

Culture of information and information exchange in a public hospital: a study based on the information orientation model and social network analysis

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Abstract

The structures of hospitals have evolved to make them centre on patients and their pathologies, with care procedures that are both interprofessional and interorganisational. This has given rise to work environments made up of teams obliged to collaborate in their problem-solving, with an essential focus on proper collaborative information behaviour (CIB). The aim was to study this behaviour in a clinical service of a hospital in relation to two aspects: information culture (IC) and the exchange of information. This entailed designing a two-part descriptive study. The first step was to administer a survey based on the information orientation model to know more about the service's IC. The second phase focussed on the exchange of information from the perspective of an analysis of social networks. The main characteristic of IC was its proactive nature, especially in the use of information to improve one's own work (mean = 4.58) and to respond to changes and new developments relating to work (mean = 4.18). The factor that least characterised IC was control, particularly in relation to knowledge of the objective of the activity itself (mean = 2.67) and the dispersion of information about hospital processes (mean = 2.64). On social networks, factors contrary to an interprofessional CIB were identified, such as homophily and low reciprocity in terms of relationships. In practice, the results identified a need to reinforce the perception of information as a resource, the proper use of which benefits job performance at both an individual and group level. A need to reinforce flows of internal hospital-related information was likewise evident. From a theoretical and methodological point of view, a useful tool is made available for diagnosing the collaborative information behaviour of an organisation and designing strategies to improve it.

Keywords

Collaborative information behaviour; Social network analysis; Information culture; Health care personnel; Hospitals; Information Orientation; Information use; Information exchange; Information flows.

1. Introduction

Most hospitals have transformed themselves in recent decades, by moving from specialism-based structures to others that make patients and their pathologies the centre of interest. This approach to treatment is both interprofessional (involving different groups of professionals) and interorganisational (involving different organisations or organisational units) (Axelsson *et al.*, 2014). The health systems of many European countries have evolved along similar lines, adopting an approach to healthcare that seeks to integrate the activities of various disciplines, professionals, departments and organisations (Antunes; Moreira, 2011). In the case of Spain (where administration of the health system is devolved to the country's autonomous regions), health plans have made such comprehensive care part of their strategy (e.g. Ruiz-Fernández; Rabadán-Asensio; Fernández-Ajuria, 2013). This has led in many cases to changes at the organisational level, including such initiatives as the “clinical management units” of the *Health Service of the Basque Country* (2019). These entities are organised for the purposes of comprehensive public healthcare. They bring the required resources together, regardless of their position in the management structure.

This transformation in healthcare has in practice led to an approach involving work environments made up of multidisciplinary teams obliged to collaborate with each other, from their complementary perspectives, in order to solve complex problems; based largely on the efficient use and exchange of information. Proper collaborative information behaviour (CIB), understood as the behaviour of people working together in their use of information, has proved to be vital in this respect. It entails identifying a need for such information, conducting the corresponding search, and then recovering and exchanging it, before finally evaluating, synthesising and giving meaning to the information found (Karunakaran; Reddy; Spence, 2013). All of these tasks rely to a great extent on the prevailing organisational and information-related culture of the work environment. However, neither this strategic approach nor the rules that derive from it, which imply a need for such CIB, inevitably have to bring about changes in the practices, norms or values of those involved, in terms of their use and exchange of information. Indeed, and despite the existence of a regulatory framework, many practices that prevent collaboration can be maintained, including for example the restriction of information flows to people from a single group or professional area. The results of a recent survey are revealing in this respect. It rated ineffective interprofessional communication as the second-highest risk affecting the quality of care and patient safety in Spanish hospitals (Gordo *et al.*, 2021). If we are to harmonise a regulatory framework that focuses on patient-centred care and on the manner in which work teams contribute to it, we need to observe the characteristics of CIB and its influence on the efficient use of shared information.

In terms of research, it was in around the year 2000 that the first studies explicitly dedicated to CIB began to appear, extending the dominant individual perspective into the study of information behaviour. The phenomenon has been addressed in different areas since then, including studies involving software design teams (Fidel *et al.*, 2004), members of the military (Prekop, 2002), students (Hydegård, 2009), virtual communities (O'Connor, 2013), academics (Given; Willson, 2015), farmers (Ndumbaro; Mutula, 2017) and politicians (Riley; Allen; Wilson, 2022). There are however few studies carried out from this perspective in a health context. Two of the most relevant pieces of research are those carried out by Reddy and Dourish (2002) and Reddy and Spence (2008) in two hospital departments: intensive care and accident and emergency respectively, which also led to the development of a theoretical model based on their observations (Reddy; Jansen, 2008). These researchers concluded that CIB tended to occur when there was a breakdown in information flows, usually because the information concerned was unavailable, incorrect, incomplete or supplied to the wrong person. On the other hand, they did identify four triggers for changing from individual to collaborative behaviour, where the exchange of information was essential. These triggering factors were:

- the greater complexity of problems involving information;
- difficulty in accessing information immediately;
- lack of experience or knowledge of the issue concerned; and
- the fragmented nature of the information that was available.

Various studies have meanwhile shown that these practices are derived from individual characteristics and interactions within the group, conditioned in turn by the prevailing informational culture (IC). This is characterised by a series of values and beliefs relating to the search for, use of and management of information, which are different for each organisation (Oliver, 2008; Widén; Hansen, 2012).

It is in this context that our research is situated, with the aim of gaining knowledge of the CIB of the employees of the clinical service of a specific Spanish hospital. It is carried out from two complementary perspectives: the IC aspect (understood to be the most-immediate social context in which these professionals carry out their work), and from the perspective of the exchange of information that takes place among them as they perform their healthcare-related activities. We will now go on to examine the conceptual foundations that guided the design of our research.

2. Information culture (IC)

Choo *et al.* (2008) define IC as the values, standards and practices that underlie and determine how information is used and managed. It is the pattern of collective behaviours and attitudes that express an organisation's orientation vis-à-vis information (Davenport; Prusak, 1997). IC is therefore the set of norms and beliefs adopted by the members

of an organisation regarding the value and use of information likely to have a bearing on CIB in such organisations. Certain cultures will thus favour proper CIB, while others have characteristics that make it difficult on the grounds of being difficult to identify. In this sense, one of the models that turned IC into an operational concept is that of **Marchand, Kettinger and Rollins** (2002), now known as “information orientation”. It covers three areas related to the use of information:

“Multidisciplinary teams must collaborate to solve complex problems”

- technologies;
- information management;
- behaviour regarding the use of information.

The first two lie within the formal dimension of the organisation, while the third is informal; but all three have a decisive bearing on IC.

