology and simply capturing any relational embeddedness of organisational action) on one hand and networks as a form of governance on the other (e.g., Grabher and Powell 2004).

The next section introduces social network analysis and its applications. Section 5, below, addresses the concept of network governance and research relating to this area.

## **4. Social Network Analysis**

### **4.1 Description, features and applications of social network analysis**

Social network analysis can provide information on the position of the person within a network, e.g., of the relationship between network members, of the characteristics of the network structure (whether it is dense or loose), of the ties that connect actors (whether they are strong or weak), and of the relationships between network structure and position and access to the resources within those networks (Hawe, Webster, and Shiell 2004). For example, work by Brass (1984) examined the relationships between structural positions and individual influence in an organisation, with the results providing support for a structural perspective on intra-organisational influence. Burt (1982: p. 20) defined network models as describing ‘the structure of one or more networks of relations within a system of actors’. Thus network analysis can also examine networks of networks.

The four features of modern social network analysis are defined by Freeman (2004: p. 3) as:

1. Social network analysis is motivated by a structural intuition based on ties linking social actors,
2. It is grounded in systematic empirical data,
3. It draws heavily on graphic imagery, and
4. It relies on the use of mathematical and/or computational models.

Wellman (1988: p. 86) argues that the essence of community is its social structure, not its spatial structure. By assessing actual ties between network members, one can empirically examine whether community exists and whether that community is defined on the basis of neighbourhood, kinship, friendship, institutional affiliation or other characteristics. Newman and colleagues point to the

importance of the number of ties that actors have to other actors, their so-called *degrees* (Newman, Watts, and Strogatz 2002). For example, in many networks, the distribution of actors' degrees is highly skewed, with a small number having an unusually large number of ties. Newman and colleagues cite analytic work that suggests that this 'skewness' could have an impact on the way in which communities operate, including the way information travels through the network and the sustainability of networks.

Granovetter (1973) showed that close or strong ties were involved in the process of finding a job less frequently than were weak ties. Building on this work, Burt's (1992) theory of *structural holes* defines them as non-redundant relationships where the hole acts as an insulator. The research on structural holes suggests it is more beneficial to be the exclusive link between individuals and groups (thus filling a structural hole) who are not themselves tied to each other. So, non-redundant relationships to others are more beneficial in terms of accessing others' information and power. Burt (1992) argues that dense networks are less efficient than sparse networks of the same size because they return less diverse information for the same costs. Efficient networks have more structural holes: that is, they have more ties that span non-redundant contacts.

As described by Granovetter (1992: p. 35), in contrast to *relational embeddedness*, which essentially refers to the quality and depth of a single dyadic tie, *structural embeddedness* can be defined as the extent to which a 'dyad's mutual contacts are connected to one another'. Organisations do not have relationships only with each other, but with the same third parties as well, with many parties being linked indirectly by third parties. Structural embeddedness is a function of how many participants interact with one another, how likely future interactions are among participants, and how likely participants are to talk about these interactions (Granovetter 1973, 1982). The more structural embeddedness there is in a network, the more information each actor knows about all of the other actors, and the more constraints there are on each actor's behaviour (Burt 1992).

Jones and colleagues (1997) argue that structural embeddedness is critical to our understanding of how social mechanisms coordinate and safeguard exchanges in networks, for it diffuses values and norms that enhance coordination among autonomous units, and it diffuses information about parties' behaviours and strategies that enhances safeguarding customised exchanges. Further, Jones and colleagues (1997: p. 925) propose that:

[S]ince structural embeddedness diffuses information throughout a system, it also facilitates the development of macroculture – the common values, norms, and beliefs shared across firms – because parties share perceptions and understandings.

However, they note that too much embeddedness may create its own set of problems, citing Uzzi (1997) who suggests that over-embeddedness in relational embeddedness (i.e., many strong ties and few weak ties) can lead to feuding, choking off novel information from other parts of the industry, and welfare-like support of weak network members. Such overreliance on strong ties tends to develop tight, relatively isolated cliques that are not well integrated with the rest of the industry (Granovetter 1973). Granovetter and Soong (1983) proposed models of diffusion and collective behaviour, taking into account population heterogeneity. Consistent with Granovetter's (1973) strength of weak ties theory,

Valente and colleagues (2007) found that less dense networks of community coalitions facilitated adoption of substance abuse prevention programs.

Furthering the research on networks and structural holes, Ahuja (2000a) studied three aspects of a firm's network – direct ties, indirect ties, and structural holes (disconnections between a firm's partners) in relation to the firm's subsequent innovation output. Results from their longitudinal study of firms in the international chemicals industry indicated that direct and indirect ties both had a positive impact on innovation, but that the impact of indirect ties was moderated by the number of the firm's direct ties. However, increasing structural holes had a negative effect on innovation. The implication for inter-organisational network theory is that the optimal structure of inter-firm networks depends on the objectives of the network members.

The examples provided in this section have shown how social network analysis can be used to examine structural relationships and influence in networks, the way information travels in networks and the sustainability of networks. Network theories of interest include Granovetter's (1973) theory on the strength of weak ties and Burt's (1992) theory on structural holes, with efficient networks having more structural holes. Ahuja's work (2000b) furthers the structural holes theory by suggesting that the optimal structure of inter-firm networks depends on the objectives of network members. Other theories of interest include relational embeddedness (the quality and depth of ties), and structural embeddedness (a function of how many actors interact with one another) as described by Granovetter (1992: p. 35).

## 4.2 Tools of social network analysis

Comprehensive reviews of the tools of social network analysis are provided by Knoke and Yang (2008) in their revised edition of the work by Knoke and Kuklinski (1982), by Scott (1991, 2000) and by Wasserman and Faust (1994). Berkman and colleagues (2000) describe network characteristics as covering:

- Range or size (number of network members);<sup>3</sup>
- Density (the extent to which the members are connected to each other);
- Boundedness (the degree to which they are defined on the basis of traditional group structures such as kin, work, neighbourhood);
- Homogeneity (the extent to which individuals are similar to each other in a network).

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<sup>3</sup> The issue of adequately specifying the boundaries of networks presents a challenge in studying networks (Gulati 1995).

Related to network structure, Berkman and colleagues describe characteristics of individual ties as including:

- Frequency of contact (number of face-to-face contacts and/or contacts by phone or mail);
- Multiplexity (the number of types of transactions or support flowing through a set of ties);
- Duration (the length of time an individual knows another);
- Reciprocity (the extent to which exchanges or transactions are even or reciprocal).

A number of the key measures of social networks are described (Mendel et al. 2009; Valente 1995; Valente, Chou, and Pentz 2007) as: *degree centrality* (the sheer number of ties that an organisation has with other organisations in the network), *betweenness centrality* (assesses the extent to which an organisation serves as a link or bridge across different parts of the network that would otherwise not be connected), *density* (measures the general degree of interconnectedness of a network based on the ratio of observed links among nodes to the total number that could possibly exist), *transitivity* (measures how well information flows within a network, based on the proportion of times a connection from one node to two others is accompanied (or *closed*) by a connection between the other two nodes (akin to a *friend of a friend* scenario), and *network centralisation* (a measure of the extent to which a network is dominated by one or a few very central hubs, i.e., nodes with high degree and betweenness centrality).

Graphic representation can be made of network data in sociograms or in matrices. Graphs use nodes to represent actors in a network and lines to represent ties. Harary and colleagues (1965) and Hage and Harary (1983) provide details of network graph theory. A two-way matrix, a sociomatrix, can be used to represent network data. Computer packages designed specifically for network analysis are described by Scott (1991, 2000) and Wasserman and Faust (1994). Further information on social network computing programs is provided at the web-page of the International Network for Social Network Analysis (INSNA): <http://www.insna.org>.

### **4.3 Social network analysis theories and other sociological theories**

Burt (1992) and others (e.g., Granovetter 1985) have built on earlier work in exchange relations and resource dependence theory (Cook 1977; Pfeffer and Salancik 1978) to describe how actors develop and exploit privileged positions within social networks. Firms gain by linking with potential substitutes (thus preventing substitution for their products by customers) and bargaining against actors who are not connected to each other, and among whom they may therefore make substitutions. Work by Gould (2002) proposed and empirically applied a theoretical model depicting a *status hierarchy* ranking as an equilibrium resulting from individual responses to the trade-off between social influence and the distaste for making unreciprocated gestures.

Cook and Whitmeyer (1992) note that a narrow conception of network analysis exists, which considers it a type of *structural* analysis. For example, Wellman (1983: p. 157) states: 'Network analysts...try to describe [regular network patterns] and use their descriptions to learn how network structures

constrain social behaviour and social change.’ Cook and Whitmeyer (1992) link network analysis with exchange theory in sociology and therefore take a broader view of network analysis than the narrow view of purely structural analysis, so that it includes studies of the creation and/or maintenance of networks (e.g., Mizruchi and Stearns 1988) and studies that investigate the influence of non-network factors on network characteristics (e.g., Feld 1981; Laumann and Marsden 1982).

A social network perspective was employed by Goodwin and colleagues (2009) to study the leader-member exchange (LMX) relationship, a dyadic phenomenon, as it relates to the broader organisational network. By examining the relevance of both a leader’s and a follower’s informal social networks to the LMX dyad, they were able to determine how the value of a member’s social capital related to the quality of the dyadic relationship. Leaders formed high-quality LMX relationships with well-connected followers. They found (p. 973):

[A]n implicit understanding of the importance of the informal network within an organization – the use of formal position is not the only way to get results – and one’s ability to obtain a central position within informal networks is relevant to one’s relationships with leaders and subordinates.

Although leader-follower relationships may evolve over time, Goodwin and colleagues (2009: p. 973) also found that they do not necessarily switch from an economic, or instrumental, relationship to a purely social one: the instrumental and social aspects of the relationship appear to exist simultaneously. Meta-analytic research has shown an association between high quality LMX relationships and positive work-related outcomes, such as follower satisfaction, commitment and performance (Gerstner and Day 1997). In their recent review article on LMX theory, Schyns and Day (2010) introduce the concept of *LMX excellence* which involves high-quality LMX, high leader-member agreement as well as high group consensus in LMX quality – proposed as the optimal mix for achieving positive organisational outcomes. They outline how leaders’ and followers’ behaviour as well as context can enhance or hinder the development of *LMX excellence*.

Examples from organisational extremes – combat and fashion – are used by Corona and Godart (2010) to adapt and extend the *network-domain* concept from Harrison White’s *Identity and Control* (2008) to consider how social ties are interwoven with domains of meaning in organisations. Their interpretation is that modalities of behaviour in organisations are consequences of identities’ persistent movements among positions in network-domains as well as organisational efforts to manage these movements. While combat operations require internal group cohesion and constrained individuality, the fashion industry is based on the distinctiveness of designs and the display of personal tastes. Corona and Godart show how attempts at managing movements among network-domains are central to the identities in both organisational settings.

#### 4.4 Social network analysis and knowledge flows

Social network analysis is recognised as a useful tool for the investigation of knowledge flows within organisations (Chan and Liebowitz 2006; Liebowitz 2005). Rogers (2004) highlights the use of network analysis as a major analytical tool in contemporary research on diffusion of innovation. Networks can help in understanding how an idea or a specific piece of information spreads through interpersonal contacts. When an organisation is viewed as a network, there are important insights for knowledge management, and for distribution of knowledge throughout the organisation. Work on the diffusion of medical innovations (Becker 1970; Coleman, Katz, and Menzel 1966) has confirmed the importance of local peer influences or social networks. Research on medical practitioners' decision-making and practice patterns also highlights the importance of peer information based on social networks, as opposed to information based on educational strategies, in changing practitioner behaviour (Mano-Negrin and Mittman 2001).

The commercial sector has recognised the role of networks in knowledge transmission, especially in highly skilled professional service industries (Dawson 2003). Networks, or communities of practice, have been promoted and used by global corporations to obtain substantial performance and innovation impact. Examples include Novartis (Cross and Thomas 2009: pp. 11-15), Apple (Cross and Thomas 2009: p. 59), Halliburton (Cross and Thomas 2009: pp. 69-72), Xerox (Brown and Duguid 2001: p. 206), and Microsoft (Brown and Duguid 2001: p. 208). Networks are common in the health sector. They are not only structures for service provision but facilitate flexible engagement at different levels throughout the health system.

Research by Pahor and colleagues (2008) suggests that learning should be seen as both participation in a community of practice, and as a flow of previously acquired knowledge. Network learning occurs mostly in cliques, with members of the learning network forming clusters in which learning is more intense. Being in the same location, or belonging to the same business unit as one's co-worker, increases the likelihood of learning from that co-worker. Based on this research, both organisational cultures as well as organisational structures are important contextual variables that determine the structure, patterns, and success of learning networks. It is not just the individuals that are important in the network – also of crucial importance is the context in which the learning network emerges.

#### 4.5 Trust in networks

Trust has been identified as critical to the functioning of effective networks (Agranoff and McGuire 2001; Cross and Parker 2004; Edelenbos and Klijn 2007; La Porte 1996; McGuire 2006; O'Toole 1997). According to La Porte (1996), trust is essential because networks replace hierarchical power with cooperative relationships based on interdependence and have fewer super-ordinate mechanisms for ensuring sustained operations compared with hierarchies and markets composed of competing hierarchies. Lambright, Mischen and Laramée (2010: p. 64) found that (1) successful past cooperation and structural equivalence increase the likelihood the trustor will perceive the trustee as trustworthy; (2) the frequency of interactions between the trustor and trustee, trust transferability, and the perceived trustworthiness of the trustee have a direct positive impact on whether the trustor trusts the

trustee; and (3) trust between the trustor and trustee has a positive impact on expected future cooperation.

#### **4.6 Summary: Theory on structural aspects of networks**

To summarise, theory relating to structural aspects of networks can illuminate:

1. *Influence in organisations and inter-organisations*
2. *Competence , performance and sustainability of networks*
3. *Information and knowledge flows; diffusion of innovation*
4. *Structural holes- effects on efficiency of networks*
5. *Relational embeddedness and structural embeddedness – relate to exchanges in networks*
6. *Exchange relations and resource dependence theory*
7. *Leader-member exchange (LMX) relationship*
8. *Network-domain concept, and*
9. *Trust in networks.*

### **5. Network Governance**

#### **5.1 Networks as a governance structure**

The previous sections of this paper have examined the structural aspects of networks and the use of social networks analysis, and associated research theories. Balancing the examination of the structural aspects of networks, this section of the paper describes the research on *network governance*. The notion of networks as alternative governance structures will be introduced, leading onto a description of the rapid development of the rise in network governance by firms. Also addressed is the trend towards government of the state through decentralised and devolved public policy.

Williamson's seminal paper (1981) on the transaction cost approach to the study of economic organisation referred to markets, hierarchies and networks as alternative governance structures. Markets inherently lack a centralised source of sovereign control or authority, according to Hayek (1945), and although inter-firm networks may develop shared goals and coordinate in an effort to achieve those goals (Amin 2000), King and colleagues (2010: p. 298) argue that:

[I]n most cases strategic alliances are inherently more unstable than the associated organisations that constitute them. In part, this stability resides in the independent autonomy of each member organization to exit the alliance. If one member of an alliance decides to end the relationship, the partnership and its capacity to engage in independent action is dissolved. Corporations, by comparison, do not often suffer the same fate when a few members choose to leave the organization.

According to King and colleagues, communities differ most significantly from organisations in their lack of sovereignty, consisting of interdependent individuals who are not constrained by strict roles and hierarchical control. They note that 'in cases where communities are capable of unified, goal-directed action it is usually because they have organized themselves sufficiently to create a new kind of collective form – an organisation.'

Over the past 30 years, there has been a rapid rise in network governance, described by Jones and colleagues (1997) as coordination characterised by informal social systems rather than by bureaucratic structures within firms and formal contractual relationships between them. They assert that the network form of governance is a response to exchange conditions of asset specificity, demand uncertainty, task complexity, and frequency. These exchange conditions drive firms toward structurally embedding their transactions, which enables firms to use social mechanisms for coordinating and safeguarding exchanges. According to Jones and colleagues, when all of these conditions are in place, the network governance form has advantages over both hierarchy and market solutions in simultaneously adapting, coordinating, and safeguarding exchanges. Jones and colleagues (1997: p. 914) argue that *network governance*:

[I]nvolves a select, persistent, and structured set of autonomous firms (as well as non-profit agencies) engaged in creating products of services based on implicit and open-ended contracts to adapt to environmental contingencies and to coordinate and safeguard exchanges. These contracts are socially – not legally binding.

The trend towards devolved public policy where a complex range of non-profit, for-profit, and public organisations may all play a role in the context of decentralised and devolved governmental regimes is described by Milward and Provan (1993) as *the hollow state*. The central task of the hollow state is to arrange networks, while the traditional task of government is the management of hierarchies (Milward 1996). A number of authors have studied the trend towards *networked* organisations in a range of public policy settings (Agranoff and McGuire 1999; Chisholm 1998; Mandell 1999a, 1999b; O'Toole 1997). O'Toole (1997: p. 45) describes *networks* as:

[S]tructures of interdependence involving multiple organizations or parts thereof, where one unit is not merely the formal subordinate of the others in some larger hierarchical arrangement. Networks exhibit some structural stability but extend beyond formally established linkages and policy-legitimated ties.

Etzioni (2001) argued that *The Third Way* should be rooted 'in a communitarian vision of the good society': 'an ethical position that seeks to treat people as ends in themselves', with societies being able 'to achieve a dynamic balance between state, market and community'. Tracing policy manifestations of this new thinking, Considine and Lewis (2003) point to the Clinton-Blair Third Way strategy, with its support for a *mixed economy*. Both Clinton and Blair were influenced by the major proponent of *The Third Way*, sociologist Anthony Giddens (Giddens 1998). In this context, the Blair government supported *joined-up-government*, a form of network governance in which clients, suppliers and producers are linked together as co-producers. Similarly, health system 'reform' in many countries has looked to forms of network governance, as described by Sheaff and colleagues (2010). In Australia, the Health and Hospital Network structures announced as part of the Rudd government's health reforms (Australian Government 2010) could be seen as consistent with Rudd's espousal of *The Third Way* in his first speech to Parliament (1998).

Savage (2004: p. 671) posited that 'a network theory of professional production explains how knowledge, decentralisation, authority, and autonomy are linked in a way that makes sense as ways of managing knowledge and of gaining economies of scale'. In a professional network, according to Savage

(p. 667), ‘individual practitioners remain independent, but they make a long-term commitment of their substantial human capital to a hubless, indeed bossless, network’. She counters Paul Starr’s thesis in the *Social Transformation of American Medicine (1982)* about decentralised production by the medical profession forestalling a corporate rationalisation of medical care. Her argument is that most of the knowledge that drives medicine is tacit, and while the central issues of medicine involve coordination, directing resource use, and recognising autonomy and authority, the network proves more resilient than the rational corporation. Savage also defines *tacit knowledge*, in contrast to *explicit knowledge*.<sup>4</sup>

## 5.2 Network organisation and *wicked problems*

While recognising that in networks administrators cannot be expected to exercise decisive leverage by virtue of their formal position, O’Toole (1997) argues that if managers are increasingly required to deal with what Rittel and Webber (1973) have called *wicked problems* – challenges that cannot be handled by dividing them up into simple pieces in isolation from each other – then alternative forms of organising must be more suitable. Roberts (2000) explores various strategies public officials and managers can employ to cope with wicked problems, including collaborative strategies. Network forms of organisation, according to Powell (1990: p. 295), ‘typified by reciprocal patterns of communication and exchange – represent a viable pattern of economic organisation’. He contrasts networks with market and hierarchical governance structures and highlights the distinctive features of networks, noting that three enabling conditions for formation of networks include: know-how, the demand for speed, and trust (1990: pp. 324-326).

Van Bueren and colleagues (2003) argue that *wicked* policy problems face cognitive uncertainty (lack of scientific knowledge), strategic uncertainty (because many actors are involved) and institutional uncertainty (highly fragmented institutional setting). Therefore, decisions can only adequately be handled by enhancing and intensifying interactions between stakeholders, through a network approach. These are views consistent with Heckscher’s formulation of the post-bureaucratic organisation (Heckscher and Donnellon 1994), where the Weberian model of organisation, with clear lines of authority and defined functions and roles is replaced by a model based on networks. A report on a recent study of six firms by Martin and Eisenhardt (2010) provides empirical support for the theory that *rewiring*, a business unit-centric process led by *multi-business teams* of general managers, leads to better collaborations than a corporate-centric process. Borrowing from complexity theory, they also

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<sup>4</sup> Savage (2004: p. 665) explains: ‘The term *tacit knowledge* is most closely associated with Michael Polanyi (1958). Tacit knowledge is contrasted with explicit knowledge—an understanding that defies articulation. While the familiar simplifying distinction “knowing how vs. knowing that” breaks down when pushed too far, it is a useful way of beginning to think about certain situations. Some kinds of professional knowledge become embedded in the individual. So while it is possible to hire consultants to tell you some things about how to manage your business, for example, in the end they can’t tell you all they know; they wouldn’t know consciously what to tell you. Only by hiring that person (or integrating them into the network of professionals, in our case) can you place them in a position to access context-specific knowledge.’

found that multi-business organisations with strong performance operate as complex adaptive systems to address changing markets.

### 5.3 Networks and collaboration

In an examination of types of cooperation between local government managers, LeRoux and colleagues (2010) found that different types of networks were not equally effective in promoting service delivery across local government jurisdictions. Networking through a regional association that afforded opportunities for face-to-face interaction (such as a council of government), and being linked by a common set of professional norms and disciplinary values to members of the same discipline, both substantially increased cooperation. Manager participation in professional associations, however, did not increase inter-local cooperation.

Collaboration in networks requires explicit framing of the network's goals and tasks (Mandell 1999b), such that collaboration between network members is legitimised (Provan and Kenis 2007). Also required are known stable rules for interactions (Klijn 1996; Mandell 1999b) as a basis for reciprocity and trust (Plickert, Côté, and Wellman 2007; Thomson and Perry 2006). Sheaff and colleagues (2010) argue that a network's *macroculture* articulates these shared goals and values, giving them concrete representation in artefacts, language and symbols. They contrast *macroculture* with the *microculture* (or simply *culture*) of each member-organisation in the network, and with the wider national and social cultures (sometimes also called *macrocultures*) within which particular health networks are embedded. With the domination and coordination of a network by one focal organisation, network macroculture may acquire a hierarchical character, even when the member organisations are formally independent (Dhanarag and Parkhe 2006).

The advantages of network coordination in both public and private sectors are listed by Provan and Kenis (2007) as: enhanced learning, more efficient use of resources, increased capacity to plan for and address complex problems, greater competitiveness, and better services for clients and customers (as shown in: Alter and Hage 1993; Brass et al. 2004; Huxham and Vangan 2005). However, Provan and Kenis point to a considerable discrepancy between the acclamation and attention networks receive and the knowledge we have about the overall functioning of networks: that is, the process by which certain network conditions lead to various network-level outcomes.

## 6. Combining Network Analytical and Governance Perspectives

Salancik (1995) warns of the 'danger in network analysis of not seeing the trees for the forest', and the need to recognise interactions when considering the role of networks in a theory of organisation. Acknowledging Salancik's work, Dhanarag and Parkhe (2006) argue that 'the trees and the forest are both important to understand'. They contend that in studying inter-organisational networks, the *player-structure duality* must be taken into account through addressing both the structural inducements and constraints of the network, as well as organisational action that perpetuates the network. Therefore, alliance literature and network theory must be linked.

Provan and Kenis (2007) propose combining the network analytical and governance perspectives, to examine different network governance configurations and the conditions for the effectiveness of each form. Their focus is on the governance and management of networks themselves, with this focus on governance involving the use of institutions and structures of authority and collaboration to allocate resources and to coordinate and control joint action across the network as a whole. A related paper by Provan and colleagues (2007) reviews and discusses the 'modest' empirical literature on inter-organisational networks at the network level of analysis (i.e., whole networks). Although there is a developing literature on networks as a unit of analysis, most of this work has been descriptive (Agronoff and McGuire 1999; Huxham and Vangan 2005; van Bueren, Klijn, and Koppenjan 2003).

The critical role of network governance and its impact on *network effectiveness* is explored by Provan and Kenis (2007). They define network effectiveness as 'the attainment of positive network level outcomes that could not normally be achieved by individual organizational participants acting independently'. The specific type of network-level outcome considered depends on the particular constituency assessing the functioning of the network – the community, the network itself, and the network's organisational participants (Provan and Milward 2001). Hence, networks must be evaluated at these three levels of analysis. While the three levels are related, each has its own set of effectiveness criteria that must be considered. Provan and Milward (2001) note that comparative network data that are tied to outcomes are scarce, citing work by Lehman and colleagues (1994) and Provan and Milward (1995). They argue that, consistent with pressures to perform effectively from a broad range of key stakeholders, networks must be evaluated at three levels of analysis: community, network and organisation/participant levels.

## **7. Clinical and Health Networks**

Types of networks in the health care system, with particular relevance to quality of care and patient safety, may be seen in terms of a broad spectrum, from forums to share information and experiences to defined organisations and more tightly integrated forms. (The different types of networks of health professionals are described in Section 8 below.) According to Southon (2006), while networks in the health sector 'usually develop spontaneously, they are often not optimally structured, adequately supported, or effectively exploited by health service organisations'.

In the health sector, quality improvement collaboratives (QICs) are one type of *clinical network*. Initially implemented in the United States and the United Kingdom, followed by adoption in many countries including Australia over the last 10 years, this type of network has attracted considerable research activity. There are many variations on this model, but the *Breakthrough* model of the US Institute for Healthcare Improvement (IHI) is the most well known model (Wilson, Berwick, and Cleary 2003; Plsek 1997). The US Veterans Affairs System has developed its own intra-organisational QICs addressing specific topic areas that bring together researchers, quality improvement leaders, and organisational leaders to work on learning and applying the best science in change management and in medical care (Solberg 2005).

