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Partnerships for productive development: the establishment of socio-technical networks in the Economic-Industrial Complex of Health

Parcerias para o desenvolvimento produtivo: a constituição de redes sociotécnicas no Complexo Econômico-Industrial da Saúde

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ABSTRACT

Partnerships for Productive Development (PDP) are an instrument of the Brazilian state for the development of the Industrial Economic Health Complex and for accomplishing the constitutional prerogative of health as a fundamental right. These partnerships involve cooperation between public and private laboratories for the development, transfer and absorption of technology, production, productive and technological capacity of the country in strategic products to meet the demands of the "*Sistema Único de Saúde*", using for this, the purchasing power of the Ministry of Health. From a documentary research, the actors involved in these processes and their interactions were identified; and the socio-technical networks formed from the drug PDP were built graphically by Gephi software. It was found that the efficient management of PDP partnerships depends primarily on the effective articulation of several actors from different ministries, Anvisa, development agencies and public and private entities, being important that each actor also recognizes itself as a fundamental part of the process to improve the results obtained.

KEYWORDS: Public-Private Sector Partnerships; Technology Transfer; Health; Social Networking

RESUMO

As Parcerias para o Desenvolvimento Produtivo (PDP) são um instrumento do Estado brasileiro para o desenvolvimento do Complexo Econômico Industrial da Saúde e para a busca da prerrogativa constitucional da saúde como direito fundamental. Estas parcerias envolvem a cooperação entre laboratórios públicos e privados para: desenvolvimento, transferência e absorção de tecnologia, produção, capacitação produtiva e tecnológica do País em produtos estratégicos para atendimento às demandas do Sistema Único de Saúde, utilizando, para tal, o poder de compra do Ministério da Saúde. A partir da pesquisa documental, identificaram-se os atores sociais envolvidos nesse processo e suas interações e construiu-se graficamente, pelo *software* Gephi, as redes sociotécnicas constituídas a partir das PDP de medicamentos. Verificou-se que a gestão eficiente das parcerias depende primordialmente da articulação efetiva de vários atores de diferentes órgãos ministeriais, Anvisa, agências de fomento e entidades públicas e privadas, sendo importante que cada ator também se reconheça como peça fundamental do processo para que os resultados obtidos a partir desta iniciativa possam ser aprimorados.

PALAVRAS-CHAVE: Parcerias Público-Privadas; Transferência de Tecnologia; Saúde; Redes sociais

INTRODUCTION

Economic and social policies have been implemented over the years by the Brazilian government to guarantee the fundamental right to health established in the Federal Constitution of 1988. The need for integration between these policies, aimed at the development of healthcare policies and social well-being, is increasingly evident[1], especially when it comes to the expansion of the productive base of healthcare in the National Innovation System[2].

Increasingly, public policies must meet specific, "mission-driven" goals leveraged by innovations to guide smart economic growth, taking advantage of opportunities and overcoming fragilities within the National Innovation System[3]. In this context, the government has the role of bringing about the creation of dynamic public-private partnerships[3] for the development of the Industrial Economic Health Complex (IEHC).

The IEHC represents a set of productive segments (industrial and services), involved in the provision of health services, that establish a systemic relationship[2]. This includes three interdependent subsystems: "chemical and biotechnological", "mechanical, electronic, and material", and "health services"[4], which may be the basis for the further strengthening of the internal Brazilian production with the enhancement of more complex technological processes, which, historically, have been desired[5].

The development of this complex therefore encompasses the social dimension as a primary factor for universal access to medications and health products (new technologies) and the economic dimension as a strategic axis for generating employment, income, and wealth in the country[6], not excluding the processes of technical progress and accumulation[7].

The greater capacity to innovate has been associated with better access to new technologies and the implementation of policies to generate, use, and disseminate knowledge[8]. It is also important that the new national innovation policy is based on stimulating the interaction between research institutions, the productive sector, and universities, as well as the new instruments for financing innovation in the private sector that allow greater interaction between the science and technology infrastructure and the productive sector[9].

In this context, the Production Development Agreements, later known as Production Development Partnerships (PDPs), started in 2009, with the coordination of the Ministry of Health[10,11]. Until now, these partnerships have been considered to have the type of performance that has shown the most results, shaping the technological and industrial policies as one of the attributions of the public health policy[12].

This strategy is the result of the communication between the National Health Policy, in which the Pharmaceutical Assistance Policy is inserted, the Science, Technology, and Innovation Policy, and the Industrial Policy conducted by the federal government for the development of the Brazilian economy. There is a strong influence of ideas related to "innovation as a source of competitiveness, economic development, and transformation of society"[13].

The partnerships involve the cooperation between public institutions and private entities for the development, transfer, and absorbtion of technology, as well as the production and technological capacity of the country in strategic products to meet the demands of the Brazilian Unified Health System (SUS), using the purchasing power of health for this purpose[14,15]. Recently they have been understood to be "instruments of public action with norms and values representative of this regional framework of public policy."[16]

Thus, as pointed out by Sundfeld and Souza[17], as instruments for the implementation of public policies on medications and incentives for innovation in Brazil, the PDPs contribute to the industrial development, the increase of the technological autonomy of the national productive sector of the health area, and the saving of resources of the Brazilian government. Rezende[18] also indicates the reduction of economic deficit in the balance of trade in the health area, and Bercovici[14] mentions the expansion of innovation, and access to health by the population, as objectives of this initiative.

The monitoring and follow-up of projects is carried out by the Department of Science, Technology, and Strategic Inputs of the Ministry of Health (STSI/MoH) with the participation of the Brazilian Agency of Sanitary Surveillance (ANVISA), using technical regulatory committees (TRC)[15]. They aim to monitor projects involving transfer of technology and basic research findings from the laboratory to applied environments involving specific needs for the SUS[19].

The TRC are made up of technicians from STSI/MoH, ANVISA, and participating public institutions. Their role includes the "monitoring of activities related to the development, production, and recording of medications and health products"[20], which are the object of partnerships, in a proactive way, focusing on the planned execution of actions with technical and regulatory assistance.

With the revision of the regulatory framework in 2014, the evaluation of new proposals and the analysis of changes in partners, schedules, and current technologies of the PDPs now have two sections: the Technical Evaluation Committee (TEC) and the Deliberative Committee (DC), with representatives from different ministerial agencies, development agencies, and regulatory agencies[11,15].

From this instrument of the integration of public policies, socio-technical networks were then set up within the framework of the IEHC, in line with the objectives of the strategy, and we highlight two of them that are strictly related to the constitution of these networks:

> V – to foster technological development and the *exchange of knowledge for innovation* within public institutions and private entities, contributing for the development of the IEHC and to make them competitive and empowered; [...]

