Editorial

Understanding quality improvement through social network analysis

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Quality improvement involves bringing about change to enhance the effectiveness, safety and patient experience of healthcare. Change is predicated on learning, and this requires flows of information and interactions between networks of people, groups or organisations. The nature of these interactions is an important part of the context of quality improvement.[1,2] The scientific study of networks, and in particular the understanding of social networks, is becoming increasingly important for improvement science, and fundamental for our understanding of how quality improvement does and could occur. The science of networks has developed a language that is important to understand in order to be able to communicate its concepts and theories.[3,4]

A network is a set of 'nodes' (or 'vertices') of ideas, people, groups or organisations and the relationships (or 'edges') between them. The simplest networks consist of two (dyads) or three (triads) nodes, but most social networks have many nodes and a great many connections. Health networks are sometimes characterised as sociotechnical systems because they consist of complex systems involving socio (human behavioural) and technical (health technology) components.[5]

The relationships between nodes may be based on a single particular feature such as friendship, peer or patient, but may also be multiple (termed 'multiplex'), for example, when providing treatment for a patient who is also a colleague. Relationships are vectors with directional properties; they may be mutual, symmetrical and bidirectional as in some peer-to-peer interactions; or they may be asymmetrical and unidirectional as in some doctor-centred patient consultations. Relationships in networks are commonly based on features such as co-location, termed 'propinquity', or similarity in attributes, termed 'homophily'.[3] Homophily can be based on shared characteristics, such as professional identity or shared attributes such as age, gender or ethnicity.[6]

Networks may be egocentric based on connections with a single node (e.g. an individual's patients' Facebook friends or Twitter followers), socio-centric

based on a closed community (e.g. everyone working in a healthcare organisation) or open where boundaries are fuzzier (e.g. other professionals that a healthcare worker relates to or other bodies that a health organisation interacts with). In healthcare, and other organisational systems, networks can be mandated as part of the formal organisational structure or they can develop informally through interactions between individuals, so-called natural networks. Mandated networks are usually shown as organisational charts, whereas natural networks are depicted using graphs, called sociograms.[5]

Sociograms can be used to show features of the network distribution such as the total number of connections ('density'), the nature of these connections (whether single or 'multiplex'), areas of lack of connectedness ('structural holes'), the degree of connectedness of individual nodes ('popularity' or 'centrality'), the number of nodes that intervene between those at extremes of the network ('distance') and roles or positions of individual nodes. Distance describes how many nodes need to be intermediaries to traverse the network and is described in the notion of the 'small-world' or six degrees of separation. Roles may be determined or identified by the social network itself, for example, an executive or manager in an organisation, or identified by an external observer, for example, an opinion leader.[3]

The structure of networks can be further described by the properties of parts or segments of the network. Network segments can have nodes with closer face-to-face contact (called 'primary groups') which in the health improvement context include quality improvement teams and clinical microsystems; greater organisation of roles into hierarchies ('clusters'), such as in healthcare organisations or quality improvement collaboratives; or higher degrees of interconnectedness and cohesion ('cliques'), which characterise some communities of practice. Based on such features, nodes within a network can be described as being at the core or periphery.

Depending on their structural characteristics, networks are motivated by two contrasting and some-
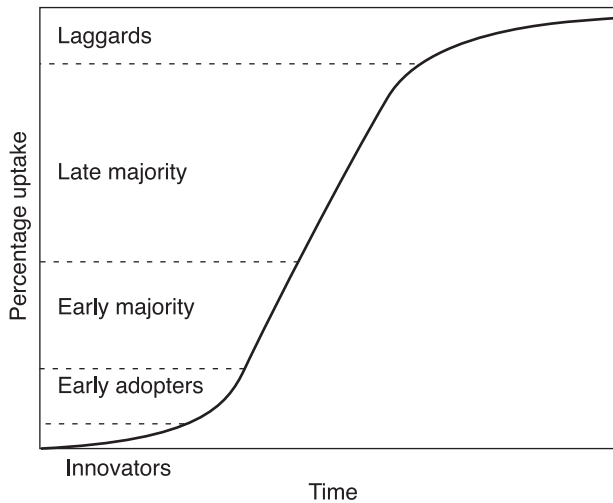
Figure 1 The adoption curve. From Rogers' 'Diffusion of Innovation'[6]

