The role of social networks in the governance of health systems: the case of eye care systems in Ghana

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Efforts have been increasingly invested to improve local health systems’ capacities in developing countries. We describe the application of innovative methods based on a social network analysis approach. The findings presented refer to a study carried out between July 2008 and January 2010 in the Brong Ahafo region of Ghana. Social network analysis methods were applied in five different districts using the software package Ucinet to calculate the various properties of the social network of eye care providers. The study focused on the managerial decisions made by Ghanaian district hospital managers about the governance of the health system. The study showed that the health system in the Brong Ahafo region experienced significant changes specifically after a key shock, the departure of an international organization. Several other actors at different levels of the network disappeared, the positions of nurses and hospital managers changed, creating new relationships and power balances that resulted in a change in the general structure of the network. The system shifted from a centralized and dense hierarchical network towards an enclaved network composed of five sub-networks. The new structure was less able to respond to shocks, circulate information and knowledge across scales and implement multi-scale solutions than that which it replaced. Although the network became less resilient, it responded better to the management needs of the hospital managers who now had better access to information, even if this information was partial. The change of the network over time also showed the influence of the international organization on generating links and creating connections between actors from different levels. The findings of the study reveal the importance of creating international health connections between actors working in different spatial scales of the health system.

Keywords Social networks, health systems, ophthalmology, health services, management

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KEY MESSAGES

- An innovative method based on a social network analysis (SNA) approach is used to investigate the relationships between a health system’s properties and its governance.
- Between 2006 and 2009, following the departure of an international organization, the health system in the Brong Ahafo region, Ghana, changed from a dense hierarchical network towards an enclaved network.
- The new structure was less able to respond to shocks, circulate information across levels and implement multi-scale solutions, but it responded better to the needs of hospital managers who could more rapidly access information.
- Managing health systems requires understanding who the actors are, the relationships between these actors and how the social network of actors is structured.

Information at the heart of health systems research

Health systems have become a key priority for researchers and policy makers (Murray and Frenk 2000; Sachs et al. 2004; Reich et al. 2008), a development highlighted during the First Global Symposium on Health Systems Research organized in 2010 in Montrouex, Switzerland. Evidence provided by a number of authors suggests that the effectiveness of health interventions in developing countries is limited by the capacities of the health system (Berman 1995; Cassels 1995; Gilson and Mills 1995; Bossert 1998; Glassman et al. 1999; Ranson et al. 2003; Dodd and Cassels 2006). As a result, efforts have been invested by the international community to bring more coherence to health systems thinking, and elaborate appropriate conceptual frameworks. Health systems research aims to understand the governance and organization of systems and how these two aspects influence the responsiveness of health systems (World Health Organization 2009).

The World Health Organization (WHO), in the World Health Report 2000, defined a health system as ‘all [the]organizations, people and actions whose primary intent is to promote, restore or maintain health’ (World Health Organization 2000, p. 1). This definition has been perceived by some as a constraining framework that restricts health policy makers to normative and linear understandings of health systems and prevents them searching for innovative and alternative solutions that address current complex global health needs and problems (Bloom and Standing 2008). The WHO framework has also been seen as representing a Western perspective, the ‘dominant paradigm’, and neglecting the point of view of local health providers in non-Western countries (LaFond 1995). Inspired by new research trends in ecology and social science, Bloom and Standing (2008) looked at health systems from a different perspective, one that focused on the flows of information between actors within the system (i.e. information related to the intervention, the management of services and any kind of information that is needed by policy makers and health service managers to make managerial and strategic decisions). Focusing on flows of information between a health system’s actors can help improve understanding of the pressures and constraints faced by stakeholders (Brinkerhoff 2004) and of the factors influencing local actors’ decisions (Walker et al. 2004). Bloom and Standing (2008, p. 2070) defined health systems as ‘complex technical systems for organizing specialized services (prevention, diagnostics and treatment) and goods (pharmaceuticals and equipment)’. It is this definition that is adopted in this paper. This definition focuses on the relationships between actors and how their interactions can produce goods and services, and highlights the dynamics of actors and systems, which is coherent with the approach adopted by the authors of this paper.