> VIII – to stimulate the *development of the public production network* in Brazil and its strategic role for the SUS (our italics)[15].

According to Kauchakje et al.[21], the socio-technical network involves organization among social players, stimulated and mediated by technological instruments and language codified in digital resources, so that the interactions between these players can be effective. As presented by these authors, the objects and objectives of this network may be beyond the socio-technical network itself, such as in society or in the territory.

This is evident in the socio-technical network formed by the PDPs, related to the Brazilian society and the regions of the country where the laboratories are located, in which goals are seen, such as increasing the access of the population to strategic products, and the regional technological and economic development.

Callon[22] argues that, in the socio-technical network, people want to know the translations, and what is moved between points: "to know what the operation of displacements are and how they occur, what is circulating, to appreciate what is at stake, what is being manufactured as identity, the nature of what is moved, etc."

As pointed out by Nunes et al.[23], networking allows the connection, the mobility and the breaking of the boundaries of projects, ideas, and persons, the creation of other organizational geometries, the formation of links, and the establishment of dialogs.

In this sense, Lastres and Cassiolato[8] argue that the diffusion of information and communication technologies "has provided the technical means for the articulation in real time of geographically distant organizations, individuals, and instances", promoting innovations and new possibilities of economic and social return. It is also important to identify the structuring elements formed from the implementation of the partnerships with the analysis of the participation of the public policy players involved in them[16].

Thus, in the context of PDPs, some questions arise: How are socio-technical networks set up in the context of the PDP of medications in the IEHC? What social players are involved in these networks and how are they organized? What is moved in these networks and what goals have been achieved?

As presented by Jesus[24], the connections and information can be potentiated in the networks. In this way, the interaction of different social players, public institutions, private entities, ANVISA, Ministry of Health (MoH), development agencies, and other government agencies can add positive results to the SUS and to the health of the population.

In addition, as argued by Maia and Souza[25], in order to guarantee the right to health, it is essential that the National Health Surveillance System broaden its focus and increase the capacity of response in a fast and integrated manner with different governmental and nongovernmental agencies, international organizations, producing entities, scientific community, among others.

This study aimed to identify and characterize the socio-technical networks constituted by the PDPs of medications that have acted as an instrument of integration of public policies to guarantee the fundamental right to health and the development of IEHC.

METHOD

This project was based on a qualitative approach, starting from the document search, and later graphic description of the socio-technical network of the PDP of medications in the context of the IEHC.

The document search was carried out in the Virtual Health Library and Google Scholar databases using the expression "Productive Development Partnerships" for the search period from 2008 to 2016, and the electronic website of the Department of the Industrial Complex and Innovation in Health of STSI/MoH, available *at* www.saude.gov.br/deciis, for the search of documents on PDPs and the ordinances for the constitution of the TRC, TEC, and DC.

The search for the expression "Productive Development Partnerships" in the period from 2008 to 2016 yielded 79 publications in Google Scholar and one in the Virtual Health Library. From the content analyses of these publications, we described the PDPs, as shown below.

The data collected also served as a basis for identifying the institutions and players involved and their interaction in the process of establishing and monitoring the projects. The players were identified by codes and their interactions were mapped.

From these data, the socio-technical networks of the constituted PDP of medications were constructed graphically, using the *software* Gephi[26], which were later analyzed.

RESULTS AND DISCUSSION

Characterization of the PDPs

The PDPs reflect a form of expression of the public function to stir up the Brazilian government in the health area, and they are focused on the development and transfer of technology enabling the production of strategic products and medications for the SUS from private partner to public laboratory[15,17].

Therefore, these partnerships reflect the encouragement and support given by the government, specifically by the Ministry of Health, for the constitution of strategic alliances as provided for in the Innovation Law (Law 10,973/2004)[27]:

> Article 3· The government, the states, the federal district, the municipalities, and the respective development agencies can encourage and support the formation of strategic alliances and the development of cooperation projects involving companies, institutions of science and technology, and private non-profit entities dedicated to research and development, aimed at the generation of innovative products, processes, and services and the transfer and diffusion of technology. (Translated from Law No. 13,243, of 2016)

Sole Paragraph. The support provided in the head of the article may contemplate international technological research networks and projects, actions of technological entrepreneurship and creation of innovative environments, including incubators and technology parks, and the training and qualification of eligible human resources. (Translated from Law No. 13,243, of 2016)

According to Gadelha and Costa[6], this initiative presents potential for the selective reversal of gaps in the national productive base by allowing the internalization of technologies for the production of strategic inputs for the provision of health services.

As pointed out by Bercovici[14], the advantage of the PDPs is the "joint technological development; therefore, it is not a question of making private investments feasible from outsourcing with the payment for services."

Since the bidding of products from these public-private partnerships is unnecessary during the execution of the technology transfer, the purchasing power of the government is used to execute this instrument[17,28]. To this end, the normative criteria of the partnerships must be met, as well as regulatory and sanitary requirements[15].

Thus, there are gains for all those involved in the strategy: (a) the government, by absorbing the technology and being able to use or disseminate it and obtain the medication at lower prices, (b) the private partner, by transferring technology and being economically strengthened from the supply of the product on a large scale and thus leveraging the development of the domestic industry, and (c) the user of health care actions and services, by having ensured the supply of the SUS or the access to medicines at reduced prices because of competition[17].

PLAYERS INVOLVED WITH THE PDPS

Within the scope of the PDPs, direct action and collaboration of the following subjects can be verified: (1) private entity that owns or develops the technology of the product, responsible for the transfer of this technology to the public institution, (2) public institution responsible for absorbing technology and manufacturing the product at the end of the technology internalization phase, and (3) public institution or private entity that is a national developer and a local producer of the active pharmaceutical ingredient (API), in the case of medications, or a critical technological component, in the case of health products (Figure 1)[15].

This arrangement clearly represents the partnerships of chemical synthesis medication, with the identification of the national producer of the API (identified in item 3) for the private entity. However, there are variations in these arrangements depending on the type of product, object of the PDPs[18].