When it comes to promoting the efficient use of information as a resource, **Marchand, Kettinger and Rollins** (2002) propose that IC should be characterised by the adoption of certain values and collective practices. These take shape in six dimensions:

- 1) integrity: “the use of information in a reliable way and based on principles at the individual and organisational level” (p. 121);
- 2) formality: “a willingness to use and rely on institutionalised information from informal sources” (p. 122);
- 3) control: “the extent to which information relating to performance is continually presented to people in order to let them manage and monitor their own performance” (p. 123);
- 4) transparency of information: “openness in communication and the disclosure of information regarding errors, failures and mistakes” (p. 124);
- 5) exchange of information: “the willingness to provide information to others in an appropriate and collaborative way” (p. 124); and
- 6) proactive use of information: “an active concern about how to use information and obtain new information, along with a desire to implement useful information” (**Marchand; Kettinger; Rollins**, 2002, p. 125-126).

The “information orientation” model has enjoyed a long trajectory in the field of business organisation management, but it has been applied to a lesser extent in the context of documentation, with hardly any studies in the health field (**Nordsteien; Byström**, 2018). Various pieces of research have used these six dimensions to characterise and operationalise the social and informational context of organisations. This is the case in the work of **Choo et al.** (2006), which carried out research into the management of IC at a Canadian law firm, where exchange, proactivity, transparency and formality were dominant features of its IC; and also **Choo et al.** (2008), which focused on the ties between culture and the use of information in the same firm, as well as in a public health agency and at an engineering company. The health agency and engineering company shared proactivity and exchange as characteristic features of their IC, but differed in a third aspect: transparency (the health agency) and integrity (the engineering company). In addition to Choo and his collaborators, **Lauri, Heidmets and Virkus** (2016) investigated the cultural factors that had the greatest impact on problem-solving at 3 Estonian universities, identifying integrity, proactivity and formality as dominant characteristics of their IC. Finally, the research of **Barbosa and Gonçalves** (2017) examined information behaviour and values at a Brazilian airfreight company. In this case, the factors that characterised the organisation’s culture were: exchange, formality and control. All these studies started with a quantitative approach based on the administration of surveys. This contrasts with the research of **Nordsteien and Byström** (2018), which used focus groups and observation to examine the involvement of recently recruited Norwegian healthcare professionals in information practices in a new work environment. All aspects of the information orientation model were identified, but integrity was a dominant feature in this case.

3. The exchange of information

Understanding IC to be the immediate context in which information is used, **Davenport and Prusak** (1997) consider the exchange of information to be one of the behaviours that are decisive for building a healthy information culture. In this sense, one of the angles from which their research has been approached is that of social network analysis (SNA). SNA is based, from a theoretical point of view, on the idea that people’s behaviour is conditioned more by their ties and the networks in which they participate than by personal norms and attributes (**Haythornthwaite; Wellman**, 1998). SNA seen in this light focuses on the patterns of relationships between actors observing the availability of tangible resources (such as money) or intangibles (such as information) and the exchange of these resources (**Haythornthwaite**, 1996). SNA can thus be used to study the exchange relationships or information flows (ties) established between the members (nodes or actors) of a social network. Expressed in another way, this research focuses on individuals as the nodes of a network based on a social group that establishes a set of relationships (**González-Teruel; Andreu-Ramos**, 2013).

SNA has a long tradition in the context of health research, but it was in the 1990s that it experienced a strong boost. **Chapman, Verdery and Moody** (2022) attribute it to various factors, such as

- the HIV epidemic and the need to know its transmission processes;
- the risky sexual behaviour on the part of adolescents; and, finally,
- the increased use of text-based and software tools that facilitated the search for, collection and analysis of the data concerned.

Scientific production on this issue has continued to increase since then, leading to numerous systematic reviews focused on various aspects of SNA, such as:

- 1) the way in which the social networks formed within health organisations contribute to the quality of patient care and treatment (**Cunningham et al.**, 2012; **Bae et al.**, 2015; **Blacklock et al.**, 2022);
- 2) the process by which various health interventions are linked to the use of networks (**Perkins; Subramanian; Christakis**, 2015; **Smit et al.**, 2020) or changes in such organisations (**Chambers et al.**, 2012);
- 3) the dynamics of social networking between healthcare workers and patients (**DuGolf et al.**, 2018);
- 4) the types of networks that are configured in a healthcare setting (**Poghosyan et al.**, 2016); and, finally,
- 5) the characteristics of social networks that influence communications established in a healthcare environment (**Braithwaite**, 2010; **Long; Cunningham; Braithwaite**, 2013; **Tasselli**, 2014; **Sabot et al.**, 2017; **Glegg; Jenkins; Kothari**, 2019; **Benton et al.**, 2015).

4. Methodology

In order to achieve the proposed objective, a descriptive study was carried out in a clinical service of a Spanish public hospital offering level-three care, reflecting the tendency of hospital organisations to conform to an interprofessional and interorganisational framework. Its functional structure consisted of seven interprofessional clinical units designed for the care of groups of related pathologies, made up of 28 physicians sub-specialised in these pathologies and one coordinator per unit. The service also employed nursing staff (20) and nursing assistants (17) not attached to any particular unit, but rather to the outpatients' department or the hospital's wards. Each of these two areas was run by a head clinician, with a head of service in charge of the structure as a whole. The 65 persons employed by the service constituted the reference population.

The study was divided into two parts.

a) The first of these used a questionnaire, along with the gathering of sociodemographic data and information on the characteristics of the service's IC. Its design was based on the six dimensions of the information orientation model of **Marchand, Kettinger** and **Rollins** (2002) and the survey that they developed to study the perception of the business performance of senior managers, as well as the adapted version of **Choo et al.** (2006; 2008) to ascertain the IC of various organisations based on the practices and values included in the model. The signatories of this research translated both questionnaires into Spanish, and adapted the questions to the specific environment of the hospital. The resulting questionnaire was made up of 22 statements grouped according to the six dimensions mentioned above: integrity (5 items), formality (4), control (4), transparency (3), information exchange (3) and proactivity (3) (see Appendix 1). For each of these 22 statements, respondents had to assess their agreement on a scale of 1 (totally disagree) to 5 (totally agree). A pilot trial was conducted before the questionnaire was administered. This used a sample of individuals with the same profile as that of the reference population, but from another hospital. They answered the questionnaire individually and, once completed, a researcher was also able to collect information on their perception of various aspects of it. Specifically, and with reference to **Cea-D'Ancona** (2004), it was found that the questions were understood and had an adequate vocabulary, that the instructions were adequate and did not need clarification, that they followed a logical sequence, that they offer the planned responses with sufficient variability and that they offered a significant overview of each dimension of IC. With all this information to hand, the definitive questionnaire was drawn up. Analysis of the information collected in this part of the study entailed calculating the frequency of the different sociodemographic variables involved, as well as the mean and standard deviation of the scores assigned by respondents in accordance with their level of agreement with the statements referring to IC. *SPSS* software was used throughout this stage.