QICs are described by Øvretveit and colleagues as organising:

[G]roups of practitioners from different healthcare organisations to work in a structured way to improve one aspect of the quality of their service. It involves them in a series of meetings to learn about best practices in the area chosen, about quality methods and change ideas, and to share experiences of making changes in their own local setting. (2002: p. 345)

Collaboratives use continuous quality improvement methods to effect changes. Referring to work by Dúckers and colleagues (2009) and Ferlie and Shortell (2001), Cretin, Shortell and Keeler (2004) argue that continuous quality improvement involves multi-disciplinary teamwork, team empowerment, an iterative approach to problem solving and ongoing measurement.

Summarising the research findings on collaboratives, Øvretveit and colleagues (2002) reported that many professionals valued taking part in a collaborative. Participation helped to build interprofessional cooperation within the team attending the collaborative and in their home organisation, and helped professionals to make links with colleagues in other organisations. There was also evidence that while not all teams were successful, some teams participating in collaboratives made significant clinical and organisational performance improvements more quickly than they might have done on their own.

According to Mittman (2004), QICs are presented as ‘arguably the healthcare delivery industry’s most important response to quality and safety gaps’, and represent substantial investments of time, effort, and funding. Nevertheless, Mittman concluded that ‘its [the QIC method] overall effectiveness remains highly uncertain but is probably modest’. Dúckers and colleagues (2009) summarises the key findings: ‘the problem is that despite its popularity, the evidence for QIC effectiveness is positive but limited,’ (based on: Cretin, Shortell, and Keeler 2004; Mittman 2004; Øvretveit et al. 2002). Similarly, Schouten and colleagues (2008) concluded: ‘The evidence on QICs is positive, but limited, however it is not possible to predict the effects with great certainty.’

Citing findings from Øvretveit and colleagues (2002), Mittman (2004), Landon and colleagues (2004), Leatherman (2002), and Solberg (2005), Dúckers and colleagues (2009) have pushed for more research into the different types of QICs and their effectiveness, along with the linking of QIC practices explicitly to organisational and change management theory. As noted by Dúckers and colleagues (2009) and Øvretveit and colleagues (2002), additional research is needed to test the effectiveness of QICs as a spread strategy. There is also a need to assess how external change agent support influences team organisation, how team learning within a QIC takes place, and how QICs contribute to organisational learning. In addition, Dúckers and colleagues note that sustainability needs to be investigated. They point to the conclusions from Greenhalgh and colleagues’ (2004) review of *diffusion of innovation*: many studies addressed adoption, implementation and diffusion, but only a limited number of studies dealt with sustainability.

In the United Kingdom, following the election of the Labour government in 1997, network-based models of service delivery were adopted as a mode of organising UK public services, in addition to the alternative forms of markets or bureaucracies. Managed clinical networks were introduced in the National Health Service (NHS) to streamline and standardise care across organisational boundaries and

to diffuse evidence and ‘best practice’ across the health system (Calman and Hine 1995). A study of managed NHS cancer networks found that networks concentrated on structural reconfiguration, while their knowledge management role remained marginal (Addicott, McGivern, and Ferlie 2006). Sheaff and colleagues (2010) examined the impact of the NHS quasi-market reforms on health networks’ macrocultures by comparing these impacts across two care networks, a program network and a user-experience network. The artefacts (the network’s collective products or services and technologies and inputs) adapted to health system reform faster than espoused values.

In Australia, the first forms of clinical networks, specifically associated with clinician engagement and quality improvement, were established in New South Wales (NSW), through the Greater Metropolitan Clinical Taskforce and its predecessor agencies, as described by Braithwaite and Goulston (2004). A majority of Australian states have also introduced clinical networks, mostly as a result of recommendations in major state health system reviews. However, to date there is a lack of independent evaluation of Australian clinical networks in the published peer reviewed literature.

## 8. Research Question and Definitions

It follows that while there is a considerable corpus of literature on networks within and outside of the health sector, there are multiple research questions to be answered. The research question explored in the systematic review of the literature was:

How has research on social and professional networks of health professionals been used to examine the effectiveness and sustainability of networks in relation to quality of care and safety?

The concept of networks, as applied to health professionals, has encompassed a diverse range of groupings as set out in Table 1:

**Table 1: Types of Professional Networks**

Network	Examples
Linked, professional networks	Either ‘expertise’ or clinical referral ‘care’ networks, referred to by Braithwaite et al. (2009b), Sheaff et al. (2010) and by Southon et al. (2005). Savage (2004) proposed a working definition of ‘professional networks’ as ‘communities of independent practitioners who share a core competence and who form strategic alliances across ownership boundaries’.
Clinical networks	Linked groups of health professionals and organisations from primary, secondary, and tertiary care working in a co-ordinated manner, unconstrained by existing professional and [organisational] boundaries to ensure equitable provision of high quality effective services (UK National Health Service -The Scottish Office Department of Health 1999).
Project networks	Bring together expertise to achieve a particular goal (Southon, Perkins, and Galler 2005).
Program (‘linkage’) networks	Examples include WHO-style programs (Sheaff et al. 2010).
Policy networks	Examples include policy ‘communities’ (Sheaff et al. 2010).

Network	Examples
Managerial networks	Groups of managers brought together for a common purpose. Sometimes facilitated by a College, eg, Australasian College of Health Service Management.
Learning networks	Learners create connections and develop a network that contributes to their professional development and knowledge (Drydon and Vos 2005; Sheaff et al. 2010).
Interest networks	Usually open, characterised by informal exchanges between a wide range of people interested in the same issues (Southon, Perkins, and Galler 2005).
Networks of practice	Examples include the Asian Development Bank's regional knowledge hubs to encourage research and networking on innovative knowledge products and services (Asian Development Bank 2010).

The concept of networks has also included *collaborating communities* (Braithwaite et al. 2009b), *multi-organisational collaborative groups* (Øvretveit et al. 2002; Pedlar 2001; Plsek 1997), *alliances* (Barringer and Harrison 2000), *partnerships* (Barringer and Harrison 2000), *systems*, including complex socio-technical systems, (Braithwaite, Runciman, and Merry 2009a), and *communities of practice* (Wenger 1998). In health care, social networks often manifest as groups of clinicians with common professional interests in particular care or services, e.g., cancer, patient safety or asthma (Braithwaite et al. 2009b).

The World Health Organization (1998) provides a relatively straightforward network definition:

A network is a grouping of individuals, organisations and agencies organised on a non-hierarchical basis around common issues or concerns, which are pursued proactively and systematically, based on commitment and trust.

Provan and Kenis (2007: p. 231) provide a more narrow definition of organisational networks:

[G]roups of three or more legally autonomous organisations that work together to achieve not only their own goals but also a collective goal.

Braithwaite, Runciman and Merry (2009a) describe two types of networks: *mandated networks* (purpose-designed, funded and designed by someone in authority) and *natural networks* (which emerge spontaneously, and in health care manifest as 'groups of clinicians who interact professionally to share information, support, consult, refer and jointly manage patients'). They continue:

For every health care problem there are networks, hubs and sub-clusters made up of clinicians with a special interest and expertise in that area. Such people are typically willing to devote time and effort to solving the problems in which they have a natural interest, as part of their professional lives, whether or not adequate funding is available.

In a paper prepared for the United Kingdom Health Development Agency, Pedlar (2001) lists the common characteristics of networks:

- *Groups of people linked by common goals ...*
- *held together primarily by personal relationships....*

- *ties* of mutual interest, sharing, reciprocity and trust and...
- *links* via various connecting and co-ordinating means such as meetings, conferences, newsletters, joint projects, working partnerships.
- Network *nodes* can be individuals, groups, teams or organisations and in the ...
- *spaces* or interstices spanned by these nodes and links are the potentials for learning and innovation.
- Networks *include and exclude* people, and ...
- *status and authority* are based less on formal position or qualifications and more on knowledge, usefulness, sharing and innovativeness.
- They can be in whole or in part *virtual associations* where the technology of computer networking underpins and enhances face-to-face interaction.

## 9. The Literature Review Process

Against this background and definitional work, the literature was reviewed and analysed. The literature review was based on a rigorous systematic search strategy followed by content analysis of those papers that met specified inclusion criteria. These components are detailed in this section and represented in Figure 1. The process was based on a model developed by Travaglia, Braithwaite and Debono (2008), building on the work of earlier researchers (Braithwaite and Travaglia 2005; Greenfield and Braithwaite 2007; Travaglia and Braithwaite 2007).

### 9.1 The search strategy and inclusion strategy

The literature search was conducted between September and December 2009 using a search of three health-related and two broader electronic databases. The period covered in the search was from 1995 to 2009. The search was limited to this period as the study of networks is still relatively new, with most of the empirical work on health networks conducted in recent years. The data sources and the periods searched are presented in Table 2.

**Table 2: Academic Literature Databases Searched**

DATABASES	SEARCHED FROM
MEDLINE (Medicine)	1995 to September 2009
CINAHL (Cumulative Index of Nursing and Allied Health Literature)	1995 to September 2009
Embase (Medicine and health services)	1995 to September 2009
Web of Science (Science Citation Index, Social Science Citation Index, Arts & Humanities Citation Index)	1995 to September 2009
Business Source Premier (Management and Business)	1995 to September 2009

Following a preliminary extensive review of terms in the literature, and of the MeSH database definitions of terms, key search terms were identified by the researchers. The inclusion and exclusion

criteria were established and academic databases were selected. The search terms chosen reflect the aim of the review to identify published research literature on social networks of health professionals. The key search term utilised was 'social network' for the initial search.

Terms associated with *social networks* of health professionals in the health sector literature include:

- Inter-professional relations
- Interpersonal relations
- Interdisciplinary communication
- Organisational culture
- Models, organisational

As the intent was to explore the literature relating only to *social networks* of health professionals, the following terms were used to assist in refining the search:

- Healthcare OR Health care
- Healthcare sector OR health care sector
- Health personnel
- Medical staff
- Workforce
- Professional practice
- Delivery of healthcare OR delivery of health care

To narrow the search to relevant material, a two-stage approach was used so that the articles generated from the first stage, the initial 'social network' search, were then searched in combination with each of the subsequent terms, in separate searches. Where appropriate, the singular and plural of terms were used to ensure capture of relevant articles. (The term '\*' allows for a search of plurals, that is, social network or social networks and 'exp' searches using the selected term and all of its more specific terms.) Where standardised Medical Subject Headings (MeSH) were available, these were used; where a MeSH term was not available, a keyword search was conducted. A complete list of the search terms is provided in Table 3.

The search proceeded with a systematic examination of multiple electronic academic literature databases in late September 2009 and early October 2009, using the search terms set out in Table 3. The databases searched were Medline (health and medicine literature), CINAHL (Cumulative Index to Nursing and Allied Health Literature), EMBASE (medicine and health services literature), Web of Science (Science Citation Index, Social Sciences Citation Index, Arts and Humanities Citation Index), and Business Source Premier (business and management literature). Trial searches were undertaken with a number of additional electronic databases (LISA, Scopus, ABI-Inform-Global, IBSS, EconLit), however these did not yield additional papers, and were not included in the search.

**Table 3: Search terms**

SEARCH TERMS FOR SOCIAL NETWORKS (HEALTH PROFESSIONALS)	
1.	'Social network**' AND
2.	'Health care' OR 'Healthcare'
3.	OR 'Healthcare sector' OR 'Health care sector'
4.	OR 'Health personnel'
5.	OR 'Medical staff'
6.	OR 'Workforce'
7.	OR 'Professional practice'
8.	OR 'Delivery of healthcare' OR 'Delivery of health care'
9.	OR 'Interprofessional relations'
10.	OR 'Interpersonal relations'
11.	OR 'Interdisciplinary communication'
12.	OR 'Organi*ational culture'
13.	OR 'Models, organi*ational'

The limiters used in the search included the period from January 1995 to September 2009, and, when available, 'human', 'English language', 'scholarly journals', and 'abstract available'. Articles identified were downloaded into Endnote version X3, a reference management software package, for subsequent assessment. The search results are presented in Table 4. From this search, the identified articles were reviewed, and the search process removed duplicates and incomplete references (e.g., author and/or abstract missing). The search of the health professional social networks literature, SN (N), resulted in a total of 1 560 articles retrieved. N is the number of references and SN refers to the health professional social networks literature.

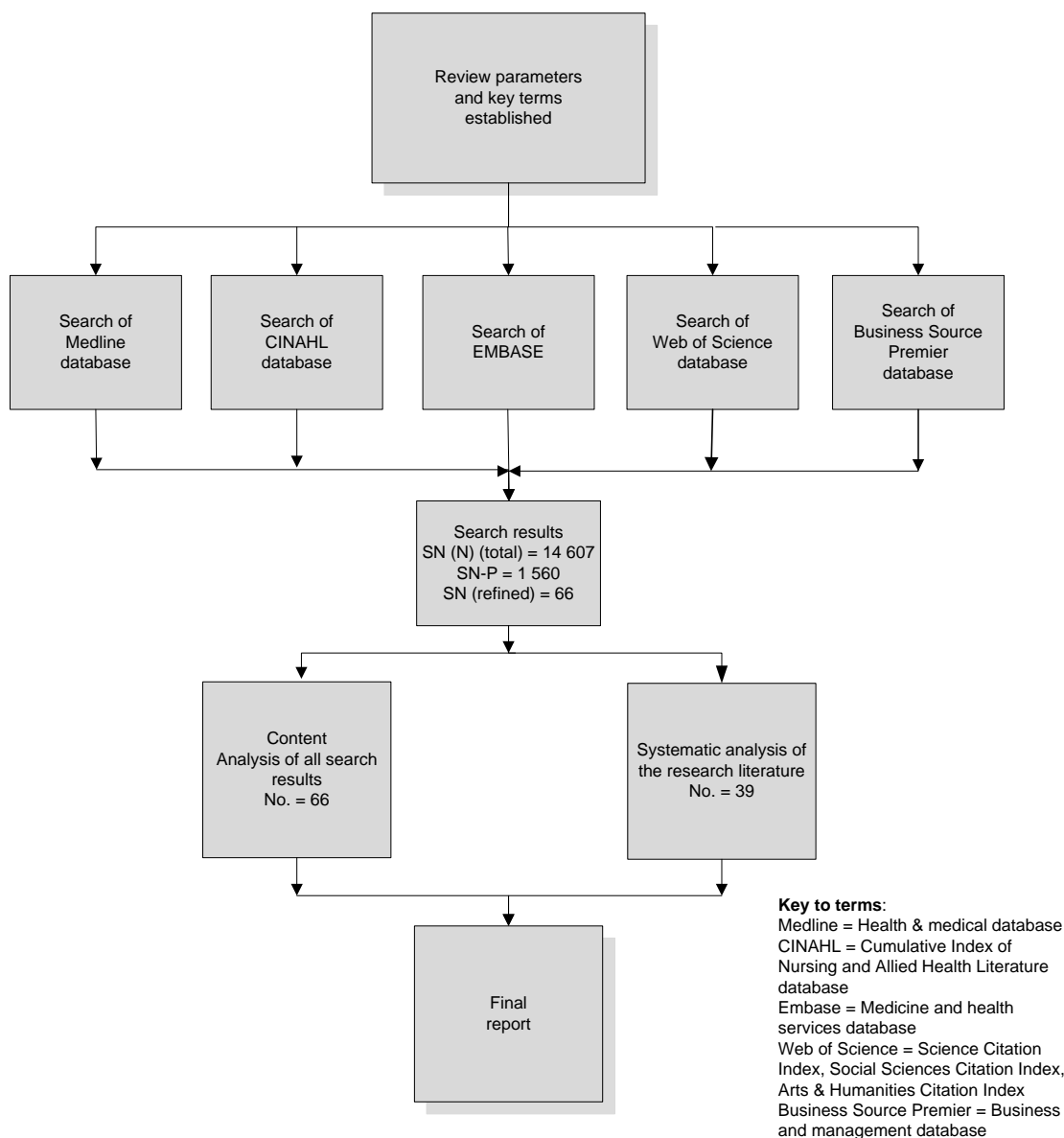
A similar search was conducted using the term *professional network* instead of *social network*, with all the associated terms (2 to 13 above), and the search results are presented in Table 5. An analysis of titles and abstracts of these references (SN-P=1560, and PN=275) was conducted by two reviewers (FC and DM). Articles were removed if they were incomplete, or if they did not meet the inclusion criteria.

Using specified selection criteria, studies were excluded if they reported on:

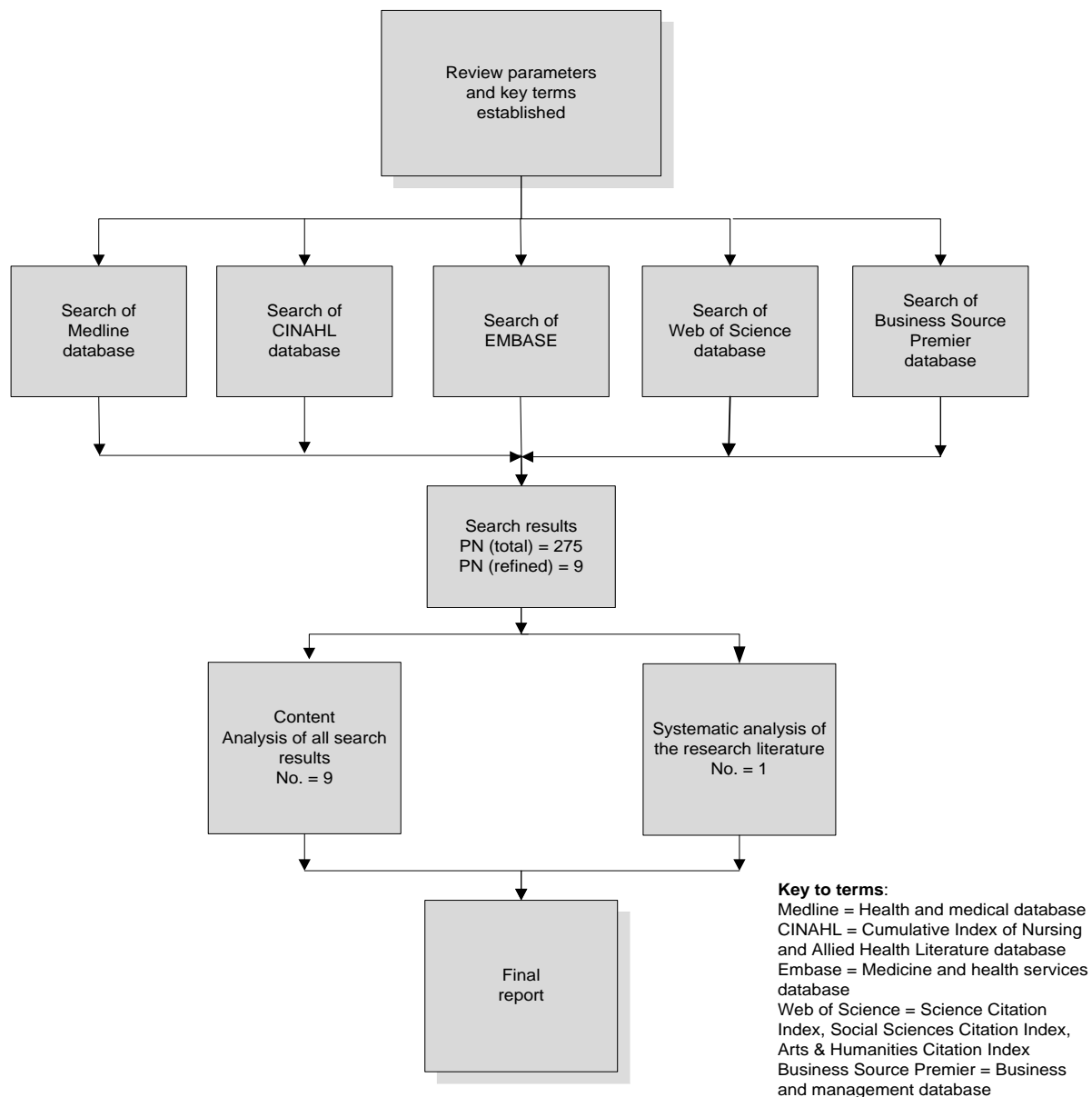
- social networks of patients, clients or caregivers,
- health service networks (if they provided a description of service arrangements only, rather than having relevance to health professional practice),
- non-health professionals (except for inclusion of articles on social workers and care workers if working in the health system; and except for health administrators or health policy makers),
- internet social networking (unless specifically related to health professional practice),
- university-based students in health disciplines, and student-education processes,

- academics in health-related faculties (e.g., biomedical informatics) or research scientists,
- infection control or epidemiological networks (e.g., modelling disease, contagion outbreaks – unless specifically related to professional networks),
- bio-networks and neural networks, and
- e-health systems and software (not relating to health professional practice).

**Figure 1: Social Networks of Health Professionals - literature review process**



**Figure 2: Professional Networks of Health Professionals–Literature Review Process**



The findings of the reviewers were blinded from each other until completion of this step. Articles were not excluded if there was any doubt about their content. Where there was a difference in agreement on the inclusion of any article, this was resolved through discussion and a further review of the abstract. The reviewers quickly identified and discarded articles not relevant to social networks of practising health professionals. The majority of articles excluded related to social networks of patients or clients. The total for the search of the literature on social networks of health professionals, SN-P, resulted in 66 references. The 66 references were considered to be potentially relevant and were obtained in full text for review.

**Table 4: Search results for selected databases on Social Networks: 280909 - 061009**

SEARCH TERMS	DATABASE RESULTS: NUMBER OF ARTICLES					
	MEDLINE	CINAHL	EMBASE	WEB OF SCIENCE (SCI, SSCI/AHCI)	BUSINESS SOURCE PREMIER	TOTAL
1. 'Social Network*'	2290	1325	1722	7831	1439	<b>14 607</b>
Term Searches:						
2. 'Health Care' OR 'Healthcare'	231	49	148	319	0	<b>751</b>
3. 'Health Care Sector'	0	0	0	0	0	<b>0</b>
4. 'Health Personnel'	15	26	2	4	0	<b>47</b>
5. 'Medical Staff'	0	0	3	1	0	<b>4</b>
6. 'Workforce'	6	3	2	14	0	<b>25</b>
7. 'Professional Practice'	6	5	0	0	0	<b>11</b>
8. 'Delivery of health care'	16	0	1	0	0	<b>17</b>
9. 'Interprofessional relations'	30	2	0	0	2	<b>34</b>
10. 'Interpersonal relations'	351	126	2	23	211	<b>714</b>
11. 'Interdisciplinary communication'	12	0	0	0	0	<b>12</b>
12. 'Organi*ational culture'	15	7	1	7	0	<b>30</b>
13. 'Models, organi*ational'	22	0	0	0	0	<b>22</b>

SEARCH TERMS	DATABASE RESULTS: NUMBER OF ARTICLES					
	MEDLINE	CINAHL	EMBASE	WEB OF SCIENCE (SCI, SSCI/AHCI)	BUSINESS SOURCE PREMIER	TOTAL
Combined results	704	218	159	368	218	<b>1 667</b>
Total (after duplicates removed)	<b>609</b>	<b>218</b>	<b>153</b>	<b>367</b>	<b>213</b>	<b>1560</b>
Total (after removing non-human, missing abstract, missing author, irrelevant (e.g., patient networks, etc.))	<b>41</b>	<b>6</b>	<b>11</b>	<b>22</b>	<b>2</b>	<b>82</b>
Total after duplicates removed	<b>66</b>					
Identification of research literature	<b>39</b>					

Similarly, the search of the professional networks of health professionals (PN) resulted in 9 references (Figure 2). These were additional to those in the social networks of health professionals search.

In the next assessment of these references, articles were included only if they met the inclusion criteria above, and if they were empirical research articles (using research methods). Discussion and commentary pieces were excluded, and articles on proposed research studies. The reports were also critically appraised to identify and exclude those not peer-reviewed or not meeting methodological criteria (e.g., pilot studies, or with low sample sizes), or lacking in sufficient detail for meaningful analysis. On the basis of this reading review by FC and DM, only 40 empirical, peer-reviewed, research articles were considered to meet the inclusion criteria from the search (39 from the social networks of health professionals literature,<sup>5</sup> and one from the professional networks of health professionals literature). Review articles identified in the search and pertinent to the literature review were examined to further inform the review process, but were not included in the review proper.

A snowballing step included a review of new research articles identified through search alerts after the initial search until December 2009. This step identified four additional articles, making a total of 44 research articles on social and professional networks of health professionals.

<sup>5</sup> The paper by Benham-Hutchins and Effken (2010) was included in the search results, in lieu of the doctoral dissertation on this study by Benham-Hutchins (2008) which was identified by the search, but was not available for review.

**Table 5: Search results for selected databases on Professional Networks: 261109**

SEARCH TERMS	DATABASE RESULTS: NUMBER OF ARTICLES					
	MEDLINE	CINAHL	EMBASE	WEB OF SCIENCE (SCI, SSCI/AHCI)	BUSINESS SOURCE PREMIER	TOTAL
1. 'Professional Network*'	76	19	35	145	0	275
Term Searches:						
2. 'Health Care' OR 'Healthcare'	20	2	6	22	0	50
3. 'Health Care Sector'	0	0	1	0	0	1
4. 'Health Personnel'	3	0	0	1	0	4
5. 'Medical Staff'	0	0	0	0	0	0
6. 'Workforce'	2	0	0	3	0	5
7. 'Professional Practice'	2	1	0	0	0	3
8. 'Delivery of health care'	1	0	0	0	0	1
9. 'Interprofessional relations'	11	0	0	0	0	11
10. 'Interpersonal relations'	4	0	0	0	0	4
11. 'Interdisciplinary communication'	2	0	0	0	0	2
12. 'Organi*ational culture'	0	1	0	0	0	1
13. 'Models, organi*ational'	1	0	0	0	0	1

SEARCH TERMS	DATABASE RESULTS: NUMBER OF ARTICLES					
	MEDLINE	CINAHL	EMBASE	WEB OF SCIENCE (SCI, SSCI/AHCI)	BUSINESS SOURCE PREMIER	TOTAL
Combined results	46	4	7	26	0	83
Total (after duplicates removed)	34	4	6	26	0	70
Total (after removing non-human, missing abstract, missing author, irrelevant (e.g., patient networks, etc.))	9	3	3	9	0	24
Total after duplicates removed	9					
Identification of research literature	1					

## 10. Systematic Analysis of the Research Literature

The literature search produced a total of 44 empirical research articles for analysis. On closer review of these articles, three were found to relate to one study, and there were two instances of two articles relating to one study. Hence, the number of distinct studies was reduced to 40. Analysis of the literature was conducted through a systematic analysis of this research literature. This process included reviewing the documents, identifying emerging common themes and summarising the findings.