Health systems are characterized by strong asymmetries in the flow of information between actors. For example, there are asymmetries between health providers and health authorities, and between health providers and international support organizations (e.g. non-governmental organizations and donors) (Millar and McKevitt 2000). Ludwig et al. (1997) and Walker et al. (2004) have shown that research should focus on capturing the complex interactions between the actors in a health system and the adaptive capacities of systems to respond to shocks. Shocks are viewed ‘as arising from shifting framings of actors’ understandings of the system and its environment, or from shifting conditions in the systems and environments themselves’ (Leach et al. 2007b, p. 6). Hence, within the research programme that is in part being reported here, we developed and tested an innovative method—based on a social network analysis (SNA) approach—to investigate the relationships between health systems’ properties and the governance of health systems (Blanchet and James 2011b). The research programme was carried out in the Brong Ahafo region of Ghana between July 2008 and January 2010 and focused on district health systems. Evidence generated through the study aims to inform policy makers, health service managers and programme managers on how to structure and govern health systems in order to be able to better adapt to shocks. The objective of the study was to understand the relationship between social networks of a health system and the capacity to govern health systems. The study focused on three different aspects: (1) the actors of the health system; (2) the circulation of information between actors; (3) the relationships between actors as a determinant of the structure and governance of health systems. First, the following section explains what SNA is about and how it can be applied to health systems research.

Social network analysis

SNA provides an avenue for analysing and comparing information flows in a system. Although SNA and health care have long been interconnected (Moreno 1934), SNA has rarely been applied to health systems research in developing countries.
process: the circulation of information within a social network (Manring 2007). However, all these relationships rely on a key mechanisms between actors can help understand the social of trust, conflicts or knowledge sharing (Folke et al. 2006; Manring 2007). However, all these relationships rely on a key process: the circulation of information within a social network (Bodin et al. 2006; Manring 2007). Studying information flow mechanisms between actors can help understand the social processes influencing health systems' structure.

Social networks are grouped in different categories according to their structure (Diani 2003). The type of structure influences the collective capacity of the network to solve problems (Ernstson et al. 2008). For example, in a centralized network only a few actors collect and circulate information, whereas in more segmented networks information is generated by various subgroups (Ernstson 2008). A centralized structure is better adapted than any other structure to the management of simple and easily identifiable tasks, whilst a more segmented network provides opportunities to find multi-scale solutions to complex problems (Cash et al. 2006). Scales (or levels) are defined as the spatial, jurisdictional and administrative dimension of a health system (Ostrom 2005; Cash et al. 2006). A scale could be the catchment area of a health centre or a health district, for example.

Social network scholars have often sought to analyse the structure of social networks through the roles and functions of actors and the structural position of these actors within the network (Newman and Dale 2005; Bodin et al. 2006). Actors can be individuals, informal groups of people or formal organizations (e.g. companies or hospitals) (Freeman 1979; Grimble and Wellard 1996; Brugha and Varvasovszky 2000). Using mathematical algorithms and software (e.g. UCINET or Pajek), researchers have analysed how patterns of relationships between actors within a system affect decisions and actions, and the adaptive capacity of a system (Newman and Dale 2005; Bodin et al. 2006). It is recognized, in SNA, that collective action is influenced by the presence and position within the network of specific actors who play the role of facilitators or bottlenecks in the diffusion of information (Wasserman and Faust 1994; Borgatti and Cross 2003). These actors are called 'brokers' (Borgatti and Cross 2003; Burt 2003) or 'bridging organizations' (Olsson et al. 2007). Brokers have the unique capacity and power, with their in-between position, to create bridges between actors and understand how to connect organizations and individuals with each other (Manring 2007; Olsson et al. 2007). Freeman (1984) showed that actors who positioned themselves in-between many other actors and had a high number of links with different actors were able to control the circulation of resources. SNA describes the flows of information within a network and explains how the circulation of information can be influenced by the structure of the network and the role of brokers.

In the present paper, original methods are presented that were specifically developed by the authors to analyse the nature and positions of key actors, the structure of social networks and the dynamics of systems. Before presenting the methodology, the conceptual framework for the study and the general context where the study took place is described.

The conceptual framework

Lebel et al. (2006) proposed a conceptual framework in which three characteristics of ‘good’ governance within social–ecological systems were described: (i) capacity to engage effectively with and handle multiple- and cross-scale dynamics; (ii) capacity to anticipate and cope with uncertainties and surprises; and finally (iii) capacity to combine and integrate different forms of knowledge. This framework also describes the relationship between governance and the resilience of the systems. Resilient systems are those in which individuals and organizations have the adaptive capacities to deal with shocks (i.e. unexpected events) (Folke et al. 2004; Olsson et al. 2004; Walker et al. 2004) and the ability to learn from mistakes (Adger et al. 2003), which, in turn, largely depends on the capacity of individuals or organizations and their social networks to innovate (Armitage 2007).

We adapted the conceptual framework of Lebel et al. (2006) to the specific contexts of health systems. In this adaptation, governance is defined in broad terms as how actors interact with others to respond to dynamic shocks (Richards and Smith 2002; Leach et al. 2007a). Resilience is defined as ‘the capacity of individuals, families, communities, systems and institutions to anticipate, withstand and/or judiciously engage with catastrophic events and/or experiences’ (Almedom and Tumwine 2008, p. 1). These adaptations are shown diagrammatically in Figure 1.