Information culture determines how information is used and managed

b) The second part of the study was focused on examining the exchange of information among employees of the service, from the point of view of SNA. This involved the use of a second questionnaire containing a name generator (i.e. a list of the names of all the people employed by the service). Respondents were then told to identify up to a maximum of five colleagues whom they frequently approached, in a workplace setting, to ask for information. This information was used to analyse the characteristics of the network, the centrality of respondents (social network nodes) in information flows, and groups within the social network. *Ucinet* and *Gephi* software was used for this purpose.

Network characteristics: centrality, flows and groups

The social network characteristics calculated were: size, density, diameter and average path length, as well as the direction and reciprocity of ties. "Size" refers to the number of nodes that make up the network, while "density" is the ratio of actual ties to possible ones. Given the limited choice of five persons per respondent, the maximum number of possible

ties was 275. The density of a network gives an idea of the probability of information being disseminated within that network, so the greater the density, the greater the likelihood of dissemination. On the other hand, the diameter of a network is the length of the longest geodesic distance between pairs of nodes throughout that network. We define “geodesic distance” as the length of the shortest path between two nodes (Knoke; Yang, 2020). “Average path length” is meanwhile the mean number of ties on the network’s shortest possible routes (i.e. the mean of geodesic distances between nodes). These measurements reflect the efficiency of the transfer of information within that network, in such a way that in networks with a high density, geodesic distances are normally small, suggesting that information can travel fairly quickly (Hanneman; Riddle, 2011). Finally, we observed the direction of ties between professional categories and their levels of reciprocity. These data highlight the flows of information between network nodes.

“The exchange of information is one of the behaviours that are decisive for building a healthy information culture”

Centrality of nodes

The second aspect of the social network to be studied was the centrality of nodes. This refers to the prominence or visibility of each node for the rest of the nodes in the network, and their involvement in the relationships so established (Knoke; Yang, 2020). These were information exchange relationships, in our case. As there is no single measure of “centrality”, we have to use complementary factors to observe the prominence of nodes. This research used four: degree, closeness, betweenness and eigenvector. We decided in advance that the main actors would be those with a relevant position in at least three of the four measurements. The degree of a node is thus defined as the number of ties connecting it to other nodes. On networks with directional ties, like the one studied here, a distinction is made between in-degree and out-degree. “Closeness” refers to the speed with which an actor can interact with other actors on the network, whether directly or indirectly through intermediaries. It is based on the distance of one node from the others, considering the shortest of all possible paths (geodesic distance). A high closeness value indicates the presence of many short paths, implying quick communication with others; while a low value denotes long distances between one node and the others, and slow transmission of messages (Knoke; Yang, 2020). “Betweenness” refers to the influence or intervention of an actor in information exchange relationships, and is therefore the measure of how actors connect on the geodesic path between pairs of actors who are not directly connected (Knoke; Yang, 2020). The eigenvector weighs up each of the nodes with direct ties to an actor based on centrality. It evaluates that actor’s influence or popularity in such a way that a high score means that an actor is connected to many nodes that also have high scores (Knoke; Yang, 2020). In other words, the actor concerned is in a highly favourable position to disseminate or access information.

Modularity

The final aspect of the social network to be observed was modularity. This is one of the procedures used in SNA to detect communities. It is based on the relationship between the ties within a partition with those outside that partition, compared in turn to an expected value for ties established at random (Freeman, 2011). Knoke and Yang (2020) explain it as follows:

“If the observed number of lines is no greater than random, modularity is zero, and thus network partitioning into meaningful subgraphs is not possible. As modularity approaches a maximum of one, a network is characterized by a strong community structure with higher-than-random intragroup ties and sparse intergroup connections.”

The respective questionnaires on IC and the service’s social network were administered simultaneously, either in person or online (using *Google Forms*). Before responding to the questionnaires, respondents read and signed an informed consent covering the objectives of the study, a description of its methodology, the approximate time needed to complete the form and information on their voluntary, anonymous and confidential participation. The design of the research was approved by the *Ethics Committee* of the authors’ academic institution.

5. Results

5.1. Respondent characteristics

Of the 65 persons employed by the service at the time of the study, 55 (84.6%) completed the questionnaires. They included 12 nursing assistants, 19 nurses and 24 doctors. Broken down by sex, 37 (67.3%) were women and 18 (32.7%) men. In terms of age, most respondents (38.3%) were between 46 and 55 years old. Only two respondents were under 25. All university graduates holding a postgraduate qualification were to be found among the doctors, with the sole exception of one graduate nurse. All other members of staff had studied only to higher secondary or diploma level. Finally, and applying to all respondents, average years of professional experience amounted to 18.5 years, with 63.3% having worked in the service for ten years or less, and only 18.2% for over 15 years (see table in Appendix 2).

5.2. Information culture (IC)

Table 1 shows the mean scores, based on the extent of agreement with the statements in the IC questionnaire, ranging from a value of 1 for “totally disagree” to 5 for “totally agree”. The scores generally indicate respondents’ agreement with most of the items relating to the dimensions of proactivity, formality, exchange of information, transparency and

integrity. Firstly, the dimension that most characterised the IC of service was proactivity, with a high degree of agreement with all the statements (table 1, items 20 to 22). Regarding formality, this reflects respondents' agreement with the importance of information supplied formally, although a small proportion also took informal sources into account (items 6 to 8). On the point of information exchange, there was a lower level of agreement on the items referring to the sharing of information with other hospital departments (item 18, mean=3.18) and other health services (item 19, mean=3.04). In the case of transparency, the lowest level of agreement was with the statement regarding a climate of openness and confidence in sharing information on mistakes (item 14, mean=3.27). When it came to integrity, there was less agreement with the statements in items 3 to 5, reflecting how some respondents believed that information was given to legitimise decisions already made, or that information was withheld for the possessor's own benefit or, in particular, that information was used for personal advantage.

The dimension that characterised IC the least was control. There was a degree of agreement above the midpoint of the scale regarding the statement on the use of internal information to improve one's work (item 11, mean=3.44). However, there was disagreement on the statement regarding access to information on the organisation's operation and results (item 10, mean=2.82), knowledge of the objective of the activity itself (item 13, mean=2.67) and ease in gaining knowledge on processes and the people who carry them out (item 12, mean=2.64).