The analysis and findings are presented in two sections. The first section presents an analysis of the characteristics of the empirical studies (section 11.1). The second section presents an analysis of the empirical studies categorised using six topics (section 11.2). The topics are: (1) the influence of information sources on the awareness and adoption of a new technology or innovation; (2) the communication and exchange of patient clinical and other information between practitioners or organisations; (3) understanding the structural relationships and social context of professionals or organisations or between organisations; (4) advice seeking patterns of health practitioners; (5) information / knowledge exchange between health practitioners; and (6) identification of opinion leaders. The next section (section 12) provides a synthesis of the systematic analysis.

## 11. Analysis and Findings

### 11.1 Characteristics of the empirical studies

The empirical studies are analysed according to the following characteristics: countries where research has been conducted; research settings; professions researched in the studies; and research designs and methods. Each of these is now summarised. Table 2 in **Appendix 1** presents a summary table with the details of each individual study, including author, setting and country, study objective, study design and methodology, and study findings.

#### 11.1.1 Location of the research studies

Although research has been conducted in 11 different countries, over half of the studies was undertaken in the United States (52%), followed by Australia (10%), Canada (10%) and the United Kingdom (10%). Table 6 provides the details of the countries and the number of studies that have been conducted in each country.

**Table 6: Countries where the research has been conducted**

COUNTRY	NUMBER OF STUDIES (No.=40)
United States	21
Australia	4
Canada	4
United Kingdom (England; Scotland)	4 (2, 2)
Germany	1
Ireland	1
Italy	1
Norway	1
Sweden	1
The Netherlands	1
Taiwan	1

#### 11.1.2 Research settings

The research settings can be classified into seven categories. The majority of the studies, 16 (40%), were hospital-based. Ten studies (25%) were conducted on primary and secondary health care professionals, while eight studies (20%) were conducted in community health settings, with the majority of these in mental health. The remaining four categories (specialist services, health care collaboratives, aged care facility, and multi-disciplinary research institute) have one or two studies. Table 7 presents the settings and the number of studies associated with each type of setting. (Table 2 in **Appendix 1** provides further detail on the research setting of each study.)

**Table 7: Research settings and the number of studies**

RESEARCH SETTING	NUMBER OF STUDIES (No.=40)	AUTHORS
<b>Hospital</b> (including seven in acute services, one in open heart ICU and general surgical ICU, one in a renal ward, two in emergency departments, one in a dialysis department, four in general hospitals)	16	Benham-Hutchins and Effken (2010) Barrera and van de Bunt (2009) Chase (1995) Creswick and Westbrook (2007) Creswick, Westbrook, and Braithwaite (2009) Curran and Abidi (2007) Garåsen and Johnsen (2007) Garrett and McDaniel (2001) Heng, McGeorge, and Loosemore (2005) MacPhee (2000), MacPhee and Scott (2002) Ommen et al. (2009) Pappas, Flaherty, Wooldridge (2003), Pappas, Flaherty, and Wooldridge (2004) Peng (2006) Rangachari (2008) West and Barron (2005), West et al. (1999)
<b>Primary and Secondary Care Health Professionals</b> (one in the UK NHS; one of a diabetes managed clinical network in Scotland, one in a region of a US health maintenance organisation, one primary care MDs in a hospital practice, one Australian primary care, one public medical centre, one US study with 2 primary care centres; one of GPs in Italy, one on surgeons; one of chief manager nurses and of clinical director physicians)	10	Fattore et al. (2009) Greene et al. (2009) Grimshaw et al. (2006) Kane and Alavi (2008) Keating et al. (2007) Lewis, Baeza, and Alexander (2008) Lindholm (2006), Lindholm et al. (2003), Lindholm et al. (2004) Mossholder, Settoon, and Henagan (2005) Scott et al. (2005) Vanderveen et al. (Vanderveen et al. 2006)
<b>Community Health</b> (including two in dementia care, six in mental health)	8	Calloway et al. (1999) Carpentier et al. (2008) Curran et al. (2005) Lemieux-Charles et al. (2005) Milward and Provan (1998) Milward and Provan (2003) Ormrod et al. (2007) Webster et al. (1999)

RESEARCH SETTING	NUMBER OF STUDIES (No.=40)	AUTHORS
<b>Specialist Services</b> (one in interventional radiology, one in a forensic science laboratory)	2	Ankem (2003) Doak and Assimakopoulos (2007)
<b>Health Care Collaboratives</b> (one consisting of US health care plans, one US patient safety organisations)	2	Gold, Doreian, and Taylor (2008) Mendel et al. (2009)
<b>Aged Care Facility</b> (one multi-level facility)	1	Cott (1997)
<b>Multi-disciplinary Research Institute</b>	1	Lurie, Fogg, and Dozier (2009)

### 11.1.3 Professions researched in the studies

The majority of studies, 12 (30%), focused on multi-disciplinary groups of clinicians, with a number including non-clinical staff. There were six studies (15%) on medical practitioners or physicians, five studies (12%) on mental health professionals, and five (12%) on health service managers, or administrative staff. There were another four studies on nurses, and four on varied health professionals. There were three studies on medical specialists and one on health practitioners in dementia care. Two studies were undertaken at the organisational level, not at the individual professional level. Table 8 displays the professions researched, the number of studies and the authors that correspond to each.

### 11.1.4 Research designs and methodologies

The research designs and study methodologies were identified for all the studies, and are presented in Table 9. A majority of the studies, 38 studies (95% of the studies reviewed), used quantitative research methodologies. The two qualitative studies used an ethnographic approach. The research designs of the quantitative studies included cross-sectional studies, case-studies and multi case-studies, comparative studies, retrospective studies, prospective studies, a quasi-experimental design, an experiment, and an exploratory study. Data were collected for the studies using the techniques of survey, interview, document analysis, and observation. A majority of the studies, 30 (75%), used social network analysis to analyse the study data. Four of these studies used social network analysis and multiple regression techniques, and one of the studies used survival analysis as well as social network analysis. Details of other approaches to statistical analysis used in the studies are provided in Table 9 below.

**Table 8: Professions on whom the research has focused**

PROFESSIONS	NUMBER OF STUDIES (No.=40)	AUTHORS
Multi-disciplinary clinicians / staff	12	Barrera and van de Bunt (2009) Benham-Hutchins and Effken (2010) Chase (1995) Cott (1997) Creswick and Westbrook (2007) Creswick, Westbrook & Braithwaite (2009) Curran and Abidi (2007) Garåsen and Johnsen (2007) Lemieux-Charles et al. (2005) Lurie et al. (2009) Mossholder, Settoon & Henagan (2005) Scott et al. (2005)
Medical practitioners / physicians	6	Curran et al. (2005) Fattore et al. (2009) Greene et al. (2009) Keating et al. (2007) Lindholm et al.(2004) Ommen et al. (2009)
Mental health professionals	5	Calloway et al. (1999) Milward and Provan (1998) Milward and Provan (2003) Ormrod et al. (2007) Webster et al. (1999)
Health service managers/ administrative staff	5	Heng, McGeorge & Loosemore (2005) Lewis, Baeza & Alexander (2008) Pappas, Flaherty & Wooldridge (2003), Pappas, Flaherty & Wooldridge (2004) Peng et al. (2006) Rangachari (2008)
Nurses	4	Garrett and McDaniel (2001) Lindholm et al. (2003) MacPhee (2000) MacPhee and Scott (2002)

**Table 8: Professions on whom the research has focused (Continued)**

PROFESSIONS	NUMBER OF STUDIES (No.=40)	AUTHORS
Health professionals - varied	4	Grimshaw et al. (2006) Kane and Alavi (2008) Lindholm (2006) West and Barron (2005); West et al. (1999)
Medical specialists (including interventional radiologists, forensic scientists, surgeons),	3	Ankem (2003) Doak and Assimakopoulos (2007) Vanderveen et al. (2006)
Health professionals – dementia care	1	Carpentier et al. (2008)

### 11.1.5 Level of analysis

In network studies, a key area of interest is the level of analysis used in the study. From an organisational perspective, these levels are broadly at the level of *the individual actor or actors*, the *organisational (or network) level*, and *inter-organisational (or inter-network) level*. As summarised in Table 9, four studies (10%) were directed at the actors' level, 14 studies (35%) looked at two levels, the actors and the organisational levels, three studies looked at the two levels of the actors and the team. Seven studies (17.5%) conducted their analyses at the organisational level. Seven studies (17.5%) focused on the inter-organisational level. Two studies looked at the actors and their professional group, two studies were on actors and their networks, one study looked at the actors' level and the inter-organisational level, and one study examined the three levels of analysis.

## 11.2 Thematic categorisation of the studies

The studies were analysed to determine the key research areas addressed in each study. Overall, as presented in Table 10, there were five major themes covering:

- (1) understanding the structural relationships and social context of professionals or organisations, or between organisations (25 studies);
- (2) information / knowledge exchange between health practitioners; or advice seeking of health practitioners (10 studies);
- (3) communication and exchange of patient clinical and other information between practitioners or organisations (5 studies);
- (4) influence of information sources on awareness and adoption of a new technology or innovations (3 studies); and
- (5) identification and role of opinion leaders/leaders (3 studies);

**Table 9: Research Design and Methodology of Studies**

Study	Research Design	Methodology						
		Survey	Inter-view	Observation	Document Analysis	Social Network Analysis	Level of Social Network Analysis	Other Statistical Analysis
Ankem 2003	Cross-sectional study		√				actors/organisation	Chi-square; factor analysis
Barrera and van de Bunt 2009	Prospective, longitudinal case study	√		√		√	actors/organisation	Mult.regression
Benham-Hutchins and Effken 2010	Case study	√				√	actors/organisation	
Calloway et al. 1999	Comparative study		√			√	inter-organisation	
Carpentier et al. 2008	Comparative study		√		√	√	3 levels	
Chase 1995	Ethnographic study			√			organisation	
Cott 1997	Case study	√				√	actors/team	
Creswick and Westbrook 2007	Case study	√				√	actors/organisation	
Creswick, Westbrook & Braithwaite 2009	Case study	√				√	actors/organisation	
Curran et al. 2005	Quasi-experimental	√	√		√	√	organisation	
Curran and Abidi 2007	Experiment	√			√		actors/inter-organisation	
Doak and Assimakopoulos 2006	Case study	√				√	actors/organisation	
Fattore et al. 2009	Comparative case study					√	actors/networks	Mult.regression OLS
Garåsen and Johnson 2007	Retrospective study				√		actors/organisation	
Garrett and McDaniel 2001	Exploratory study	√					actors/organisation	Mult.regression
Gold, Doreian & Taylor 2008	Cross-sectional study	√	√			√	inter-organisation	

**Table 9: Research Design and Methodology of Studies (Continued)**

Study	Research Design	Methodology						
		Survey	Inter-view	Observation	Document Analysis	Social Network Analysis	Level of Social Network Analysis	Other Statistical Analysis
Greene et al. 2009	Retrospective, mixed-methods evaluation		√	√	√		network	Trend analysis: clinical outcomes
Grimshaw 2006	Cross-sectional study	√					actors/prof. group	
Heng, McGeorge & Loosemore 2005	Case study	√				√	actor/organisation	
Kane and Alavi 2008	Multi-case study	√				√	organisation	Mult.regression
Keating et al. 2007	Case study	√				√	actors	
Lemieux-Charles et al. 2005	Case study	√			√	√	inter-organisation	
Lewis, Baeza & Alexander 2008	Multi-case study		√			√	organisation	
Lindholm 2006; Lindholm et al. 2003; Lindholm et al. 2004	Cross-sectional study	√					actors	Odds ratios
Lurie, Fogg & Dozier 2009	Case study	√				√	actors/organisation	
MacPhee 2000	Case study	√				√	actors/organisation	
MacPhee and Scott 2002	Comparative case study	√				√	actors/organisation	T-tests
Mendel et al 2009	Prospective study	√	√			√	inter-organisation	
Milward and Provan 1998	Multi-case study	√	√			√	inter-organisation	
Milward and Provan 2003	Multi-case study	√	√			√	inter-organisation	
Mossholder, Settoon and Henagan 2005	Case study	√				√	actors/organisation	Survival analysis
Ommen et al. 2009	Cross-sectional study	√					actors	Linear regression

**Table 9: Research Design and Methodology of Studies (Continued)**

Study	Research Design	Methodology						
		Survey	Inter-view	Observation	Document Analysis	Social Network Analysis	Level of Social Network Analysis	Other Statistical Analysis
Ormrod et al. 2007	Ethnographic study			√			actors/team	
Pappas, Flaherty & Wooldridge 2003; 2004	Case study	√	√			√	actors/organisation	OLS regression
Peng et al. 2006	Cross-sectional study	√				√	organisation	
Rangachari 2008	Multi-case study	√	√			√	organisation	
Scott et al. 2005	Comparative case study; ethnography.		√	√	√	√	organisation	
Vanderveen et al. 2006	Cross-sectional study	√	√			√	actors	
Webster et al. 1999	Multi-case study		√			√	actors/teams	
West and Barron 2005; West et al. 1999	Cross-sectional study	√				√	actors/networks	
<b>TOTAL</b>	<b>40</b>	<b>29</b>	<b>15</b>	<b>5</b>	<b>7</b>	<b>30</b>		

Other areas of research included: the relationships between practitioner characteristics, work climate and burnout; the influence of information systems; the resource-outcome relationship; sustainability; the relationship between network structure and network effectiveness; the relationship between network and behavioural variables and turnover; the relationship between social capital and job satisfaction; the relationship between resources and centrality on performance; the effects of information in a network on trust relations and reciprocity; the relationship between hospital knowledge sharing and coding performance; and leadership styles. Each of the key study areas is summarised and research findings are now provided.

### **11.2.1 Social-professional networks and structural relationships**

As discussed in this section, the 25 studies that examined social-professional networks and structural relationships addressed the following sub-areas: structural relationships within and between organisations, health professionals and social context, the structure of quality collaboratives and healthcare partnerships, and structure in knowledge sharing networks.

#### *Structural relationships within and between organisations*

Carpentier and colleagues (2008) combined social network analysis and an interpretive approach in an exploratory study of seven organisations examining the micro-organisational dynamics that influence relationships between the various networks that provide assistance to patients with early-stage dementia living in the community in Montreal, Canada. Three levels of analysis were explored: interactions between practitioners and caregivers, internal structures, and linkages between groups. Their findings suggested that the quality of the practitioner-caregiver interface was determined by the three levels of interactions.

Another Canadian study on dementia care (Lemieux-Charles et al. 2005) used a case-study method to evaluate the effectiveness of four community-based dementia care networks in Ontario. The evolution, structure and processes of each network were documented and social network analysis was used to identify patterns of administrative and clinical exchanges among networked agencies. Network effectiveness was measured at two levels: (1) the network itself and (2) perspectives of the network's organisational participants (i.e., service-delivery agencies). While differences were found between the four networks in terms of their perceptions of service-delivery effectiveness, perceptions of administrative effectiveness integration – measured by the types of exchanges within as opposed to across networks – differentiated the four networks studied.

Milward and Provan (1998) reported on two studies of networks, using social network analysis to examine the structural relationships between organisations. In the first study, four community mental health networks provided services to seriously mentally ill adults, while the network in the second study addressed the prevention of drug and alcohol abuse in young people. Each of the four mental health networks was found to be well integrated, based on two measures – organisational links and cooperative links – but in quite different ways. In the substance-abuse prevention network study, social network analysis helped to identify agencies that were not well linked to the system.

Further work by Milward and Provan (2003) also used social network analysis on the results of the 1998 research on the four mental health networks, along with a four-year study of one of the four networks, to evaluate the strategies of collaboration and contracting. The relationship between network structure and network effectiveness was found to be mediated by the network context within which services were provided. Resource munificence and network stability were identified as the two contextual variables. The four-city study found that resource munificence alone did not result in an effective network, nor did resource scarcity mean that a network had to be ineffective – that is, other variables in the model mattered more. The most critical variable in moderating the impact of resources was the stability of the network. Similarly, in the second study, an effective network was identified as one with enough stability to be able to maintain its ability to manage a set of jointly produced services.

A further study in the mental healthcare setting was conducted by Calloway and colleagues (1999), who compared two rural and four urban systems providing care to people with severe mental disorders (SMD) in the United States. Social network analysis showed that both rural sites had numerous coordination linkages between the two types of provider groups (SMD and other service providers) for service planning and delivery. Density scores revealed the extent of service dependency when providers coordinated care to people with SMD in rural sites compared with urban sites. Service relationships between all specialised mental health providers were more likely to occur in rural than in urban areas. Rural SMD providers initiated more relationships and made greater use of other mental health providers compared with urban providers.

A study of chief executive officers in all accredited hospitals in Taiwan was undertaken by Peng and colleagues (2006) to examine the impact of hospital resources, network resources, and centrality on hospital performance (measured by a 15-item question put to hospital managers). Hospital resources and centrality were found to independently affect performance, whereas network resources did not. The higher the centrality of the hospital (defined as the extent to which a hospital is viewed as a leading, powerful, and dominant actor in a network), the better was the performance. The authors conclude that a hospital should improve performance by exploiting its in-house resources rather than obtaining network resources externally, while hospitals should aim to occupy a central position for creating a structural niche.

#### *Health professionals and social context*

In a study of two intensive care units (ICUs) in a teaching hospital in the United States, Chase (1995) used an ethnographic approach to analyse structure and communication patterns relating to the social context in which the process of critical care clinical judgment occurred from the nurse's perspective. Chase described clinical judgement as 'the complex cognitive process by which a clinician interprets patient behaviours and builds a communicable description of the status of patients. Making a judgment involves making a decision about whether a patient needs the initiation or modification of treatment.' With multiple clinicians being involved in decision making about ICU patient care, the study found that parallel hierarchies of nurses and of doctors allowed for checks on judgment both within and across professional lines. Also, rituals (nursing reports, physician rounds, flow sheet use) provided a context to check judgment processes.

**Table 10: Categorisation of Studies**

Study	Focus of Study					
	Influence of information sources on awareness and adoption of a new technology / innovations	Communication and exchange of patient clinical and other information between practitioners / organisations	Understanding the structural relationships and social context of professionals / organisations / between organisations	Information / knowledge exchange between health practitioners/ advice seeking	Identification of opinion leaders	Other study areas
Ankem 2003	√				√	
Barrera and van de Bunt 2009				√		Effects, over time, of information in a network on interpersonal trust relations and reciprocity.
Benham-Hutchins and Effken 2010		√				
Calloway et al. 1999			√			
Carpentier et al. 2008			√			
Chase 1995			√			
Cott 1997			√			
Creswick and Westbrook 2007			√	√		
Creswick, Westbrook & Braithwaite 2009			√	√		
Curran et al. 2005	√					
Curran and Abidi 2007				√	√	
Doak and Assimakopoulos 2007				√		
Fattore et al. 2009			√			Impact of GP network organisation on their prescribing behaviour.
Garåsen and Johnson 2007		√				
Garrett and McDaniel 2001			√			Relationships between nurse characteristics, work climate, burnout.
Greene et al. 2009						Network quality improvement strategies; clinician engagement Network impact on health outcomes.

Table 10: Categorisation of Studies (Continued)

Study	Focus of Study					
	Influence of information sources on awareness and adoption of a new technology / innovations	Communication and exchange of patient clinical and other information between practitioners / organisations	Understanding the structural relationships and social context of professionals / organisations / between organisations	Information / knowledge exchange between health practitioners/ advice seeking	Identification of opinion leaders	Other study areas
Grimshaw et al. 2006					√	
Heng, McGeorge & Loosemore 2005			√			
Kane and Alavi 2008						Influence of information systems on organisational performance outcomes.
Keating et al. 2007				√		
Lemieux-Charles et al. 2005		√	√			Resource-outcome relationship.
Lewis, Baeza & Alexander 2008		√	√			Sustainability.
Lindholm 2006; Lindholm et al. 2003; Lindholm et al. 2004			√			Psychosocial work conditions, network factors associated with work stress.
Lurie, Fogg, & Dozier 2009			√			
MacPhee 2000			√			
MacPhee and Scott 2002			√			
Mendel et al. 2009			√	√		Changes over time.
Milward and Provan 1998			√			

**Table 10: Categorisation of Studies (Continued)**

Study	Focus of Study					
	Influence of information sources on awareness and adoption of a new technology / innovations	Communication and exchange of patient clinical and other information between practitioners / organisations	Understanding the structural relationships and social context of professionals / organisations / between organisations	Information / knowledge exchange between health practitioners/ advice seeking	Identification of opinion leaders	Other study areas
Milward and Provan 2003			√			Relationship between network structure and network effectiveness.
Mossholder, Settoon & Henagan 2005			√			Relationship between network and behavioural variables and employee turnover.
Ommen et al. 2009			√			Relationship between job satisfaction and social capital.
Ormrod, S. et al. 2007	√					
Pappas, Flaherty & Wooldridge 2003; 2004				√		
Peng et al. 2006			√			Relationship between hospital resources, network resources and centrality on hospital performance.
Rangachari 2008			√	√		Relationship between organisational knowledge sharing structure, and hospital coding performance.
Scott et al. 2005		√				
Vanderveen et al. 2006	√					
Webster et al. 1999			√	√		Leadership styles.
West and Barron 2005; West et al. 1999			√			
<b>TOTAL</b>	<b>4</b>	<b>5</b>	<b>25</b>	<b>10</b>	<b>3</b>	<b>15</b>

Lurie and colleagues (2009) applied social network analysis to three settings in one US clinical institution: team function in the ICU, the interdisciplinary composition of advisory committees, and relationships between key function directors at an institution-wide research institute. Social network analysis allowed the researchers to compare teams on aspects of their clinical team functioning, and showed the degree of inter-disciplinarity of various clinical departments on the advisory committees. SNA highlighted potential problem areas in relationships among academic departments.

Social network analysis was used by Cott (1997) to describe the structure of multi-disciplinary long-term care teams in a geriatric care facility in Toronto, Canada. The multi-professional sub-team had an *organic* structure, with involvement in teamwork on decision-making and problem-solving, whereas the nursing sub-team had a *mechanistic* structure with involvement in task oriented work. The study found that the effects of teamwork in sharing decision-making were limited to a group of higher status health professionals other than medicine. Garrett and McDaniel (2001) used a cross-sectional study design in five hospital-based units in a US hospital to explore the relationships of environmental uncertainty, nurse characteristics and perceived work climate with professional burnout. Environmental uncertainty and perceptions of social-work climate were associated with burnout. Study findings suggest that a positive social network climate can shield workers from the negative effects of crisis.

A study in Sweden (Lindholm 2006), on a similar topic, investigated whether psychosocial work conditions, professional network, job support, social network and support, sick leave and salary were associated with work stress in nurses in chief managers' positions above ward level and physicians in clinical director positions. For both nurse managers and clinical directors, the study found a significant association between exposure to high job demands and a high level of work stress. The available psychosocial resources, both inside and outside work, did not balance the experienced work stress in nurse managers and clinical directors exposed to high work demands. Earlier work in this study (Lindholm et al. 2003) found that nurse managers exposed to high job demands had elevated odds for low self-rated health, regardless of the level of psychosocial resources within or outside work. Two-thirds of nurse managers who were affiliated with professional networks did not consider this a supporting factor in their management work. Key findings in relation to clinical directors (Lindholm et al. 2004), were that participants who reported high job demands had a significantly higher probability of low self-rated health than those who did not. In relation to social network and social support outside work, clinical directors who reported low social stability, low social participation and/or low emotional support increased their probability of low self-rated health many times.

The work of nurses with flexible and traditional schedules was compared in a US case study in a paediatric acute care hospital by MacPhee (2000). When social network analysis was employed to examine the types of social networks used by both groups of nurses and to compare the workplace socialisation of the two groups, no significant differences were found in the nurses' social network composition. However, nurses working traditional schedules used significantly more peer members for different types of emotional support, such as reassurance and handling emotional upsets. Another study by MacPhee and Scott (2002) researched the workplace social support networks of hospital nurses in a rural region, and compared the data with that from the earlier study on urban nurses. Social network analysis was similarly employed to analyse the data. Findings indicated that nurses' networks were

predominantly peer-based, but managers provided significant functional supports, with rural nurses expecting more guidance from management than did their urban counterparts.

Mossholder and colleagues (2005) used social network analysis, and survival analysis, in a study of health care employees in a large public US medical centre to examine whether structural, attitudinal and behavioural variables of a relational nature were predictive of employee turnover. Two variables, network centrality and interpersonal citizenship behaviour, predicted turnover and their effects were above and beyond the effects of job satisfaction. With network centrality, it appeared that how individuals were connected affected their leaving the organisation. Those forming a greater number of ties with co-workers became more embedded and had lower turnover, while higher interpersonal citizenship behaviour resulted in lower turnover.

A study in Germany (Ommen et al. 2009) surveyed physicians in four hospitals to analyse the relationship between overall job satisfaction of physicians and social capital in the hospitals. In addition to professional experience and workload, the social capital of an organisation, was a significant predictor of overall job satisfaction of physicians. Job satisfaction was also significantly associated with professional experience, and with lower workloads, while socio-demographic variables, such as age and gender, did not have a significant impact.