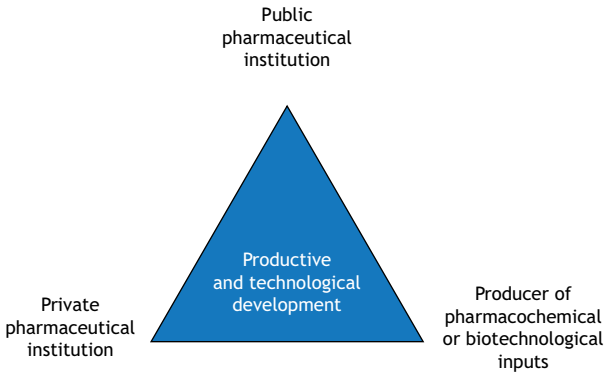
For vaccine projects, for example, the national producer of the API (item 3) corresponds with the public institution that absorbs the technology (same subject in item 2). For some PDPs of biological products, two entities, one national and one international, jointly participate in the transfer of technology corresponding to the subject identified in item 1, and the same national private entity (item 1) and the public institution (item 2) share responsibilities in the national production of the API and representation of the subject identified in item 3.

In March 2016, 81 PDPs were in force for 51 medications[A] – 29 are chemical syntheses, four are mixed syntheses, 14 are biological, four are vaccines – and 27 are health products. These partnerships are at different stages of the technology transfer process defined in Ordinance No. 2,531/2014: five in research and development, 53 in phase II, of the PDP project, with the implementation of the Instrument of Commitment[B], and 23 in phase III, PDPs, with the supply of products to the Ministry of Health[29].

Of these projects, 18 public laboratories located in different states in Brazil are participating, and more than one public laboratory can participate in one PDP, and some laboratories have partnerships in both medications and health products (Table)[29].

These public laboratories interact with 43 private entities, both national (Table 2) and with foreign capital (Table 3), which are responsible for the development of the medication or health product and the technology transfer to the public institution or the national development and production of the API during the process of establishing the PDP[29].

As a forum for monitoring regulatory activities and the technology transfer processes, there are TRCs set up for each public laboratory participating in a PDP: 16 for medication projects and five for health products[20]. These technical committees are established and coordinated by ANVISA and consist of members and substitutes of that agency, the MoH, and the corresponding public institution.



Source: Rezende[18].

Figure 1. Basic model of structure of a PDP.

[a] The same medication can have more than one PDP. These 51 medications correspond to 66 PDPs.

[b] The Instrument of Commitment is the document signed between the public laboratory, which is responsible for the investment, development, transfer, and absorption of technology, and the Ministry of Health, which is responsible for the acquisition of the product of the PDPs, with attached declaration of agreement of the private partners[15].

Table. Public laboratories participating in PDPs, the state in which they are located, PDP number, and type of PDP product.

#	Public laboratory	State	Type of product objective of the PDP	Total
1	*Fundação Baiana de Pesquisa Científica e Desenvolvimento Tecnológico, Fornecimento e Distribuição de Medicamentos* (Bahiafarma)	Bahia	Biological, mixed, and chemical synthesis medication	6
2	*Instituto de Tecnologia em Imunobiológicos* - Biomanguinhos	Rio de Janeiro	Biological medication and vaccine	11
3	*Instituto Butantan* (IB)	São Paulo	Biological medication and vaccine	7
4	*Centro de Tecnologia e Geociências/ Universidade Federal de Pernambuco* (CTG/UFPE)	Pernambuco	Health product	1
5	*Instituto de Tecnologia em Fármacos* - Farmanguinhos	Rio de Janeiro	Mixed and chemical synthesis medication	13
6	*Fundação Ezequiel Dias* (Funed)	Minas Gerais	Chemical synthesis medication	4
7	*Fundação para o Remédio Popular* (FURP)	São Paulo	Chemical synthesis medication and health product	15
8	*Hemobrás*	Pernambuco	Biological medication	2
9	*Indústria Química do Estado de Goiás* (Iquego)	Goiás	Chemical synthesis medication and health product	3
10	*Instituto Vital Brazil* (IVB)	Rio de Janeiro	Biological, chemical synthesis medication and product for health	11
11	*Laboratório Farmacêutico do Estado de Pernambuco Governador Miguel Arraes* (Lafepe)	Pernambuco	Chemical synthesis medication	7
12	*Laboratório Farmacêutico do Estado do Rio Grande do Sul* (Lafergs)	Rio Grande do Sul	Health product	1
13	*Laboratório Farmacêutico da Marinha* (LFM)	Rio de Janeiro	Chemical synthesis medication	5
14	*Laboratório Industrial Farmacêutico de Alagoas* (Lifal)	Alagoas	Chemical synthesis medication	3
15	*Laboratório Químico Farmacêutico do Exército* (LQFEx)	Rio de Janeiro	Mixed and chemical synthesis medication	4
16	*Núcleo de Pesquisa em Alimentos e Medicamentos* (Nuplam)	Rio Grande do Norte	Chemical synthesis medication	1
17	*Núcleo de Tecnologias Estratégicas em Saúde/ Universidade Estadual da Paraíba* (Nutes/UEPB)	Paraíba	Health product	2
18	*Instituto de Tecnologia do Paraná* (Tecpar)	Paraná	Biological medication and health product	2

Source: Own elaboration from data from the Ministry of Health[29].

In addition to TRCs, there are two instances of evaluation of the PDPs: the TEC and DC[11]. The TEC consists of eight full members and respective substitutes of the following agencies and entities: STSI/MoH, Ministry of Health Care of the MoH, Ministry of Health Surveillance of the MoH, Ministry of Development, Industry, and Foreign Trade (MDIF), Ministry of Science, Technology, and Innovation (MSTI), Brazilian Development Bank (BNDES), FINEP – Innovation and Research, and ANVISA[15].

The DC consists of four members and their respective substitutes of the MoH, MDIF, MSTI, and ANVISA, and its composition is distinct from the TEC[30].

The creation of socio-technical networks

Oliveira et al.[11] recognized the importance of integrating the social players involved in the PDPs so that the policy could become effective.

The first interaction that occurs to begin the process of establishing the PDPs involves the directors or presidents of public institutions and private entities interested in developing a technology transfer project. Once the negotiations have been completed and the partnership established, a project proposal is prepared by these partners.

The second step involves the presentation of the project proposal by the public institution to the MoH, which is evaluated by the TEC and, later, by the DC. The proposals approved by this deliberation are then communicated to the public laboratories to sign the Instruments of Commitment, between themselves and the MoH[15].

At this point, actions are initiated between public laboratories and private partners to implement the Instrument of Commitment and the activities of technology transfer and absorption.

As presented by Fleury and Ouverney[31], "only when there is interinstitutional convergence towards a common goal are the necessary links developed to articulate the interdependence between the players in a coordinated way and we can affirm that a network structure is developed."

