Managing Information Dissemination during Handoffs: a Social Network Analysis View

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Abstract
Handoff and transitional care are among the most common and consequential errors in healthcare service. This study aims to identify the most important healthcare service provider, which must continuously manage information as a patient moves from place to place within the healthcare system, seen through a Social Network Analysis lens.

Keywords: Handoffs, Social networking analysis, Healthcare
Introduction
Identifying the most important actors within a social network is one of the applications of graph theory in social network analysis. Several measures of centrality and visibility have been created to identify the most important and prominent actors within a social network (Zemiljic and Hlebec 2005).

West et al. (1999) suggest that socialization among health-sector professionals and the structural position of these actors are important factors of social networking and should be considered when developing strategies that include information and the influence of actors in the health sector. The structural dimension provides information on the social-network patterns of links between individuals; for example, the number of connections among actors in the network (degree) and the control over the information flow in the network (betweenness).

Patient transfers within departments of a hospital can be interpreted as acts organized by a team of health-sector professionals who are connected to each other to promote a flow of information about patients. A social network analysis (SNA) can verify the implications of the restrictions of actors involved in the information flow during this process. There is international pressure for the development of policies regarding patient transfers, due to growing recognition of the damage associated with transferring medical or surgical care within the various sectors of a hospital (Wachter 2012).

Is there a predominant categorical role among health professionals that establishes an optimal number of connections needed or feasible in order to ensure a secure flow of information about patients within sectors of a hospital?

This research analyzes five measures of centrality and visibility in relation to the actors involved in seven handoffs. The main goal is to identify the actors’ categorical role to enable better structural positioning for the development of strategies that include reliable information on handoffs.

The research is structured as follows: in the next section, a literature review is conducted to identify the concepts surrounding, types, applications and limitations of centrality measures. The applied methodology is then described, followed by a description and discussion of the results. Final remarks conclude the presentation.

Centrality measures in social network analysis
Frank (2002) discusses the centrality of an actor as a latent property, which allows the actor to create a private social network structure. Centrality measures are conceived as descriptive
statistics of actors’ or social networks’ specific structural properties. From this perspective, a response pattern of an individual, such as within information exchanges with other persons they are associated with, may establish a functional relationship with the individual’s power degree (latent property) in the context in which they are inserted.

The centrality measure of intermediation (*betweenness*) determines the proportion of indirect contact with other actors through a central actor. For example, betweenness expresses an exploratory variable on the central actor’s attributions that give that actor influence or control over the social network. *Degree* determines the number of instances of direct contact an actor has with other actors in the network. This centrality measure has been explored in studies on the popularity and activity of actors in a social network. The centrality measures of proximity (*closeness*) and information (*actor information centrality*) analyze the distances and routes between the actors. Thus, these properties provide evidence of the structural properties of the network in relation to availability, security and guarantees in the vicinity of the actors. The focus of centrality measures is on capturing structural properties in order to explain other attributes of the actors or performance properties of the social network (Borgatti and Everett 2006, Freeman 1979, Wasserman and Faust 1994).

Bonacich (2007) argues that the *eigenvector* centrality measure can be seen as a weighted sum of both direct and indirect connections, which considers the whole pattern of the network. This measure also makes it possible to assess social networking with both positive and negative ties, so that a hostile network connection with another network of higher status can reduce the former’s status, and vice versa.

The route by which a flow (e.g., information flow, resource flow) is processed is crucial to the operation of most social networks. Many centrality measures quantify the importance of sharing these routes within the social network. The measure of betweenness ranks the actors in terms of their individual importance in the social network, but does not make clear in advance how they exert their influence on the social network. Studies on how this influence occurs are important in terms of understanding how actors form social groups or coalitions. (Kolaczyk and Barthélémy 2009).

Research on organizational connectivity and readiness in public health suggests that organizational-connectivity perception may be a good indicator of organizational readiness (Dorn et al. 2007). In fact, in an emergency, it is important for an organization to understand in a timely manner the availability of the resources needed to take action. Actions to improve formal links between actors may allow greater collaboration, open communication, and
teamwork, and enhance the ability of the global system to respond to emergencies with flexibility and resilience (Hall; Shiell, 2010).

Ferriani et al. (2009) found evidence that project leaders with greater centrality in the social network are more likely to succeed in their business ventures. This suggests that the connections are an expression of how social capital provides access to opportunities for projects. However, Ferriani et al (2009) research suggests that there is a potential disadvantage to excessive exposure within the network. New SNAs have demonstrated the negative implications of excessive centralization, at both the individual and the organizational level. As the connectivity of an actor increases in the network, the benefits of high degrees of centrality decrease (McFadyen and Canella 2004, Owner-Smith and Powell 2003, Sampson 2005).