The general context

Decentralization of the health system in Ghana

Ghana has adopted many health initiatives recommended by WHO and has experienced positive trends in terms of health service outputs compared with neighbouring countries (e.g. contracting, delegation to local health agencies, user fees exemptions, subsidies to the poor, social marketing and community development) (Ministry of Health 2008). In 1997, Ghana implemented a health sector reform leading to the decentralization of health services, giving more responsibilities to district and regional health authorities and facilities (Sakyi 2008). In 2010, Ghana had 10 administrative regions. Brong Ahafo, one of these administrative regions, and where this study took place, had 19 districts. In line with the Ghanaian Government’s decentralization and primary health care policies, every District Health Management Team determined its priority health needs based on national priorities, and developed appropriate strategies and actions to address these needs. The District Health Management Teams were also in charge of co-
ordinating all health activities that were implemented in communities (health education and prevention) as well as in sub-district clinics.

The health intervention under study
Eye care is viewed as a discreet health intervention involving a multitude of national and international actors working at different levels of the health system, combining various health and education activities to prevent and treat both non-communicable and communicable eye-related diseases (e.g. trachoma, glaucoma, cataract, conjunctivitis) (Thylefors 2001; Blanchet and Lindfield 2010). The eye care programme under study was funded by the Swiss Red Cross for 10 years between January 1996 and December 2006. The project was jointly implemented by the Ghanaian Ministry of Health and the Ghana Red Cross Society, and was implemented in 12 districts of the Brong Ahafo region of Ghana. The objective of the eye care programme was to increase the uptake of eye care services in Brong Ahafo with a strong focus on cataract surgery. The strategy adopted by the implementing agencies was to provide both preventative and curative care, as well as facility and community-based services.

Rogers (1995) distinguished between the hardware and software components of an innovation. The hardware component is an object, a tool or an infrastructure, and the software aspect constitutes the information necessary to use the tool or the facilities. The hardware component of the eye care programme had three elements: (1) eye care equipment (e.g. microscope, surgical kits etc.); (2) transportation means (e.g. car for the surgical teams and motorbike for the ophthalmic nurses); and (3) infrastructures (building of eye clinics in district hospitals). The software component, although less tangible than the hardware component, was composed of:

1. delivery of services (consultations, surgeries, outreach consultations and school screening); 2. training and supervision of eye care staff; 3. planning and monitoring of activities; and 4. co-ordination of activities.

The eye care programme was implemented in a regional health system, which during the course of the programme between 1996 and 2010, was affected by diverse shocks. Full details of the shocks and their impact will be described in detail in another paper. In brief, these shocks were characterized by:

1. Their origin: they could be caused by factors specific to each district (e.g. the resignation of an ophthalmic nurse, breakdown of a motorbike, or start of a new partnership with a local organization), regional factors (e.g. sickness of the regional ophthalmologist), national factors (e.g. creation of the National Health Insurance Scheme, and decrease in the number of nurses trained by the national teaching school) and international factors (e.g. cessation of international funding);
2. Their impact (i.e. negative or positive) on the district health system;
3. Their nature (i.e. implementation event, joint implementation and routinization event, or routinization event) [see Pluye et al. (2004, 2005) for more details].

All the programme activities involved a multitude of diverse actors. In order to capture the diverse relationships between actors and their impact on the system’s governance, a SNA methodology was adopted.

Methodology
A specific methodology was developed for the purpose of the study and was described in detail by Blanchet and James (2011).
The methodology consists of three stages: (1) defining the list of actors and the members of the network; (2) analysing the relationships between actors; and finally (3) analysing the structure and dynamics of social networks.

Defining the list of actors and members of the network

The actors involved in a system were identified by combining two different but complementary methods proposed by Grimble and Chan (1995): (1) based on a detailed review of programme proposals and documents, a list of actors involved in a system was compiled; (2) this list was added to from information collected through interviews with key respondents. The iterative process continued until no new actors were identified during the interviews.

The study was conducted in five of the 12 districts in Brong Ahafo where the Swiss Red Cross-supported eye care programme took place between 1996 and 2006. Districts were selected based on their level of sustainability, i.e. the number of activities that were continued 18 months after the end of international funding (Honadle and Sant 1985). The number of district activities that were maintained varied between two and five. For every level of sustainability, two districts were selected, when available: one managed by the public agency of the Ministry of Health, the Ghana Health Service (GHS), and a second one managed by the faith-based agency, Christian Health Association of Ghana (CHAG). The district of Atebubu-Amantin (Atebubu hospital) of the GHS had a low level of sustainability with two activities maintained. Two districts maintained three activities (Jaman South (Drobo hospital) of CHAG and Tano South (Bechem hospital) of the GHS). The Nkoranza district (Nkoranza hospital) of CHAG maintained four activities and the Wenchi district (Wenchi hospital) was the only district amongst the 12 districts of the region with the maximum level of sustainability with five activities maintained. In total, two hospitals were GHS facilities (i.e. Atebubu and Bechem hospitals) and three hospitals were CHAG facilities (i.e. Drobo, Nkoranza and Wenchi).