Thus, it can be said that the organization and interaction of the social players of each of the subjects of the PDPs form socio-technical networks in the IEHC, which is further complemented by other social players responsible for the evaluation and monitoring of these projects – TRC, TEC, and DC – in order to achieve the objectives of the partnerships[15].

The TRC and networking

For the analysis of the 16 Ordinances that constituted the TRC of the PDP of medications, we identified 81 social players who interact to monitor the activities related to the development,

Table 2. National private entities participating in PDP and types of products object of their PDP.

N°	Brazilian entities	Type of product object of PDP
1	Biomm	Biological medication
2	Bionovis	Biological medication
3	Blanver	Chemical synthesis medication
4	Cristália	Biological and chemical synthesis API and medication
5	CYG	Chemical synthesis API
6	E.M.S.	Chemical synthesis medication
7	Eurofarma	Biological API and medication
8	First Line	Health product
9	Globe	Chemical synthesis API
10	Hygéia	Chemical synthesis API
11	Injeflex	Health product
12	ITF	Chemical synthesis API
13	Laborvida	Chemical synthesis medication
14	Libbs	Biological, mixed, and chemical synthesis API and medication
15	Lifemed	Health product
16	Medtronic Comercial	Health product
17	Microbiológica	Chemical synthesis API
18	Nortec	Chemical synthesis API
19	NPA	Chemical synthesis API
20	Opto Eletrônica	Health product
21	Orygen	Biological medication
22	PharmaPraxis	Biological medication
23	Politec	Health product
24	Scitech	Health product
25	Supera	Chemical synthesis medication

API: active pharmaceutical ingredient
Source: Own elaboration from data from the Ministry of Health[29].

Table 3. Private entities with foreign capital participating in PDPs and types of product objectives of their PDP.

N°	Entities with foreign capital	Type of product objective of the PDP
1	Alteogen	Biological medication
2	Apotex	Biological medication
3	Baxter	Biological medication
4	Biocad	Biological medication
5	Biocen	Biological medication
6	Boehringer	Chemical synthesis medication
7	Bristol	Chemical synthesis medication
8	Chemo	Chemical synthesis medication
9	GSK	Vaccine
10	IGL Group	Health product
11	Janssen-Cilag	Biological medication
12	Jonhson&Jonhson	Health product
13	Lupin	Chemical synthesis medication
14	Mabxience (Chemo Group)	Biological medication
15	MSD	Vaccine
16	Merck Serono	Biological medication
17	Pfizer	Biological medication
18	Protalix	Biological medication

Source: Own elaboration from data from the Ministry of Health[29].

production, registration, and post-registration of the medications and their active pharmaceutical inputs. They refer to the 47 technicians from different areas of the ANVISA, such as sanitary inspection, registration and post-registration of biological and chemical synthesis and medications, the two public servants of the STSI/MoH responsible for monitoring all partnerships in the pharmaceutical sector, and the 32 employees of the public laboratories that produce medications or vaccines, between managers and technicians involved in the process of technology absorption.

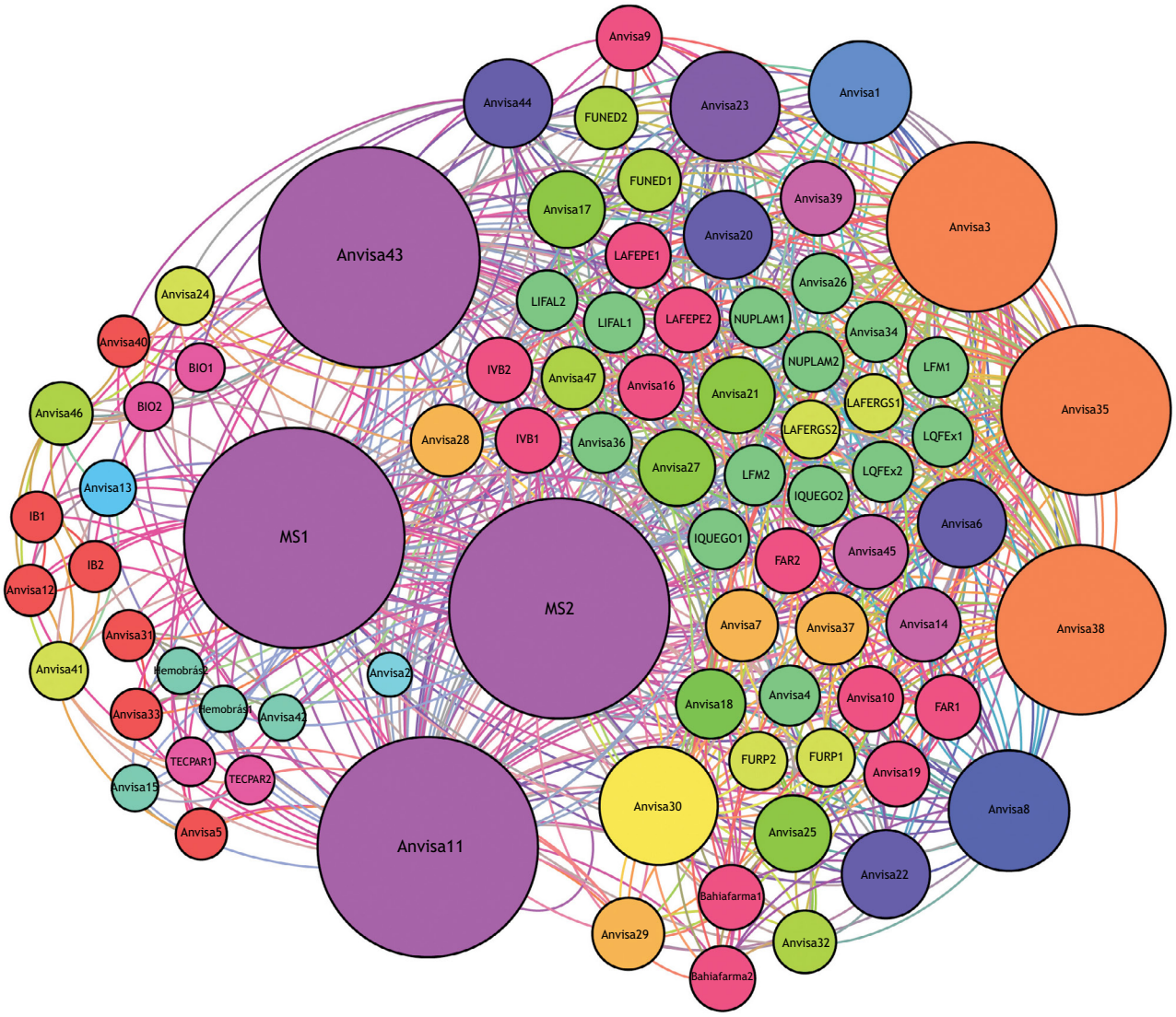
These players were identified by a code (nodes[c]) and the articulation existing between them (edges[d]), between the different TRCs, was mapped. The data obtained were recorded using the *Gephi software*, resulting in the graph shown in Figure 2, which represents the socio-technical network formed. This graph shows the distribution in the "Force Atlas" model, which represents the result of directing forces of attraction between the players[26]. The volume of the nodes, represented by the circles, is directly related to the number of interactions between that player and the others. The greater the number of communications, the greater is the influence, or the capacity of information diffusion, of these players[24].