An ethnographic approach was used by Ormrod and colleagues (2007) in three UK NHS mental health clinics to examine how organisational practices were spread within networks of practice. Professional networks within psychiatry were found not to spread particular work practices equally to psychiatrists and their associated multi-disciplinary teams at the two new sites. This was largely due to ideological differences in psychiatric practice approaches and differences in founder influence.

Webster and colleagues (1999) used social network data, looking at advice and social relations, to examine differences in eight mental health case management teams in a county mental health system in the United States. The results from the social network analysis showed that male supervisors were on average substantially more central for instrumental (advice) relations than female supervisors – showing an autocratic leadership style. Teams with male supervisors were on average more centralised than teams with female supervisors. For the social relations, male team supervisors were on average more central than were female supervisors. The teams headed by female supervisors were more centralised than those with male supervisors, yet the female leaders were not the most central team member, showing a tendency for female leaders to have a democratic leadership style.

A study of the professional social networks of clinical directors of medicine and directors of nursing in hospitals in the United Kingdom was undertaken by West and colleagues (1999). Directors of nursing were found to be more central in their networks than clinical directors of medicine, and their networks were more hierarchical. The networks of directors of nursing were lower in density (having advantages in terms of access to information) than the clinical directors of medicine who tended to be embedded in much more densely connected networks, described as cliques. In comparison to nurses' networks, doctors' networks were egalitarian and decentralised. The authors conclude that change processes for

the latter would need to involve group processes, rather than simply convincing individuals of the need to change.

In a further analysis of the study data, West and colleagues (2005) explored the social and geographical boundaries around the networks of directors of nursing and clinical directors of medicine. Both groups discussed 'important professional matters' with others who were similar to themselves in terms of profession, gender, age, and seniority (i.e., homophilous networks), with physicians being more extreme in this regard. Managers (non-clinically qualified) occupied a powerful brokerage role for both nurses and doctors, whereas nurses and doctors rarely figured on each other's networks. Barriers were found between doctors and non-doctors, men and women, and between the generations. Female doctors appeared infrequently as discussion partners. Also, the networks of female nurses seemed to be less supportive than those of male doctors. Nursing and medicine were found to have quite different social structures. There were few informal ties between the two professions, meaning that information is unlikely to be spread between the two professions by informal sources.

#### *Structure of quality collaboratives and healthcare partnerships*

In a US study of quality collaboratives, Gold and colleagues (2008) applied social network analysis to research relationships (structure and processes) among organisations participating in a large-scale public-private collaboration among major health plans to reduce racial and ethnic disparities in health care. Their findings suggest that sponsors and support organisations, along with a few of the health plans, formed the 'glue' that held the collaboration together. The limited communication amongst health plans pointed to a potential weakness in network structure: if the collaboration ended without greater communication among the non-core organisations, the absence of the core would leave a very sparse network. The authors suggest that sponsors of a collaborative need to think about both short- and long-term goals and whether they can be pursued if a collaborative ends: 'Activities that seek ultimately to encourage change within organisations may be easier to sustain than those that require ongoing interaction across organisations.'

Mendel and colleagues (2009) used social network analysis to explore the numbers and types of inter-organisational partnerships within the US patient safety domain, the changes over time in these networks, and their potential for disseminating patient safety knowledge and practices. Between 2004 and 2006, the study found growth in partnerships in all activity domains, particularly dissemination and tools development, signifying growing strength in the capacity to disseminate and implement patient safety advancements in the US health care system. Fragmentation of the overall partnership network decreased, and potential for information flow increased. On the other hand, network centralisation increased, suggesting vulnerability to partnership failure if key participants disengaged. The role of the Agency for Health Research and Quality (AHRQ) was central in these networks, reflecting its leadership role in disseminating the information, tools, and practices resulting from patient safety research projects.

A study by Lewis and colleagues (2008) used social network analysis to examine network structure, dynamics and sustainability in partnerships in primary care (a prescriptive form of network governance)

in Victoria, Australia, at three points in time between 2002 and 2005. Although network structures changed over the three years of the study, there was the continuing centrality of the independent staff, employed to manage the partnerships, who had a crucial role in holding partnerships together. The study indicated that the partnerships required long term support, and not just start-up funding.

Fattore and colleagues (2009) used SNA to study whether collaboration initiatives by a local health authority (LHA) in Italy between 2001 and 2004 had any effect on individual and district-level general practitioner performance, measured in terms of drug expenditure targets. The researchers found that with this general practitioner (GP) collaboration initiative, the social influence mechanism (the relationship between the performance of peers to whom the GP is connected and the GP's ability to meet the expenditure targets) was more relevant than the social capital mechanism (the centrality of the GP in his or her network). The study suggested that while collaborative arrangements could induce more homogeneous behaviour among GPs, they did not necessarily improve the ability of GPs' to meet the LHA objectives.

#### *Structure in knowledge sharing networks*

Research in four large US teaching hospitals by Rangachari (2008) explored the relationship between the organisational knowledge sharing structure related to quality, and hospital coding performance related to quality. Social network analysis was used on survey data of administrators and staff in each hospital to examine the knowledge sharing structures. Good-coding performance was found to be associated with a knowledge sharing network structure rich in brokerage and hierarchy (with senior leaders coordinating knowledge exchange related to quality and connecting the organisation with the external environment), rather than density – with everyone connected to everyone else. The findings suggested that senior hospital administrators must play a proactive role in providing education on coding and quality measurement, and in exposing physician and coder subgroups to the changing environment.

Heng and colleagues (2005) explored the brokerage role of facilities management in a hospital in Sydney, Australia, by using social network analysis to identify and analyse the communication networks of players in the hospital environment. The study found that the facilities manager was actively bridging information and knowledge across different functions. The analysis showed that facilities managers fill structural holes within a communication network structure and hence are positioned to identify interdisciplinary opportunities. The identification of relationship linkages between different functional units could create potential brokerage opportunities and add value to health care delivery.

### **11.2.2 Information (and advice seeking) or knowledge exchange between health practitioners**

A study in a renal ward of a metropolitan Australian teaching hospital by Creswick and Westbrook (2007) used social network analysis to examine how a network of staff sought medication advice. There was a relatively low level of advice-seeking about medication-related decisions and tasks. Most communication occurred within professional groups. Medication advice was sought from several key individuals in the ward both within and across professional groups. A further study by Creswick and colleagues (2009) in an Australian hospital emergency department (ED) examined the problem-solving,

medication advice-seeking and socialising networks of staff. Individuals were found to be more closely connected to colleagues from within their own professional groups. ED staff relied on each other's help in solving work-related problems, but in the medication advice network, doctors were very central in giving advice relating to medication decisions and tasks.

Similarly, researchers (Keating et al. 2007) evaluated the network of influential discussions among primary care physicians in a US hospital-based academic practice. Social network analysis was used to describe the network of discussions and to examine factors predictive of a physician's location in the network. Physicians obtained information from colleagues with greater expertise and experience as well as from colleagues who were accessible based on location and schedule. Physicians were found to be more likely to have discussions with physicians of the same gender.

Knowledge flows over a three day period between forensic scientists in a forensic science laboratory in Ireland were explored by Doak and Assimakopoulos (2007). Social networks graphs were used to portray the diffusion of tacit knowledge and to show that the working structure of the laboratory fell into four communities of practice – biology, chemistry, DNA, and drugs. The density and prestige network graphs showed that the less experienced forensic scientists sought advice in casework problems from prominent forensic scientists who had major sources of evident tacit knowledge. Trainee scientists found that standard operating procedures gave a beneficial baseline of knowledge; however tacit knowledge was an integral part of the activities of the expert forensic scientists.

One of the very few studies on the effects of learning on trust using longitudinal survey data was conducted in the dialysis department of a Dutch hospital (Barrera and van de Bunt 2009). The researchers investigated the effects of information originating from social networks on the development of interpersonal trust relations in this department. Actors learned to trust from their own past experiences and preferred to reciprocate pre-existing relations.

Curran and Abidi (2007) evaluated the impact of an online discussion forum created for 18 months to support information exchange for nurses and physicians working in nine rural and two urban emergency departments in Nova Scotia, Canada. Data were also collected on offline interaction data through a follow-up survey. The online medium stimulated more knowledge seeking and sharing opportunities and interactions compared with the offline media.

A survey of middle managers in a medium-sized US hospital was undertaken by Pappas and colleagues (2003, 2004) to explore how these managers used strategic knowledge to achieve consensus in shaping hospital priorities. The analysis used social network analysis to examine social structure and ordinary least squares regression was used to test all of the hypotheses. Strategic consensus was significantly related to both middle managers' knowledge of their external environment and their internal knowledge of resources and capabilities. The study found a curvilinear relationship between consensus and degree centrality: although high levels of centrality might improve the middle manager's ability to understand the strategy of the hospital, at some point managers' centrality might hinder their ability to formulate ideas that challenged the strategic wisdom of the firm. Although degree centrality moderated the positive relationship between knowledge of internal resources and capabilities, it had no effect on

knowledge of the external organisational environment. The 2004 study found that a manager's ability to influence upper management depended on how well members knew each other and shared common beliefs. A clear linkage was shown among strategic knowledge, social structure, and upward-oriented activities that led to the development of new capabilities.

### **11.2.3 Communication or exchange of patient clinical and other information**

A study of five patient handoffs by Benham-Hutchins and Effken (2010) examined how healthcare providers communicated and exchanged patient clinical information during patient handoffs (transfers) between units in an acute care US hospital. Social network analysis was used to develop sociograms of communication patterns and to identify the role of individual providers in the handoff process. Network patterns showed the overlapping use of synchronous and asynchronous communication methods (verbally via telephone or in person; or written via paper charts and/or an electronic record). Each handoff network exhibited unique communication patterns and information coordination by two or more influential providers from nursing, medicine, or pharmacy. Of the 25 survey respondents, most preferred verbal communication. Overall satisfaction with the current communication process varied by unit, with 82 per cent of emergency department providers and 54 per cent of the providers working in the admitting units stating that they were satisfied or very satisfied.

Garåsen and Johnsen (2007) used a Delphi technique with two expert panels to examine referral and discharge letters between general practitioners and general hospital physicians for patients in a city general hospital in Trondheim, Norway, to assess the quality of written communication between general practitioners and general hospital physicians. Information in the referral letters on actual medical situation, medical history, symptoms, signs and medications was assessed to be of high quality in 84 per cent, 39 per cent, 56 per cent and 39 per cent, respectively; and in discharge letters it was 96 per cent, 60 per cent, 60 per cent, 55 per cent and 82 per cent. Information on Activities of Daily Living was satisfactory in only half of the discharge letters. The researchers found that both referral and discharge letters were missing vital medical information for safe patient care.

Observational ethnographic field data were collected on office staff and clinicians over a two week period in a study (Scott et al. 2005) to characterise and compare the communication patterns in two US primary care practices. In addition, interviews were conducted with clinicians and office staff, and social network analysis was used in the data analysis. Clear differences were found between the two practices for all the SNA measures: density (a measure of decision-making interactions), clustering coefficient (a measure of collaboration in groups) and centralisation (the degree to which a network approaches the configuration of a 'star' network). Decision-making patterns differed widely in the two sample practices.

### **11.2.4 Influence of information sources on new technology adoption/innovations**

Ankem (2003) undertook a study of interventional radiologists in Michigan, United States, to investigate the influence of information sources on the awareness and adoption of uterine fibroid embolisation (UTE) by the interventional radiologists, and to examine communication relations in their social network conducive to information flow on UTE. Although journals were important information sources for creating awareness and stimulating adoption of innovation among both early and late adopters of new

procedures in interventional radiology, conferences were significantly more important for creating early awareness, while interactions with colleagues was the most important factor in stimulating use of the innovation among later adopters. The study found that opinion leaders in non-academic hospitals may be more influential than individuals in the academic community.

Researchers (Vanderveen et al. 2006) undertook a cross-sectional survey of surgeons providing surgical breast cancer care within a three-county urban region of the United States to describe the timing of sentinel lymph node biopsy (SLNB) adoption and patterns of surgeon interactions with the following educational sources: a local university training program, surgical literature, national meetings and courses, national specialty centres and other local surgeons. The timing of adoption was associated with specialty affiliation (e.g., surgical oncologist compared with general surgeon), but was not related to age. Although surgical oncologists were older than general surgeons, they had used SLNB longer. Two social network diagrams were created: surgeon-surgeon interactions and timing of SLNB adoption; and surgeon interactions with key learning sources. Almost all surgeons used two or more sources when learning a new surgical technique for breast cancer care. Early in their practice, surgeons relied heavily on exposure during residency as their primary information source, with a minority seeking additional sources.

#### **11.2.5 Identification and role of opinion leaders**

Grimshaw and colleagues (2006) examined the feasibility of identifying opinion leaders in different professional groups within the UK National Health Service, in Scotland, to describe the professional and personal characteristics of the opinion leaders identified, and to determine whether opinion leaders were inclined to adopt changes based on evidence. Generic sociometric opinion leaders (SOL) were more likely to belong to professional groups, have been qualified longer, be in a senior position, and have high effectiveness and keeping-up-to-date scores. Condition-specific SOLs were more likely to belong to professional groups and be in a senior position. They were less likely to have attended a local medical school. Generic self-designated opinion leaders (SDOLs) were more likely to have high effectiveness and keeping-up-to-date scores. The results suggested that the extent of social networks and potential coverage of the study population in primary and secondary care was highly idiosyncratic, and adequate coverage rates should not be assumed. In contrast, relatively complex networks with good coverage rates were observed in both national specialty groups (obstetrics and gynaecology, and oncology consultants).

Curran and colleagues (2005) tested an opinion leader-driven intervention to improve practice guideline-based medication management for patients with schizophrenia in US Veterans Affairs medical centres. They found that physicians did not always agree on who was the opinion leader. There was also an issue of how much directive should be given to the opinion leaders concerning how to influence attitudes and behaviours. Although the broad objective of the study by Ankem (2003) of interventional radiologists in Michigan, United States, was to understand the influence of information sources on the awareness and adoption of uterine fibroid embolisation by the radiologists, one finding of interest was that opinion leaders in non-academic hospitals could be more influential than individuals in the academic community.

In the study of a diabetes managed clinical network in Scotland by Greene and colleagues (2009), the key to network success was found to be the engagement of primary care and specialist clinicians in network planning and quality improvement. This achievement was facilitated by network leadership being enthusiastic and committed, and by such leadership being shared between specialists and general practitioners. Network success was measured by examining trends in patient outcome data.

### **11.2.6 Other study areas**

Researchers (Kane and Alavi 2008) investigated the influence of information systems on group-level organisational performance outcomes in 40 health care groups of a regional division of a US health maintenance organisation. Social network analysis was used as a framework for understanding user-system interactions. User-system tie strength was not significantly related to efficiency of care or quality of care. Information system centrality in the multimodal network was related to lower patient waits and positively related to outcomes (keeping patients' diabetes under control). The authors suggest that the wider multi-modal network of multiple systems should be examined to fully assess the role of information systems in organisations.

## **12. Synthesis of the systematic analysis**

The systematic analysis has identified how research on social and professional networks of health professionals has been used, especially with relevance to quality of care and safety. A focus of a majority of the studies was on understanding the structural relationships and interactions at the different levels of network analysis – actor/s, organisation (or network), and inter-organisation (or inter-network). Such studies have illuminated the interactions between professionals (Chase 1995; Cott 1997; Heng, McGeorge, and Loosemore 2005; Lurie, Fogg, and Dozier 2009; Webster et al. 1999; West et al. 1999; West and Barron 2005), and between practitioners and caregivers (Carpentier et al. 2008), the level of integration of the networks in the broader health system (Milward and Provan 1998), and the service coordination linkages and use of specialist clinical services of provider groups (Calloway et al. 1999). Several studies have examined psychosocial work conditions and professional and social networks in relation to employee work satisfaction, support, stress or turnover (Garrett and McDaniel 2001; Lindholm et al. 2003; Lindholm et al. 2004; Lindholm 2006; MacPhee 2000; MacPhee and Scott 2002; Mossholder, Settoon, and Henagan 2005; Ommen et al. 2009).

A number of studies examined the structure of the social network of health professionals in relation to information and advice seeking behaviour and knowledge flows (Benham-Hutchins and Effken 2010; Creswick and Westbrook 2007; Creswick, Westbrook, and Braithwaite 2009; Curran and Abidi 2007; Doak and Assimakopoulos 2007; Garåsen and Johnsen 2007; Keating et al. 2007; Scott et al. 2005). Such studies have highlighted the importance of *homophily* and tribal behaviour with professional disciplines in social networks of health professionals. While providing a comparison of network relationships associated with tacit knowledge and with explicit knowledge, the study by Doak and Assimakopoulos also demonstrated that it is possible to use social network analysis to identify separate communities of practice within a network.

Barrera and van de Bunt (2009) provide evidence, based on longitudinal survey data of dialysis department professionals, that actors learn to trust from their own past experiences and that they prefer to reciprocate pre-existing relations.<sup>6</sup> Similarly, findings from Pappas and colleagues (2004) show that a hospital manager's ability to influence upper management depends on how well members know each other and share common beliefs. Their earlier analysis (2003) found that although high levels of centrality might improve the middle manager's ability to understand the strategy of the hospital, at some point, manager's centrality might hinder their capacity to challenge the accepted strategic wisdom of the firm.

Social network analysis has been used to explore relationships between organisations participating in quality collaborative and healthcare partnerships (Gold, Doreian, and Taylor 2008; Lewis, Baeza, and Alexander 2008; Mendel et al. 2009). Such studies have highlighted the important support role of the network facilitator as broker. Looking at another form of quality improvement collaborative, Greene and colleagues (2009) used patient outcome measures in a diabetes managed clinical network to evaluate the impact of the network's quality improvement strategies. The network engaged clinicians, persuading them to improve the quality of diabetes care without significant additional resources.

Several studies have examined the influence of information sources on new technology adoption or innovation. For example, Ormrod and colleagues (2007) looked at the diffusion of organisational practices within networks of practice. Ankem (2003) found that interactions with colleagues of interventional radiologists served as the most important factor in stimulating use of innovation among later adopters, and pointed to the greater influence of opinion leaders in non-academic hospitals, compared with use of individuals in the academic community. The timing of adoption of a new breast cancer surgical technique was found by Vanderveen and colleagues (2006) to be associated with specialty affiliation, another example of homophily. Keating and colleagues (2007) found that primary care physicians obtained information on women's health issues from colleagues with greater expertise and experience as well as from colleagues who were accessible based on location and schedule. However they were more likely to have discussions with physicians of the same gender, providing further evidence of homophily.

The issue of the identification and role of opinion leaders has been addressed in several studies (Curran et al. 2005; Greene et al. 2009; Grimshaw et al. 2006). Grimshaw and colleagues found generic sociometric opinion leaders were more likely to belong to professional groups, have been qualified longer, to be in a senior position, and have high effectiveness and keeping-up-to-date scores, while condition-specific sociometric opinion leaders were more likely to belong to professional groups, to be in a senior position, and less likely to have attended a local medical school. Work by Curran and colleagues found that physicians did not always agree on who was the opinion leader. The issue of leadership itself was addressed in the study by Greene and colleagues who found that the success of a

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<sup>6</sup> Interestingly, this work indirectly provides a link to the original work on social networks that was conducted by the anthropologist, Warner (1937) on the anthropological mapping of kinship relationships in Australian aboriginal society, where reciprocity has strong cultural significance.

diabetes managed clinical network was facilitated by the enthusiasm and commitment of the network leadership.

Fewer studies have looked at professional networks, not only from the perspective of the structural relationships, but also in relation to their performance, or effectiveness and sustainability (Fattore et al. 2009; Lemieux-Charles et al. 2005; Milward and Provan 1998). Milward and Provan (2003) found that the relationship between network structure and network effectiveness was mediated by the network context within which services were provided. Interestingly, they also found that resource munificence alone did not result in an effective network, with the stability of the network being the most critical variable moderating the impact of resources. Fattore and colleagues (2009) found that *social influence* was more relevant to GP performance on drug expenditure targets than *social capital*.

Looking at all accredited hospitals in Taiwan, Peng and colleagues (2006) found that the higher the centrality of the hospital in a network, the better was the performance. Evidence was provided by Rangachari (2008) that good hospital-coding performance was associated with a knowledge sharing network structure rich in brokerage and hierarchy, rather than density. Kane and Alavi (2008) used social network analysis to investigate the influence of information systems on group-level organisational performance outcomes of health care groups. They found that information system centrality in the multimodal network was related to lower patient waits and positively related to patient outcomes in diabetic care.

A number of studies have used longitudinal study designs to examine issues relating to the study of networks over time, for example, Barrera and van de Bunt (2009), Greene and colleagues (2009), Lewis and colleagues (2008), and Mendel and colleagues (2009). Barrera and van de Bunt investigated the effects of information from social networks on the development of interpersonal trust relations in a Dutch hospital dialysis department. They found that when people received positive information about others in the past, they were more likely to trust them in the present. A retrospective study design was used by Greene and colleagues to examine the impact of a managed care network from 1998 to 2005 on diabetes management. There was rapid improvement in simple diabetes process measures, such as glycated haemoglobin measurement. More complex process measures such as eye screening improved more slowly, showing greater dependence on the redesign of the care pathway.

Lewis and colleagues found that although the network structures of primary health care partnerships in Victoria, Australia, changed over the three years of the study, a constant feature was the continuing centrality of independent staff employed to manage the partnerships. Social network analysis was used by Mendel and colleagues to examine the structure and composition of US patient safety partnership networks and changes between 2004 and 2006. Partnerships expanded between 2004 and 2006. Fragmentation of the overall partnership network decreased and potential for information flow increased. However network centralisation increased, suggesting vulnerability to partnership failure if key participants disengaged.

A small number of studies addressed the performance of professional networks in relation to aspects of quality of care (Greene et al. 2009; Rangachari 2008), patient outcomes (Kane and Alavi 2008) or service

effectiveness (Lemieux-Charles et al. 2005). Several studies (Ankem 2003; Curran et al. 2005; Vanderveen et al. 2006) examined network characteristics in relation to the diffusion of health care innovations, which could be assumed to relate in an intermediate way to quality of care. Other studies have examined professional networks and social and work climate in relation to work support or stress, or employee burnout or turnover (Garrett and McDaniel 2001; Lindholm 2006; Lindholm et al. 2003; Lindholm et al. 2004; MacPhee 2000; MacPhee and Scott 2002; Mossholder, Settoon, and Henagan 2005; Ommen et al. 2009). Again, such outcomes could be seen as being indirectly related to aspects of quality of care and patient safety. Hence, to date little research has been able to show a relationship, let alone demonstrate causality, resulting from the effects of network characteristics on quality and patient safety outcomes.

### **13. Conclusion**

The approach to looking at health professionals from the perspective of their social and professional networks has proven useful in shedding light on structural and other relationships. In terms of analytical methodologies used to examine social-professional networks in the health sector, a majority of the studies gleaned from the systematic review have used social network analysis to assist in understanding structural relationships. Such studies have shown that social network analysis and the associated methodologies and theoretical perspectives can be usefully applied to investigating and evaluating the different levels of social and professional networks in the health sector.

As a majority of the studies were undertaken in the United States and a range of other countries where there are different health system and health care delivery and financing arrangements, the extent of the transferability and generalisability of study findings to other settings is not clear. Therefore, there is a strong case for further research replicating studies that have had findings of interest in other countries. Additional empirical research on networks of health professionals should be directed at exploring both social network structural characteristics and network governance (including facilitation and leadership), in relation to quality of care and safety, and effectiveness and sustainability. Although a small number of studies examined aspects of health professional networks relevant to quality of care and safety, and some studies addressed issues of effectiveness and sustainability, there is a need for further rigorous research.

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## 15. Selected Abstracts

Ankem, K. 2003. **Influence of information sources on the adoption of uterine fibroid embolisation by interventional radiologists.** *Journal of the Medical Library Association* 91(4): 450-459.

**Objectives:** The purpose of the research was to (1) understand the influence of information sources on the awareness and adoption of uterine fibroid embolisation (UFE) by interventional radiologists in Michigan and (2) to decipher communication relations in the social network of interventional radiologists that were most conducive to the flow of information about UFE. **Methods:** Diffusion of innovations theory and constructs in social network analysis formed the basis for the development of an interview guide. Thirty-two interventional radiologists in Michigan were interviewed over the phone. Chi-square statistics were employed to analyse the awareness and adoption of UFE. Factor analysis was applied to decipher important communication relations in the social network of interventional radiologists. **Results:** Conferences were found to be an initial source of information, creating awareness among early adopters ( $P < 0.05$ ), but other individuals were found to be influential sources in the adoption of UFE by later adopters ( $P < 0.05$ ). Radiologists rarely browsed Websites for information. Work relations in everyday clinical practice were the communication relations most conducive to the flow of information about UFE. Preliminary qualitative data indicated that opinion leaders in the diffusion of UFE in Michigan were located in hospitals primarily dedicated to practice rather than in hospitals affiliated with universities. **Conclusions:** Journals are important information sources for creating awareness and stimulating adoption of innovation among both early and late adopters of new procedures in interventional radiology. Conferences, however, are significantly more important for creating early awareness, while interactions with colleagues is the most important factor in stimulating use of the innovation among later adopters. Among colleagues, opinion leaders in non-academic hospitals may be more influential than individuals in the academic community.

Barrera, D. and G. G. van de Bunt. 2009. **Learning to trust: Networks effects through time.** *European Sociological Review* 25(6): 709-721.

This article investigates the effects of information originating from social networks on the development of interpersonal trust relations in the context of a dialysis department of a Dutch medium-sized hospital. Hypotheses on learning effects are developed from existing theories and tested using longitudinal data concerning the complete networks of trust and (informal) communication relations among employees observed at four different time points. The results support the existence of a learning mechanism operating both within dyads and through the social networks in which the dyads are embedded: actors learn to trust (or distrust) each other from their own past experience as well as from information that they receive from colleagues with whom they have regular communication.