The relationships between actors

Once the hospitals were selected, the investigators focused on the ties between actors that were described in terms of flows of information between all the actors who were involved in the delivery of eye care services. Information was defined in two ways: (1) any piece of information shared between two actors that helped one of the actors or both actors to conduct their day-to-day tasks, and (2) any piece of information that concerned more long-term and strategic issues (Lewis et al. 2008). Face-to-face interviews were conducted in Ghana by the first author. In order to capture the dynamics of social networks, the same people were interviewed at three points in time as suggested by Lewis et al. (2008): December 2006, July 2008 and January 2010 (see Table 1 for the list of interviewees).

In December 2006, the first author conducted interviews with key informants (i.e. the Swiss Red Cross country delegate, the regional ophthalmologist and the regional Secretary of the Ghana Red Cross) to identify the links between the actors of the network. The interviews conducted in July 2008 consisted of verifying the accuracy of the information collected during the year 2006. The actors of the social network were interviewed. The same people were interviewed in January 2010 to find out more about the social network as it was 1 month earlier in December 2009.

All interviews were recorded and then transcribed by the first author. The interviews were composed of two parts: a series of closed questions that was used to build the social network graph (i.e. list of actors of the network and ties between actors), and a series of open questions to capture additional elements of information about the changes that occurred between 2006 and 2009 and the nature of relationships between actors.

A valuable method for generating self-reported ties, which was applied during the interviews, is to use recall lists (Marsden 1990): a list of all organizations in the field with adjoining empty columns in which respondents could mark their different relations to others (Diani 2003). Every interviewee was asked about the information received from other actors (receipt of information): do you receive information from this actor? If the interviewee answered "Yes", then the investigator asked additional questions to collect qualitative information about the type of information received. For example, what kind of information do you receive? How do you receive it: by phone, through visits, letters...? The same questions were systematically asked about every actor identified. Once this was completed, the investigator started again at the beginning of the list of actors and asked about the information sent to other actors (supply of information): do you provide information to this actor? If the answer from the interviewee was "Yes", the investigator asked more questions about the type of information provided and the way the information is circulated.

Data collected by the researcher were recorded in two information flow matrices (Brinkerhoff 2004) (see Table 2 for

<table>
<thead>
<tr>
<th>Level of the health system/Position</th>
<th>No. of individuals interviewed</th>
</tr>
</thead>
<tbody>
<tr>
<td>District level</td>
<td></td>
</tr>
<tr>
<td>District hospital managers*</td>
<td>15</td>
</tr>
<tr>
<td>Ophthalmic nurses</td>
<td>5</td>
</tr>
<tr>
<td>District Health Officers</td>
<td>4</td>
</tr>
<tr>
<td>District Education Officers</td>
<td>3</td>
</tr>
<tr>
<td>Community health volunteers</td>
<td>7</td>
</tr>
<tr>
<td>Nurses in sub-district clinics</td>
<td>4</td>
</tr>
<tr>
<td>Regional level</td>
<td></td>
</tr>
<tr>
<td>Regional Health Officers</td>
<td>4</td>
</tr>
<tr>
<td>Co-ordinator of community health workers</td>
<td>1</td>
</tr>
<tr>
<td>National level</td>
<td></td>
</tr>
<tr>
<td>National Health Officers</td>
<td>4</td>
</tr>
<tr>
<td>Co-ordinators of the international organization</td>
<td>3</td>
</tr>
<tr>
<td>International level</td>
<td></td>
</tr>
<tr>
<td>Co-ordinators of the international organization</td>
<td>3</td>
</tr>
<tr>
<td>Total</td>
<td>53</td>
</tr>
</tbody>
</table>

Note: *District hospital managers are members of the management committee and are usually: the administrator, the medical officer, the head of nursing, the pharmacist, the accountant and the human resource officer.
Table 2  Example of information flow matrix showing the circulation of information between actors

<table>
<thead>
<tr>
<th>Circulation of information between actors listed in column 1 with actors listed in row 1</th>
<th>User</th>
<th>Regional Directorate</th>
<th>Regional doctor</th>
<th>Hospital manager</th>
<th>Community-based organization</th>
</tr>
</thead>
<tbody>
<tr>
<td>User</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>Regional Directorate</td>
<td>0</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Regional doctor</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Hospital manager</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Community-based organization</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>


The results described in the present paper are categorized into three areas that are related to the three foci of the study:

(1) An analysis of the nature of actors with specific attention to the spatial scale of their intervention and the identification of brokers [i.e. actors who create links between users and researchers (Thompson et al. 2006) and build bridges between different groups of the system (Burt 2003; Newman and Dale 2005)];
(2) The relationships between actors and their evolution over time;
(3) The structure of the social network and the impact of this determinant on the governance of the local health system.