The codes MoH1, MoH2, Anvisa11, and Anvisa43 indicate the players who had more interaction in the network, and they are the representatives of the Ministry of Health in the TRC of the PDP of medications and the coordinators and substitutes of the TRC. These players are important nodes for the mediation of information in the network, representing the articulations in their institutions and their relations beyond the context of the TRC. This mediation is important, so that the knowledge generated in this network is shared with the other instances involved in the process of establishing the PDPs (in a context of an even larger network as we will present below).

The number of players from ANVISA in this network, formed from the TRC, is representative and important in view of the variety of products involved in the projects, the complexity of their development and production, and the diversity of stages and sectors related to the registration and post-registration process of medications. By adding players from different areas of the agency, with knowledge of the various regulatory steps, we have

[c] The nodes are represented in the graph by points, corresponding to the players in the network[32].

[d] The edges are represented in the graph by lines, corresponding to the actions and interactions of the players in the networks[32].



Source: Own elaboration.

Figure 2. Degree of distribution of players in the socio-technical network constituted from Regulatory Technical Committees of the PDP of medications.

a positive articulation for the evolution of projects. In this sense, we highlight the fundamental role of integration of the sanitary surveillance with a modern network of laboratories, structured and dedicated to the objects under its regulation, to ensure the monitoring and research in this area[25].

The disposition of these players in the network demonstrates different profiles of the members of the TRC in relation to the object of work, that is, the product object of the PDPs. This differentiation results in the distribution of players in the network: technicians from public laboratories producing mixed or chemical synthesis medications are close to each other, together with technicians from ANVISA involved in the registration, post-registration, and inspection of production plants, which are concentrated on the right side of the graph representing the network. In this portion of the graph, three players can be highlighted, identified by the codes Anvisa3, Anvisa35, and Anvisa38, which present a large number of interactions in the network.

In a similar way, the players involved in the processes of biological products are approached, and are concentrated on the left side of the graph of the network.

It is important to emphasize that the exchange of knowledge in this network associated with the dialog about the difficulties and priorities identified by the players can simplify relations and provide an adequate environment for these projects to bring collective benefits[25]. The discussion and exchange of knowledge of registration and post-registration processes, as well as the structural adjustments required for the certificate of Good Manufacturing Practices, under the TRC, allow the PDPs to be conducted more effectively, and with greater agility, bringing results to the SUS.

The PDPs and the creation of an extended socio-technical network

With the publication of GM/MoH Ordinances No. 2,531/2014 and 1,020/2015, new players were included in the process of establishing partnerships with the creation of evaluation instances[11], expanding the socio-technical network within the context of the PDPs. They are employees of the MSTI, MDIF, MoH, ANVISA, BNDES, and FINEP, who make up the TEC and have qualified technical knowledge in technological projects, allowing the qualified evaluation of the proposals presented. In addition, the managers of the first four institutions that are part of the DC present an important political articulation in the economic and social aspects, allowing the deliberative analysis of the partnerships integrated with other strategic actions.

From the research on the electronic website of the Ministry of Health, the Ordinances that constituted these instances were identified: Ordinances STSI/MoH No. 28, of June 18, 2015, No. 41, of September 3, 2015, and No. 69, of November 30, 2015, which nominally established the members of the TEC, and Ordinances GM/MoH No. 918, of July 6, 2015, No. 1418, of September 11, 2015, No. 1,976, of December 3, 2015, and No. 180, of February 12, 2016, which established the members of the DC. From these ordinances, the players of these instances were identified by a code and the articulation existing between them and the different TRC was mapped.

The private entities participating in the PDPs and their relationship with the players of public institutions were verified in the relationship of existing medication partnerships on the electronic website of the Ministry of Health[29].

The data obtained were added to the chart of TRC in the *Gephi software*, resulting in the graph shown in Figure 3, which represents the extended socio-technical network of the PDPs. This graph considers the distribution of nodes and edges in the "Fruchterman-Reingold" model[e].

In this graph, we identified three *clusters*, that is, three sets of strongly-connected nodes, which, in socio-technical terms in the extended network, represent groups of common interests and affinities[32]: (1) the evaluation instances (TEC and DC), identified in red in the graph, (2) the TRC, in green, and (3) the entities participating in the projects, the private entities linked to the public institutions, in blue.

In the *cluster* of evaluation instances, we can verify that the members of the TEC of a certain agency or entity articulate with the members of the DC of this same agency or entity, establishing the flow of information between these instances. The interaction of this *cluster* and the cluster of the TRC occurs in two ways with the members of the TEC: (1) the Ministry of Health with the representatives of the MoH in the TRC, and (2) the ANVISA with the coordinators of the TRC. This articulation includes the combination of efforts, experiences, and knowledge to evaluate the PDPs, which guarantees a better technical basis for the decision-making process according to the precepts of the regulatory framework of these partnerships[15].

This *cluster* also articulated with the third *cluster* with the members of the Ministry of Health of the DC with the player of this Ministry responsible for establishing the PDPs with the public laboratories.

Analyzing the interactions of the *cluster* of the TRC, we can see that some members of public institutions are the directors of laboratories, who establish the PDP with the Ministry of Health and who articulate with the directors of private partner entities (identified in the third *cluster*). On the other hand, for some public institutions, the directors are not part of the TRC making the third *cluster*, and the communication between them and the TRC goes through technicians. Thus, in the extended network of the PDPs, we can verify the participation of two players (director and technician) or three players (director and two technicians) of each public laboratory depending on this peculiarity, and when only two players are included, their number of interactions is increased.

Only one of the public institutions of the TRCs, codes Lafergs1 and Lafergs2, does not interact with private entities since the PDP of medications of this institution were terminated in 2015 after constitution of the TRC[34].