Yamaguchi (1994) found that social networking systems with two or more subgroups connected by bridges can become more efficient because the actors that act as bridges become more central in their own subgroups. This may explain why open systems tend to be more organized, so that communication to the center of the system is easier than communication with its peripheries.

Relations between centrality and power may be more contextual than previously believed. Even in social networks that provide multiple possibilities for interactions, when social influence is contrasted against decision making, for example, a high degree of centrality does not guarantee success for an actor. A semiperipheral actor that monopolizes communication flows with peripheral actors, and is skilled at surrounding central actors, may emerge with more power than the actor with the highest centrality degree. Centrality measures are important for understanding the power of an actor, but they have different degrees of importance. The way in which an actor’s centrality affects their power is deeply related to the social network structure in which they are embedded. A third significant aspect of the structure of the social network involves the number of existing subgroups, as well as how a central actor is able to perform in order to resolve deadlocks between competing groups (Mizruchi and Potts 1998).

Data collection and preparation

This research used an exploratory survey conducted in a field environment, as well as non-probabilistic convenience sampling and the snowball technique.

Using the snowball sampling method, the initial respondents were chosen for convenience. These respondents were used to identify other respondents who had participated
in the transfer of patients among hospital departments. The data-collection process continued until the saturation point was reached (Frank 2002, Frank and Snijders 1994).

Data were collected in the second half of 2012, in a hospital in the city of São Paulo. Semi-structured interviews were conducted with actors involved in six handoffs that had occurred within the hospital. A seventh handoff was created as a hypothetical model based on identification of the categorical roles involved in the six handoffs studied.

In the hypothetical model, Handoff 7, we inserted a categorical role referred to as a clinical integration agent (cia_U). The implementation of this strategy to use a person as an intermediary in patient-care transitions has been described in 30 studies (of which 21 were randomized and controlled trials). Involving the patient has been among the interventions applied by the intermediary in 20 of these works (Rennke et al. 2013).

The data were processed using the software UCINET for Windows (Borgatti et al. 2002), and were not dichotomized (ordinal scale transformed into a binary scale).

The interviewees were classified into categorical roles according to their operating units. Table 1 presents a description of the units and the categorical roles applied in this research. These designations were arbitrary.

*Table 1 – List of sectors and categorical roles in handoffs. Source: prepared by the authors, 2013*

<table>
<thead>
<tr>
<th>Unity</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ADM</td>
<td>administration</td>
</tr>
<tr>
<td>WRD</td>
<td>ward</td>
</tr>
<tr>
<td>OSP</td>
<td>outpatient specialty</td>
</tr>
<tr>
<td>PHR</td>
<td>pharmacy</td>
</tr>
<tr>
<td>ERM</td>
<td>emergency room</td>
</tr>
<tr>
<td>NDS</td>
<td>nutrition and dietetics services</td>
</tr>
<tr>
<td>ICU</td>
<td>intensive care unit</td>
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<table>
<thead>
<tr>
<th>Categorical role</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>aas</td>
<td>administrative assistant</td>
</tr>
<tr>
<td>hag</td>
<td>hospitality agent</td>
</tr>
<tr>
<td>cia</td>
<td>clinical integration agent</td>
</tr>
<tr>
<td>swr</td>
<td>social worker</td>
</tr>
<tr>
<td>nrs</td>
<td>nurse</td>
</tr>
<tr>
<td>phr</td>
<td>pharmaceutical</td>
</tr>
<tr>
<td>pht</td>
<td>physiotherapist</td>
</tr>
<tr>
<td>phs</td>
<td>physician</td>
</tr>
<tr>
<td>pfm</td>
<td>patient’s family member</td>
</tr>
<tr>
<td>ntr</td>
<td>nutritionist</td>
</tr>
<tr>
<td>ptn</td>
<td>patient</td>
</tr>
<tr>
<td>rcp</td>
<td>receptionist</td>
</tr>
<tr>
<td>ntc</td>
<td>nursing technician</td>
</tr>
<tr>
<td>amn</td>
<td>administrative manager</td>
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</table>
The centrality measures were correlated with the average level of satisfaction with the handoff, and verified in terms of the extent to which the centrality measures correlate with one another.

The respondents’ participation was voluntary and free of coercion, force or requirements. Their right to anonymity and confidentiality was assured by restricting access to the respondents’ identifying details to the researchers. There were no conflicts of interest in the research. The results of the interviews are described in the next section.