The actors of the system

The spatial scale of intervention of actors

In December 2006, 51 actors were involved in the eye care intervention. They were grouped in six categories based on the level (or scale) of intervention in the health system structure. For example, the regional ophthalmologist not only operated and consulted patients in every district, but also had responsibilities at the regional level for the implementation of the project and negotiations with authorities. The level of intervention of an actor was determined by their highest spatial scale of intervention. In the case of the regional ophthalmologist, it was the regional level. Six different levels were identified: international, national, regional, district, sub-district and community. Table 3 summarizes the actors classified by level of intervention.

Another mode of classification was defined and fitted better with the analysis of relationships within the social network. The community, sub-district and district levels were merged together and differentiation was made by district—five in total. It resulted in a classification comprising eight groups:

- International level
- National level
- Regional level
- Atebubu District
- Bechem District
- Drobo District
- Nkoranza District
- Wenchi District.

This classification not only met the need of the present study to identify systems and subsystems, but also reflected a closer vision of how implementing agencies described the structure of the project in the programme proposals (e.g. annual reports and evaluation reports).

The type of actors

Among the 51 actors present in the eye care system in December 2006, 23 were non-public service actors, i.e. members...
of the local community (e.g. users, non users) or members of the not-for-profit sector (Swiss Red Cross, Ghana Red Cross, volunteers). All the providers of the curative eye care services were from the public or faith-based hospitals. There was no actor from the private eye care sector in the Brong Ahafo region. Every district presented a similar composition of actors (i.e. the nature and number of actors were all similar). As illustrated in Figure 2, from the community to the international level, six levels of interventions can be counted and at each level of the system, different types of actors were present. Between 2006 and 2009 the Swiss Red Cross had completely disappeared from the region. Six other actors became inactive between 2006 and 2010, although they were still present in the Brong Ahafo region: the Ghana Red Cross Secretary, the two district organizers of Nkoranza and Atebubu, the volunteers in Drobo and two networks of schools (Bechem and Atebubu). In 2009, these actors had no formal link with the actors of the eye care network. The network of 51 actors in 2006 became a network of 44 active members in 2009.

### The brokers

The brokers of the system were identified. Brokers are actors who have links with actors from different spatial scales of the system and have a position in the network that is in-between several different actors (Cash et al. 2006).

In the network of December 2006, the Swiss Red Cross was the main broker of the network, being the actor with the highest extent of betweenness. Indeed, 26% of the time, the Swiss Red Cross was located in the shortest path between two actors. The second main broker with the second highest score was the regional ophthalmologist, who was in the path between two actors in 21% of cases. These two actors accounted for almost 50% of the total number of possible paths in the network. The five ophthalmic nurses and the regional Ghana Red Cross Secretary represented the third group of actors with the highest extent of betweenness in the network of 2006, followed in fourth position by the ophthalmic nurse of Atebubu with 13% of the ties. In fifth position, a group of six actors accounted for 7–9% of the ties. This group was composed of the ophthalmic nurses, the Ghana Red Cross Society and the Regional Directorate. The sixth group, composed of nine actors who were in the path between two actors in 1–4% of cases, was mainly composed of the hospital managers and volunteers. The remaining actors (33 out of 51 actors) accounted for less than 1% of the ties each. Figure 3 is a representation of the actors of the system by score of betweenness. The size of the spot is proportional to the score of betweenness: the bigger the spot, the higher the score of betweenness.

In December 2006, the Swiss Red Cross was the main broker of the network. This actor had links with actors from different spatial levels of the health system from the national to the sub-district level. The only level not directly connected with the Swiss Red Cross was the community level. The regional ophthalmologist was also a broker as he was in contact with every level of the network, including the community level. In 2009, the situation was different from 2006 as the main broker of the network (i.e. the Swiss Red Cross) was not part of the network anymore. The regional ophthalmologist became the main broker of the 2009 network as 38% of the possible paths between nodes went through the regional ophthalmologist. The second broker of the network was the ophthalmic nurse of Wenchi. However, the second broker was far less influential than the regional ophthalmologist as his betweenness score, of 11%, was almost 4 times lower than that of the regional ophthalmologist. The third group of brokers with a betweenness score varying between 7 and 9% was composed of five actors (i.e. the other four other ophthalmic nurses and the national eye care unit at the Ministry of Health). In fourth position, five actors (two hospital managers, the users and volunteers and the sub-district clinics of Bechem) had a betweenness score between 1 and 4%. All the remaining 32 actors had a betweenness score of zero.