In the *cluster* of entities participating in the PDP of medications, the ones that stand out for the greater number of interactions with different players are: (1) IVB, Farmanguinhos, and Bahiafarma, among the players of the public laboratories, and (2) Nortec, EMS, and Cristália, among private entities.

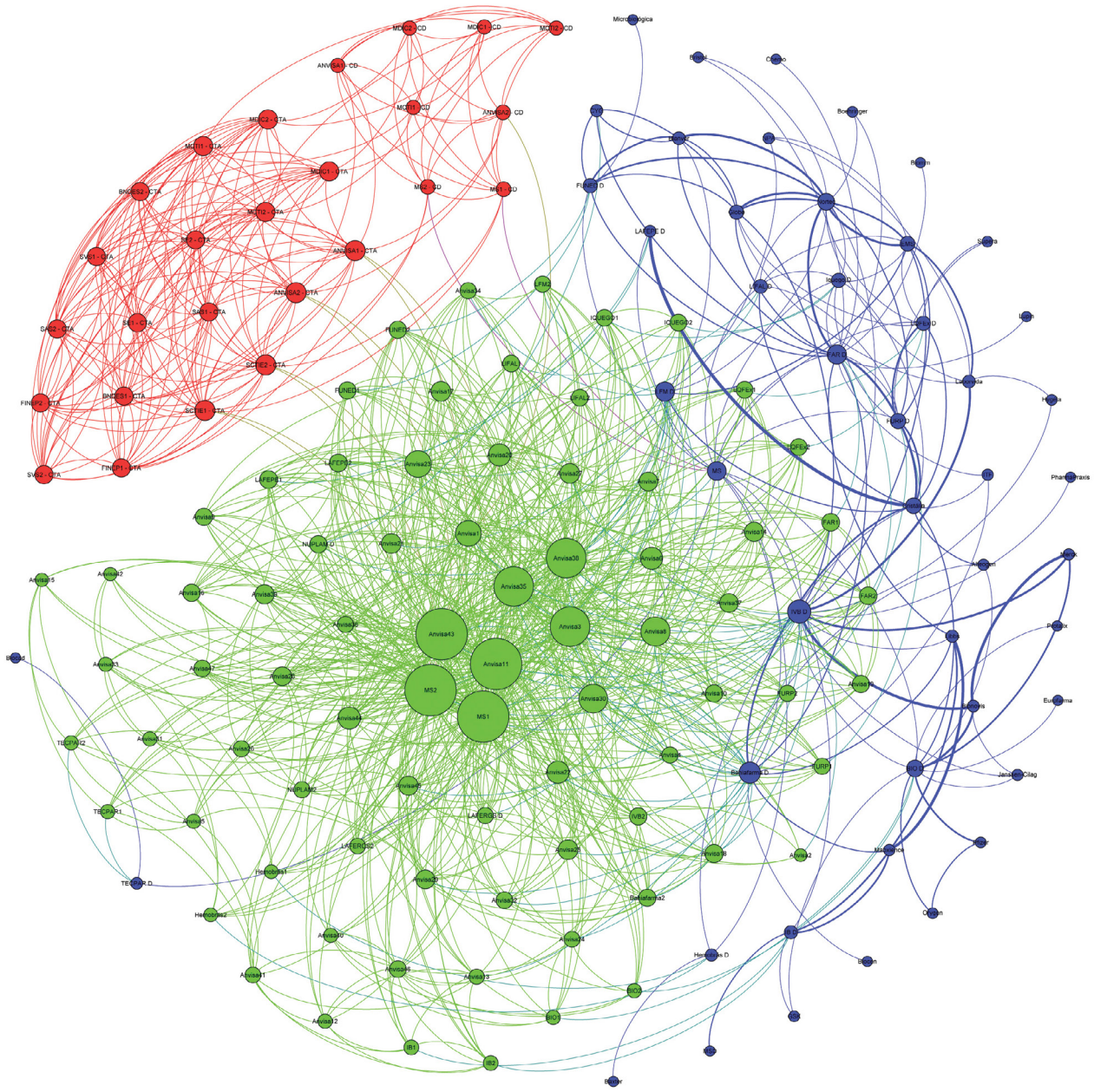
Within each of these public laboratories and private companies, there is also the conformation of networks for the execution of a technological project such as the PDPs: they are employees of different areas of the industry – quality assurance, production, quality control, project management, warehousing, administration – involved in the technology transfer and absorption process. The result of this internal interaction of each organization is usually led to the external environment by the Director or the President of each laboratory, who becomes the "spokesperson" or the interlocutor with the external social players.

Remarks

It is important to highlight the relationship among public laboratories in the network for the establishment of the PDP for medications, although it is still at an early stage. Located in different regions of Brazil, these laboratories play a key role in guaranteeing access to medications, and for local development.

The socio-technical networks formed by the PDPs allow the exchange of knowledge for innovation between public laboratories and private entities, contributing with the development of

[e] This model is representative of a system of mass particles[33].



Source: Own elaboration.

Figure 3. *Clusters* in the extended socio-technical network of the PDPs.

the IEHC and making them competitive and qualified, according to one of the objectives of these partnerships[15].

As argued by Scherer et al.[35], network relationships are fundamental for the development of innovations. With alliances and partnerships, challenges can be overcome and the rapid evolution of knowledge can be monitored.

According to Albagli and Maciel[36], studies have shown that cooperating organizations and agents introduce more innovations and the degree of innovation increases with the variety of partners who communicate and cooperate in a network.

The socio-technical networks constituted also work as a means of integrating the government sector, the development and regulatory agencies, and the public and private entities, as well as a basis for the development of PDPs.

The multiplicity of players present in this context of the constituted networks highlights the need for convergence based on plurality and autonomy in order to have a shared value[31].

The monitoring of the PDPs by the TRC, instituted by ANVISA with the integration with the Ministry of Health, is an important collaborator for the registration of medications in the various stages

of technology transfer[18]. Of the 66 current PDP of medications, 31 have sanitary registration by one of the partners and 21 already supply the medication of the PDP to the Ministry of Health[29].

With Ordinance GM/MoH No. 2,531/2014[15], the evaluation and decision-making process of the PDPs began being conducted and optimized in an extended network. The sharing of information between the different instances of evaluation and monitoring of the PDPs brings gains to the process, involving players from different areas, specialized in technological projects, and discussing scenarios from different angles.

However, such a decision-making process in networks requires the effective perception of the players involved in its interdependence, a transformation of the cultural foundations of the relationship between them, the development of a means of consensus building, and sharing of perceptions, as well as the institution of organizational structures of support and intermediation among the players involved[22]. In the context of instances of evaluation of the PDPs that bring together interministerial and interagency actions, the role of these structures has been performed by the coordinators of each instance in the MoH.