**Results**

Within handoffs, the nurse from the origin unit was found to have the most direct contact with the other actors, and thus has greater popularity and prestige in the network, *i.e.* the highest degree measure.

The nurses in the origin unit had the highest betweenness (except in Handoff 01), the highest closeness (except in Handoff 02), the highest eigenvector (except in Handoff 06) and the highest actor information centrality (except in Handoff 2). No significant correlations were found in relation to centrality measures and the average level of satisfaction with the handoffs.

The sociogram in Figure 1, *i.e.* shows the structural position of the actors involved in Handoff 04. The nrs_ICU was based in a structural position, followed by nrs_WRD. Asymmetric relationships predominated between the actors. There was no information exchange with the patient or the patient’s family member.
The sociogram in Figure 2 shows the structural positions of the actors involved in Handoff 07. The cia_U was located in a structural position, followed by nrs_WRD, ptn_U and pmf_U. Symmetry relations predominated between the actors. The cia_U exchanged information with all network actors.

An interpretation of these results for practical applications in transitions of care follows in the next session.

Discussion

The analysis of structural features in handoffs has identified a categorical role, that of nurses in the origin unit, who have high centrality and represent the only link to the others actors. The handoffs become vulnerable by relying on a single actor for formal connections between subgroups of actors, and the central actor’s personal interests can occasionally surpass those of the subgroups. In Figure 2, despite the fact that cia_U was found to have the highest centrality within the network, alternative routes can be observed by which the information flow processes could be achieved. In particular, routes that involve the patient or their relatives suggest that the involvement of these actors is important for reducing errors during transitions of care (Rennke et al. 2013).
Connectivity unites several agents within a common action (Marcus and Henderson 2006). For example, in a network of, connectivity can facilitate a more secure handoff. Figure 1 reveals the fragility of the connections between the actors, and contrasts the high levels of connectivity among the actors shown in Figure 2.

Note that, in Figure 1, most of the relationships among the actors are asymmetric; the actors are positioned more on the periphery of the network and express low connectivity. Structural analysis of Handoff 04 identifies the nrs ICU as an influential actor. The dependence on this actor may have jeopardized the social capital, and therefore the efficiency and safety, of the handoff; the satisfaction level here was the lowest among the six handoffs.

The existence of gaps in care transitions can contribute to the success or failure of the transition strategy. Among the failures, for example, are improper selection of information (not relevant), and heterogeneity in categorical roles and type of patient involved (Rennke et al. 2013). In the six handoffs analyzed, improper selection of information emerged as the main failure, followed by the absence of an electronic system to disseminate information.

The formation of a team to implement a handoff should reduce the risk of a patient’s improper care transition. A balanced configuration between the actors within the subgroups may be more appropriate to ensure a better setting and better team performance. Connections are an expression of how social capital provides access to information (Ferriani et al. 2009). These characteristics seem more likely to occur in the network configuration model of Handoff 07 than in the configuration of Handoff 04.

However, there may be a potential disadvantages in relation to excessive exposure within the network. As the connectivity of an actor in the network is increased, the benefits of high degrees of centrality decrease (McFadyen and Canella 2004, Ower-Smith and Powell 2003, Sampson 2005). A disparity in the actors’ centrality also helps to increase inefficiency in terms of information flow in closed systems (Yamaguchi 1994).

Final remarks
In the handoffs studied, it must be concluded that, among health professionals, nurses provide the largest number of connections necessary or feasible to facilitate safe information flow about patients between departments within a hospital environment.

The nurse in the origin unit of the handoff has the greatest popularity (degree, eingenvector), influence or control (betweenness) and access to information on the handoff
(closeness, actor information centrality). The patient or their family even appears to be central in the handoff, which contradicts the concept of patient-centered medicine.

In the literature, there is a lack of studies assessing the effectiveness of strategies for the prevention of adverse events via the exchange of patient information through a clinical integration agent. Therefore, research is needed to obtain information on contextual factors relating to the implementation and costs of strategies and interventions related to care transitions, such as the insertion of a clinical intermediary.

Specific interventions on the quality of information exchange in handoffs, such as patient monitoring, recommendations, patient and family education, medical reconciliation and follow-up, have not been studied. This also represents a limitation of this study, despite the fact that it obtained information about the respondents’ level of satisfaction with the handoff. Another limitation lies in the fact that the sample did not have significant power to detect important differences between the analyzed handoffs and the hypothetical model.

References