The regional ophthalmologist was the main broker of the 2009 network. However, the network of the regional ophthalmologist in 2009 was almost half the size of the one built by the Swiss Red Cross in 2006. The regional ophthalmologist had a network of 18 actors in 2009 compared with the wider network of 33 actors of the Swiss Red Cross in 2006. Between 2006 and 2009, the regional ophthalmologist also lost some influence. His own network also nearly halved in size over the years, declining from 32 actors in 2006 to 18 actors in 2009.

In summary, between 2006 and 2009, the number of actors active in the regional network decreased by 14%. The main broker of the system in 2006, the Swiss Red Cross, disappeared from the network and was not replaced by another broker with an equivalent extended network.

### The structure of the network

#### The structure of the system: from a regional system to five district systems

Figures 4 and 5 show the changes that happened in the structure of the social network between 2006 and 2009. In 2006, all the district organizers of the Ghana Red Cross and the ophthalmic nurses were connected with each other and met...
every quarter to discuss and plan activities, and share information (Figure 4). All these actors were also connected with the regional Directorate and therefore had access to information from the central level. The disappearance of the Swiss Red Cross from the network after December 2006 meant that the main facilitator of links between district actors disappeared and no actor took the initiative to replace this stakeholder, including the regional ophthalmologist. Direct relationships

**Figure 2** The sub-network of the eye care project in the district of Atebubu with the six levels of the health system from community to international levels

<table>
<thead>
<tr>
<th>Scale of intervention</th>
<th>Name of the actor</th>
<th>Shape of the node</th>
</tr>
</thead>
<tbody>
<tr>
<td>International</td>
<td>Swiss Red Cross</td>
<td>△</td>
</tr>
<tr>
<td>National</td>
<td>National Eye Care Unit</td>
<td>⬇️</td>
</tr>
<tr>
<td>Regional</td>
<td>Regional Directorate</td>
<td>△</td>
</tr>
<tr>
<td></td>
<td>Regional ophthalmologist</td>
<td>△</td>
</tr>
<tr>
<td></td>
<td>Ghana Red Cross Secretary</td>
<td>△</td>
</tr>
<tr>
<td>District</td>
<td>District organizers (DO)</td>
<td>□</td>
</tr>
<tr>
<td></td>
<td>District Directorate</td>
<td>□</td>
</tr>
<tr>
<td></td>
<td>Hospital managers</td>
<td>□</td>
</tr>
<tr>
<td></td>
<td>Ophthalmic nurse (ON)</td>
<td>□</td>
</tr>
<tr>
<td>Sub district</td>
<td>Volunteers</td>
<td>⬆️</td>
</tr>
<tr>
<td></td>
<td>Schools</td>
<td>⬆️</td>
</tr>
<tr>
<td></td>
<td>Sub-district clinics</td>
<td>⬆️</td>
</tr>
<tr>
<td>Community</td>
<td>Users</td>
<td>⬆️</td>
</tr>
<tr>
<td></td>
<td>Non users</td>
<td>⬆️</td>
</tr>
</tbody>
</table>
Figure 3 The social network of the eye care project in 2006 with actors represented by squares of different size. The size of the square is proportional to the level of betweenness of the actor: the bigger the square, the higher the level of betweenness of the actor.

Figure 4 The social network of the eye care project in December 2006.
between districts disappeared after the departure of the Swiss Red Cross. Districts were only connected with each other through intermediaries, mainly the regional ophthalmologist and the national eye care unit.

Several measures from SNA can help understand the governance capacities of a system described in the conceptual framework (see Figure 1). These systems properties can be translated into social network measures: density, distance and degree centrality (Blanchet and James 2011).

One quantitative indicator to describe the number of links a network can have is ‘density’. Density is a measure of cohesiveness in networks (Freeman 1977). The underlying assumption is that if a network consists of actors that are well connected, then information flows rapidly between them. Density values lie on a scale ranging from 0 (no ties at all) to 1 (every actor is connected to every other actor). The density value for the 2006 network was 0.127 with 325 ties; in 2009 it was 0.057 with 146 ties. This means that the social network became almost three times less dense in 2009 compared with 2006. With the disappearance of the broker actor of the 2006 network, 179 ties disappeared.

Another SNA indicator, ‘distance’, corresponds to the number of links that separate two actors. If all actors were directly connected to one another, the average distance would be 1 and information diffusion would be expected to be fast (Freeman 1977). The mean distance for the 2006 network was 2.424, and, despite there being fewer actors, there was a slight increase in 2009 to 2.893. These figures mean that many actors do not have direct contact with each other and that, on average, both in 2006 and 2009, there was at least one intermediary between each actor.