Table 1. Information culture of the hospital service being studied

Dimensions	N	Mean	DE
Integrity			
1. The integrity of service employees allows information to be shared.	55	3.73	0.804
*2. Inaccurate information is often distributed deliberately.	55	4.09	0.967
*3. Information is often supplied in order to justify decisions already made.	55	3.07	1.086
*4. Possessors of information often keep it to themselves.	55	3.35	1.174
*5. People commonly take advantage of information for their own benefit.	55	3.35	1.174
Formality			
*6. Greater trust in informal sources than formal ones.	55	3.71	1.066
*7. Wide use of informal sources, even when formal sources exist and are credible.	55	3.38	1.130
*8. Use of informal sources of information in order to verify and improve the quality of formal ones.	55	3.76	1.170
9. Trust in the quality of formal information.	55	3.64	1.060
Control			
10. Receipt of information on the operation and results of the hospital and its service.	55	2.82	1.203
11. Use of hospital information to improve one's own work.	55	3.44	1.118
*12. Diffuse and difficult-to-obtain information on processes and people who carry them out.	55	2.64	1.078
*13. You know what you have to do, but the objective of the activity itself is unknown.	55	2.67	1.139
Transparency			
14. A climate of openness and trust is encouraged for the exchange of information regarding mistakes.	55	3.27	1.079
15. Information concerning mistakes is shared.	55	3.47	0.920
16. Information on mistakes is used to solve problems.	55	3.89	0.936
The exchange of information		3.55	
17. Information is exchanged with employees of the service.	55	4.42	0.658
18. Information is exchanged with employees of other services.	55	3.18	1.292
19. Information is exchanged with employees of other healthcare centres.	55	3.04	1.453
Proactivity			
20. The search for information on changes and trends relating to work.	55	3.84	1.135
21. The use of information to respond to changes and new developments relating to one's own work.	55	4.18	0.884
22. The use of information to improve one's own work.	55	4.58	0.567

*Items whose responses have been inversely encoded. They should therefore likewise be interpreted in reverse.

5.3. Social network

General characteristics

The replies of the 55 respondents who answered the questionnaire revealed the existence of 238 out of 275 possible ties, corresponding to a density of 0.86; a figure close to the 1 considered to be the maximum density (86.5% of possible ties, given the design of the survey). On the other hand, the diameter of the network was 8; a high value, considering its size. However, the average path length was 3.2, meaning that, on average, information had to go through another two nodes in order to connect one pair of nodes (table 2).

Most of the 238 ties (62.2%) were established between respondents belonging to the same professional group, i.e. between nursing assistants or nurses or between doctors; an issue reflected in the position of the nodes on the social network (fig. 1 to 5). Around a quarter of ties (26.5%) were between nursing assistants and nurses or between nurses and doctors. There were only three ties between nursing assistants and doctors. Only 11.3% were ties between doctors and nurses, and between nurses and nursing assistants, with just four ties established between doctors and nursing assistants. Finally, 62 ties (26.1% of the total) were reciprocal. Most of these (40) were between nodes belonging to the same group.

Centrality

Table 3 shows the mean, maximum and minimum values obtained for the four measurements of centrality.

Table 4 includes the nodes of the social network that gave values equal to or greater than the mean for each measurement (see Appendix 3 for a list of the 55 nodes).

Table 4. Nodes on the social network with positions relevant to centrality

Informant/ node	In-degree	Informant/ node	Betweenness	Informant/ node	Closeness	Informant/ node	Eigenvector
E19	21	E19	0.19	E3	0.36	E7*	1
E7*	17	F9	0.18	F9	0.35	F9	0.9
F12*	15	A2	0.11	E2	0.35	F12*	0.8
F9	14	F8	0.11	E18	0.34	E19	0.7
E12	11	F2	0.10	E5	0.34	F21*	0.7
F16*	11	F12	0.08	E15	0.34	F16*	0.7
F21*	11	E7*	0.08	E6	0.34	E17	0.7
E17	8	F21	0.07	A5	0.33	F17*	0.6
E18	8	F5	0.07	E13	0.33	F24	0.6
F17*	8	E14	0.06	A1	0.33	F8*	0.5
F8*	8	E18	0.06	E19	0.33	F14	0.4
E16	7	F11	0.05	A4	0.33	E18	0.4
F24	7	E12	0.05	A12	0.32	E12	0.3
A5	6	F16	0.05	A2	0.32	E14	0.2
E14	6	E17	0.05	E1	0.32	E11	0.2
E11	5	E16	0.04	F16*	0.32		
E13	5	F23	0.03	E8	0.32		
A10	4	F24	0.03	A7	0.32		
A6	4	A1	0.03	F21*	0.32		
A8	4	A10	0.03	A8	0.32		
E15	4			E4	0.32		
F14	4			E7*	0.32		
F20	4			E14	0.32		

* Holding a position of responsibility.

**Values above average; the shaded 20% obtained the highest value.

a) Degree

The mean in-degree was 4.3 (nursing assistants: 2.3; nurses: 5.5; doctors: 4.5). Of the 55 nodes, 23 reached this value or a higher one, of which 11 were within 20%, with the highest in-degree (Figure 1). This latter group consisted only of nurses and doctors, with no nursing assistants. The highest in-degree (E19=21 y E7=17) was achieved by two nurses with a service record of between 11 and 15 years, with one of them holding a post of responsibility. A doctor with a post of responsibility was placed immediately below this (F12 = 15), followed by another assigned only care-related tasks on

Table 2. General characteristics of the overall social network

Number of nodes	55
Number of ties	238
Theoretical maximum density	1
Actual density	0.86
Network diameter	8
Average path length (geodetic distance)	3.2
Reciprocity	0.261

Table 3. Measurements of centrality

	Mean	Maximum	Minimum
In-degree	4.30	21.00	0
Betweenness	0.03	0.19	0
Closeness	0.03	0.33	0.27
Eigenvector	0.17	1.00	0

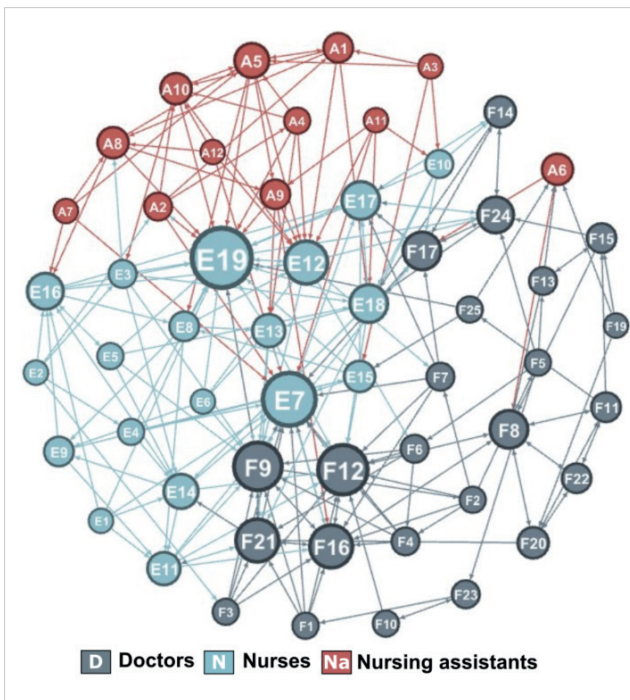


Figure 1. The overall social network, weighted according to the in-degree of its nodes

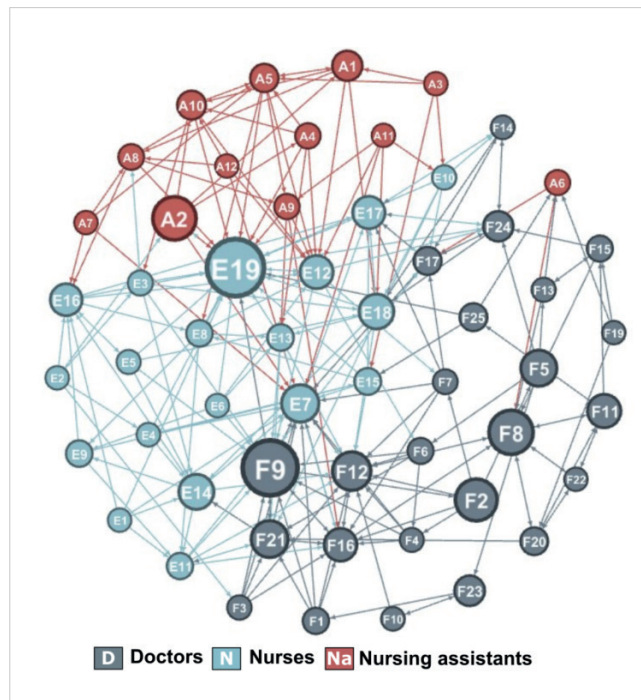


Figure 2. The overall social network, weighted according to the betweenness of its nodes

the hospital's wards (F9 = 14). Three nodes had an in-degree of 11: one nurse (E12), who was one of the longest-serving employees of the service, and two doctors (F21 and F16), each with a post of responsibility and, in the case of F21, one of the longest-serving doctors. The latter four nodes, with an in-degree of ≥ 8 , were two nurses belonging to the same unit (E17 and E18) and two doctors; one of them the unit coordinator, the other with a position of managerial responsibility (F8 and F17).

b) Betweenness

The mean betweenness value was 0.03 (nursing assistants: 0.02; nurses: 0.03; doctors: 0.04). Of the 55 nodes, 20 reached this value or a higher one, of which 11 were within 20%, with the highest betweenness (seven of them were likewise in the 20% with a higher in-degree). This latter group contained six doctors, four nurses and one nursing assistant (Figure 2). The maximum betweenness value was 0.19, which was obtained by the same nurse with the highest in-degree (E19), followed by a doctor (F9), likewise with a prominent position in the degree ranking. These were followed by a nursing assistant (A12=0.11) with fewer than five years' service and two doctors (F8=0.11 and F2=0.10). Most of the remaining nodes within the 20% of highest betweenness likewise occupied a relevant position with regard to in-degree. There were just two nodes in the betweenness ranking that did not also appear in the degree ranking: one doctor (F5) and one nurse (E-14), both of whom worked on the hospital's wards. It should be noted, in addition to the relevant betweenness positions, that 11 nodes obtained a value of zero in this respect, meaning that 11 nodes did not participate in any of the shorter paths that linked pairs of nodes on the network.

c) Closeness

The mean closeness value was 0.3 (nursing assistants: 0.31; nurses: 0.32; doctors: 0.28), with a maximum of 0.33 and a minimum of 0.27, i.e. very similar values that also denote short distances between nodes. Eleven nodes stood at 20%, with a value greater than the rest. Only three of them had already obtained a relevant position in the betweenness or degree. Furthermore, eight of the eleven were nurses and three were nursing assistants, with just one doctor in the group. We should stress, with regard to this measurement, that the low-value nodes correspond to six doctors and one nursing assistant (F10, F23, F19, F22, F15, A6, and particularly F13). They appear at peripheral locations in the graphic representation of the social network (Figure 3). Furthermore, all of them worked in the outpatients' department.

d) Eigenvector

The mean eigenvector value was 0.2 (nursing assistants: 0.01; nurses: 0.2; doctors: 0.2). Of the 55 nodes, 15 reached this value or a higher one, of which 12 were within 20%, with the highest in-degree (fig. 4). All of the above were nurses or doctors; none were nursing assistants. Most of the nodes highlighted on the basis of this measurement also stood out with respect to the previous measurement of centrality (except for nodes F14 and F24). Furthermore, six of the twelve most relevant individuals in this case also held posts of responsibility. In this sense, the highest eigenvector was obtained by a node (E7 = 1) that had already obtained higher values in terms of degree and betweenness. It corresponds to a nurse with a coordinating role in their professional group. It is also worth noting that 33 nodes on the network (60% of the total) obtained a value of zero in this respect (Figure 4).

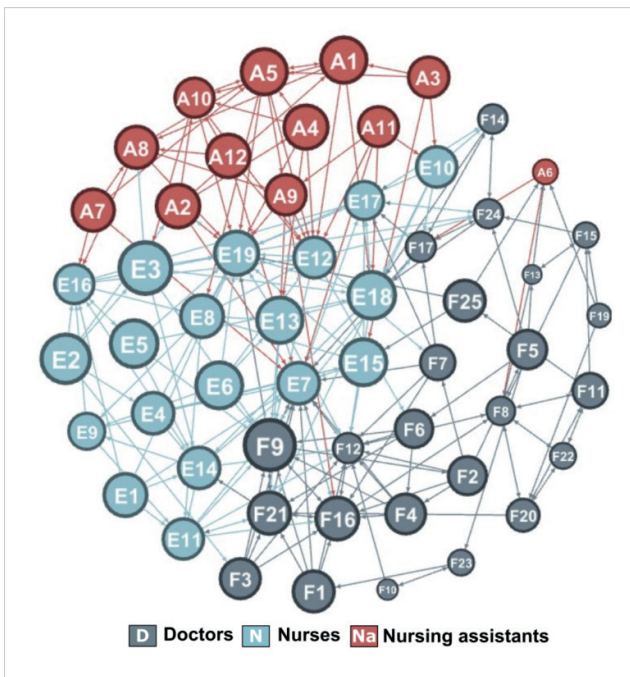


Figure 3. The overall social network, weighted according to the closeness of its nodes

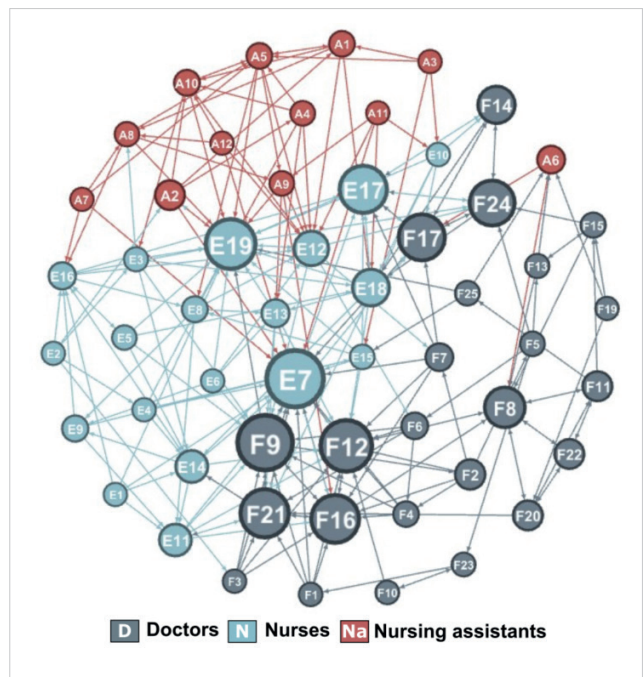


Figure 4. The overall social network, weighted according to the eigenvector of its nodes

Based on the previous four measurements, the nodes present in the most relevant group (the top 20%) that figured in at least three of those measurements (i.e. the most central within the context of this research, highlighted in the table in Appendix 2) totalled seven. Four of these (F8, F9, F12 and F21) were doctors, of whom three held some position of responsibility, along with three nurses (E7, E18 and E19), one with a post of responsibility. It should also be noted that two nurses and one doctor (E18, E19 and F19) achieved relevant degrees of centrality (in the highest 20%) in the four measurements, without occupying any position of responsibility in the department's organisation chart.

Modularity: groups on the social network

Figure 5 shows the department's social network. It makes a distinction between the five groups identified through modularity analysis.

Firstly, group 1 was the largest, consisting of ten nursing assistants and five nurses, all from the hospital's wards; with no doctors. One member of the group (E19) was one of the most-central nodes on the network.

Group 2 consisted of 14 nodes. All but one of them (E7) were doctors employed exclusively or partly on the hospital's wards. The doctors included one of the service's managers, and four members stood out for their centrality on the network (E7, F9, F12, F21).

Group 3 consisted of ten nurses employed on the hospital's wards, with no doctors or nursing assistants. None of them had a degree centrality in the top 20%.

Group 4 consisted of nine doctors and one nursing assistant, employed almost exclusively in the outpatients' department. Only one node (F8) stood out in terms of at least three measures of centrality.

Finally, group 5, with seven nodes, was the only one made up of representatives of the three professional groups: doctors, nurses and nursing assistants. All the doctors were part of the same healthcare unit, as were two of the nurses. The third nurse also performed treatment-related tasks in this unit on occasions. Just one node (E18) was among the most prominent in terms of centrality.

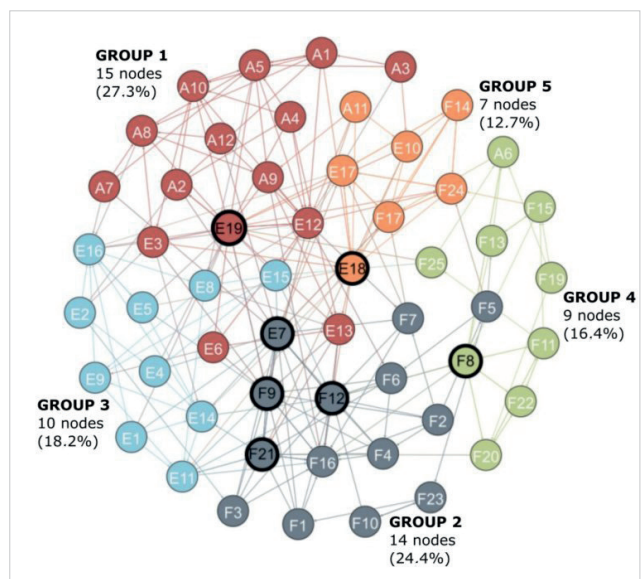


Fig. 5. The overall social network of the department, based on the group to which its nodes belong (the seven most-central nodes are outlined in black)

6. Discussion

The objective of this research was to study the collaborative information behaviour (CIB) of the members of the clinical service of a hospital organised around patient care and the treatment of medical conditions. For this organisation to be effective, collaboration is necessary wherever there are flows of information between interprofessional teams. In this sense, the results showed an information culture (IC) conducive to this in five of the six dimensions. Nevertheless, some specific aspects of these five dimensions showed room for improvement.

In first place, although the service's IC was generally characterised by its integrity, the fact that some respondents perceived an incomplete use of information is something that could harm the climate of trust necessary for its effective use, and even affect the dimensions of formality and transparency (Marchand; Kettinger; Rollins, 2002). Despite this, the dimension of formality stood out for being favourable to this effective use of information, as stated by Marchand, Kettinger and Rollins (2002), since the preferential use of formal sources is a desirable value. It is to be hoped that organisations will go to informal channels of information to verify the reliability of formal information, or to complement the formal information available.

“ The dimension that characterised information culture the least was control ”

Transparency was likewise a value that contributed to an IC favourable to the effective use of information. We should however not forget that some respondents did not perceive this integrity in relation, for example, to the existence of a climate of openness towards the exchange of information regarding mistakes made at work. This aspect of the model of Marchand, Kettinger and Rollins (2002) signifies a difficulty for collective learning, and it is a result that Choo *et al.* (2008) attributed to the predominance of a competitive environment. In our case, it could be due to the consolidation process in which the staff members were immersed and/or a fear of being questioned. It is in any case an aspect that would need more research, given that it can be more problematic in health organisations due to the important impact that it may have on patients' health (Stevens; Hulme; Salmon, 2021; Gordo *et al.*, 2021). In similar studies carried out in a health context, it is indeed a feature that undoubtedly characterises the culture of the organisation concerned (Nordsteien; Bystrom, 2018).

On the other hand, the exchange of information and proactivity were also favourable for an effective use of information. Regarding the exchange of information with colleagues in the service, results are consistent with the information-handling habits of medical staff (Younger, 2010). However, the lack of communication beyond the service itself should be addressed, as it runs counter to what is expected of an organisation with an interprofessional and interorganisational structure that favours free flows of information. One danger arising from such habits might be a loss of external information relevant to job performance, in a group whose very cohesion could turn it into a small world isolated from its surroundings (Kadushin, 2013). The proactive use of information was the dimension best perceived by respondents in all its aspects.

Finally, the dimension of control was the only one of the six that would not fully characterise the IC of the service. According to Marchand, Kettinger and Rollins (2002), it is a result that might harm the organisation, as performance can only be improved if you know what situation you are in, as well as knowing the role that it plays in fulfilling the collective mission. It might also hinder collaborative work, as ignorance of the results obtained would prevent job performance being adapted to the achievement of the entire team's shared mission.

If the various dimensions of the information orientation model allow the organisation to be characterised in terms of its IC, SNA completes this impression by identifying established flows of information. The general characteristics of the social network thus revealed favourable aspects of a well-connected group, such as high density and short average path length, in comparison to previous studies of similar networks (Chan *et al.*, 2017). The network's diameter was relatively large for its size however, indicating the relative isolation of some of its nodes.