times competing functions: first, in structurally dense networks, characterised by high degrees of inter-connectedness, they provide safety and affiliation through a web of close trusting relationships; second, networks, particularly those with segments having less dense connections and more structural holes, enable nodes (agents) that span these segments to facilitate the flow of information. The ability to link segments through conveying knowledge or providing a communication channel also increases the effectiveness and enhances the status of these agents. Agents which can perform this function are sometimes called 'boundary spanners', 'mavens', 'salesmen', 'connectors' or 'brokers': they are the change agents who enable diffusion and the spread of ideas.[7]

Diffusion is often described in terms of the sigma curve of adoption (Figure 1).[6] Change agents affect the early stages of diffusion through three modes of influence: they can be a direct source of advice, they can seek to actively persuade, or they can provide a model to be followed. This latter is often termed 'opinion leadership'. Opinion leaders within organisations characteristically have slightly higher status, greater degrees of connectedness and more personal influence than their followers or others in their network. Rather than being innovators or early adopters, they are usually found in the early majority of the adoption curve.

Adoption is the result of a number of factors including the appeal or 'stickiness' of the idea itself, the effect of advice, persuasion or modelling by change agents and the effect of external influences to exceed individual thresholds and overcome resistance to change. The early slower phase of adoption is usually the result of persuasion and external influence. The more rapid mid-phase of adoption occurs when adoption accelerates through modelling or imitation without persuasion or external influence, and this is sometimes termed the 'tipping point' at which innovations become adopted very widely.[8]

Traditionally, networks in healthcare are based on professional groups or organisations. This reflects how health professionals are trained and how they are employed. Professional and organisational boundaries often constitute structural holes, where gaps in care are evident.[9] Improvement initiatives, for example, Quality Improvement Collaboratives,[10] provide a real opportunity for healthcare staff in a variety of professional groups and across organisational boundaries to learn about quality improvement methods and to apply these to gaps in the care they provide.[11]

The theory and analysis of social networks has become an essential part of the armamentarium of quality improvement science. It has begun to provide ways of understanding how quality improvement occurs, but also to enable us to design more effective improvement initiatives.

REFERENCES

1 Kaplan HC, Provost LP, Froehle CM and Margolis PA. The Model for Understanding Success in Quality (MUSIQ): building a theory of context in healthcare quality improvement. *BMJ Quality and Safety* 2012;21:13–20.

2 Siriwardena AN. Why quality improvement initiatives succeed or fail: the MUSIQ of quality improvement. *Quality in Primary Care* 2012;20:1–3.

3 Kadushin C. *Understanding Social Networks: theories, concepts, and findings.* Oxford University Press: New York, 2012.

4 Borgatti SP, Everett MG and Johnson JC. *Analyzing Social Networks.* SAGE: London, 2013.

5 Braithwaite J, Runciman WB and Merry AF. Towards safer, better healthcare: harnessing the natural properties of

complex sociotechnical systems. *Quality and Safety in Health Care* 2009;18:37–41.

6 Rogers EM. *Diffusion of Innovations* (5e). Simon & Schuster: New York, 2003.

7 Siriwardena AN and Gillam S. Systems and spread. *Quality in Primary Care* 2014;22:7–10.

8 Gladwell M. *The Tipping Point: how little things can make a big difference.* Back Bay Books: Boston, 2002.

9 Braithwaite J. Between-group behaviour in health care: gaps, edges, boundaries, disconnections, weak ties, spaces and holes. A systematic review. *BMC Health Services Research* 2010;10:330.

10 Siriwardena AN, Shaw D, Essam N *et al.* The effect of a national quality improvement collaborative on pre-hospital care for acute myocardial infarction and stroke in England. *Implementation Science* 2014;9:17.

11 Cunningham FC, Ranmuthugala G, Plumb J, Georgiou A, Westbrook JI and Braithwaite J. Health professional networks as a vector for improving healthcare quality and safety: a systematic review. *BMJ Quality & Safety* 2012;21:239–49.

PEER REVIEW

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CONFLICTS OF INTEREST

None declared.

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