More insight into the diffusion of information can be obtained with a third indicator called ‘centrality’. This is the number of direct ties an actor has with any other actor compared with the total number of direct ties (Freeman 1977). It is assumed in SNA that actors that have many direct relationships have more opportunities to access diverse sources of information. The network centralization index was 27% in 2006. The actors with the highest number of direct ties were, by order of importance, the Swiss Red Cross (33 ties), the regional ophthalmologist (32 ties), Ghana Red Cross Society (20 ties) and the Regional Directorate (17 ties). These four actors represented 28% of the total number of links of the network.

This means that the circulation of information within the network was dependent on the good performance, networking skills and willingness of these nine actors. In 2009, the network was more centralized than in 2006, with a degree of centralization of 37% compared with 27% in 2006. The only actor with strong direct links in 2009 was the regional ophthalmologist, who with 18 links accounted for 13% of the direct links of the network. The regional ophthalmologist combined with the five ophthalmic nurses represented 39% of the total links in 2009. All the other actors were connected with only one or two actors. This means that the circulation of information depended on a smaller number of actors in 2009 compared with 2006. This indicates there was a substantial increase in the centralization of the network over this period of time.

The structure of the network changed between 2006 and 2009 from one that was decentralized and dense to one that was more centralized and less dense. The distance between actors increased between 2006 and 2009, making the circulation of information more difficult in 2009 compared with 2006.
From a hierarchical network to five enclaved networks: the perspective from actors

The perspectives of the hospital managers, the key actors in the governance of health districts, were analysed. In December 2006, information flowing from the regional authorities and the international organization to the districts was voluminous and was mainly going through the ophthalmic nurses. The Swiss Red Cross organized quarterly meetings between all eye care staff (regional ophthalmologists and ophthalmic nurses), project co-ordinators of the Swiss and Ghana Red Cross Societies and regional health authorities. During these meetings, participants discussed issues about the challenges met, innovations introduced and future plans. In addition, the Swiss Red Cross facilitated quarterly monitoring visits by the Regional Co-ordination Team (i.e. the regional ophthalmologist, the Ghana Red Cross Co-ordinator and the Swiss Red Cross Co-ordinator). Flow of information between districts was made possible by exchanges between ophthalmic nurses during quarterly meetings, and by the quarterly visits of the regional ophthalmologist and the Swiss Red Cross Co-ordinators.

Between 1996 and 2006, during the period of international funding, the hospital managers were neither directly nor frequently in contact with the decision-makers of the programme: the Swiss Red Cross and the regional ophthalmologist. One co-ordinator of the programme explained that “the ophthalmic nurses were our main point of contact. They were the ones who made the decisions about the eye clinic. We realised too late that the hospital managers had not been given any responsibility in the management of the eye care activities.” The hospital managers admitted that they had difficulties in understanding the various decisions that were made by programme managers. One hospital manager recognized that “at some point, we even stopped trying to find information about the eye clinic. We knew that the regional authorities were involved and we assumed they [the regional health authorities] did not want to see us involved in the management of the clinic.”

The organization of the network in 2009 presented a great advantage for the hospital managers. They became the main point of contact in the district for the eye care activities. The departure of the Swiss Red Cross created another mode of functioning—one that is closer to the centralized structure existing within the Ministry of Health structure and other health services. All information concerning eye care was then channelled through hospital managers instead of being directly circulated to the ophthalmic nurses. In 2009, it was much easier for hospital managers to really understand what was going on in the eye clinic and make decisions about the clinic in response to the various shocks affecting the district (e.g. sickness of the regional ophthalmologist, recruitment of staff and implementation of the national health insurance). In 2009, hospital managers could control the flow of information as they were on the path between the regional ophthalmologist and the nurses. This change of position of hospital managers in the social network increased their power and authority over the eye care staff.

However, the structure of the social network in 2009 presented a major disadvantage for hospital managers compared with the one in 2006. Hospital managers felt very isolated from each other as reflected by the star shape of the network. They could not get access to information about what was going on in the other districts. As a result, when confronted with a regional shock, such as the non-availability of the regional ophthalmologist for surgeries, the information took weeks to reach hospital managers. The lack of cohesion and communication between hospital managers of different districts resulted in difficulty in finding joint solutions in responding to regional shocks. As one hospital manager mentioned, “access to resources is so limited that we compete with others to recruit a new ophthalmic nurse for example. Instead of finding solutions to common problems, we find solutions against each other.” Hospital managers hid information from other hospital managers in order to be able to hire the health staff in time.

Another example concerns the regional ophthalmologist, the only person in the region who could perform cataract surgeries, who, as a regional doctor, had a duty to offer his services to every district hospital. However, his performance was regulated by market forces: the law of supply and demand. The regional ophthalmologist received a discretionary fee, negotiated with the hospital manager, in addition to his salary, for every patient on which he operated. Being in a monopoly situation the regional ophthalmologist was in a position of power to negotiate advantageous tariffs and offer his services to the hospitals that proposed the highest fees. A few hospitals, which had smaller financial capacities, could not compete with the rates proposed by the biggest hospitals. As a result, in 2009, two out of five of the hospitals in the sample did not offer any cataract surgery to their patients and saw their waiting list increasing without being able to respond to the needs of the population.