On the other hand, analysis of the ties between the nodes of the social network revealed two significant factors. The first was the phenomenon of homophily, or the tendency to establish ties between similar nodes on a network (Kadushin, 2013). This was reflected in the direction of these ties, which in most cases were established among equals. This is shown in the graphic representation of the network, where the three groups of well-differentiated professionals appeared and, finally, in the configuration of four of the five groups identified in the study of modularity and consisting of a single group of professionals. This phenomenon has already been documented in a healthcare setting (Cunningham *et al.*, 2012; Bae *et al.*, 2015). The opinion of Blacklock *et al.* (2022) is that it could create barriers in hospitals, along with silos of information and redundant information, among certain groups of employees, while also giving rise to different norms and values conditioned by the individuals with influence in that group. There is however also documented research showing an absence of this homophily (Shoham *et al.*, 2016; Schweighoffer; Reeves; Liebig, 2020); a phenomenon generally attributed to the interprofessional nature of the groups observed. Conversely, it could be deduced that in our case there is no necessary fluidity of communication among doctors, nurses and nursing assistants, which would go against

“ The absence of truly interprofessional work is corroborated by observing the reciprocity of ties ”

the notion of proper CIB. Indeed, only one of the groups identified in terms of modularity (group 5) was made up of actors from the three professional groups; a reflection of the fact that there is a truly interprofessional work dynamic in this group, which favours the multidirectional exchange of information. In opinion of **Bae et al.** (2015), this would be the ideal model; unlike the rest of the groups made up solely of staff from one of the three collectives.

“ Most of the actors with the best centrality scores are rated for their in-degree and betweenness ”

The absence of truly interprofessional work is corroborated by observing the reciprocity of ties, where low reciprocity (26.1%) could be evidence of a hierarchical structure, in the opinion of **Borgatti, Everett and Johnson** (2018). In this way, and from a functional point of view, the attention of the service focuses on groups of related pathologies, although the homophily and reciprocity data indicate that structures were maintained in which work was organised by professional category. This fact could translate into bottom-up information flows, and not those based on the achieving of common goals regardless of status. This is a pattern of information exchange that **Wahn** (1987) observed in highly hierarchical work teams in the health sector, where the doctor decided what was to be done and the other health professionals did it.

Along with the characteristics of the network and the relationship between its nodes, the centrality measurement allowed us to identify the most prominent or visible service employees from the point of view of information flows. In this way, those with the best centrality scores were, on the one hand, people with roles of responsibility; a situation already documented in similar studies (**Martínez-Ariño; Salas-Torrent, 2009; Patterson et al., 2013**), reflecting the formal structure of management or its organisation chart. On the other hand however, it was also possible to identify people who, while not assuming positions of responsibility, had an advantageous position in the social network being studied. In this case, their respective positions did not respond to their positions in the formal organisation chart. This might be attributable to their seniority, as stated by **Naccarella** (2009), or to some personal characteristic such as accessibility, empathy or professionalism. In any case, and from the point of view of structuring a proper CIB, making these employees visible would allow us to organise truly collaborative work among peers. Furthermore, actors with higher centrality scores can be attributed key roles in creating resilient organisations, as highlighted by **Bertoni, Saurin and Fogliatto** (2022).

On the other hand, most of the actors with the best centrality scores are rated for their in-degree and betweenness, characteristics submitted to them thanks to their linking role at the information level on the workplace social network, with a capacity to intervene in and even control a large part of the information that circulates on the network, as well as to connect the three professional groups. This is especially significant in the case of nursing staff (an aspect already documented in similar studies), where they go so far as to assume the role of a bridge between patients and relatives (**Creswick; Westbrook; Braithwaite, 2009; Martínez-Ariño; Salas-Torrent, 2009; Patterson et al., 2013; Shoham et al., 2016**). In short, and as stated by **Long, Cunningham and Braithwaite** (2013), a dense, cohesive network with intermediaries between groups is the ideal structure for the transmission of information. We should however not forget that an excessive dependence on such actors can lead to the group being isolated from other groups in their absence.

Finally, we come to the other side of the coin with regard to these central actors, where two instances of isolation were identified; an issue that was already evident at a general level when determining the diameter of the social network. The first was the situation in which the members of a unit were physically separated from other teams. In this sense, analysis of closeness highlighted the most isolated nodes corresponding to a specific group (group 4). The results are thus in line with what **Heng, McGeorge and Loosemore** (2005) previously pointed out, in the sense that the geographical distance of a group of actors belonging to the same network seemed to influence their lack of communication, in this case the physical distance between the outpatients' department and the hospital's wards. The second instance of isolation was seen in the low centrality scores, on all counts, of the nursing assistants. This was not surprising, as they were the respondents least referred to as reference names when requesting information. This situation could be evidence of a potential loss of circulating information on part of the social network, which is in line with the hierarchical way of working and the structure described above.

We could therefore say, on the whole, that the hospital service studied had a series of conditions that favoured collaborative work. These were, at the IC level, proactivity, formality, information exchange, transparency and integrity and, at the social network level, high density and connectivity. There were however other characteristics that reflected factors likely to hinder such collaborative work: in relation to the IC, the control dimension and, specifically, the fact that there is no perception of easy access to the information generated within the hospital. From the point of view of the social network, the phenomenon of homophily and the low reciprocity of relationships pointed to a hierarchical structure that would not favour information flows among professionals or between organisational units.

Despite having been able to identify both the strengths and weaknesses of this organisation in relation to its CIB, there are limitations (as in any research). We should emphasise in this respect that despite having reached a high response rate, we must not forget the 15.4% who did not participate and who, if they had, might possibly

“ The organisation of the service studied is the result of a series of strategic and political mandates to configure patient-centred care on the basis of collaborative work ”

have changed the results significantly, taking into account also that the sample population was so small. Any reading of the results should therefore consider that there is a proportion of potential respondents whose perception of the values and practices that constitute the service's IC is unknown. We also do not know what role, if any, they would assume in the network of information exchange relationships, as their participation is not reflected. There are likewise other complementary analyses that could have enriched the results presented here, such as of the relationship between the IC and the network of information exchange relationships, or the exploitation of other variables, like the gender of respondents and its impact on both aspects of CIB. These are issues which, together with research into other dimensions of the IC and the inclusion of other social network measurements, constitute lines of work to be addressed in the future.

7. Conclusion

The organisation of the service studied is the result of a series of strategic and political mandates to configure patient-centred care on the basis of collaborative work. In practice, most of the observed factors favour this; but there are others that do not. We therefore need to adopt a critical perspective and analyse those factors that interrupt flows of information, or which are likely to do so in the future. In this sense, it is paradoxical that it is the control dimension that least characterises the information culture (IC). It is at management level that strategy and policy are implemented, but also management that should supply information regarding the organisation's functioning and results. But this is not what happens, or at least the respondents do not perceive it. Furthermore, although facilities have been provided to allow people to collaborate at an organisational level, the results mostly reveal a hierarchical structure run by certain collectives. There is also a small proportion of people who are suspicious of a full use of information, preferring to use informal sources. They do not perceive a climate of openness and trust, and there is generally no communication beyond the department. These are aspects which, despite some of them being minority issues, can ultimately hinder quality healthcare. They therefore need to be addressed, so that the strategic lines and practices of the work teams are in tune with each other.