The results of networking by the PDPs can be verified beyond the network itself, both in the public administration and in society. The economy has been verified in practice, after the first purchases under the PDPs[37]. It is estimated that, from 2011 to July 2015, the PDPs generated savings of R$ 2.5 billion to the MoH[38]. Two technologies have already been absorbed and internalized by public laboratories in the context of the PDPs and technological projects – influenza vaccine and clozapine – reducing the vulnerability of the SUS in relation to the international market and ensuring greater access of the population to these products[39].

CONCLUSION

The graphical construction of the socio-economic networks established in the IEHC from the PDPs allowed the understanding of the scenario generated with these partnerships, the identification of the social players involved and their interactions, and the discussion of the goals achieved from the networking of these players.

Other social players are involved in the process of establishing the PDPs, such as the technicians and suppliers of each laboratory, and the technicians of the Ministry of Health, responsible for monitoring the PDPs, who could not be mapped in this first work.

The identification of these networks contribute to the recognition that the efficient management of this public policy instrument depends primarily on the effective articulation of several players from different ministerial agencies, ANVISA, and public and private entities. Therefore, it is important for each player also to be recognized as a fundamental part of the process acting as such, so that the results obtained from the PDPs can be improved.

Such recognition can contribute with the effective implementation of actions among the players and institutions involved (participants of the TRC, TEC, and DC), the dissemination of results, the strengthening of technical capacities for evaluation and monitoring, and the maintenance of due transparency in the decision-making process. With these actions, the aim is to share knowledge to improve the access to pharmaceutical care with the production of safe, effective, and quality medication within the SUS, promoting ways to develop the IEHC and to guarantee the fundamental right to health.

REFERENCES

1. Menicucci TMG. O Sistema Único de Saúde, 20 anos: balanço e perspectivas. Cad Saúde Pública. 2009;25(7):1620-5. https://doi.org/10.1590/S0102-311X2009000700021
2. Gadelha CAG, Barbosa PR, Maldonado J, Vargas MA, Costa LS. O complexo econômico-industrial da saúde: conceitos e características gerais. Inf CEIS. 2010[acesso 20 dez 2015];1(1). Disponível em: http://www.fiocruz.br/vppis/imagens/ceis/Boletim%20Complexo%20Saude%20Vol%201%202010.pdf
3. Mazzucato M, Penna CCR. The Brazilian innovation system: a mission-oriented policy proposal: sumário executivo. Brasília, DF: Centro de Gestão e Estudos Estratégicos; 2016. (Temas estratégicas para o desenvolvimento do Brasil, vol 1).
4. Gadelha CAG, Costa LS, Maldonado J. O Complexo Econômico-Industrial da Saúde e a dimensão social e econômica do desenvolvimento. Rev Saúde Pública. 2012;46(supl 1):21-8.
5. Furtado C. Formação econômica no Brasil. 32a ed. São Paulo: Companhia Editora Nacional; 2005.
6. Gadelha CAG, Costa LS. Saúde e desenvolvimento no Brasil: avanços e desafios. Rev Saúde Pública. 2012;46(Supl):13-20.
7. Cassiolato JE, Lastres HMM. Celso Furtado e os dilemas da indústria e inovação no Brasil. Cad Desenvolv. 2006;10(17):188-213.
8. Lastres HMM, Cassiolato JE. Novas políticas na Era do Conhecimento: o foco em arranjos produtivos e inovativos locais. Parec Estrat. 2010;8(17):5-30.
9. Szapiro M, Vargas MA, Cassiolato JE. Avanços e limitações da política de inovação brasileira na última década: uma análise exploratória. Rev Espacios. 2016;37(5):18.
10. Ministério da Saúde (BR). Mais Saúde: resultados e conquistas 2009: uma prestação de contas à sociedade. Brasília, DF: Ministério da Saúde; 2009[acesso 9 jan 2016]. Disponível em: http://bvsms.saude.gov.br/bvs/publicacoes/mais_saude_resultados_conquistas.pdf
11. Oliveira EJV, Vivan AL, Albuquerque FC, Silva GO, Rezende KS, Barbosa LP. A consolidação do marco regulatório das parcerias para o desenvolvimento produtivo. Rev Eletr Gest Saúde. 2015;6(supl 4):3175-93.
12. Guimarães R. O desenvolvimento produtivo e as plataformas inteligentes. Facto. 2016;10(50):6-8.

13. Costa LS. Saúde, desenvolvimento e inovação. Cad Saúde Pública. 2016;32(supl 2):eED01S216. https://doi.org/10.1590/0102-311X00029615

14. Bercovici G. Complexo industrial da saúde, desenvolvimento e proteção. Rev Dir Sanit. 2013;14(2):9-42. https://doi.org/10.11606/issn.2316-9044.v14i2p9-42

15. Ministério da Saúde (BR). Portaria Nº 2.531, de 12 novembro de 2014. Redefine as diretrizes e os critérios para a definição da lista de produtos estratégicos para o Sistema Único de Saúde (SUS) e o estabelecimento das Parcerias para o Desenvolvimento Produtivo (PDP) e disciplina os respectivos processos de submissão, instrução, decisão, transferência e absorção de tecnologia, aquisição de produtos estratégicos para o SUS no âmbito das PDP e o respectivo monitoramento e avaliação. Brasília, DF: Ministério da Saúde; 2014[acesso 29 jan 2016]. Disponível em: http://bvsms.saude.gov.br/bvs/saudelegis/gm/2014/prt2531_12_11_2014.html

16. Costa LS, Metten A, Delgado IJG. As parcerias para o desenvolvimento produtivo em saúde na nova agenda de desenvolvimento nacional. Saúde Debate. 2016;40(111):279-91. https://doi.org/10.1590/0103-1104201611122

17. Sundfeld CA, Souza RP. Parcerias para o desenvolvimento produtivo em medicamentos e a Lei de Licitações. Rev Direito Adm. 2013;264:91-133.

18. Rezende KS. As parcerias para o desenvolvimento produtivo e o estímulo à inovação em instituições farmacêuticas públicas e privadas [dissertação]. Rio de Janeiro: Escola Nacional de Saúde Pública Sérgio Arouca; 2013.