Discussion

Between 2006 and 2009, the social network of the eye care system in the Brong Ahafo region of Ghana lost its main broker, the Swiss Red Cross. The structure of the network became more centralized and less dense, which made the circulation of information slower in 2009 than in 2006. The relationship between hospital managers from different districts became nonexistent in 2009. All these changes that occurred between 2006 and 2009 had an impact on the governance of the system. The main question of the study is: did the disappearance of the main brokers and the new structure of the system influence the governance of the system and the adaptive capacity of hospital managers to respond to shocks?

The high density of the 2006 network implies that the flow of information was more fluid in 2006 than in 2009. The 2006 network by its density was defined by Milward and Provan (2000) as hierarchical. The 2009 network had the shape of a star with five branches where every branch represented one of the five districts. The star shape has been described in SNA literature as a centralized but segmented structure (Diani 2003) or an enclaved structure (Milward and Provan 2000). Actors in a dense network such as the 2006 network have difficulties accessing diverse forms of knowledge as most actors have similar backgrounds and values (Granovetter 1973; Frank and Yasumoto 1998), which has an impact on the property of good governance defined in the framework (i.e. first property: capacity to engage effectively with and handle multiple- and cross-scale dynamics). The less centralized structure of the
network in 2006 also helped the brokers control information and distribute it across scales (third property of good governance: capacity to combine and integrate different forms of knowledge). The position of brokers at the centre of the 2006 network, combined with their capacity to reach actors from different levels of the network, had a positive influence on the flow of information. In conclusion, from a SNA perspective, the system in 2006 was better governed than it became in 2009.

The changes that occurred between 2006 and 2009 also involved changes in roles and powers between hospital managers and nurses. The 2009 network illustrated the isolation of districts from each other, and the challenges faced by hospital managers in bringing appropriate solutions to potential shocks: specifically regional and national shocks. However, the 2009 system appeared to district hospital managers as more manageable and easier to control. Their change of position in the network helped them control the circulation of information and get access to information to make decisions and respond to shocks. These results are in line with work from Provan and Milward (1995) and Milward and Provan (2000), who studied the networks involved in the provision of mental health services in the United States. They found that hierarchical networks such as the 2006 network are easier to manage for a broker than any other form of networks (Powell et al. 1996). In contrast, enclosed networks such as the 2009 network are preferred when it is about ensuring the acceptance of innovations and creating a sense of ownership and trust (Sullivan and Skelcher 2002).

The study also highlighted the importance of brokers in the governance of systems and their impact on circulation of information. Several denominations have been given to brokers—a term which belongs to the vocabulary of SNA (Borgatti et al. 2009)—in the wider literature: Bossert (1990) referred to champions, while Shediac-Rizkallah et al. (1998) preferred the term leader, and others have used facilitator, broker linking agent or change agent (Thompson et al. 2006). Although there are nuances in the definition of these different terms depending on the theoretical paradigm from which they are perceived, Thompson et al. (2006) showed that these key players all have the capacity of building bridges between actors and facilitating the circulation of knowledge and information between actors. A systematic Cochrane review conducted by Thompson O’Brien et al. (2000) highlighted that interventions in education, health or management were more likely to be maintained if they were facilitated by a broker. In the present study, the absence of a key broker in 2009, such as the Swiss Red Cross in 2006, also proved to be a major obstacle to the maintenance of a dense network where districts could stay interconnected. In fact, in 2009 the network became an enclosed network that conforms to the structure of the general health system in Ghana (Larbi 1998; Bossert and Beauvais 2002; Koranteng and Larbi 2008). The presence of a strong broker in 2006 proved that it was possible to create new links between actors and districts that constituted an innovation compared with general health system.

**Conclusion**

Between 2006 and 2009, the health system in the Brong Ahafo region experienced significant changes, specifically after a key shock, the departure of the international organization. Several other actors at different levels of the network disappeared, the positions of nurses and hospital managers changed, creating new relationships and power balances and resulting in a change in the general structure of the network. The system shifted from a dense hierarchical network towards an enclosed network composed of five sub-networks. The new structure in 2009 was less able to respond to shocks, circulate information across levels and implement multi-scale solutions. The 2009 network also limited the capacities of hospital managers to find multi-level solutions to respond to shocks. The 2009 network nevertheless responded better to the needs of the hospital managers who could more rapidly access information. The change of the network over time also showed the influence of a strong broker in a network on generating links and creating connections between actors from different levels. In conclusion, managing health systems requires understanding who the actors are, the relationships between these actors and how the social network of actors is structured.

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**References**