Benham-Hutchins, M. M. and J. A. Effken. 2010. **Multi-professional patterns and methods of communication during patient handoffs.** *International Journal of Medical Informatics* 79(4): 252-267.

**Objective:** Health information technology has been shown to influence the communication patterns of healthcare providers. The goal of this study was to learn more about how healthcare providers communicate and exchange patient clinical information during patient handoffs (transfers) between

units in an acute care setting. **Methods:** Convenience sampling was used to select five patient handoffs. Questionnaires were distributed to providers identified through observation and snowball sampling. Social network analysis methodology was used to develop sociograms of the emergent communication patterns and identify the role of individual providers in the handoff process based on the number of contacts with other providers and incoming and outgoing communication activity. Individual handoff network size ranged from 11 to 20 providers. Participants were asked to describe the method of communication they used to access or share clinical information with other providers, their preferred method of communication; their satisfaction with the available options; and their suggestions for how the process could be improved. **Results:** The network patterns that emerged uncovered the overlapping use of synchronous and asynchronous communication methods (verbally via phone or in person; or written via paper charts and/or an electronic records). No particular professional group dominated or coordinated information flow; instead each handoff network exhibited unique communication patterns and information coordination by two or more influential providers from nursing, medicine, or pharmacy. Most (84%) participants preferred verbal communication. Overall satisfaction with the current communication process varied by unit: 82% of emergency department providers and 54% of the providers working in the admitting units stated they were satisfied or very satisfied. Recommendations for improvement included converting all units to the electronic health record, electronic handoff communication modules and asynchronous multi-professional communication logs. **Conclusions:** The results of this exploratory study provide a foundation for future research examining how network structure and communication principles can be used to design health information technology that compliments the non-linear information gathering and dissemination behaviours of providers from multiple professions. (C) 2009 Elsevier Ireland Ltd. All rights reserved.

Calloway, M., B. Fried, M. Johnsen, and J. Morrissey. 1999. **Characterization of rural mental health service systems.** *Journal of Rural Health* 15(3): 296-307.

This paper explores two mental health systems in rural North Carolina that provide services to people with severe mental disorders. Recent findings show rural people with mental disorders receive less mental health care than their urban counterparts. This study asks whether rural service systems differ from urban systems in the way that their services are coordinated and structured. A popular conception is that public mental health systems in the United States are uncoordinated with many services provided outside the mental health sector. Rural service providers are seen as even more dependent on non-specialized mental health providers than their urban counterparts. While many rural service barriers are attributed to the rural environment, little is known about rural service systems and how their organization might contribute to or negate barriers to care. Social network methods were used in this study to compare two rural with four urban systems of care. Findings confirm that mental health systems fit the de facto hypothesis, but that rural systems differ in ways not anticipated by the hypothesis. Rather than being more dependent on non-mental health agencies, rural mental health agencies are more interdependent.

Carpentier, N., M. P. Pomey, R. Contreras and I. Olazabal. 2008. **Social care interface in early-stage dementia: Practitioners' perspectives on the links between formal and informal networks.** *Journal of Aging and Health* 20(6): 710-738.

Objective: Although issues of complementarity and coordination between health care institutions have recently generated great interest, few scholars have studied the thorny interface between formal and informal service networks. This exploratory study investigates the interface between health care practitioners and caregivers of people with Alzheimer's disease living in the community. Method: Using Pescosolido's multilevel network model and Martuccelli's sociology of the individual, the authors interviewed 20 practitioners drawn from seven urban groups and analysed contacts between practitioners and caregivers at the beginning of the care trajectory. Results: The quality of the practitioner-caregiver interface was determined by the players' profiles, internal structures, and external links. Heterogeneous professional groups and the establishment of contacts in the early stages of dementia seemed beneficial. Discussion: The problematic interface between formal and informal service networks could be improved by a greater understanding of microsocial- and organisational-level interactions and implementing a social model of care.

Chase, S. K. 1995. **The social context of critical care clinical judgment.** *Heart & Lung* 24(2): 154-162.

Background: Clinical judgment in critical care is supported by a rich social network of care providers. The purpose of this study was to describe the social context in which the process of critical care clinical judgment occurs from the nurse's perspective. Methods: An ethnographic study was conducted that included interviews with 10 nurses and participant observation in an open heart surgery unit with 59 nurses and two surgical teams during a 2-year period. Results: Nurses and physicians were organised in hierarchies of nurse manager, resource nurse, charge nurse, and staff nurse or attending surgeon, fellow, chief resident, and resident. These parallel hierarchies allowed for checks on judgment both within and across professional lines. Rituals, such as nursing report, physician rounds, and flow sheet use, provided a context for a critique on judgment processes. Communication of judgment was frequently a casual, open conversation. At other times, differences in perspective could result in conflict. Communication between nurses and physicians has been associated with better patient outcomes. Critical care unit directors and managers can use an analysis of communication patterns to develop supports to clinical judgment.

Cott, C. 1997. **'We decide, you carry it out': A social network analysis of multidisciplinary long-term care teams.** *Social Science & Medicine* 45(9): 1411-1421.

The purpose of this study was to describe the structure of multidisciplinary long-term care teams by identifying the pattern of relationships that develop amongst staff as they go about their work. Using a social network analysis approach, team members were classified as occupying the same structural position based on their patterns of relationships with other team members. The analysis was based on the results of a self-administered survey of 93 health care workers on three teams in the same multilevel geriatric care facility in Metropolitan Toronto. A common structure of the teams was identified consisting of two sub-teams: a multiprofessional sub-team and a nursing sub-team, each of which has a different structure indicating differential involvement in different types of teamwork. The multiprofessional sub-team has an 'organic' structure and is mainly involved in teamwork that involves

decision-making and problem-solving, whereas the nursing sub-team has a 'mechanistic' structure and is mainly involved in task oriented work. The findings of this analysis indicate that while teamwork may be increasing the participation in decision-making by health professionals other than medicine, rather than flattening the hierarchical structure throughout the health care division of labour, its effects are limited to a group of higher status professionals. The clearly defined hierarchy remains for the lower status subdisciplines, and 'I decide, you carry it out' has simply become 'We decide, you carry it out'.

Creswick, N. and J. I. Westbrook 2007. **The medication advice-seeking network of staff in an Australian hospital renal ward.** *Studies in Health Technology & Informatics* 130: 217-231.

Electronic medication systems may impact communication in hospital wards. To identify the ways in which communication patterns may be altered it is necessary to compare processes both before and after system introduction. This paper reports the use of a social network approach to examine the medication advice-seeking network of an Australian hospital renal ward before the introduction of an electronic medication management system. A social network questionnaire was completed by 96% of staff members (doctors, nurses, allied health professionals and administrative staff) on the ward (n=45). Survey data were analysed to produce a sociogram to display the medication advice-seeking network of the staff in the ward. The results showed that there was a relatively low level of advice-seeking about medication-related decisions and tasks. Most communication occurred within professional groups. Several key individuals were pivotal in providing advice both within and across professional groups.

Creswick, N., J. I. Westbrook and J. Braithwaite. 2009. **Understanding communication networks in the emergency department.** *BMC Health Services Research* 9.

Background: Emergency departments (EDs) are high pressure health care settings involving complex interactions between staff members in providing and organising patient care. Without good communication and cooperation amongst members of the ED team, quality of care is at risk. This study examined the problem-solving, medication advice-seeking and socialising networks of staff working in an Australian hospital ED. Methods: A social network survey (Response Rate = 94%) was administered to all ED staff (n = 109) including doctors, nurses, allied health professionals, administrative staff and ward assistants. Analysis of the network characteristics was carried out by applying measures of density (the extent participants are concentrated), connectedness (how related they are), isolates (how segregated), degree centrality (who has most connections measured in two ways, in-degree, the number of ties directed to an individual and out-degree, the number of ties directed from an individual), betweenness centrality (who is important or powerful), degree of separation (how many ties lie between people) and reciprocity (how bi-directional are interactions). Results: In all three networks, individuals were more closely connected to colleagues from within their respective professional groups. The problem-solving network was the most densely connected network, followed by the medication advice network, and the loosely connected socialising network. ED staff relied on each other for help to solve work-related problems, but some senior doctors, some junior doctors and a senior nurse were important sources of medication advice for their ED colleagues. Conclusions: Network analyses provide useful ways to assess social structures in clinical settings by allowing us to understand how ED staff relate within their social and professional structures. This can provide insights of potential benefit to ED staff, their leaders, policymakers and researchers.

Curran, G. M., C. R. Thrush, J.L. Smith, R.R. Owen, M. Ritchie and D. Chadwick. 2005. **Implementing research findings into practice using clinical opinion leaders: Barriers and lessons learned.** *Joint Commission Journal on Quality & Patient Safety* 31(12): 700-707.

Background: An opinion leader-driven intervention to improve practice guideline-based medication management for patients with schizophrenia was tested at four Department of Veterans Affairs health care facilities. The concept of using opinion leaders as disseminators of research evidence and internal agents of change has been widely reported. Project Overview: Each intervention site received an intensive, multicomponent intervention during the course of one year. The project's process evaluation included ongoing brief surveys of physicians' attitudes and behaviours, logs of reports from opinion leader conference calls, and interviews with the opinion leaders toward the end of the implementation period. Barriers or Issues and Potential Solutions: Several barriers or problematic issues surfaced: (1) physicians do not always agree on who is an opinion leader; some sites may have no opinion leader; (2) some sites had poorly developed formal and informal social networks among physicians; (3) a focus on physicians only as agents of change; and (4) how much directive should be given to the opinion leaders concerning how to influence attitudes and behaviours? Discussion: Four major problematic issues encountered during the project offer potential solutions for addressing them.

Curran, J. A. and S. S. R. Abidi. 2007. **Evaluation of an online discussion forum for emergency practitioners.** *Health Informatics Journal* 13(4): 255-266.

Knowledge is a critical element in the delivery of quality healthcare. In a busy emergency department (ED) clinicians attempting clinically relevant discussion with their peers face multiple interruptions and a lack of sustained meaningful interactions. Information and communication technologies such as online discussion forums enable practitioners to share practice knowledge at times that fit into their daily workflow. We conducted an experiment in which we provided emergency clinicians with access to an asynchronous discussion forum as a medium to support development of an online social network for information exchange. The outcomes were evaluated using a social network perspective to better understand the knowledge seeking and sharing behaviours among rural and urban emergency practitioners participating in the online discussion forum. The online discussion forum created an opportunity for emergency practitioners from multiple ED sites to engage in dialogue around topics that were relevant to their practice learning needs.

Doak, S. and D. Assimakopoulos. 2007. **How do forensic scientists learn to become competent in casework reporting in practice: A theoretical and empirical approach.** *Forensic Science International* 167(2-3): 201-206.

In their day-to-day work, carrying out complex tasks, forensic scientists use a combination of explicit, codified standard operating procedures and tacit knowledge developed through their ongoing practice. We show that tacit knowledge is an integral part of the activities of expert forensic science practitioners who continually add to their knowledge repertoire by engaging other scientists through communities of practice. We wish to shed fresh light on the gaining of tacit knowledge by forensic scientists during their apprentice formative years, termed as legitimate peripheral participation. In quantifying tacit knowledge exchanges, we use social network analysis, a methodology for the analysis of social structures, to map relational knowledge flows between forensic scientists within communities of practice at the Forensic

Science Laboratory, Ireland. This paper sheds light on the importance of tacit knowledge within the training regime of forensic scientists and its recognition as equal to the part played by explicit knowledge.

Fattore, G., F. Frosini, D. Salvatore and V. Tozzi. 2009. **Social network analysis in primary care: The impact of interactions on prescribing behaviour.** *Health Policy* 92(2-3): 141-148.

Objectives: In many healthcare systems of affluent countries, general practitioners (GPs) are encouraged to work in collaborative arrangements to increase patients' accessibility and the quality of care. There are two lines of thought regarding the ways in which belonging to a network can affect GP behaviour: (1) the social capital framework posits that, through relationships, individuals acquire resources, such as information, that allow them to perform better; and (2) the social influence framework sees relationships as avenues through which individual actors influence other individuals and through which behavioural norms are developed and enforced. The objective of this study is to provide an evaluation of the effects of GP network organisation on their prescribing behaviour. Methods: We used administrative data from a Local Health Authority (LHA) in Italy concerning GPs organisation and prescriptions. Results: We found that GPs working in a collaborative arrangement have a similar prescribing behaviour while we did not find a significant relationship between the centrality of a GP and her capability to meet LHA's targets. Conclusions: Our data support the conclusion that, in the case of GP collaboration initiatives, the social influence mechanism is more relevant than the social capital mechanism. (C) 2009 Elsevier Ireland Ltd. All rights reserved.

Garåsen, H. and R. Johnsen. 2007. **The quality of communication about older patients between hospital physicians and general practitioners: A panel study assessment.** *BMC Health Services Research* 7: 133.

Background: Optimal care of patients is dependent on good professional interaction between general practitioners and general hospital physicians. In Norway this is mainly based upon referral and discharge letters. The main objectives of this study were to assess the quality of the written communication between physicians and to estimate the number of patients that could have been treated at primary care level instead of at a general hospital. Methods: This study comprised referral and discharge letters for 100 patients above 75 years of age admitted to orthopaedic, pulmonary and cardiological departments at the city general hospital in Trondheim, Norway. The assessments were done using a Delphi technique with two expert panels, each with one general hospital specialist, one general practitioner and one public health nurse using a standardised evaluation protocol with a visual analogue scale (VAS). The panels assessed the quality of the description of the patient's actual medical condition, former medical history, signs, medication, Activity of Daily Living (ADL), social network, need of home care and the benefit of general hospital care. Results: While information in the referral letters on actual medical situation, medical history, symptoms, signs and medications was assessed to be of high quality in 84%, 39%, 56%, 56% and 39%, respectively, the corresponding information assessed to be of high quality in discharge letters was for actual medical situation 96%, medical history 92%, symptoms 60%, signs 55% and medications 82%. Only half of the discharge letters had satisfactory information on ADL. Some two-thirds of the patients were assessed to have had large health benefits from the general hospital care in question. One of six patients could have been treated without a general hospital

admission. The specialists assessed that 77% of the patients had had a large benefit from the general hospital care; however, the general practitioners assessment was only 59%. One of four of the discharge letters did not describe who was responsible for follow-up care. Conclusion: In this study from one general hospital both referral and discharge letters were missing vital medical information, and referral letters to such an extent that it might represent a health hazard for older patients. There was also low consensus between health professionals at primary and secondary level of what was high benefit of care for older patients at a general hospital.

Garrett, D. K. and A. M. McDaniel. 2001. **A new look at nurse burnout: The effects of environmental uncertainty and social climate.** *Journal of Nursing Administration* 31(2): 91-96.

As healthcare organisations deal with changes in the external environment, uncertainty in the internal environment is created. The purpose of this study was to explore the relationships among environmental uncertainty, social climate, and burnout among staff nurses. Multiple regression analysis was used to explore relationships among study variables. Perceived environmental uncertainty predicted burnout among staff nurses, although there was no significant relationship between burnout and objective measures of unit activity. The social climate of the workplace was negatively associated with burnout. The authors concluded that social networks are important during times of change and uncertainty in the work environment; in other words, a supportive workplace can protect against burnout.

Gold, M., P. Doreian, and E.F. Taylor. 2008. **Understanding a collaborative effort to reduce racial and ethnic disparities in health care: contributions from social network analysis.** *Social Science & Medicine* 67(6): 1018-1027.

Quality improvement collaboratives have become a common strategy for improving health care. This paper uses social network analysis to study the relationships among organisations participating in a large-scale public-private collaboration among major health plans to reduce racial and ethnic disparities in health care in the United States. Pre-existing ties, the collaborative process, participants' perceived contributions, and the overall organisational standing of participants were examined. Findings suggest that sponsors and support organisations, along with a few of the health plans, form the core of this network and act as the 'glue' that holds the collaboration together. Most health plans (and one or two support organisations) are in the periphery. While health plans do not interact much with one another, their interactions with the core organisations provided a way of helping achieve health plans' disparities goals. The findings illustrate the role sponsors can play in encouraging organisations to voluntarily work together to achieve social ends while also highlighting the challenges.

Greene, A., C. Pagliari, S. Cunningham, P. Donnan, J. Evans, A. Emslie-Smith, A. Morris and B. Guthrie. 2009. **Do managed clinical networks improve quality of diabetes care? Evidence from a retrospective mixed-methods evaluation.** *Quality and Safety in Health Care* 18(6): 456-461.

System-wide improvement of chronic disease care is challenging because it requires collaboration and communication across organisational and professional boundaries. Managed clinical networks are one potential solution, but there is little evidence of their effectiveness. Retrospective, mixed-methods evaluation of the form and impact of quality improvement in the Tayside Diabetes Managed Clinical Network (MCN) 1998–2005. Progressive implementation of multiple quality improvement strategies

predominately directed at individuals and clinical teams (guideline development and dissemination, education, clinical audit, encouragement of multidisciplinary team working, task redesign). Information technology played an important role in supporting QI activity, but participants identified it as facilitative rather than delivering QI by itself. More important was achieving widespread clinical engagement through persuasion and appeal to shared professional values by clinical leaders. Simple process measures such as glycated haemoglobin measurement rapidly improved. More complex process measures such as eye screening improved more slowly, and were more dependent on redesign of the care pathway. Improvement was greater for type 2 than type 1 diabetes. Significant shifts of care for type 2 diabetes into primary care were achieved, but were harder to achieve without additional resources. Delivering better care to whole populations across organisational and professional boundaries required sustained work over long periods, and at all levels of the system of care. Past network focus on clinical collaboration has been effective at improving clinical process and outcome, and the network is now prioritising work with managers and patients to support future redesign.

Grimshaw, J. M., M. P. Eccles, J. Greener, G. Maclennan, T. Ibbotson, J.P. Hahan and F. Sullivan. 2006. **Is the involvement of opinion leaders in the implementation of research findings a feasible strategy?** *Implementation Science* 1.

Background: There is only limited empirical evidence about the effectiveness of opinion leaders as health care change agents. Aim: To test the feasibility of identifying, and the characteristics of, opinion leaders using a sociometric instrument and a self-designating instrument in different professional groups within the UK National Health Service. Design: Postal questionnaire survey. Setting and participants: All general practitioners, practice nurses and practice managers in two regions of Scotland. All physicians and surgeons (junior hospital doctors and consultants) and medical and surgical nursing staff in two district general hospitals and one teaching hospital in Scotland, as well as all Scottish obstetric and gynaecology, and oncology consultants. Results: Using the sociometric instrument, the extent of social networks and potential coverage of the study population in primary and secondary care was highly idiosyncratic. In contrast, relatively complex networks with good coverage rates were observed in both national specialty groups. Identified opinion leaders were more likely to have the expected characteristics of opinion leaders identified from diffusion and social influence theories. Moreover, opinion leaders appeared to be condition-specific. The self-designating instrument identified more opinion leaders, but it was not possible to estimate the extent and structure of social networks or likely coverage by opinion leaders. There was poor agreement in the responses to the sociometric and self-designating instruments. Conclusion: The feasibility of identifying opinion leaders using an off-the-shelf sociometric instrument is variable across different professional groups and settings within the NHS. Whilst it is possible to identify opinion leaders using a self-designating instrument, the effectiveness of such opinion leaders has not been rigorously tested in health care settings. Opinion leaders appear to be monomorphic (different leaders for different issues). Recruitment of opinion leaders is unlikely to be an effective general strategy across all settings and professional groups; the more specialised the group, the more opinion leaders may be a useful strategy.

Heng, H. K. S., W. D. McGeorge and M. Loosemore. 2005. **Beyond strategy: Exploring the brokerage role of facilities manager in hospitals.** *Journal of Health Organization & Management* 19(1): 16-31.

Purpose: Seeks to explore the brokerage role of facilities manager in hospitals, based on the premise that facilities management (FM) is largely concerned with 'strategic brokerage'. Strategic brokerage is the term coined by Akhaghi to explain the integration of a wide range of support services to ensure the effective operation of the core business of an organisation. Design/Methodology/Approach: The research was conducted in the health service sector using a single case study approach to examine the brokerage potential for FM in a hospital in the Sydney Metropolitan area. A social network analysis technique was used to identify and analyse the communication networks of players in a hospital environment. Two general questions guided the analysis. First, what is the brokerage potential within the FM process? Second, where are the opportunities for brokerage? Findings: The results indicate that identifying relationship linkages between different functional units can create potential brokerage opportunities. Originality/Value: The proposition is made that viewing FM from a brokerage perspective can add value to the delivery of health-care services.

Kane, G. C. and M. Alavi. 2008. **Casting the net: A multimodal network perspective on user-system interactions.** *Information Systems Research* 19(3): 253-272.

Information systems (IS) researchers have typically examined the user-system relationship as an isolated dyad between a single, independent user and an individual, freestanding information system. We argue that this conceptualisation does not adequately represent most organisations today, in which multiple users interact with multiple information systems within a group. Relying heavily on the theory and methods behind social network analysis, we introduce the concept of multimodal networks to assess both users and information systems as equivalent nodes in a single social network. This perspective allows us to examine the influence of information systems on organisational outcomes as a function of all of the user-system and interpersonal interactions in a group. We explore two different possible mechanisms for this influence: (1) direct user-system interactions by aggregating the strength of all the dyadic user-system interactions in a group, and (2) indirect user-system interactions by assessing the centrality of the information systems within the social network. We survey approximately 600 individuals in 40 healthcare groups to test whether either or both of these mechanisms are associated with two types of organisational performance outcomes—efficiency and quality of care. We find that the centrality of the information systems within the network is significantly and positively associated with both efficiency and quality outcomes, but that the average strength of the user-system interactions is not. Implications are that managers and researchers should examine the wider multimodal network of multiple users and multiple systems when assessing the role of IS in organisations in relation to organisational performance outcomes.

Keating, N. L., J. Z. Ayanian, P.D. Cleary, and P.V. Marsden. 2007. **Factors affecting influential discussions among physicians: A social network analysis of a primary care practice.** *Journal of General Internal Medicine* 22(6): 794-798.

Background: Physicians often rely on colleagues for new information and advice about the care of their patients. Objective: Evaluate the network of influential discussions among primary care physicians in a hospital-based academic practice. Design: Survey of physicians about influential discussions with their

colleagues regarding women's health issues. We used social network analysis to describe the network of discussions and examined factors predictive of a physician's location in the network. Subjects: All 38 primary care physicians in a hospital-based academic practice. Measurements: Location of physician within the influential discussion network and relationship with other physicians in the network. RESULTS: Of 33 responding physicians (response rate = 87%), the 5 reporting expertise in women's health were more likely than others to be cited as sources of influential information (odds ratio [OR] 6.81, 95% Bayesian confidence interval [CI] 2.25-23.81). Physicians caring for more women were also more often cited (OR 1.03, 95% CI 1.01-1.05 for a 1 percentage-point increase in the proportion of women patients). Influential discussions were more frequent among physicians practicing in the same clinic within the practice than among those in different clinics (OR 5.03, 95% CI 3.10-8.33) and with physicians having more weekly clinical sessions (OR 1.33, 95% CI 1.15 to 1.54 for each additional session). Conclusions: In the primary care practice studied, physicians obtained information from colleagues with greater expertise and experience as well as colleagues who were accessible based on location and schedule. It may be possible to organise practices to promote more rapid dissemination of high-quality evidence-based medicine.

Lemieux-Charles, L., L. W. Chambers, R. Cockerill, S. Jaglal, K. Brazil, C. Cohen, K. LeClair, B. Dalziel and B. Schulman. 2005. **Evaluating the effectiveness of community-based dementia care networks: The Dementia Care Networks' Study.** *Gerontologist* 45(4): 456-464.

Purpose: The Dementia Care Networks' Study examined the effectiveness of four community-based, not-for-profit dementia networks. The study involved assessing the relationship between the types of administrative and service-delivery exchanges that occurred among the networked agencies and the network members' perception of the effectiveness of these exchanges. Design and Methods: With the use of a case-study method, the evolution, structure, and processes of each network were documented. Social network analysis using a standardised questionnaire completed by member agencies identified patterns of administrative and clinical exchanges among networked agencies. Results: Differences were found between the four networks in terms of their perceptions of service-delivery effectiveness; perceptions of administrative effectiveness did not factor significantly. Exchanges between groups of agencies (cliques) within each of the four networks were found to be more critical than those between individual agencies within each network. Implications: Integration-measured by the types of exchanges within as opposed to across networks-differentiated the four networks studied. This research contributes to our understanding of the use of multiple measures to evaluate the inner workings of service delivery and their impact on elder health and elder health care.

Lewis, J. M., J. I. Baeza and D. Alexander. 2008. **Partnerships in primary care in Australia: Network structure, dynamics and sustainability.** *Social Science & Medicine* 67(2): 280-291.

Partnerships represent a prescriptive form of network governance, based on the idea of cooperation. This article has four aims. The first is to describe why network governance and partnerships are important now, and what one particular example - Primary Care Partnerships - is addressing. The second is to analyse the network structure of two of these partnerships, and the third is to examine network dynamics. The fourth aim is to explore relationships and sustainability over the longer term. Two government-funded and steered partnerships, which were established to increase coordination

between primary care services in Victoria, Australia, were examined. Annual interviews at three points in time between 2002 and 2005 were used to explore relationships between organisations within these two partnerships. The structure of two different communication networks, based on contacts for work and contacts for strategic information, were examined using social network analysis. Tracing network structures over time highlighted partnership dynamics. The network structures changed over the three years of the study, but an important constant was the continuing centrality of the independent staff employed to manage the partnerships. Over the longer term, it seems to be more important to fund independent partnership staff, rather than people who connect partnerships to the funding agency. If partnerships are seen as valuable in improving service coordination and health outcomes, then long term rather than just start-up funding support is required.

Lindholm, M. 2006. **Working conditions, psychosocial resources and work stress in nurses and physicians in chief managers' positions.** *Journal of Nursing Management* 14(4): 300-309.

