Wenzel H, Bjegovic-Mikanovic V, Laaser U. Piloting an advanced methodology to analyse health care policy networks: The example of Belgrade, Serbia (Original research). SEEJPH 2015, posted: 27 July 2015. DOI 10.12908/SEEJPH-2014-52

ORIGINAL RESEARCH

Piloting an advanced methodology to analyse health care policy networks: The example of Belgrade, Serbia

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Abstract

Aim: Political decisions usually emerge from the competing interests of politicians, voters, and special interest groups. We investigated the applicability of an advanced methodological concept to determine whether certain institutional positions in a cooperating network have influence on the decision-making procedures. To that end, we made use of the institutional network of relevant health care and health governance institutions, concentrated in Belgrade, Serbia.

Methods: We used a Principal Component Analysis (PCA) based on a combination of measures for centrality in order to evaluate the positions of 25 players in Belgrade's institutional network. Their directed links were determined by a simulated position approach employing the authors' long-term involvement. Software packages used consisted of *Visone 2.9*, *UCINET 6*, and *KeyPlayer 1.44*.

Results: In our analysis, the network density score in Belgrade was 71%. The PCA revealed two dimensions: *control* and *attractiveness*. The Ministry of Health exerted the highest level of control but displayed a low attractiveness in terms of receiving links from important players. The National Health Insurance Fund had less control capacity but a high attractiveness. The National Institute of Public Health's position was characterized by a low control capacity and high attractiveness, whereas the National Drug Agency, the National Health Council, and Non-Governmental Organisations were no prominent players.

Conclusions: The advanced methodologies used here to analyse the health care policy network in Belgrade provided consistent results indicating that the intended decentralization of the health care network in Belgrade may be incomplete, still with low participation of civil society representatives. With the present study we set the stage for a broad-range survey-based data collection applying the methodology piloted in Belgrade.

Keywords: Belgrade's health care policy network, policy analysis, Serbia, social network analysis, sources of power.

Conflicts of interest: None.

Acknowledgments: This work was supported by the Ministry of Science and Technological Development, Republic of Serbia, Contract No. 175042.

Introduction

Political decisions are not primarily the result of scientific (rational) problem solving - like e.g. the illustration of the policy cycle suggests (1,2). The decisions usually will emerge from the competing interests of politicians, voters, and special interest groups. The policy literature considers this issue and suggests a variety of frameworks and analytic models for policy analysis (3). The spectrum ranges from the rather normative scientific problem solving approach to a more 'incrementalistic' way (4). Lindblom even calls it 'muddling through' (5) - and finally to the paradigm of 'bounded rationality' (6,7). Analyzing decision outcomes (policies) has to consider the specific organisational structure (policy) and the initiated processes (politics), comparable to Donabedian's concept of structure and process as a prerequisite of outcome quality (8). Related questions are: How will political decision processes possibly influence policy-making (6)? Do certain individual or institutional positions in a cooperating network have more or less influence on the decision-making procedures?

To explore the complex governmental portfolio of resources, Hood et al. (9,10) propose a classification scheme, which gets to the point with only four important sources of power: *Nodality, