Getting Around Regional Inequalities: Solidary Cooperation of the Health Professionals Relationship Network

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Abstract

Context The Brazilian Health Care Program is formed by a complex network of public and private services that often complement each other, especially in the area of qualified Human Resources for Health (HRH). Due to social inequalities, the shortage of qualified HRH in remote regions is a reality in Brazil. The workforce imbalance associated with the socioeconomic inequality of the population in these regions reduces the access to these health maintenance services. Given this reality, this research aimed to explore and analyze the cooperation network of health professionals, a strategy used to alleviate the problems of care through social inequality, in a district of the Amazon region far from the great centers.

Method A questionnaire was answered by doctors, dentists, physiotherapists and occupational therapists in the district of Rondon do Pará (Brazil). The collected data were dichotomized and analyzed using the Social Network Analysis technique using the Ucinet software.

Results By means of the figures of the network of related players, it was found that cooperation between health professionals occurs in the exercise of the profession, with many strong and essential relationships for the existence of the network as well as the essential and centralized participation of medical professionals, as it reveals strong cooperative relationships with all network professionals, even if some are not reciprocal or are weak, such as relationships between physiotherapists, occupational therapists and dentists, even playing important relationship roles.

Conclusions The results indicate that there is a network of health professionals cooperating in solidarity in the district of Rondon do Pará, Brazilian Amazon region. In face of difficulties in working in the profession and social inequalities, the research participants follow the principle of solidarity, cooperating with information among professional colleagues to serve the population of the district. Besides the existence of the cooperation network, being the doctors the key professionals for its execution, the collected data indicated the main difficulties faced as the lack of: opportunity for professional improvement, infrastructure to perform the work, technical support in equipment maintenance, supplies and support for people with special needs.

Background

The Brazilian Health Care Program is formed by a complex network of public and private services that often complement each other, especially in the area of qualified Human Resources for Health (HRH) [1].

The workforce shortage in the health area in remote regions is a reality in Brazil given the social inequalities, especially in the states that make up the Amazon region. In the northern region of the country, located in the Amazon complex, the difficulties are numerous in the performance of health services due to the diversity existing in the states.

Compared to the other regions, inequalities in the cities of the northern region are represented by low Human Development Index-HDI, insufficient health service network and establishment of trained health professionals [2].

The qualification and distribution of health care professionals to meet the population's demand are considered critical points for the guarantee of a health system with excellence standards [2] and in view of that, the

Brazilian federal government has made efforts to bring health professionals to regions considered distant from the major centers and capitals.

However, the difficulty of allocating these professionals in remote areas persists in most cities far from urban centers, as the distribution of health professionals is often not performed in a socially appropriate manner.

Health services that require greater complexity are treated only in the capital cities of the states, a fact that punishes the population upon the vulnerability of people with low purchasing power living in remote areas.

As for the Brazilian federal government, several deficit factors do not serve the population in these areas, starting with the financial transfers compared to the national average and the sanitary infrastructure, which is not adequate to the needs and demands of the people of the region. The government has created several programs to minimize the problem, mainly due to the shortage of medical professionals [3]. The political interventions addressing the issue of the shortage of health professionals in relation to geographic availability and accessibility are: Projeto Rondon, Telessaúde, Pró-residência, Fies, Provab and Programa mais médicos [1].

In Brazil, the health care program is organized by the public segment of the Federal Program of the Single Health System—SUS, which provides free assistance to all Brazilian citizens in the 5,564 municipalities of the country, and through the private segment, which is restricted to those who are financially able to enjoy this type of service [4].

In the last 50 years, there has been a growth in the medical population in the country; however, this increase in the number of health professionals cannot meet the demands of the most remote regions [5]. “In 2013, Brazil had about 400,000 doctors, corresponding to a rate of approximately two doctors per thousand inhabitants” [5].

In 2019, according to data provided by the Federal Council of Medicine [6], the country has 514,196 doctors in good standing working in all states. The largest medical population is centered in the Southeast region of the country with 276,686 professionals, representing 54% of these professionals.

The northern region, which is part of the Amazon complex, has the lowest number of doctors with 22,884 professionals, representing only 5% of the total doctors in the country.

The distribution of medical professionals in the northern region is organized among the states as follows: Acre with 1,010, Amazonas with 5,164, Amapá with 954, Rondônia with 2,940, Roraima with 913, Tocantins with 2,940 and Pará with 8,963 medical professionals.

In the state of Pará, the supply of 8,963 doctors (approximately 1.6% of the total doctors in the country) to serve around 8,513,497 inhabitants, according to information registered by the government agency Brazilian Institute of Geography and Statistics - IBGE [7]. According to data on the number of inhabitants and professionals, figures indicate that there is one doctor for every 1,000 inhabitants approximately.

In the case of dental surgeons, the Federal Council of Dentistry [8] presents the following numbers for the states: Acre with 866, Amazonas with 4,655, Amapá with 1,041, Rondônia with 2,362, Roraima with 875, Tocantins with 2,256 and Pará with 5,759 dental surgeon professionals. Considering the quantity of inhabitants in Pará, the state has 1 dental professional for approximately 1,500 inhabitants.

Due to the inequalities in the regions, public agencies are prone to create strategic actions for companies and professionals to operate in peculiar markets, "Such strategies imply the reinvention of behaviors that go beyond economic limits, in which social aspects strictly linked to personal and professional values are intertwined in the process regulatory norms" [9].

When considering the health care relationship network, the network is an alternative that can be decisive in the coordinated actions of various services and sectors through the empirical observation of life maintenance. Connected supporters can be considered life support and care networks in the primary care (initial care or simple cases), secondary care (ambulatories and hospital) and tertiary care (more complex care) networks, which are integrated into health services care and actions at their different levels [10].

The network of integrated and regionalized services is formed by the premises of primary health care for the population with multiprofessionals who have the common objectives of sanitary and economic interest [11]. One of the important points of the network is the articulation to reduce risks and share resources to obtain expertise and information.

The Pan American Health Organization [12] points out that "the proliferation of networks shows that this sector has advanced towards freedom, diversity and the sharing of common goals, without losing identity differences".

Given this reality in the Amazon complex, the few professionals working in these areas face various difficulties and, through the professional relationship network, they seek information and knowledge that add value to their work activities.

The workforce of networked medical professionals can be a practical outlet to meet the demand for health maintenance services through flexibility and connectivity for using shared communication as a growth strategy, thus transforming individual development into collective development.

Research from the perspective of the social network is important for academia since there is no research addressing the solidarity cooperation between health promotion professionals, supported by a network of doctors, dentists, physiotherapists and occupational therapists who share the same demands, difficulties and prospects around benefiting the local population.

Given these findings, the following question arises: How health professionals in the city of Rondon do Pará, a district located in the Amazon region, far from great centers, form a social network, and generate cooperative behavior in the face of diversity and difficulties for performance of the health profession in serving the population.

The purpose of this research is to explore and analyze the cooperative behavior network among these professionals, as well as to know the difficulties faced in the exercise of the function in this region considered

a region that lacks infrastructure, located in the heart of the Amazon complex, very difficult to access, due to local adversities.

- Social or Interorganizational Networks in the form of Cooperative Behavior Network

The people or organizations that participate in a network are willing to socialize activities among the players and are intended to share information and knowledge through interactions [13]. According to the authors, acting in the network fosters trust, commitment and integration regarding the exchange of experiences and skills.

“The exchange of ideas, opinions and beliefs provided by conversations enables the first and most important step towards knowledge creation: The sharing of tacit knowledge within the network community” [14].

Relationship networks are understood as interorganizational strategies that go beyond the economic limits of social aspects related to personal and professional values. Network studies can happen through their form or content, studied through the connections between people, informal groups or organizations in their forms of relationship intensity and engagement measures, through content with their relationship measures and documents and reports made, and may be of social, economic or friendship and kinship, as well as of status and politics among others [15].

Existing interorganizational cooperation is increasingly considered as the development strategy process, especially in education and health organizations, which are motivated by essential knowledge to health promotion and quality services [9]. Noting that professionals who work in this perspective deal with the life, death, well-being and suffering of the individual, as well as of the population in general.

“Health promotion and training needs require mobilization and interrelation with various social partners in order to respond to community problems with quality” [9].

Relationship networking through its members’ social networks could better manage available resources such as capital and political influence [16], the intensity of social ties can allow free sharing of information and knowledge through mutual learning and innovation [17].

- Social Network Analysis

The study of the network is related to the understanding of the relationship of the players or individuals as well as their attributes, aiming to understand how the players are related to each other and how these relationship activities act in the contribution of a social life[18].

The network presents the structure through the factors: *Us* (companies and activities), *positions and links* (division of labor) and *flows of goods and information* [19].

The relationships stories with other individuals or social groups and their cultures result from their own social identity [20], where the set of interpersonal relationships are constituted by the social network of people inserted in a relational context [18].

Network analysis can be defined as an instrument of social analysis [21] and behaves as an inductive instrument of social investigation of relationships between players for the systematic measurement of the links [22].

The relations between the network members are characterized by ties that are connected to the players of the inserted network, as well as the degree of intensity through mutual commitment and reciprocity through conditions of *being bidirectional or not* (when flowing on both sides) [23]. Ties can be attributed to existing bonds and can be multiple from this player's involvement with various other players or through intense or weak relationships depending on the involvement [24]. Connectivity or the ability to interconnect individuals is directly dependent on the frequency of communication between the players [25].

For this research were used the players' attributions regarding the ties (relations, links, connections) between them, as the measures of:

- *Density*: Which is the ratio between the number of relationships in the network versus the number of relationships possible. This metric deals with the number of existing interrelations by increasing or decreasing the density of relationships within the social network. This measure results from the exchange of information and resources and a closed system of trust and shared standards in the social network. The network acts as interactions between the players involved through common interests for the purpose of exchanging knowledge and mutual cooperation [26]. "From the degree, it is possible to understand the general functioning of the network, specifically in relation to the performance of each player, by analyzing their relationships with other players" because the greater the number of links, the greater the ability to influence other players in the network [27].

- *Reciprocity*: Which is the ratio of the amount of reciprocal relationships versus the number of network relationships. Reciprocity is represented by the number of two-way connections divided by the number of connections, that is, which professionals are reciprocal in cooperative health relations. Reciprocal ties must be linked to a relationship of agreement between the players for knowledge exchange [28].

- *Betweenness*: Intermediate players may have some control over the interactions of non-adjacent players. Intermediation "represents how much a player acts as a bridge, facilitating the flow of information in a given network" and this intermediation is based on the interaction between two non-adjacent authors [29].

- *Degree - indegree and outdegree*: Which is the ratio of the amount of connections that each player has (i.e. how many professionals cooperate with such player). This measure is based on the number of links or ties that exists between the network players. The degree metric indicates how many links or ties are presented in the network between the players and respectively how many links each player presents according to the demand or supply of relationships [22, 23].

“The greater the number of bonds (ties) of a player, the greater their degree, which indicates a more favored position, a position that exchanges more information and, thus, with greater influence on the network” [27]. The degree metric can be classified as *indegree* and *outdegree* and differ in the sense of the relation to demand or to offer information exchange. For example, in the *indegree* classification, player X has an indication of how many professionals he cooperates with professionally and in the case of *outdegree*, how many professionals cooperate with him.

- *Core-periphery*: Indicates which players belong to the center of the network, i.e., cooperate more (*core*) and which players cooperate less, that is, are in the periphery of the network (*periphery*).. In order to understand the cohesion of the network, the formation of groups and the strength of ties/relationships of the players, the center-periphery metric is used to identify the center and the periphery of the network, thus contributing to the understanding of the grouping of players [30]. The cores can be presented as a space of concentration of several links, in which the players are strongly connected to each other and, in contrast to the peripheries, are characterized by few relationships, in which the players are little related, that is, they cooperate less among them which indicates less cohesive subgroup formation [27].

Methods

This study was submitted and approved by an Ethics Committee and the respondents signed the Informed Consent Form.

The study was geographically delimited to the district of Rondon do Pará, located in the state of Pará, Amazon region, with approximately 50,000 inhabitants [7] and to health professionals, exclusively doctors, dentists, physiotherapists and occupational therapists working in the city both in the free health care program and privately in their offices.

Health professionals work in public hospitals and private practice offices in the municipality and in smaller neighboring cities, in an attempt to meet the population's demand for health.

Due to the fact that the researched district is located in a region of difficult access with poorly maintained roads in the Amazon complex, the professionals allocated in the region suffer from the difficulty and distance from the great centers, which is why the research sought to identify the degree of cooperation and solidarity of health professionals through a relationship network for the exchange of information and knowledge about health.

In 2018, the city of Rondon do Pará had 36 health professionals, including doctors, dentists, physiotherapists and occupational therapists, of whom 30 professionals, 83% of the total, agreed to participate in the study, in accordance with the ethics committee standards and were interviewed in person from April to September 2018, by signing the Informed Consent Form—TCLE.

For data collection, semi-structured questionnaires with closed questions and a field were used so that the interviewees could report the main difficulties encountered in practicing the profession and serving the population, contributing qualitatively to the research.

The questionnaire was divided into two sections, the first one was the characterization of the respondent and opinion about the main difficulties faced in the exercise of the profession, and the second section with the selection of professionals who cooperate in the performance of their function, through a list of the participants with the names of all professionals working in the district regarding medical, dental, occupational therapist and physical therapy services

Participants received a spreadsheet with the names of all professionals working in the municipality (as doctors, dentists, physiotherapists and occupational therapists) in which each professional had the option of marking each member. For the beginning of data processing, the results were dichotomized with a value of one (1) for the existence of the cooperation relationship and zero (0) for the absence of the cooperation relationship.

In order to guarantee freedom of response to the participants, the questionnaires were delivered by the agents hired and accompanied by the researchers, with explanations, and sufficient time was allowed for the participant to respond with calm and later returned to the researcher. The data were analyzed without the identification of the professional, aiming to characterize the difficulties that may occur in any city in Brazil far from the great centers.

30 questionnaires were collected and in the operationalization of the data, the *UCINET 6.0 software* was used to handle the data from a square matrix of players, relating people and attributes.

Through the said literature, the guiding question of the research was: *From your experiences regarding cooperation in the exercise of the activity, mark with "X" the professionals who cooperate in some way with you.*

The characterization questions of the respondents included: Age, gender, length of experience, performance in the public or private network and maximum title. In addition to personal data, data were collected regarding the main difficulties encountered by professionals.

Results-discussion

The health professional participants, called players, were identified by letters and numbers to protect the confidentiality of the information and to identify the health specialties of each participant. All the data analyzed were based on the question: From your experiences regarding cooperation in the exercise of the activity, mark with an "X" the professionals who cooperate in some way with you. The results of the characterization of the respondents are presented in table 1.

Table 1: Characterization of Health Professional Respondents

11 Doctors	Female: 4 professionals
	Male: 7 professionals
	Up to 5 years of experience: 4 professionals
	6 to 10 years of experience: 2 professionals
	11 to 20 years of experience: 1 professional
	Over 20 years of experience: 4 professionals
<hr/>	
16 Dentists	Female: 9 professionals
	Male: 7 professionals
	Up to 5 years of experience: 4 professionals
	6 to 10 years of experience: 7 professionals
	11 to 20 years of experience: 5 professionals
	With Specialization: 15 professionals
<hr/>	
2 Physiotherapists	Female: 1 professional
	Male: 1 professional
	Up to 5 years of experience: 1 professional
	Over 20 years of experience: 1 professional
	With Specialization: 2 professionals
<hr/>	
1 Occupational Therapist	Female: 1 professional
	11 to 20 years of experience: 1 professional
	With Specialization: 1 professional
<hr/>	
Source: Field Research (2018)	

The survey was answered by 30 health professionals, 16 dentists (53.3%), 11 doctors (36.7%), 2 physiotherapists (6.6%) and 1 occupational therapist (3.3%). Regarding gender, there is an equalization, as 50% of respondents are female and 50% male. Experience time shows that 9 professionals have practiced the profession for up to 5 years, 9 professionals from 6 to 10 years, 6 professionals from 11 to 20 years and 5 professionals over 20 years. Regarding the academic title, 26 professionals have specialization and only 1 has master's degree.

Participants had the opportunity to mention up to 5 aspects referring to the main difficulties of these health professionals to work in this region chosen for the development of their work, as shown in table 2:

Table 2: Main difficulties reported by health professionals

Major difficulties for the professionals	39% of respondents reported the lack of opportunity to professionally develop in health.
	36% of respondents reported the lack of infrastructure for the performance of the work.
	33% of respondents reported the lack of technical support for equipment maintenance and material supply
Other difficulties reported	Lack of specialized training in various areas of health
	Lack of support and hospital structure of secondary, tertiary and ICU level
	Lack of professional health support for people with special disabilities
Source: Field Research (2018)	

With 39% of the attributes listed by professionals with lack of specialization in health, mainly due to the fact that they are 130 km from the reference city, the roads have poor traffic conditions, restricting professionals to seek specializations in the area. The attribute with the highest complaint percentage is due to the difficulty of professional updating and specialization.

With 36%, the lack of infrastructure reflects the quality of the work performed by these professionals, as well as the lack of health equipment maintenance professionals, as well as material suppliers in this area that represents 33% of complaints, making it difficult to speed patient treatment through diagnostic mechanisms and equipment.

Other difficulties were reported by respondents such as the lack of specialists in various health areas, more complex hospital support, as well as ICU care for severe cases and health care professionals for people with special needs.

Regarding the cooperation network and information sharing of health professionals, the results are shown in figure 1.

Figure 1: Cooperation network of health professionals

Source: Field Research (2018). *Note:* Health professionals from the Rondon do Pará district (Amazon complex) were invited to identify other health professionals who cooperate in the exercise of their duties. The graph presents the model of cooperation network of health professionals, namely, doctors (red color), dentists (blue color), physiotherapists (black color) and occupational therapist (white color) and their relationships or connections between participants or players and their “links”. The directions of the arrows indicate which member they identified as cooperating in the exercise of the population health maintenance function.

Figure 1 shows the existence of a cooperation network between the players involved. Relationships reach all professionals, but the players are more gathered by their profession, dentists to the left (blue squares), doctors

to the right (red squares), physiotherapists and occupational therapist involved between dentists and doctors.

From the confirmation of the existence of a cooperation network between health professionals, we started to measure the network. Table 3 shows the metrics used for the analysis of the cooperation network.

Metrics in the research:

Table 3: Metrics used in the research for cooperation network analysis

Density	20.1%
Average connection per participant	5.83
Reciprocity	78 (44.6%)
Total of Ties	175
<i>Betweenness</i>	M2/98.35
	D2/86.43
	D14/65.56
	F1/52.10
	D3/50.82
Degree: <i>Outdegree</i>	D14/14
	F1/12
	M3/11
	M2/10
	TO1/9
Degree: <i>Indegree</i>	M2/16
	M1/15
	M4/13
	M5.M8/11
	D11/9

Source: Field Research (2018)

- *Density*: Table 3 presents the data of the network analyzed as for the cooperation, although all are interconnected, the network has a low density of 20.1% of the total possible cooperation relations between professionals, with an average of 6 ties (connections) per person.

- *Reciprocity*: Analyzing the data in Table 3, the reciprocity between the players in the cooperation network between professionals, it was observed that 44.6% have reciprocal ties with their professional peers represented by 78 out of a total of 136. According to the data, reciprocal ties are more concentrated in the medical class that take care of the priority maintenance of the population's health.

- *Betweenness*: From players shown in table 3, participants considered intermediate in the cooperative relationship, two stand out with 98.35% for a doctor (M2) and 86.43% for a dentist D2. These are considered the main players that mediate cooperation in the exercise of activity among all other professionals. According to the literature, bridges are considered to other cooperative relationships between medical professionals.

- *Degree: indegree and outdegree*: According to table 3, measures of centrality of the degree of involvement with other players, such as *indegree* representing the most requested players in the network or those most sought for cooperation in terms of information on professional activity and the *outdegree* measure that indicates the players that obtain a higher density of demand for cooperation, being those that most request cooperation in the network.

In the network, the players that most demand cooperation (*outdegree*) are represented by doctors M2 and M3, dentist D14, physiotherapist F1 and occupational therapist TO1, and, when observed, the players who cooperate (*indegree*) mostly by doctors M2, M1, M4, M5, M8 and dentist D11 characterizing them according to the literature as providers of cooperation exchange relations, thus having a greater ability to influence the network.

- *Core periphery*: Through the analyzed data, the network presents a *core* with professionals more related in terms of cooperation and on the other hand also presents the existence of peripheral relations with few ties. Players located in the core of the network can also relate to those in the periphery and vice versa.

In the network of health professionals, based on the core-periphery measure, it was possible to identify the core with a density of 80.3%, representing the cooperation relations between the core's players (with more relationships in the network). The density of relations between the core and the periphery was 12.5% and from the periphery to the core was 24.4% and the density of the relations between the periphery itself was 14.1%.

The core is represented by doctors M1, M2, M3, M4, M5, M7, M10 and physiotherapist F1. Peripheral players (with few relationships in the network) are represented by doctors, dentists, occupational therapist and physical therapist: D1, D2, D3, D4, D5, D6, D7, D8, D9, D10, D11, M6, M8, D12, D13, D14, M9, D15, TO1, F2, D16, M11.

Thus, it can be seen that the cooperation network confirms the information contained in the theoretical framework, that is, the contribution to the understanding of the groups of players with the predominance of doctors in the core of the network.

Figure 2 shows the players that exert the greatest influence on the cooperation network.

Figure 2: Cooperation network highlighting the most influential players

Source: Field Research (2018)

Note: This graph highlights the most influential health professionals in the solidarity cooperation network in the exercise of their duties. The players highlighted in Figure 2 with the largest size are the professionals who are most sought to help in the professional cooperation network, being 3 dentists (D2, D14 and D1), 6 doctors (M4, M2, M10, M3, M1 and M5) and 1 physiotherapist (F1). The red ties (connections) are reciprocal and the light blue ones are not reciprocal. For example, dentist D2 receives cooperation from dentist D7, but the reverse does not occur. Reciprocity is represented in the connections between doctors M1 and M4.

For dentists, the most influential participants (highest degrees) are those with the longest experience, where one participant (D14) excels with more than 20 years in the profession and two (D1 and D2) with 6 to 10 years of experience. In the case of doctors, two participants (M2 and M5) have more than 20 years in the profession, while two (M4 and M3) have 6 to 10 years of experience. The influential (highest degree) cooperative physiotherapist (F1) has 20 years of experience in the profession.

Conclusions

This research aimed to verify the social network of health professionals in the role of the district of Rondon do Pará located in a region with peculiar difficulties of the Amazon region.

The Social Networks theory was used to describe the players' relationships and their interactions or information among health professionals and provided insights into their understanding of cooperative relationships.

The trained health professionals have approximately 37 people, including doctors, dentists, physiotherapists and occupational therapists. Approximately 80% of this population participated and answered the research questionnaire: 11 doctors, 16 dentists, 2 physiotherapists and 1 occupational therapist. These professionals serve approximately 50,000 inhabitants, thus representing approximately 1 doctor for every 3,500 inhabitants, 1 dentist for every 2,740 inhabitants, 1 physiotherapist for every 26,000 inhabitants and 1 occupational therapist to serve the entire district.

Through the research, it was possible to understand the cooperation structure among professionals, identifying and analyzing cooperative relationships and the possible differences and similarities of ties between doctors, dentists and occupational therapists.