The study investigated whether psychosocial work conditions, professional network, job support, social network and support, sick leave and salary were associated with work stress in nurses in chief managers' positions above ward level and physicians in clinical director positions. A sample consisting of 205 nurses and 274 physicians in chief managers' positions at higher structural level answered a questionnaire. Odds ratios were used for estimating the bivariate association between work stress and psychosocial resources. The result showed that both nurse managers (OR 6.8; 95% CI: 3.5-13.5) and clinical directors (OR 6.7; 95% CI: 3.6-12.5) exposed to high job demands had a significantly higher probability of high level of work stress. The results also indicated that the available psychosocial resources taken together inside and outside work did not balance the experienced work stress in nurse managers and the clinical directors who were exposed to high work demands. No relation was found between work stress and sick leave and salary.

Lindholm, M., E. Dejin-Karlsson, et al. 2003. **Nurse managers' professional networks, psychosocial resources and self-rated health.** *Journal of Advanced Nursing* 42(5): 506-515.

Background: Nurse managers act under constant pressure to develop strategies in response to professional challenges within a changing and restructured health care system. When such environmental stress is present, they need access to sufficient psychosocial recourse. Aim: The study aimed to investigate whether nurse managers' professional networks, psychosocial work conditions, job support, social network and support were associated with self-rated health, sick-leave and salary. Methods: From a total of 268 Swedish nurse managers, active in management positions, 205 (77%) agreed to participate in the study by answering a self-report questionnaire. Cronbach's alpha was used to calculate internal consistency. Odds ratios were used to estimate the bivariate association between self-rated health and psychosocial resources. Results: Nurse managers exposed to high job demands had significantly increased odds for low self-rated health. It was also found that low level of support from professional network, job support, social network and social support outside work displayed increased odds for low self-rated health, independently of age, gender and education. There were additive (but no synergistic) effects found for job demand in combination with professional networks, job support and emotional support and in relation to self-rated health. Conclusion: The study showed that nurse managers exposed to high job demands had elevated odds for low self-rated health, regardless of level

of psychosocial resources within or outside work. Two-thirds of the nurse managers who were affiliated to professional networks did not consider this a supporting factor in their management work. Those with low job support had increased odds for sick-leave compared with those with high support. No significant associations were found between psychosocial characteristics and salary.

Lindholm, M., E. Dejin-Karlsson, et al. 2004. **Physicians as clinical directors: Working conditions, psychosocial resources and self-rated health.** *Occupational Medicine* 54(3): 182-189.

Background: Physicians in clinical directors' positions fulfil their commitments in demanding work environments characterised by organisational changes and economic cutbacks. Little is known about the self-rated health of this group. Aim: To investigate whether self-rated health was associated with psychosocial working conditions, professional networks, job support, social networks and social support, sick leave and salary in Swedish physicians working as clinical directors. Methods: A self-reported questionnaire was sent to 373 clinical directors. Odds ratios (ORs) were used for estimating the bivariate association between self-rated health and psychosocial resources. Results: A total of 274 clinical directors agreed to participate in the study. The response rate was 73%. The clinical directors exposed to high job demands had a significantly higher probability of low self-rated health [OR = 3.4 and 95% confidence interval (CI) = 1.6-7.0] than those who were not in this situation. Furthermore, participants who were exposed to high job demands had an increased risk of low self-rated health (OR = 3.8 and 95% CI = 1.8-8.1) irrespective of available social support inside or outside work. High average working hours more than doubled the risk of low self-rated health (OR = 2.2 and 95% CI = 1.1-4.4). Conclusion: The job demands on physicians in clinical directors' positions may exceed ordinary means of support with consequent adverse effects on self-rated health. More research is needed to investigate the interaction between job demands and support systems in this group of health care workers.

Lurie, S. J., T. T. Fogg, et al. 2009. **Social network analysis as a method of assessing institutional culture: Three case studies.** *Academic Medicine* 84(8): 1029-1035.

Purpose: To describe the basic concepts of social network analysis (SNA), which assesses the unique structure of interrelationships among individuals and programs, and introduce some applications of this technique in assessing aspects of institutional culture at a medical centre. Method: The authors applied SNA to three settings at their institution: team function in the intensive care unit, interdisciplinary composition of advisory committees for 53 federal career development awardees, and relationships between key function directors at an institution-wide Clinical Translational Sciences Institute (CTSI). (Key functions are the major administrative units of the CTSI.) Results: In the ICU setting, SNA provides interpretable summaries of aspects of clinical team functioning. When applied to membership on mentorship committees, it allows for summary descriptions of the degree of interdisciplinarity of various clinical departments. Finally, when applied to relationships among leaders of an institution-wide research enterprise, it highlights potential problem areas in relationships among academic departments. In all cases, data collection is relatively rapid and simple, thereby allowing for the possibility of frequent repeated analyses over time. Conclusions: SNA provides a useful and standardised set of tools for measuring important aspects of team function, interdisciplinarity, and organisational culture that may otherwise be difficult to measure in an objective way.

MacPhee, M. 2000. **Hospital networking. Comparing the work of nurses with flexible and traditional schedules.** *Journal of Nursing Administration* 30(4): 190-198.

**Objective:** This research study was conducted to contrast workplace socialisation of nurses working flexible (flex) and traditional schedules in an acute care setting. The study illustrates the types of social networks used by both types of nurses in a reengineered healthcare environment. **Summary, Background, Data:** Reengineering strategies, such as flex nurse staffing, add a new dimension to workplace change and adaptation. Few studies have examined the similarities and differences between nurses working flex and traditional schedules. The research literature shows that workplace socialisation significantly affects job satisfaction, organisational commitment, and retention. No studies have examined how the process of socialisation--forming social networks--differs for nurses working traditional or flex schedules. **Methods and Subjects:** A convenience sample of 120 nurses working traditional schedules and 46 nurses working flex schedules from a paediatric, tertiary care setting completed the Social Network Questionnaire (SNQ), a standardised instrument that records individuals' social network composition and function. **Results:** No significant differences were found in the nurses' social network composition. Both types of nurses constructed peer-based networks and nurse managers were also present in their networks. Nurses working traditional schedules used significantly more peer members for different types of emotional support, such as reassurance and handling emotional upsets. **Conclusions:** Workplace networks are important to both types of nurses. Nurses on flex schedules may form less social attachments in order to manage the increased demands of moving among multiple units. This group of nurses can provide clues for adaptive change in reengineered environments.

MacPhee, M. and J. Scott. 2002. **The role of social support networks for rural hospital nurses: Supporting and sustaining the rural nursing work force.** *Journal of Nursing Administration* 32(5): 264-272.

**Objective:** This survey study describes the workplace social support networks of rural hospital nurses in one geographic region of Colorado. This rural sample was compared with data from a sample of urban hospital nurses in Colorado. **Background:** Social support networks influence nurses' satisfaction and retention. Nursing recruitment and retention is especially critical in rural areas where it takes healthcare facilities 60% longer than urban facilities to fill nursing vacancies. Little is known about rural nurses' social support networks. **Methods:** The Social Network Questionnaire (SNQ) was mailed to all nurses within one rural region of Colorado. Descriptive, correlational and comparative statistics were used to evaluate the structure and function of these nurses' networks. **Results:** The nurses' networks were predominantly peer-based, but managers provided significant functional supports. The types of support provided by managers depended on the managers' placement in the nurses' networks. Some managers provided only performance feedback, and other managers offered physical assistance and emotional support. Rural nurses expected more guidance from management than did their urban counterparts. **Implications:** This sample of nurses clearly delineated the types of leadership styles most beneficial to them. Communication of roles and expectations between staff and management can enhance nursing satisfaction in the workplace setting.

Mendel, P., C. L. Damberg, et al. 2009. **The Growth of Partnerships to Support Patient Safety Practice Adoption.** *Health Services Research* 44(2): 717-738.

To document the numbers and types of interorganisational partnerships within the national patient safety domain, changes over time in these networks, and their potential for disseminating patient safety knowledge and practices. Self-reported information gathered from representatives of national-level organisations active in promoting patient safety. Social network analysis was used to examine the structure and composition of partnership networks and changes between 2004 and 2006. Two rounds of structured telephone interviews (n=35 organisations in 2004 and 55 in 2006). Patient safety partnerships expanded between 2004 and 2006. The average number of partnerships per interviewed organisation increased 40 percent and activities per reported partnership increased over 50 percent. Partnerships increased in all activity domains, particularly dissemination and tools development. Fragmentation of the overall partnership network decreased and potential for information flow increased. Yet network centralisation increased, suggesting vulnerability to partnership failure if key participants disengage. Growth in partnerships signifies growing strength in the capacity to disseminate and implement patient safety advancements in the US health care system. The centrality of AHRQ in these networks of partnerships bodes well for its leadership role in disseminating information, tools, and practices generated by patient safety research projects.

Milward, H. B. and K. G. Provan. 1998. **Measuring network structure.** *Public Administration* 76(2): 387-407.

Networks have been a research issue in public administration for many years. Because of the difficulty of measuring networks, they have often been treated as a metaphor, a conceptual scheme, or a management technique (networking). The work on networks in public administration is almost all of the case study and rarely of the comparative case variety. This article presents the results of two studies of networks using social network analysis as a technique for studying structural relationships between organisations. This technique is utilised to show both the research and practical potential of network analysis as an evaluation methodology for organisations that jointly produce a service. In the first study, the network provides mental health services to seriously mentally ill adults. In the second study, the network attempts to prevent young people from abusing drugs and alcohol. The two studies were undertaken for different reasons. The first was an elaborate comparative study of four mental health networks and the relationship between network design and performance. The second was a much simpler consulting effort to help a local prevention partnership create linkages to other community organisations. However, in both of the studies the goal was to measure the structural ties in the network based on various types of relationships that exist in a given field of practice. These linkages are ties that bind the network together and become data that can be used to compare networks on their degree and type of integration. The article makes the argument that links in a network are one way that scholars can compare networks in similar or different policy domains. At the same time, the article argues that analysing linkages in an organisation's network is an effective and practical means of determining how well integrated any given organisation is in a network.

Milward, H. B. and K. G. Provan. 2003. **Managing the Hollow State**. *Public Management Review* 5(1): 1-18.

This article presents what the authors have learned about managing networks of public, private and nonprofit service providers in the context of decentralised and devolved governmental regimes — what the authors have termed the hollow state. The characteristics of the hollow state are discussed along with two strategies for managing networks of organisations that jointly produce a public service — collaboration and contracting. The article revisits the authors' preliminary theory of network effectiveness, based on a four-city study of mental health in light of an evolutionary study conducted on one city's mental health system over four years.

Mossholder, K. W., R. P. Settoon, and S.C. Henagan. 2005. **A relational perspective on turnover: Examining structural, attitudinal, and behavioural predictors**. *Academy of Management Journal* 48(4): 607-618.

This study examined whether structural, attitudinal, and behavioural variables of a relational nature were predictive of employee turnover. Participants were a sample of 176 health care employees from a large public medical centre. Using survival analysis over a five-year time frame, we found that two such variables, network centrality and interpersonal citizenship behaviour, predicted turnover. Implications of taking a relational perspective toward turnover and other withdrawal behaviours found in organisations are discussed.

Ommen, O., E. Driller, E., T. Kohler, C. Kowalski, N. Ernstmann, M. Neumann, P. Steffen, and P. Holger. 2009. **The relationship between social capital in hospitals and physician job satisfaction**. *BMC Health Services Research* 9: 81.

Background: Job satisfaction in the hospital is an important predictor for many significant management ratios. Acceptance in professional life or high workload are known as important predictors for job satisfaction. The influence of social capital in hospitals on job satisfaction within the health care system, however, remains to be determined. Thus, this article aimed at analysing the relationship between overall job satisfaction of physicians and social capital in hospitals. Methods: The results of this study are based upon questionnaires sent by mail to 454 physicians working in the field of patient care in 4 different German hospitals in 2002. 277 clinicians responded to the poll, for a response rate of 61%. Analysis was performed using three linear regression models with physician overall job satisfaction as the dependent variable and age, gender, professional experience, workload, and social capital as independent variables. Results: The first regression model explained nearly 9% of the variance of job satisfaction. Whereas job satisfaction increased slightly with age, gender and professional experience were not identified as significant factors to explain the variance. Setting up a second model with the addition of subjectively-perceived workload to the analysis, the explained variance increased to 18% and job satisfaction decreased significantly with increasing workload. The third model including social capital in hospital explained 36% of the variance with social capital, professional experience and workload as significant factors. Conclusion: This analysis demonstrated that the social capital of an organisation, in addition to professional experience and workload, represents a significant predictor of overall job satisfaction of physicians working in the field of patient care. Trust, mutual understanding, shared aims,

and ethical values are qualities of social capital that unify members of social networks and communities and enable them to act cooperatively.

Ormrod, S., E. Ferlie, et al. 2007. **The appropriation of new organizational forms within networks of practice: founder and founder-related ideological power.** *Human Relations* 60(5): 745-767.

In this article, we address the question of how organisational practices are diffused within networks of practice. We do so by drawing on the results of an ethnographic study of the diffusion of a complex mental health care treatment modality - the Democratic Therapeutic Community - that involved the attempted spread of novel work practices within a professional network of psychiatrists and their associated multi-disciplinary teams at two new clinical sites. We orientate the study within the networks of practice (NOP) literature on the diffusion of new work practices, considering in particular the issue of organisational power, which has been neglected hitherto. After presenting our ethnographic material, we draw attention to the role of clinical ideology, derived from founders and upheld by new, local clinical leaders in the appropriation process. By bringing in a concern for organisational power, we add to the existing literature through stressing the importance of ideological power, in supplying collective meaning, and the influential role of founders as creators and 'institutionalisers' of underlying ideologies.

Pappas, J. M., K. E. Flaherty, et al. 2003. **Achieving strategic consensus in the hospital setting: a middle management perspective.** *Hospital Topics* 81(1): 15-22.

This study adopts a social network methodology to explore the achievement of strategic consensus in a hospital system. On the basis of responses from 88 middle managers, the authors determined that a manager's (1) knowledge of the internal capabilities and the external environment of an organisation and (2) his or her social position in a management structure significantly affect the realisation of strategic consensus. Managerial knowledge is essential, and its importance in the consensus-building process is enhanced by a manager's social position.

Pappas, J. M., K. E. Flaherty, et al. 2004. **Tapping into hospital champions - strategic middle managers.** *Health Care Management Review* 29(1): 8-16.

A social network analysis of eighty-nine midlevel health care professionals showed that middle managers' strategic knowledge is positively associated with championing alternative ideas and synthesising new information for upper management. In addition, the relationship between knowledge and middle management strategic activities in informal networks is moderated by the manager's social position.

Peng, T. J. A., F. Y. Lo, et al. 2006. **Benefiting from networks by occupying central positions: An empirical study of the Taiwan health care industry.** *Health Care Management Review* 31(4): 317-327.

At issue is whether network resources imply some resources available to all members in networks or available only to those occupying structurally central positions in networks. In this article, two conceptual models, the additive and interaction models of the firm, are empirically tested regarding the impact of hospital resources, network resources, and centrality on hospital performance in the Taiwan health care industry. The results demonstrate that: (1) in the additive model, hospital resources and centrality independently affect performance, whereas network resources do not; and (2) no evidence supports the interaction effect of centrality and resources on performance. Based on our findings in

Taiwanese practices, the extent to which the resources are acquired externally from networks, we suggest that while adopting interorganisational strategies, hospitals should clearly identify those important resources that reside in-house and those transferred from network partners. How hospitals access resources from central positions is more important than what network resources can hospitals acquire from networks. Hospitals should improve performance by exploiting its in-house resources rather than obtaining network resources externally. In addition, hospitals should not only invest in hospital resources for better performance but should also move to central positions in networks to benefit from collaborations.

Rangachari, P. 2008. **Knowledge sharing networks related to hospital quality measurement and reporting.** *Health Care Management Review* 33(3): 253-263.

Background: With the growing momentum toward hospital quality reporting by public payers, hospitals face increasing pressures to improve their medical record documentation and administrative data coding performance. The literature on 'professional complex systems' has put forth various strategies for improving the performance of professional organisations. In doing so, it has emphasised the importance of creating effective structures for knowledge sharing and organisational learning. This study integrates knowledge networks and professional organisations literatures to develop hypotheses related to knowledge sharing network effectiveness in professional organisations. Purpose: Correspondingly, this study explores the relationship between the organisational knowledge sharing structure related to quality and hospital coding performance related to quality. Simultaneously, this study seeks to identify other organisational characteristics associated with coding for quality measurement. The purpose is to identify strategies not only for improving hospital coding performance but also for the organisation to adapt to the changing environment. Methods: An exploratory and comparative research design is used. The sample is composed of four hospitals, two showing 'good-coding' performance for quality measurement and two showing 'poor-coding' performance. Interviews and surveys are conducted with administrators and staff in the quality, medical staff, and coding subgroups in each facility. Survey data are subjected to social network analysis to examine knowledge sharing structures. Findings and Implications: This study finds that good-coding performance is systematically associated with a knowledge sharing network structure rich in brokerage and hierarchy (with leaders connecting different professional subgroups to each other and to the external environment) rather than in density (where everyone is directly connected to everyone else). From a health care management perspective, this study suggests that to improve hospital coding performance, senior administrators must undertake proactive and unceasing efforts to coordinate knowledge exchange across physician and coding subgroups and connect these subgroups with the changing external environment.

Scott, J., A. Tallia, et al. 2005. **Social network analysis as an analytic tool for interaction patterns in primary care practices.** *Annals of Family Medicine* 3(5): 443-448.

Purpose: Social network analysis (SNA) provides a way of quantitatively analysing relationships among people or other information-processing agents. Using two practices as illustrations, we describe how SNA can be used to characterise and compare communication patterns in primary care practices. Methods: Based on data from ethnographic field notes, we constructed matrices identifying how practice members interact when practice-level decisions are made. SNA software (UCInet and KrackPlot)

calculates quantitative measures of network structure including density, centralisation, hierarchy and clustering coefficient. The software also generates a visual representation of networks through network diagrams. Results: The two examples show clear distinctions between practices for all the SNA measures. Potential uses of these measures for analysis of primary care practices are described. Conclusions: SNA can be useful for quantitative analysis of interaction patterns that can distinguish differences among primary care practices.

Vanderveen, K. A., D. A. Paterniti, et al. 2006. **Diffusion of surgical techniques in early stage breast cancer: Variables related to adoption and implementation of sentinel lymph node biopsy**. 77th Annual Meeting of the Pacific-Coast-Surgical-Association, San Francisco, CA.

Background: Understanding how physicians acquire and adopt new technologies for cancer diagnosis and treatment is poorly understood, yet is critical to the dissemination of evidence-based practices. Sentinel lymph node biopsy (SLNB) has recently become a standard technique for axillary staging in early breast cancer and is an ideal platform for studying medical technology diffusion. We sought to describe the timing of SLNB adoption and patterns of surgeon interactions with the following educational sources: local university training program, surgical literature, national meetings/courses, national specialty centres, and other local surgeons. Methods: A cross-sectional survey that used semi-structured interviews was used to assess timing of adoption, practice patterns, and learning sources for SLNB among surgical oncologists and general surgeons in a single metropolitan area. Results: A total of 44 eligible surgeons were identified; 38 (86%) participated. All surgical oncologists (11 of 11) and most general surgeons (26 of 27) had implemented SLNB. Surgical oncologists were older (mean 51 vs. 48 years,  $P = .02$ ) and had used SLNB longer (6.1 vs. 3.3 years,  $P = .01$ ) than general surgeons. By use of social network diagrams, surgical oncologists and the university training program were shown to be key intermediaries between general surgeons and national specialty centres. Surgeons in group practice tended to use more learning sources than solo practitioners. Conclusions: Surgical oncologists and university-based surgeons play key educational roles in disseminating new cancer treatments and therefore have a professional responsibility to educate other community physicians to increase the use of the most current, evidence-based practices.

Webster, C., O. Grusky, et al. 1999. **Team leadership: network differences in women's and men's instrumental and expressive relations**. *Administration & Policy in Mental Health* 26(3): 169-190.

Recent studies have emphasised differences in leadership styles between women and men. Women have an 'interactive' leadership style while men are more 'directive' and 'authoritative'. Social network analysis is used to examine differences in eight mental health case management teams, half formally supervised by women and half by men. The techniques used are graphical displays and measures of centrality. Results show male leaders as the most central team member for both instrumental and expressive relations. Female leaders, however, do not adhere to a single leadership style. Team centralisation also differs with gender composition of teams influencing leadership differences.

West, E. and D. N. Barron. 2005. **Social and geographical boundaries around senior nurse and physician leaders: an application of social network analysis.** *Canadian Journal of Nursing Research* 37(3): 132-148.

The purpose of this study was to describe the social and geographical boundaries around the networks of senior nurse executives and physician leaders and managers in acute-care hospitals in the United Kingdom. A telephone survey was conducted using standard social network methods. A random sample was drawn from a national list and repeatedly sampled until 100 respondents were interviewed. The response rate was 49.5%. Both groups tended to discuss 'important professional matters' with others who were similar to themselves in terms of profession, gender, age, and seniority, with physicians being more extreme in this regard. The implication is that gaps in the network of informal ties will impede the dissemination of information and the spread of social influence between these two important groups. Managers (non-clinically qualified) appear to occupy a powerful 'brokerage' role. Informal networks are mainly composed of local ties. The authors argue that dissemination and influence strategies that take features of the social structure into account are more likely to be successful.

West, E., D. N. Barron, et al. 1999. **Hierarchies and cliques in the social networks of health care professionals: Implications for the design of dissemination strategies.** *Social Science & Medicine* 48(5): 633-646.

Interest in how best to influence the behaviour of clinicians in the interests of both clinical and cost effectiveness has rekindled concern with the social networks of health care professionals. Ever since the seminal work of Coleman et al. [Coleman, J.S., Katz, E., Menzel, H., 1966. *Medical Innovation: A Diffusion Study*. Bobbs-Merrill, Indianapolis.], networks have been seen as important in the process by which clinicians adopt (or fail to adopt) new innovations in clinical practice. Yet very little is actually known about the social networks of clinicians in modern health care settings. This paper describes the professional social networks of two groups of health care professionals, clinical directors of medicine and directors of nursing, in hospitals in England. We focus on network density, centrality and centralisation because these characteristics have been linked to access to information, social influence and social control processes. The results show that directors of nursing are more central to their networks than clinical directors of medicine and that their networks are more hierarchical. Clinical directors of medicine tend to be embedded in much more densely connected networks which we describe as cliques. The hypotheses that the networks of directors of nursing are better adapted to gathering and disseminating information than clinical directors of medicine, but that the latter could be more potent instruments for changing, or resisting changes, in clinical behaviour, follow from a number of sociological theories. We conclude that professional socialisation and structural location are important determinants of social networks and that these factors could usefully be considered in the design of strategies to inform and influence clinicians.

## 16. Appendix 1

For Appendix 1, Tables 1 and 2 see below.

### 16.1 Table 1: Social Network Analysis – Definitions, Theories and Propositions

Item	Researcher	Definition, Theories and Propositions
Actors	Newman, Watts & Strogatz (2002)  Uzzi (1996, 1997)  Burt (1992)	People who make up a social network.  Actors favour others whom they trust.  Actors favour others with whom they exchange information, or upon whom they depend.
Broker relationships	Provan, Fish & Sydow (2007)  Burt (1992)	'To what extent does an organisation span gaps, or structural holes, in a network, and what are the implications of this for the organisation?'  'Organisations that span 'structural holes' are considered to be brokers, often occupying positions of considerable influence.'
Centrality	Bavelas (1950)        Newman, Watts & Strogatz (2002)        Webster et al. (1999: p. 171)	Within the network, the recognised leader will probably have the position of highest centrality. Based on the study of communication and information flow in a network, Bavelas noted that 'in patterns with a high, localised centrality, organisation evolves more quickly, is more stable, and errors in performance are less. At the same time, however, morale drops. It is inconceivable that morale should not, in the long run, affect stability and accuracy negatively.'  The influence of the various 'actors'.  'The most theoretically developed set of network measures for the study of leadership are measures of centrality' (Webster cites: Bavelas (1950); Beauchamp (1965); Bonacich (1987); Freeman (1979); Knoke and Burt (1983); Leavitt (1951); Sabidussi (1966). 'Both individuals and groups can be considered in terms of centrality.'

Table 1: Social Network Analysis – Definitions, Theories and Propositions (Continued)		
Item	Researcher	Definition, Theories and Propositions
'Betweenness' centrality	Mendel et al. (2009)	The extent to which an organisation serves as a link or bridge across different parts of the network that would otherwise not be connected.
	Hawe, Webster & Shiell (2004)	'The number of times an actor connects pairs of other actors, who otherwise would not be able to reach one another. It is a measure of the potential for control as an actor who is high in 'betweenness' is able to act as a gatekeeper controlling the flow of resources between the alters that he or she connects.'
Degree centrality	Freeman (1979)	Degree centrality of a point, which is the sum of all other points directly connected to it, signifies activity level.
	Mendel et al. (2009)	The sheer number of ties that an organisation has with other organisations in the network.
	Provan, Fish & Sydow (2007)	"In-degree" and "out-degree" centrality: Calculation of in-degree and out-degree centrality is also possible and is based on the extent to which assets such as resources, information, and clients are coming <i>into</i> an organisation from others in the network versus those being sent <i>out</i> to other organisations.'
Closeness centrality	Hawe, Webster & Shiell (2004)	'Based on the notion of distance. If an actor is close to all others in the network, a distance of no more than one, then she or he is not dependent on any other to reach everyone in the network. Closeness measures independence or efficiency. With disconnected networks, closeness centrality must be calculated for each component.'
Cliques	Provan, Fish & Sydow (2007)	'Cliques are clusters of three or more organisations connected to one another. At the ego-centric level, the extent of an organisation's connectedness to a clique may affect organisational outcomes in ways that are different than when the organisation is connected only through a dyad.'
Clustering	Newman, Watts & Strogatz (2002)	'Occurs when two "actors" have another mutual acquaintance, or several.'
	Scott (1991, 2000)	'The intuitive idea of a cluster corresponds to the idea of an area of relatively high density in a graph.'

Item	Researcher	Definition, Theories and Propositions
Cohesion	Hawe, Webster & Shiell (2004)	<p>The interconnectedness of actors in a network. Measures of cohesion include:</p> <p>‘Distance’: The distance ‘between two actors in a network (or nodes in a graph) is calculated by summing the number of distinct ties (lines) that exist along the shortest route between them.’</p> <p>‘Reachability’: ‘Measures whether actors within a network are related, either directly or indirectly, to all other actors. Actors who are not connected to any other actors are called <i>isolates</i>.</p> <p>‘Density’: (see definition below).</p>
Connection diversity	Strogatz (2001)	‘The links between nodes can have different weights, directions and signs.’
Datasets (network):		
Attribute datasets	Hawe, Webster & Shiell (2004)	Data on the characteristics of the network members.
Relational datasets	Hawe, Webster & Shiell (2004)	Social network analysis is the study of structure and involves ‘relational’ datasets. The structure is derived from the regularities in the patterning of relationships among social entities, which might be people, groups, or organisations.
Degrees	Newman, Watts & Strogatz (2002)	The number of ‘ties’ that ‘actors’ have to other ‘actors’.
Density	Berkman et al. (2000) West and Barron (2005)	<p>The extent to which the network members are connected to each other (whether a network is dense or loose).</p> <p>‘Where ties are dense, information and influence can spread rapidly among all those who are in frequent contact. Where ties do not exist, on the other hand, dissemination through informal interaction is impossible.’</p>
Duality	Wasserman and Faust (1994: p.295)	‘The duality in affiliation networks refers specifically to the alternative, and equally important, perspectives by which actors are linked to one another by their affiliation with events, and at the same time events are linked by the actors who are their members.’

<b>Table 1: Social Network Analysis – Definitions, Theories and Propositions (Continued)</b>		
<b>Item</b>	<b>Researcher</b>	<b>Definition, Theories and Propositions</b>
Fragmentation	Provan et al. (2005)	Are all or most network members connected, either directly or indirectly (that is, through another actor or organisation), or is the network broken up into fragments of unconnected actors or organisations?
Governance	Provan, Fish & Sydow (2007)	'What mechanism is used to govern and/or manage the overall network? Even if networks are considered as a distinct form of governance, the mechanism used can considerably vary and range from self-governance, to hub-form or lead-organisation governed, to a network administrative organisation (NAO) model.'
Homophily	McPherson, Smith-Lovin & Cook (2001)	This principle - the homophily principle - structures network ties of every type, including marriage, friendship, work, advice, support, information transfer, exchange, co-membership, and other types of relationship. (These authors note that the classic citation in the sociological literature seems to be Lazarsfeld and Merton's (1954) study of friendship process in Hilltown and Crafttown.)
Lines	Hawe, Webster & Shiell (2004)	The relational ties connecting actors.
Multiplexity	Hawe, Webster & Shiell (2008) Provan et al. (2005)	'Actors can have multiple ties with other actors.' '[T]he strength of the relationship between individual network partners, based on the number of types of different links (joint programs, referrals, etc.) they maintain.'
Network centralisation	Mendel et al (2009)	A measure of the extent to which a network is dominated by one or a few very central hubs (i.e., nodes with high degree and betweenness centrality)
Network structure	Brass (1984); Hawe, Webster & Shiell (2004)	The relationships between network structure and position and access to the resources within those networks.

<b>Table 1: Social Network Analysis – Definitions, Theories and Propositions (Continued)</b>		
<b>Item</b>	<b>Researcher</b>	<b>Definition, Theories and Propositions</b>
Network subgroup measures	Hawe, Webster & Shiell (2004)	<p>A network can be partitioned, as follows:</p> <p><i>Component:</i> A portion of the network in which all actors are connected, directly or indirectly, by at least one tie.</p> <p><i>Clique:</i> A subgroup of actors who are all directly connected to one another and no additional network member exists who is also connected to all members of the subgroup.</p>
Prestige	Wasserman and Faust (1994: p.174)	'The prestige of an actor increases as the actor becomes the object of more ties but not necessarily when the actor itself initiates the ties. In other words, one must look at ties directed to an actor to study that actor's prestige.'
Relation	Knoke and Yang (2008: p. 7)	'A relation is generally defined as a specific kind of contact, connection, or tie between a pair of actors, or dyad. Relations may be either directed, where one actor initiates and the second actor receives (e.g., advising), or nondirected, where mutuality occurs (e.g., conversing).'
Small-world network	Newman, Watts & Strogatz (2002)  Watts and Strogatz (1998)	<p>A network that exhibits a combination of short paths and social structure, the latter being defined in terms of network clustering.</p> <p>'These systems can be highly clustered, like regular lattices, yet have small characteristic path lengths, like random graphs.'</p>
Social capital	Coleman (1988)  Lin (1999, 2001)  Brass (1984)	<p>Coleman identified three forms of social capital: obligations and expectations, information channels and social norms, and described the social structural conditions under which it arises.</p> <p>'A resource (e.g., access to valuable information, word –of-mouth referrals, and power) available in one's network of relationships.'</p> <p>'Social capital is often operationalised as "network centrality", or the number of connections between an individual and others in a network, which grants the central actor access to those individuals and their resources.'</p>

Item	Researcher	Definition, Theories and Propositions
Social connectivity	Pappas, Flaherty & Wooldridge (2003: p. 16)	‘Social networks within organisations have been used ... to determine social connectivity based on friendship, trust, communication, and even intergroup conflict.’ (See also: Krackhardt and Hanson (1993); LaBianca and Brass (2006))
Social influence	Marsden and Friedkin (1994)	Social influence ‘links the structure of social relations to attitudes and behaviours of the actors who compose a network.’ ‘The proximity of two actors in a social network is associated with the occurrence of interpersonal influence between the actors.’
Structural complexity	Strogatz (2001)	The [network] wiring diagram can be an intricate tangle.
Structural embeddedness	Granovetter (1992: p. 35; 1973, 1982)  Burt (1992)  Jones, Hesterly & Borgatti (1997)  Granovetter (1973)  Uzzi (1997)	The extent to which a ‘dyad’s mutual contacts are connected to one another’. Structural embeddedness is a function of how many participants interact with one another, how likely future interactions are among participants, and how likely participants are to talk about these interactions.  The more structural embeddedness there is in a network, the more information each actor knows about all the other actors and the more constraints there are on each actor’s behaviour.  ‘Since structural embeddedness diffuses information throughout a system, it also facilitates the development of macroculture – the common values, norms, and beliefs shared across firms – because parties share perceptions and understandings.’  Overreliance on strong ties tends to develop tight, relatively isolated cliques that are not well integrated with the rest of the industry.  Over-embeddedness (many strong ties and few weak ties) can lead to feuding, choking off novel information from other parts of the industry, and welfare-like support of weak network members.
Structural holes	Burt (1992)	‘Structural holes’ are non-redundant relationships where the hole acts as an insulator. It is more beneficial to be the exclusive link between individuals and groups (thus filling a structural hole) who are not themselves tied to each other.

Item	Researcher	Definition, Theories and Propositions
Ties	<p>Wellman (1988: p. 86)</p> <p>Newman, Watts &amp; Strogatz (2002)</p> <p>Granovetter (1973)</p>	<p>The essence of community is its social structure, not its spatial structure. By assessing actual ties between network members, one can empirically test whether community exists and whether that community is defined on the basis of neighbourhood, kinship, friendship, institutional affiliation or other characteristics.</p> <p>‘The pattern of interactions between the actors.’ The importance of the number of ties that actors have to other actors, their so-called ‘degrees’. For example, in many networks, the distribution of actors’ degrees is highly skewed, with a small number having an unusually large number of ties. This skewness could have an impact on the way in which communities operate, including the way information travels through the network and the sustainability of networks.</p> <p>Ties connecting actors can be strong or weak.</p>
Transitivity	Mendel et al. (2009)	<p>Transitivity measures how well information flows within a network, based on the proportion of times a connection from one node to two others is accompanied (or ‘closed’) by a connection between the other two nodes (akin to a ‘friend of a friend’ scenario). It is a measure of the extent to which a network is dominated by one or a few very central hubs.</p>
Trust	Provan et al. (2005: p. 605)	<p>Trust refers to ‘the quality of the relationship among partners (that is, based solely on formal agreements, rules, and procedures, or on trust and informal norms of reciprocity)’.</p>

**16.2 Table 2: Research Literature - Social Networks of Health Professionals**

	Author (year published)	Setting & Country	Objective	Study design / Method	Findings / Outcome
1	Ankem, K. 2003	Interventional radiologists, Michigan, United States.	To understand the influence of information sources on the adoption of uterine fibroid embolisation (UTE) and to examine communication relations in their social network conducive to information flow on UTE.	Diffusion of innovations theory and features of social network analysis were the basis for development of an interview guide. Telephone interviews were conducted with 32 interventional radiologists in Michigan. Chi-square statistics were used to analyse the awareness and adoption of UTE. Factor analysis was used to examine communication relations in the social network.	Journals were important information sources for creating awareness and stimulating adoption of innovation among both early and late adopters of new procedures in interventional radiology. However, conferences were significantly more important for creating early awareness, while interactions with colleagues was the most important factor in stimulating use of the innovation among later adopters. Opinion leaders in non-academic hospitals may be more influential than individuals in the academic community.
2	Barrera, D. and van de Bunt, G.G. 2009	Employees, dialysis department, medium-sized hospital, The Netherlands	To investigate the effects of information originating from social networks on the development of interpersonal trust relations in a dialysis department.	Following 3 months of participant observation, longitudinal network data were collected once every 4 months over a year on the personnel (N ranged from 39 to 42). The unit of analysis was a directed dyad. Three different models were analysed through random effects regression models.	Results strongly supported the view that interpersonal trust in social networks develops by means of a learning mechanism. This study provides evidence of learning effects on trust in an intra-organisational setting based on longitudinal complete network data. Actors learn to trust from their own experiences and prefer to reciprocate pre-existing relations.

3	Benham-Hutchins, M.M. and Effken, J.A. 2010	Multi-professional healthcare providers, urban, acute-care university-based hospital, southwest region, United States.	To study how healthcare providers communicate and exchange patient clinical information during patient handoffs (transfers) between units in an acute care setting.	Five patient handoffs were selected by convenience sampling, with individual handoff network size ranging from 11 to 20 providers. Questionnaires were distributed to providers involved in hand-offs and social network analysis methodology was used to develop sociograms of communication patterns and to identify the role of individual providers in the handoff process.	Network patterns showed the overlapping use of synchronous and asynchronous communication methods (verbally via telephone or in person; or written via paper charts and/or an electronic record). Each handoff network exhibited unique communication patterns and information coordination by two or more influential providers from nursing, medicine, or pharmacy. Most (84%) participants preferred verbal communication. Overall satisfaction with the current communication process varied by unit: 82% of emergency department providers and 54% of the providers working in the admitting units stated they were satisfied or very satisfied. Recommendations for improvement included converting all units to the electronic health record, electronic handoff communication modules and asynchronous multi-professional communication logs.
4	Calloway, M., Fried, B., Johnsen, M., and Morrissey, J. 1999	Two rural (North Carolina) and 4 urban health care systems (Cincinnati, Toledo and Columbus, Ohio and Baltimore, Maryland), United States.	To explore (1) the types of agencies providing care to people with severe mental disorders in two rural catchment areas, and (2) the extent to which a system of care was clearly identified as using primarily specialty mental health agencies or involving other service agencies, and (3) to compare the rural findings with results from a study of four urban areas.	Two rural and four urban systems of care were compared using social network methods. In the rural study, social network methods and measures were used to investigate two rural systems delivering services to an identically defined population. Using network bounding methods, the researchers identified and interviewed local people knowledgeable about mental health issues in their county to compile a list for the two areas of all organisations (and key individuals) that provided clinical or supportive services to people with severe mental disorders. In the urban study, inter-organisational network data were collected in each area in 1989 and 1991. Data were collected on the exchange of case planning information (information linkages) between organisations.	Both rural sites showed numerous coordination linkages between the two types of provider groups (severe mental disorder (SMD) service providers and other service providers) for service planning and delivery. Density scores were used to reveal the extent of service dependency when providers coordinated care to people with severe mental disorders in rural sites compared with urban sites. Service relationships between all specialised mental health providers were more likely to occur in rural than in urban areas. A higher proportion of possible exchanges were initiated by SMD providers than by other providers. Rural SMD providers initiated more relationships and made greater use of other mental health providers compared with urban providers.

5	Carpentier, N., Pomey, M-P., Contreras, R., and Olazabal, I. 2008	Health practitioners in dementia care, Montreal, Canada	To analyse the context of the interface between formal and informal health care systems, especially at the beginning of the dementia care episode, from the perspective of health care professionals and community workers.	Social network analysis was used to examine the internal and external relationships of practitioners (individual level, organisational level and inter-institutional level). Twenty health practitioners in seven organisations were interviewed. All interviews were recorded and transcribed and NVivo was used to perform content analysis. The practitioner's discussion style was explored and professional activities of the 137 actors in the social networks of the 20 practitioners.	Player's profiles, internal structures and external links determined the quality of the practitioner-caregiver interface. Beneficial factors included the heterogeneity of professional groups and the establishment of contacts in the early stages of dementia. From a network perspective, the interface in the Social Model of Care was found to be a long one characterised by hesitation and sporadic contacts. The interface between networks was made up of the entire set of links between numerous actors who acted at different points in time, fulfilled different roles, and used different modes of communication.
6	Chase, S. 1995	Nurses and physicians, in a teaching hospital's open heart ICU and general surgical ICU, North-eastern United States.	To describe, from the nurse's perspective, the social context in which the critical care clinical judgment occurs, so that the effectiveness of critical care units can be maximised.	Ethnographic field research was used to describe the social context in which clinical judgments were made in an 11-bed open heart surgical ICU in a teaching hospital. Comparative data were also collected in a 10-bed general surgical ICU. Ten nurses were extensively followed in the field research. In addition, an additional 6 nurses were interviewed. Approximately 20 staff nurses and 10 physicians were observed in field observations approximately twice a week over 2 years.	Nurses and physicians were organised in parallel hierarchies of nurses (staff nurses, resource nurses, nurse clinicians, and nurse manager), and physicians (resident, fellow, attending surgeon) that provided a system of multiple checks to prevent lapses in judgment by either nurse or physician. The social context of the critical care nurse included both other nurses and physicians of various specialties.
7	Cott, C. 1997.	Geriatric care facility, metropolitan Toronto, Canada	To describe the structure of multidisciplinary long-term care teams by identifying the pattern of professional relationships of staff.	A self-administered survey was conducted on 93 health care workers on three teams in the same multilevel geriatric care facility in metropolitan Toronto. Social network analysis was used to classify the team members, identifying two sub-teams: a multiprofessional sub-team and a nursing sub-team. The analysis used 'block-modelling' in SPSS.	The multi-professional sub-team had an 'organic' structure, with involvement in teamwork on decision-making and problem-solving, whereas the nursing sub-team had a 'mechanistic' structure with involvement in task oriented work. The study found that any effects of teamwork in increasing the participation in decision-making by health professionals other than medicine were limited to a group of higher status professionals, with the clearly defined hierarchy remaining for the lower status subdisciplines.

8	Creswick, N. and Westbrook, J.I. 2007.	Renal ward, metropolitan teaching hospital, Australia	To examine how a network of staff in a hospital renal ward seek medication advice.	Social network analysis was used to examine relationships in a renal ward of an Australian metropolitan teaching hospital. Questionnaires covered the medication advice-seeking interactions of doctors, nurses, allied health professionals (N=45). Social network software, UCInet, was used to analyse the data and NetDraw was used for diagrams.	There was a relatively low level of advice-seeking about medication-related decisions and tasks. Most communication occurred within professional groups. Medication advice was sought from several key individuals in the ward both within and across professional groups.
9	Creswick, N., Westbrook, J.I. and Braithwaite, J. 2009.	Emergency department staff, Australian metropolitan teaching hospital.	To use social network analysis to examine the (1) problem-solving, (2) medication advice-seeking and (3) socialising networks of staff working in an emergency department (ED).	Data were collected through a social network survey of all ED staff (n=109). A range of social network analysis measures were examined.	In all 3 networks, individuals were more closely connected to colleagues in their own professional groups. The most densely connected network was the problem-solving network, then the medication advice network, followed by the socialising network. Although ED staff relied on each other for help in solving work problems, some senior doctors, some junior doctors and a senior nurse were important sources of medication advice for their colleagues in the ED.
10	Curran, G.M., Thrush, CR., Smith, J.L., Owen, R.R., Ritchie, M. and Chadwick, D. 2005	Four Department of Veterans Affairs health care facilities, United States.	To test an opinion leader-driven intervention to improve practice guideline-based medication management for patients with schizophrenia in medical centres.	An intensive, multicomponent intervention was delivered in each study site during the year. A quasi-experimental study design was based on four pairs (one intervention and one control) of health care facilities, with 10-15 practitioners each, in one Veterans Affairs network. The process evaluation included brief surveys of physicians' attitudes and behaviours, logs of reports from opinion leader conference calls, and interviews with the opinion leaders toward the end of the implementation period.	The study results were mixed, as some intervention sites improved care significantly, while some did not. The study found that physicians did not always agree on who was the opinion leader and some sites had poorly developed formal and informal social networks among physicians. The issue of the focus only on physicians as agents of change is raised, and also the issue of how much directive should be given to the opinion leaders concerning how to influence attitudes and behaviours.

11	Curran, J.A. and Abidi, S.S.R. 2007	Paediatric emergency department (ED) clinicians in nine rural and two urban EDs, Nova Scotia, Canada	To conduct an experiment to provide access to an asynchronous discussion forum as a medium to support development of an online social network for information exchange.	A Multidisciplinary Paediatric Emergency Care Web-based Learning Centre was established for 18 months for nurses and physicians (187 practitioners) working in nine rural and two urban emergency departments in Nova Scotia. Relational data on discussion interactions was drawn from the online discussion board. Offline interaction data were collected through a follow-up survey. Outcomes were evaluated using discussion board content analysis and social network analysis (UCInet 6) to examine knowledge seeking and sharing behaviours among rural and urban emergency practitioners at inter-institutional and individual levels, using the online discussion forum and offline media.	The online discussion forum created an opportunity for emergency practitioners from multiple emergency department sites to engage in topics relevant to practice learning needs. As an inter-organisational information exchange, the online medium stimulated more knowledge seeking and sharing opportunities and interactions compared with the offline media. Analysis of the interactions between actors showed that a limited number of actors actively reached out in both the knowledge seeking network and the knowledge sharing network.
12	Doak, S. and Assimakopoulos, D. 2007	Forensic scientists, Forensic Science Laboratory, Ireland	To show that tacit knowledge was an integral part of the activities of expert forensic science practitioners who continually added to their knowledge repertoire by engaging other scientists through communities of practice; to explore the gaining of tacit knowledge by forensic scientists during their apprentice years.	Data were collected on relational knowledge flows between 43 forensic scientists, over a 3-day period in 2005. SNA was used to create network maps of advice connections over time, utilising Pajek and UCInet software programs. The biology CoP sociomatrix was extracted from the main laboratory advice sociomatrix to examine the knowledge exchange between the scientists. A structured questionnaire was completed by a sample of forensic scientists from two CoPs at the laboratory, one qualitative and the other quantitative in the types of case reports that they produced.	Social network graphs were used to portray the diffusion of tacit knowledge, and to show that the working structure of the laboratory fell into four CoPs - biology, chemistry, DNA, and drugs. The density and prestige network graphs showed that the less experienced forensic scientists sought advice in casework problems from prominent forensic scientists who had major sources of evident tacit knowledge. Trainee scientists found standard operating procedures (SOPs) gave a beneficial baseline of knowledge, however tacit knowledge was an integral part of the activities of expert forensic science practitioners.

13	Fattore, G., Frosini, F., Salvatore, D., and Tozzi, V. 2009	General practitioners in 2 districts in the Empoli Local Health Authority, Tuscany, Italy	To use social network analysis to study whether the collaboration initiatives launched by a local health authority from 2001 to 2004 had any effect on individual and district-level GP performance, measured in terms of meeting drug expenditure targets.	Data were obtained from the Local Health Authority on the membership of individual GPs in different types of collaborative initiatives, from 2001-2004 (n=92 in 2001 and n=157 in 2004). Demographic and performance data were obtained for each GP. Social network data was obtained on GP affiliation matrices, and social network analysis was used.	The centrality of the GP to his or her network (social capital) had a very small or insignificant effect on meeting drug expenditure targets. For social influence, (1) there was a significant relationship between the performance of peers to which the GP was connected and the GP's ability to meet the drug target assigned by the LHA. Also, (2) the district with the higher density showed a lower variation in pharmaceutical expenditures.
14	Garåsen, H. and Johnsen, R. 2007	General hospital physicians and general practitioners city general hospital, Trondheim, Norway	To assess the quality of written communication between general practitioners and general hospital physicians and to estimate the number of patients that could have been treated at primary care level instead of at a general hospital.	Researchers examined referral and discharge letters for 100 patients above 75 years of age, admitted to orthopaedic, pulmonary and cardiological departments at the city general hospital. Assessment of the quality of these letters was done using a Delphi technique with two expert panels using a standardised evaluation protocol with a visual analogue scale.	Information in the referral letters on actual medical situation, medical history, symptoms, signs and medications was assessed to be of high quality in 84%, 39%, 56%, 56% and 39%, respectively; and in discharge letters it was 96%, 60%, 60%, 55% and 82%. Information on Activities of Daily Living was satisfactory in only half of the discharge letters. Around two-thirds of the patients were assessed as having had large health benefits from the general hospital care in question. There was low consensus between health professionals at primary and secondary level of the extent that older patients benefited from hospital care.
15	Garrett, D.K. and McDaniel, A.M. 2001	Full-time staff nurses employed in a 493-bed acute care hospital, Mid-Western United States.	To explore the relationships, among environmental uncertainty, in a range of hospital-based units, of nurse characteristics, and perceptions of work climate, with	A cross-sectional exploratory study design was used, with a self-administered survey of staff nurses (N=77). Data were collected on five medical/surgical units, paediatrics, maternal and infant care, labour and delivery, cardiovascular and telemetry, and medical/coronary, surgical, paediatric, and neonatal intensive care units. Standardised instruments were used to measure	Perceived environmental uncertainty was associated with all three components of burnout. Similarly, perceptions of social climate (described as work involvement) were associated with all three burnout components. A positive social climate can buffer workers from the negative effects of crisis. No significant relationship emerged between personal characteristics (education and experience) and other study variables, however the homogeneity of the sample on these characteristics may explain the lack of significance.

			professional burnout.	perceptions of social climate, perceived environmental uncertainty, and burnout. Three regression equations were produced for the three burnout components, for emotional exhaustion, for depersonalisation, and for personal accomplishment.	
16	Gold, M., Doreian, P. and Taylor, E.F. 2008	The National Health Care Collaborative (NHPC), comprising 15 large health plans across the United States.	To study the relationships among organisations participating in a large-scale public-private collaboration among major health plans to reduce racial and ethnic disparities in health care in the United States.	Qualitative data and social network data were collected, by interview and by mail, between December 2005 and January 2006 (18 months following the start of NHPC). An instrument developed by Van de Ven and Ferry (1980) was used for the social network data. The response rate was 100%. SNA methods, using UCInet, examined estimates of relations prior to the formal collaborative participation, and relations between organisations 19 months into the NHPC. Generalised block-modelling was used to delineate the structure of the whole network.	Network analyses highlighted the central role of the NHPC's sponsor organisations and primary support organisations as part of the core of the network, especially during the first few years of the NHPC. This highlighted a potential weakness in the network structure: the ongoing ability of plans to collaborate might be dependent on ongoing outside support. SNA confirmed that plan-to-plan interaction was not very prevalent within the NHPC's first phase. Through the NHPC processes, plans had an influence on one another even if they did not directly interact.
17	Greene, A., Pagliari, C., Cunningham, S., Donnan, P., Evans, J., Emslie-smith, A., Morris, A. and Guthrie, B. 2009	The Tayside Diabetes Managed Clinical Network (MCN), Scotland, United Kingdom	To evaluate the form and impact of quality improvement in the MCN from 1998 to 2005.	The study, conducted in 2004-2005, used a retrospective, mixed-methods approach (document analysis, observation, interviews of team members and patients) to examine the quality improvement (QI) strategies used by the network. Quantitative data were extracted from the regional diabetes register and analysed.	Simple process measures (e.g., glycated haemoglobin measurement) rapidly improved. There was slower improvement in more complex process measures (e.g., eye screening), being more dependent on the redesign of the care pathway. Type 2 diabetes showed greater improvement than Type 1. There was a major shift to primary care for people with Type 2 diabetes. Participants credited the MCN with engaging clinicians, persuading them to improve the quality of diabetes care without significant additional resources.