19. Guimarães R. Pesquisa Translacional: uma interpretação. Ciênc Saúde Coletiva. 2013;18(6):1731-44. https://doi.org/10.1590/S1413-81232013000600024

20. Ministério da Saúde (BR). Portal da Saúde Parceria para o Desenvolvimento Produtivo – PDP. Brasília, DF: Ministério da Saúde; 2014[acesso 18 mar 2016]. Disponível em: http://portalsaude.saude.gov.br/index.php/o-ministerio/principal/leia-mais-o-ministerio/581-sctie-raiz/deciis/l2-deciis/12090-parceria-para-o-desenvolvimento-produtivo-pdp

21. Kauchakje S, Penna MC, Frey K, Duarte F. Redes socio-técnicas y participación ciudadana: propuestas conceptuales y analíticas para el uso de las TICs. REDES. 2006[acesso 21 fev 2016];11(3). Disponível em: http://revista-redes.rediris.es/html-vol11/Vol11_3.htm

22. Callon M. Entrevista com Michel Callon: dos estudos de laboratório aos estudos de coletivos heterogêneos, passando pelos gerenciamentos econômicos. Sociologias. 2008;(19):302-21.

23. Nunes T, Bicca A, Salazar F, Portela G, Furtado L, Cardoso ML et al. Educação em saúde pública/coletiva no Brasil: rede, sinergias e renovação. CICS - Publicações EBooks [Internet]. 19 de julho de 2014 [acesso 2 fev 2016];0(0). Disponível em: http://revistacomsoc.pt/index.php/cics_ebooks/article/view/1907

24. Jesus MS. Comunicação e fluxo da informação para governança de políticas públicas: estudo de caso da rede sociotécnica da região Serrana no Distrito Federal [dissertação]. Brasília, DF: Universidade de Brasília; 2015.

25. Maia CS, Sousa NM. A VISA e suas relações: percepções diversificadas e cooperações necessárias à segurança sanitária. In: Agência Nacional de Vigilância Sanitária – Anvisa. Ciclo de debates em vigilância sanitária: desafios e tendências. Brasília, DF: Agência Nacional de Vigilância Sanitária; 2015. p. 19-27.

26. Bastian M, Heymann S, Jacomy M. Gephi: an open source software for exploring and manipulating networks. In: Proceedings of the 3rd International ICWSM Conference; 2009 [acesso 19 mar 2016]. p. 361-2. Disponível em: http://www.aaai.org/ocs/index.php/ICWSM/09/paper/view/154/1009

27. Brasil. Lei nº 10.973, de 12 de fevereiro de 2014. Dispõe sobre incentivos à inovação e à pesquisa científica e tecnológica no ambiente produtivo e dá outras providências. Diário Oficial União. 31 dez 2004.

28. Brasil. Lei nº 8.666, de 21 de junho de 1993. Regulamenta o art. 37, inciso XXI, da Constituição Federal, institui normas para licitações e contratos da Administração Pública e dá outras providências. Diário oficial União. 6 jul 1994.

29. Ministério da Saúde (BR), Secretaria de Ciência, Tecnologia e Insumos Energéticos. Propostas de projeto de PDP aprovadas de 2009 a 2014. Brasília, DF: Ministério da Saúde; 2016[acesso 3 mar 2016]. Disponível em: http://portalsaude.saude.gov.br/images/pdf/2016/fevereiro/16/Consolidado-PDP-2009-a-2014---no-site-em-16.02.2016.pdf

30. Ministério da Saúde (BR). Portaria Nº 1.020, de 21 de julho de 2015. Altera o "caput" e os §§ 3º e 4º do art. 19 da Portaria nº 2.531/GM/MS, de 12 de novembro de 2014, e acresce inciso IV ao "caput" do art. 2º da Portaria nº 918/GM/MS, de 6 de julho de 2015. Diário Oficial União. 22 jul 2015.

31. Fleury S, Ouverney A. O sistema único de saúde brasileiro: desafios da gestão em rede. Rev Port Bras Gest. 2012;11(2-3):74-83.

32. Malini F. Introdução à teoria dos grafos e análise de redes sociais. In: Extrair, minerar e visualizar controvérsias em redes sociais. Curso na Câmara dos Deputados. 6 mar 2014[acesso 19 mar 2016]. Disponível em: http://pt.slideshare.net/fabiomalini/introduo-teoria-dos-grafos-e-anlise-de-redes-sociais?next_slideshow=1

33. Gephi. The Open Graph Viz Platform. Gephi; 2008 [acesso 19 mar 2016]. Disponível em: https://gephi.org/

34. Ministério da Saúde (BR), Secretaria de Ciência, Tecnologia e Insumos Energéticos. Projetos de Parcerias para o Desenvolvimento Produtivo (PDP), PDP e PDP P, D&I extintos. Brasília, DF: Ministério da Saúde; 2016[acesso 3 mar 2016]. Disponível em: http://portalsaude.saude.gov.br/images/pdf/2016/fevereiro/16/PDP-extintas---no-site-em-16.02.2016.pdf

35. Scherer FO, Bignetti LP, Carlomagno MS. A gestão da inovação: o octógono da inovação. Porto Alegre: Innosciene Consultoria em Gestão da Inovação; 2015[acesso 29 fev 2016]. Disponível em: http://sandro.eng.br/Inovacao/a_gestao_da_inovacao_o_octogono_da_inovacao.pdf

36. Albagli S, Maciel ML. Informação e conhecimento na inovação e no desenvolvimento local. Ciênc Inform. 2004;33(3):9-16. https://doi.org/10.18225/ci.inf..v33i3.1028

37. Silvestrow SP. Licitação e o uso do poder de compra do Estado como instrumento de incentivo a inovação [monografia]. Brasília, DF: Instituto Brasileiro de Direito Público; 2015

38. Ministério da Saúde (BR). Parcerias para o desenvolvimento produtivo. In: Reunião do Grupo Executivo do Complexo Industrial da Saúde – GECIS: extraordinária; 25 set 2015[acesso 3 mar 2016]; Brasília. Disponível em: http://portalsaude.saude.gov.br/images/pdf/2015/outubro/02/Apresentacao-Parcerias-para-Desenvolvimento-Produtivo29-10-15Gecis.pdf

39. Ministério da Saúde (BR), Secretaria de Ciência, Tecnologia e Insumos Estratégicos. Fase IV: internalização de tecnologia: Parcerias para o Desenvolvimento Produtivo. Brasília, DF: Ministério da Saúde; 2016[acesso 21 mar 2016]. Disponível em: http://portalsaude.saude.gov.br/images/pdf/2016/fevereiro/16/Fase-IV---Internaliza----o-de-tecnologia---no-site-em-16.02.2016.pdf

Conflict of interest

The authors report that there is no potential conflict of interest with peers and institutions, political or financial, in this study.