The research results indicate that negative factors such as accessibility difficulties, difficulties in performing the life maintenance activity, difficulties in improving knowledge in the health area lead professionals to collaborative attitudes and behaviors, helping each other.

When the respondents indicated in the survey the names of those who assisted them in carrying out their work when they needed it, these professionals indicated an existing solidarity network of cooperation that can only be perceived through the analysis of social networks with a UCINET software tool.

Research participants follow the principle of solidarity by sharing information among colleagues in order to serve the population of that region. The literature corroborates that the relationship network can be considered as an alternative to offer coordinated actions among health maintenance professionals [10].

The density of the network found in the data corroborates the concept that the network is formed by interactions between those involved with interests in exchanging knowledge and cooperation between players [26]. However, there could be more interactions, despite the low network density. The two influential groups in the network were doctors and dentists.

Regarding the reciprocity metric in the network, it was found that professionals with more experience of age and profession are the most influential when cooperation is performed. The average age of these players is 44

years and among these, there are professionals with more than 20 years of experience and only three professionals with less than 10 years of experience.

After finding solidarity cooperation among the players, as well as the most influential ones willing to cooperate, it was observed that these players with the greatest degree of influence do not seek cooperation from other players, characterizing most ties as non-reciprocal or non-bidirectional to their relationships.

The literature conceptualizes that reciprocal ties must be linked to cooperation [28] represented by 44% of relations in the network, but through this research it was possible to verify the existence of cooperation linked to the principle of solidarity of some influential players that are essential for the maintenance of professional cooperation.

Regarding the intermediation between relations, two players can be listed by most relations of this purpose, since they present high intermediation densities in the network. These two players, one in the medical field with a density of 98.35% has extensive professional experience and the other player, a dentist, with a density of 86.43% who has been in the market for over 20 years. The data confirm the literature regarding the intermediation used as a bridge between adjacent players who exchange information [29].

As for the centrality metric (*degree*), the degree can be measured by the amount of ties of each player in relation to the other players inserted in the network [22]. From the degree analysis, it is possible to identify if there were *outdegree* and *indegree* measures. The research data pointed to the *outdegree* (information exchange demanders) metric the players of all health specialties such as doctors, dentists, physiotherapists and occupational therapists, but to the *indegree* (information exchange providers) the players with bigger averages were concentrated in the medical area, with only one of the dental area having the lowest density when compared to the other ones in the medical area.

The research demonstrated the existence of a phenomenon little discussed in the literature, the solidarity cooperation between health professionals working in environments or places with greater degrees of difficulties. The research pointed the time of professional experience as the greatest ally for the existence of this solidarity network of professional help to the colleague working in the health area.

In view of these findings, it is evident that the cooperation network among professionals is relevant, since the interaction ties end up to alleviate or mitigate the difficulties faced, a fact that meets the premises that professionals exert a relationship of social interactions among them, which purpose is to make it possible to perform their functions [31].

It should be noted that the researchers ensure that there were no conflicts of interest and that the research followed all ethical standards in accordance with international standards of ethical conduct in research with human beings.

It is suggested for future researches that the research be replicated to health professionals in other municipalities considered far from large urban centers and those with low HDI index, to verify whether or not there are relationship and cooperation networks and if this exerts any positive or negative interference with the population's quality of life.

Abbreviations

HDI—Human Development Index

HRH—Human Resources for Health

SUS—Single Health System

TCLE—Informed Consent Form

Declarations

Ethic approval and consent to participate

Ethics approval was obtained from the Health Sciences Research Ethics Board at the University Municipal of São Caetano do Sul (Protocol 2.711.125).

Consent for publication

Not applicable.

Competing interests

The authors declare that they have no competing interests.

Availability of data material

The data collection material is presented in additional main manuscript archive PDF.

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Authors' Contributions

DL, AC and AN contributed to the conception and design of the research. MF and EO conducted the systematic review. CC was responsible for the field research application. All authors have read and approved the manuscript.

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Figures

Figure 1

Cooperation network of Health Professional

Figure 2

Cooperation network highlighting influential players