18	Grimshaw, J.M., Eccles, M.P., Greener, J., MacLennan, G., Ibbotson, T., Hahan, J.P. and Sullivan, F. 2006	National Health Service, Scotland, United Kingdom.	To examine the feasibility of identifying opinion leaders in different professional groups within the United Kingdom National Health Service, to describe the professional and personal characteristics of the opinion leaders identified, and to determine whether opinion leaders are inclined to adopt changes based on evidence.	The study used postal surveys of different professional groups in different geographical areas in Scotland. In primary care, the researchers surveyed all general practitioners, practice nurses, and practice managers in two regions of Scotland. In secondary care, the researchers surveyed all medical and surgical junior hospital doctors, consultants, and nursing staff in two district general hospitals and one teaching hospital in Scotland, as well as all Scottish obstetric and gynaecology, and oncology consultants. Two different instruments were used, a sociometric instrument and a self-designating instrument.	Generic sociometric opinion leaders (SOL) were more likely to belong to professional groups, have been qualified longer, be in a senior position, and have high effectiveness and keeping-up-to-date scores. Condition-specific SOLs were more likely to belong to professional groups and be in a senior position. They were less likely to have attended a local medical school. Generic self-designated opinion leaders (SDOLs) were more likely to have high effectiveness and keeping-up-to-date scores. The results suggested that the extent of social networks and potential coverage of the study population in primary and secondary care was highly idiosyncratic, and adequate coverage rates should not be assumed. In contrast, relatively complex networks with good coverage rates were observed in both national specialty groups.
19	Heng, H.K.S., McGeorge, W.D. and Loosemore, M., 2005.	A major tertiary referral metropolitan hospital of 770 beds, Sydney, Australia.	To explore the brokerage role of facilities managers in a hospital.	A case study approach used SNA to map the network structure of facilities management departments, to illuminate the brokerage potential of a facilities manager. Six categories of non-clinical functions in a hospital were identified: estate management services, environmental management services, hotel services, site support services, business support services and space management support services. Each departmental head was given a questionnaire, to collect sociometric data to trace the communication network. UCInet software was used to analyse the data, for density, degree centrality, betweenness centrality, and structural holes.	Density results showed a reasonably low level of activities and interaction within the communication network. The facilities management director was found to be the most active and prominent network member, and a bridge in connecting the different departments. The maintenance operations department was in a similar situation. The relatively peripheral network members were energy management and linen services, both located outside the main hospital campus. The results from the structural holes measure suggested that the facilities management director's position in the network was strategic and in the best position to bridge the connections between the other departments which otherwise would form structural holes in the communication network.

20	Kane, G.C. and Alavi, M. 2008	557 individuals in 40 health care groups, a regional division of a health maintenance organisation United States.	To investigate the influence of information systems on group-level organisational performance outcomes in multi-user, multi-system groups.	The study explored the influence of information systems on organisational outcomes by examining two different mechanisms: (1) direct user-system interactions and (2) indirect user-system interactions. A survey (using a standard sociometric instrument) of 557 individuals in 40 healthcare groups tested whether either or both of these mechanisms were associated with two types of organisational performance outcomes - efficiency and quality of care. Social network analysis (using UCInet 6.97) was used as a framework for understanding user-system interactions. Independent variables were user-system tie strength and information system centrality. Dependent variables were efficiency of care and quality of care. Multiple regression techniques were used.	User-system tie strength was not significantly related to efficiency of care or quality of care. Information system centrality in the multimodal network was related to lower patient waits and positively related to outcomes (keeping patients' diabetes under control). The wider multimodal network of multiple users and multiple systems should be examined to fully assess the role of information systems in organisations.
21	Keating, N.L., Ayanian, J.Z., Cleary, P.D., and Marsden, P.V. 2007	Primary care physicians, in a teaching hospital-based academic practice, Boston, United States.	To evaluate the network of influential discussions among primary care physicians in a hospital-based academic practice.	Researchers conducted a mailed survey of physicians (in 2000) regarding their influential discussions with their colleagues on women's health issues. Social network analysis (using NetDraw graphics software) was used to describe the network of discussions and to examine factors predictive of a physician's location in the network. The unit of analysis in the study was the pair of physicians. A P2 logistic regression model was used to analyse statistical patterns in the data.	The study found that physicians obtained information from colleagues with greater expertise and experience as well as from colleagues who were accessible based on location and schedule. Physicians were slightly less likely to report having influential discussions with other physicians of different gender and thus more likely to have discussions with physicians of the same gender.

22	Lemieux-Charles, L., Chambers, L.W., Cockerill, R., Jaglal, S., Brazil, K., Cohen, C., LeClair, K., Dalziel, B. and Schulman, B. 2005	Four community-based dementia care networks, Ontario, Canada	To examine providers' perceptions of the effectiveness of four community-based, not-for-profit dementia networks, ranging in size from 13 to 17 care-provider organisations.	A case-study approach was used over a two and a half year period to document the evolution, structure, and processes of each network (Toronto, Hamilton, Niagara and Ottawa). A standardised questionnaire (including Likert-scaled items) was used on key informants (one clinician, one administrative person from each agency) as a basis for social network analysis to identify patterns of administrative and clinical exchanges among networked agencies.	There were differences between the four dementia networks in their perceptions of service-delivery effectiveness, but not with their perceptions of administrative effectiveness. Exchanges between groups of agencies (cliques) within each of the four networks were found to be more important than those between individual agencies within each network. The Ottawa network had more resources (financial and human) than the Toronto network, and had higher effectiveness scores.
23	Lewis, J.M., Baeza, J.I. and Alexander, D. 2008	Two Partnerships in Primary Care, one in Melbourne, and one rural, Victoria, Australia	To examine a partnership as a form of network governance in Victoria, in two government-funded and steered Primary Care Partnerships (PCPs); to analyse the network structure of these two partnerships, to examine network dynamics and to explore relationships and sustainability over the longer term.	Researchers used annual interviews at three points in time between 2002 and 2005 to explore relationships between organisations within these two partnerships. The study used social network analysis to examine the structure of two different communication networks, based on contacts for work and contacts for strategic information. Approximately 20 were interviewed each year, including PCP project staff, partner agency staff involved in the PCP, and regional office staff of the Department of Human Services. The interview schedule included a semi-structured component and a structured component, which investigated contacts for work and for strategic information. Data on the latter were used to generate the network data.	Partnership dynamics were highlighted by tracing network structures over time. Although network structures changed over the three years of the study, one constant was the continuing centrality of the independent staff employed to manage the partnerships. Staff from the government funding authority also had an important role in accessing strategic information. There was a surprising amount of resilience in network dynamics of the partnerships over the three study years.

24a	Lindholm, M. 2006	Nurses in chief manager positions and physicians in clinical director positions, Sweden	To investigate whether psychosocial work conditions, professional network, job support, social network and support, sick leave and salary were associated with work stress in nurses in chief manager positions and physicians in clinical director positions.	The study sample consisted of 205 nurses in chief manager positions and 274 physicians in clinical director positions across Sweden. Mailed questionnaires were used to collect data. Odds ratios were used to estimate the bivariate association between work stress and psychosocial resources.	Both nurse managers and clinical directors exposed to high job demands had a significantly high probability of a high level of work stress. Available psychosocial resources, inside and outside work, (including affiliation to a professional network) did not balance the experienced work stress in nurse managers and clinical directors exposed to high work demands. No relation was found between work stress and sick leave and salary. Compared with the nurse managers, clinical directors reported a higher level of work stress when exposed to the combination of high job demands and low job support.
24b	Lindholm, M., Dejin-Karlsson, E., Ostergren, P-O. and Uden, G. 2003	Nurse managers, Sweden	To investigate whether nurse managers' (N=205) professional networks, psychosocial work conditions, job support, social network and support were associated with self-rated health, sick leave and salary.	Self-report questionnaires, mailed in 2000, were used to collect data on a sample of nurse managers recruited from across Sweden. Data were collected on psychosocial working conditions (including participation in professional networks), on demographic, socio-economic and work related conditions, and self-reported health. Odds ratios were used to estimate the bivariate association between self-rated health and psychosocial resources.	Nurse managers exposed to high job demands had significantly increased odds for low self-rated health, regardless of the level of psychosocial resources within or outside work. Two-thirds of nurse managers who were affiliated to professional networks did not consider this a supporting factor in their management work. Those with low job support had increased odds for sick-leave compared with those with high support. No significant associations were found between psychosocial characteristics and salary.
24c	Lindholm, M., Dejin-Karlsson, E., Westin, J., Hagstrom, B. and Uden, G. 2004	Physicians in clinical director positions, Sweden	To investigate the association between the self-rated health status of Swedish physicians working as clinical directors, and their psychosocial	Mailed self-reported questionnaires were completed by 274 clinical directors in 2002. Odds ratios were used for estimating the bivariate association between self-rated health and psychosocial resources. Social network, regarded as a structural concept, was divided into two indices: social stability (the	The clinical directors exposed to high job demands had a significantly higher probability of low self-rated health than those who were not in this situation. Participants who were exposed to high job demands had an increased risk of low self-rated health irrespective of available social support inside or outside work. High average working hours more than doubled the risk of low self-rated health.

			working conditions, professional networks, job support, social networks and social support, sick leave and salary.	degree to which a person belongs to and is anchored within formal and informal groups) and social participation (how actively a person takes part in the social activities of formal and informal groups in society).	
25	Lurie, S., Fogg, T. and Dozier, A. 2009	Intensive care unit teams, and academic staff, multi-disciplinary research institute, Rochester, New York, United States	To describe social network analysis (SNA) concepts, and to apply SNA to assessing medical centre institutional culture.	SNA was applied in three settings to explore team function in the intensive care unit, the interdisciplinary composition of 53 advisory committees for the 53 federal career development awardees at the institute during the period 2004 through 2006, and relationships between directors of administrative units in the clinical research institute.	SNA provided a useful, standardised set of tools, relatively free of observer bias, for measuring aspects of team function, interdisciplinarity of different clinical departments, and explored the relationships between institutional directors. Data collection was found to be rapid and simple, providing the possibility of repeating the analyses over time.
26	MacPhee, M. 2000	Nurses in an urban, paediatric acute care hospital, western United States.	To contrast the workplace socialisation and the types of social networks of nurses working flexible and traditional schedules in an acute care setting.	The study was based on a convenience sample of 120 nurses working traditional schedules and 46 nurses working flexible schedules in a paediatric, tertiary hospital who completed the standardised Social Network Questionnaire instrument. Data on demographics, emotional support, and satisfaction were also collected.	No significant differences were found in the composition of the nurses' social networks. Both types of nurses belonged to peer-based networks which included nurse managers. Nurses working traditional schedules had significantly more peer members for different types of emotional support,

27	MacPhee, M and Scott, J. 2002	Hospital nurses, in a rural region, Colorado, United States	To describe rural hospital nurses' workplace social support networks in one region, and to compare characteristics with data on social networks of a sample of urban nurses.	Researchers used a non-experimental, comparative correlational design to study the workplace social support networks of rural nurses (N=75) in rural hospitals, compared with urban nurses (N=120). Data on rural nurses were collected by survey questionnaire. Nurses' social support networks were measured using a social network questionnaire. Three nested circles provided a framework for people to diagram their social networks, and the respondent was asked to provide a network list of the first 15 members from their network rings who were most important to the respondent at work.	Overall for the rural nurses, peers were used more than managers for all types of support. First ring peers were relied upon for emotional support, socialising, and physical assistance. Second ring peers were counted on for socialising, and no significant correlations appeared for third ring peers. First ring managers were used for all types of support except for feedback. Second ring managers were sought for guidance, emotional support, socialising and feedback while third ring managers were sought for feedback only. Independent sample t-tests were insignificant between the rural and urban hospital nurses for structural aspects of support networks, and for emotional support from peers or managers. Rural nurses expected more guidance from managers and peers.
28	Mendel, P., Damberg, C.L., Sorbero, M.E.S., Varda, D.M. and Farley, D. 2009	National-level patient safety organisations, United States	To summarise the numbers and types of inter-organisational partnerships in the national patient safety domain, document changes over time in these networks, and their capacity to disseminate patient safety knowledge and practices.	Descriptive statistics and social network analysis methods were used to explore the structure and composition of partnership networks and changes between 2004 and 2006. Data were collected via two rounds of structured telephone interviews (n=35 organisations in 2004 and n=55 in 2006). To examine the centrality of individual organisations within the partnership networks, degree centrality and betweenness centrality were used. To characterise the structure of the networks as a whole, three other network measures were used: density, transivity, and network centralisation.	The number of patient safety partnerships expanded between 2004 and 2006. There was an increase in partnerships in all activity domains, particularly dissemination and tools development. Over time, there was a decrease in the fragmentation of the overall partnership network (density) and an increase in the potential for information flow (transivity). However, there was an increase in network centralisation: if key participants disengaged, partnerships could fail. In both years, the Agency for Healthcare Research and Quality was the most central and interconnected organisation of all partnerships identified, in terms of 'degree' and 'betweenness' centrality.

29	Milward, H. and Provan, K. 1998	Four city-based, community mental health networks, and a substance-abuse prevention network, United States	To examine the level of integration of four community mental health networks, and to measure the structural ties in a substance-abuse prevention network.	The mental health study used key informants in each agency and a modified snowball interview approach to collect data from the key agencies for each mental health network (from 32 to 96 agencies for each of four cities). The same general questionnaire was used to collect data in the substance-abuse prevention network. Social network analysis (UCInet IV) was used to help the lead agency identify agencies that were not well linked to the system.	Each of the four mental health networks was found to be well integrated, based on two measures - organisational links and cooperative links - but in quite different ways. In the substance-abuse prevention network study, social network analysis helped to identify agencies that were not well linked to the system.
30	Milward, H. and Provan, K. 2003	Four mental health networks, and one managed-care mental health network, United States	To use the results of the study of four mental health networks, and a four-year study of one of the four networks, to evaluate the strategies of collaboration and contracting.	In the 1995 four-city study, the authors developed a preliminary model of network effectiveness. Network structure was measured by 'centralised integration' - the degree to which a community's mental health authority had direct relationships with the set of providers. A centrally integrated structure was found to facilitate both integration and coordination in a relatively efficient way. The second variable, direct, non-fragmented external control, measured the degree to which funding links between the purchaser and the provider were directly linked and not run through any intermediary organisations: a 'hollowness' measure. The second study, of the Tucson mental health system, examined management strategies of contracting and collaboration in the 'hollow state'.	The relationship between network structure and network effectiveness was found to be mediated by the network context within which services were provided. Resource munificence and network stability were identified as the two contextual variables. The four-city study found that resource munificence alone did not result in an effective network, nor did resource scarcity mean that a network had to be ineffective (i.e., other variables in the model mattered more). The most critical variable in moderating the impact of resources was the stability of the network. Similarly, in the second study, an effective network was found to be one with enough stability to be able to maintain its ability to manage a set of jointly produced services.

31	Mossholder, K.W, Settoon, R.P. and Henagan, S.C. 2005	Health care employees, large public medical centre, southern United States	To examine whether structural, attitudinal and behavioural variables of a relational nature were predictive of employee turnover.	An employee survey (n=176) was used to collect information on key study variables, sociometric relations and demographics. A separate supervisor survey was used to collect evaluations of employees' interpersonal citizenship behaviour. The study used survival analysis over a five-year time frame. Organisational tenure and age were control variables.	Two variables, network centrality and interpersonal citizenship behaviour, predicted turnover and their effects were above and beyond the effects of job satisfaction. With network centrality, it appeared that how individuals were connected affected their leaving the organisation. Those forming a greater number of ties with co-workers became more embedded and had lower turnover. Higher levels of interpersonal citizenship behaviour resulted in lower turnover.
32	Ommen, O., Driller, E., Kohler, T., Kowalski, C., Ernstmann, N., Neumann, M. Steffen, P. and Holger, P. 2009	Physicians in 4 different hospitals, Germany.	To analyse the relationship between overall job satisfaction of physicians and social capital in hospitals.	A questionnaire was mailed to 454 physicians working in the field of patient care in 4 German hospitals in 2002. A total of 277 physicians responded (61% response rate). Three linear regression models were used to analyse the data. The dependent variable was physician overall job satisfaction, and age, gender, professional experience, workload, and social capital (which measured common values and perceived trust at the hospital) were the independent variables.	The social capital of an organisation, in addition to professional experience and workload, was a significant predictor of overall job satisfaction of physicians working in the field of patient care. Job satisfaction was also significantly associated with professional experience, and with lower workloads. Sociodemographic variables, such as age and gender, did not have a significant impact.
33	Ormrod, S., Ferlie, E., Warren, F. and Norton, K. 2007	Psychiatrists and their teams in three NHS mental health clinics, United Kingdom	To examine how the diffusion of new work practices within a network of practice is affected by the possession and use of organisational power, including founder and ideological power.	An ethnographic study was conducted on the diffusion of a complex mental health care treatment modality, a Henderson 'Democratic Therapeutic Community'. This approach was directed at spreading novel work practices within a professional network of psychiatrists and their associated multi-disciplinary teams at two new clinical sites. Fieldwork covered the establishment of the service over two years and the first 18 months of running of the two new services.	Professional networks within psychiatry did not spread Henderson-like work practices equally to the two new sites, (1) as there were contested therapeutic community models and ideologies in place, (2) these ideological differences were deep-rooted, and long enduring, producing conflict, (3) the sites' ideologies and clinical work practices were 'imprinted' by clinical directors, and (4) these directors were influenced differentially by the ideologies of two founders.

34a	Pappas, J.M., Flaherty, K.E. and Wooldridge, B. 2003	Middle managers, medium-sized urban, Catholic hospital, north-eastern United States.	To explore how hospital middle managers use strategic knowledge to achieve consensus in shaping hospital priorities.	Semi-structured interviews assisted the development of a survey conducted on 88 employees. Questions pertained to the dependent variable, 'strategic consensus', and to independent variables, 'internal knowledge', 'external knowledge' and 'social structure'. Social network data were collected on 'social structure' and analysed using UCInet V. Control variables included age, tenure and educational background. Ordinary least squares regression was used to test all of the hypotheses.	Strategic consensus was significantly related to both middle managers' knowledge of their external environment and their internal knowledge of resources and capabilities. A curvilinear relationship was found between consensus and degree centrality. That is, although high levels of centrality may improve the middle managers' ability to understand the strategy of the hospital, at some point, managers' centrality may hinder their ability to formulate ideas that challenge the strategic wisdom of the firm. Although degree centrality moderated the positive relationship between knowledge of internal resources and capabilities, it had no effect on knowledge of the external organisational environment.
34b	Pappas, J.M., Flaherty, K.E. and Wooldridge, B. 2004	Middle managers, medium-sized urban, Catholic hospital, north-eastern United States.	To explain how middle managers' strategic knowledge and the prevailing social structure of the hospital interact to help facilitate organisational change.	Semi-structured interviews assisted the development of a survey conducted on 88 employees. Questions pertained to the dependent variable, 'upward-oriented strategic influence' (data were collected on middle management strategic activities) and to independent variables: 'strategic knowledge' and 'social structure' (social network data were collected on two informal networks, communication and friendship, and one formal network, workflow). Control variables included age, tenure and educational background.	Primary regression results indicated a significant relationship between strategic knowledge and upward-oriented strategic influence activities. Ordinary least squares results for upward activities regressed on measures of network centrality for formal and informal networks were significant for all three networks. A manager's ability to influence upper management depended on how well members knew each other and shared common beliefs. A clear linkage was shown among strategic knowledge, social structure, and upward-oriented activities that lead to the development of new capabilities.
35	Peng, T-J. A., Lo, F-Y., Lin, C-S., and Yu, C-M.J. 2006	Accreditation-qualified hospitals (98), Taiwan.	To examine the impact of hospital resources, network resources, and centrality on hospital performance in the Taiwanese health care industry.	A structured survey questionnaire was mailed in 2001 to CEOs of all 494 accreditation-qualified hospitals in Taiwan. The overall response rate (98) was 20%. In addition to descriptive statistics and correlations, hierarchical regression analysis was conducted to test hypotheses.	Hospital resources and centrality were found to independently affect performance, whereas network resources did not. The study found that the higher the centrality, the better was the performance. Findings suggest that a hospital should improve performance by exploiting its in-house resources rather than obtaining network resources externally. Also, hospitals should try to occupy a central position for creating a structural niche.

36	Rangachari, P. 2008	Four large teaching hospitals, Manhattan, New York, United States.	To explore the relationship between the organisational knowledge sharing structure related to quality, and hospital coding performance related to quality. To also identify other organisational characteristics associated with coding for quality measurement so that strategies are identified for improving hospital coding performance and for adaptation of the organisation to the changing environment.	A purposive sample of four hospitals was taken, two showing 'good-coding' performance, and two showing 'poor-coding' performance. The researcher conducted interviews and surveys with administrators and staff in the quality, medical staff, and coding subgroups in each hospital. A total of 65 persons participated in the survey (45 from good-coding facilities and 20 from poor-coding facilities). Social network analysis was used on the survey data to examine knowledge sharing structures.	Good-coding performance was found to be systematically associated with a knowledge sharing network structure rich in brokerage and hierarchy (with senior leaders coordinating knowledge exchange related to quality and connecting the organisation with the external environment), rather than density (with everyone connected to everyone else). Findings suggest that senior hospital administrators must play a proactive and increasing role in providing education on coding and quality measurement, and in exposing physician and coder subgroups to the changing environment.
37	Scott, J., Tallia, A., Crosson, J.C., Orzano, A.J., Stroebel, C., DiCicco-Bloom, B., O'Malley, D., Shaw, E., and Crabtree, B. 2005	Two primary care practices, United States.	To use social network analysis to characterise and compare the communication patterns in primary care practices.	Observational ethnographic field data were collected for 2 weeks in each practice on office staff and clinicians. In addition, key informant interviews were conducted with clinicians and office staff, in-depth interviews with a sample of practice participants, and samples were collected of various practice documents, and field notes were taken. UCInet and KrackPlot software were used to analyse the network structures, and NetDraw was used for network diagrams.	Clear differences were found between the two practices for all the SNA measures: density (a measure of decision-making interactions), clustering coefficient (a measure of collaboration in groups), hierarchy (the degree to which the network approaches a perfect hierarchy) and centralisation (the degree to which a network approaches the configuration of a 'star' network). Decision-making patterns differed widely in the two sample practices.

38	Vanderveen, K.A., Paterniti, D.A., Kravitz, R.L., and Bold, R.J. 2007	Surgeons providing surgical breast cancer care within a 3-county urban region, United States.	To describe the timing of sentinel lymph node biopsy (SLNB) adoption and patterns of surgeon interactions with the following educational sources: a local university training program, surgical literature, national meetings/courses, national specialty centres, and other local surgeons.	A cross-sectional survey of 38 surgeons (11 surgical oncologists and 27 general surgeons) was conducted, using semi-structured interviews to assess surgeons' attitudes and experiences (including timing of adoption, practice patterns, and learning sources for SLNB) among surgical oncologists and general surgeons in a single metropolitan area. Social network diagrams were created to depict connections between surgeons and key learning sources by using sociometric and graph theory principles.	The timing of adoption was associated with specialty affiliation (e.g., surgical oncologist compared with general surgeon) but was not related to age. Although surgical oncologists were older than general surgeons, they had used SLNB longer. Two network diagrams were created: surgeon-surgeon interactions and timing of SLNB adoption; and surgeon interactions with key learning sources. Almost all surgeons used two or more sources when learning a new surgical technique for breast cancer care. Early in their practice, surgeons relied heavily on exposure during residency as their primary information source, with a minority seeking additional sources.
39	Webster, C., Grusky, O., Podus, D. And Young, A. 1999	Eight mental health case management teams in a county mental health system, California, United States	To examine differences in eight mental health case management teams, ranging from 8 to 11 individuals, half formally supervised by women and half by men.	Social network data were collected on team members by individual interviews using a structured interview protocol, which included a number of self-report tasks concerning their relationships, both advice relations and social relations, with other team members. Two matrixes were developed for advice relations and social relations. UCInet IV was used for the centrality analyses, using measures of degree, closeness, and betweenness.	Male supervisors on average were substantially more central for instrumental (advice) relations than female supervisors on all three centrality measures - showing an autocratic leadership style. Teams with male supervisors were on average more centralised than teams with female supervisors. For the social relations, male team supervisors were on average more central than were female supervisors. On average for social relations, the teams headed by female supervisors were more centralised than those with male supervisors, yet the female leaders were not the most central team member, showing a tendency for female leaders to have a democratic leadership style.
40a	West, E. and Barron, D.N. 2005	Directors of nursing and clinical directors of medicine in acute-care hospitals, England, UK.	To describe the social and geographical boundaries around the networks of directors of nursing and clinical directors of medicine in acute-	A telephone survey (of a random sample of 50 clinical directors of medicine and 50 directors of nursing, sampled from a national list) was conducted using standard social network methods. Survey methodology was based on the US General Social Survey special module on social networks (Burt	Both groups discussed 'important professional matters' with others who were similar to themselves in terms of profession, gender, age, and seniority (i.e., homophilous networks), with physicians being more extreme in this regard. Managers (non-clinically qualified) occupied a powerful 'brokerage' role for both nurses and doctors, whereas nurses and doctors rarely figured on each other's networks. Barriers were found between doctors and non-doctors, men and women,

			care hospitals in the United Kingdom.	1984). The response rate was 49.5%. Information was faxed to respondents in advance of the interview. Data were collected on the profession, gender, age, rank and location of the 'alters' of the respondents. Respondents were also asked to list people with whom they had 'discussed important professional matters'.	and between the generations. Female doctors appeared infrequently as discussion partners. Also, the networks of female nurses seemed to be less supportive than those of male doctors. Nursing and medicine were found to have quite different social structures. Few informal ties were found between the two professions, meaning that information is unlikely to be spread between the two professions by informal sources.
40b	West, E., Barron, D.N., Dowsett, J. and Newton, J.N. 1999	Directors of nursing and clinical directors of medicine in acute-care hospitals, United Kingdom	To describe the professional social networks of clinical directors of medicine and directors of nursing in hospitals in the United Kingdom, focusing on network density, centrality and centralisation.	A telephone survey (of a random sample of 50 clinical directors of medicine and 50 directors of nursing, sampled from a national list) was conducted using standard social network methods. In addition to their own personal details, respondents were asked for detailed information on five alters, the nature of the relationship between ego and each alter and the relationships between each alter pair.	Directors of nursing were found to be more central to their networks than clinical directors of medicine, and their networks were more hierarchical. The networks of directors of nursing were lower in density (having advantages in terms of access to information) than the clinical directors of medicine who tended to be embedded in much more densely connected networks, described as cliques. In comparison to nurses' networks, doctors' networks were egalitarian and decentralised. Change processes for the latter would need to involve group processes, rather than simply convincing individuals of the need to change.