Beyond the bounds of practice, studying IC on the basis of the information orientation model and the exchange of information with SNA methodology has allowed us to identify intangible aspects of an organisation that give rise to an inadequate collaborative information behaviour (CIB), in a context that requires teamwork and, to a large extent, shared decisions. Integrating these two approaches, initially from two different areas, proves beneficial when addressing research-related problems in a third area: the study of CIB in a specific area, in this case a hospital service. There is thus useful tool for any organisation whose objective is to promote collaborative work. It works by identifying strengths, as well as the weaknesses that must be addressed to create them. It therefore provides a useful theoretical and methodological framework for observing organisations which, even if they do configure their structure to achieve this collaboration, contain members who continue to adopt habits of communication that are more in line with the hierarchical structures of the past than with this new configuration.

“ The centrality measurement allowed us to identify the most prominent or visible service employees from the point of view of information flows ”

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9. Appendixes

Appendix 1. Questionnaire on information culture

Each item was assessed on a scale of 1 (totally disagree) to 5 (totally agree).

Integrity
1. The strong integrity of the people I work with allows sensitive information to be shared.
2. People at my place of work often knowingly supply inaccurate information to their superiors or colleagues.
3. It is common among the people I work with to provide information to justify or legitimise decisions only after they have been made.
4. Among the people I work with, it is normal for them to keep information for themselves.
5. It is common among the people I work with to take advantage of information for personal benefit.
Informality
6. I trust informal sources of information (e.g. colleagues) more than formal ones (such as reports, memos, specialist texts etc.)
7. I use informal sources of information even when formal sources exist and are credible.
8. I use informal sources of information to verify and improve the quality of formal ones.
9. I trust the quality of formal information, and do not need to rely on informal sources.
Control
10. I receive information periodically on the operation of, and results achieved by, the hospital and my department.
11. I use the information I obtain about performance and results to improve my own work.
12. Information is so widely dispersed around the hospital that it is difficult to know the processes involved and who carries them out.
13. The staff of the hospital and the department know what to do, but are unaware of the ultimate goal and the significance of their activity.
Transparency
14. A climate of openness and trust is fostered in the hospital and my department for the exchange of information on possible errors affecting workplace performance.
15. The people I work with regularly openly share information about possible errors affecting workplace performance.
16. The people I normally work with use information about errors or mistakes to address problems constructively.
The exchange of information
17. I often exchange information with the people I work with.
18. I often exchange information with employees of other departments.
19. I often exchange information with colleagues from other hospitals or health centres.
Proactivity
20. I go outside the hospital services and departments to actively seek out relevant information on changes and trends related to my work.
21. I use information to respond to changes and new developments relating to my work.
22. I use information to improve patient care in particular and my work in general.

Appendix 2. Characteristics of informants

		Nursing assistants	Nurses	Doctors	Total	%
Gender	M	1	6	11	18	32,7
	F	11	13	13	37	67,3
	Total	12	19	24	55	100
Age	<25	1		1	2	3,6
	26-35		2	10	12	21,8
	36-45	5	3	3	11	20,0
	46-55	5	9	7	21	38,2
	56-65	1	5	3	9	16,4
	Total	12	19	24	55	100
Highest degree earned	Degree/Diploma	12	18		30	54,5
	Bachelor's degree		1	15	16	29,1
	Doctorate			9	9	16,4
	Total	12	19	24	55	100
Professional experience (years)	0-5	1		7	8	14,5
	6-10	2	2	4	8	14,5
	11-15	1	2		3	5,5
	16-20	4	2	4	10	18,2
	21-25	1	4	6	11	20,0
	26-30	2	5		7	12,7
	31+	1	4	3	8	14,5
	Total	12	19	24	55	100

		Nursing assistants	Nurses	Doctors	Total	%
Years in the service	0-5	5	6	8	19	34,5
	6-10	4	6	6	16	29,1
	11-15	3	6	1	10	18,2
	16-20			5	5	9,1
	21-25			2	2	3,6
	26-30		1		1	1,8
	31+			2	2	3,6
	Total		12	19	24	55

Appendix 3. Centrality and group of the 55 nodes

	Node/informant in the top 20% of at least 3 centrality measures.
	Node/informant in the top 20%.
	Node/reporter with a score equal to or above the mean
*	Node / informant holding a position of responsibility.

Informant/Node	In-degree	Betweenness	Closeness	Eigenvector	Group
A1	3	0,03	0,33	0	1
A2	2	0,11	0,32	0	1
A3	0	0	0,31	0	1
A4	1	0,01	0,33	0	1
A5	6	0,02	0,33	0	1
A6	4	0	0,25	0,1	4
A7	0	0	0,32	0	1
A8	4	0,01	0,32	0	1
A9	3	0,01	0,31	0	1
A10	4	0,03	0,31	0	1
A11	0	0	0,31	0	5
A12	0	0	0,32	0	1
E1	0	0	0,32	0	3
E2	0	0	0,35	0	3
E3	2	0	0,36	0	1
E4	1	0	0,32	0	3
E5	1	0	0,34	0	3
E6	0	0	0,34	0	1
E7*	17	0,08	0,32	1	2
E8	3	0,01	0,32	0	3
E9	3	0	0,29	0	3
E10	2	0	0,31	0	5
E11	5	0,01	0,31	0,2	3
E12	11	0,05	0,31	0,3	1
E13	5	0,01	0,33	0,1	1
E14	6	0,06	0,32	0,2	3
E15	4	0,01	0,34	0	3
E16	7	0,04	0,31	0,1	3
E17	8	0,05	0,3	0,7	5
E18	8	0,06	0,34	0,4	5
E19	21	0,19	0,33	0,7	1

Informant/Node	In-degree	Betweenness	Closeness	Eigenvector	Group
F1	1	0,01	0,31	0	2
F2	1	0,1	0,3	0,2	2
F3	1	0	0,31	0	2
F4	2	0	0,31	0	2
F5	1	0,07	0,3	0	2
F6	2	0,01	0,3	0	2
F7	2	0	0,29	0	2
F8*	8	0,11	0,26	0,5	4
F9	14	0,18	0,35	0,9	2
F10	1	0	0,23	0	2
F11	3	0,05	0,29	0,1	4
F12*	15	0,08	0,27	0,8	2
F13	2	0	0,22	0	4
F14	4	0	0,26	0,4	5
F15	3	0,01	0,25	0	4
F16*	11	0,05	0,32	0,7	2
F17*	8	0,02	0,27	0,6	5
F19*	0	0	0,24	0	4
F20*	4	0,02	0,28	0,1	4
F21*	11	0,07	0,32	0,7	2
F22	3	0	0,25	0,1	4
F23	2	0,03	0,25	0	2
F24	7	0,03	0,26	0,6	5
F25*	1	0,02	0,31	0	4

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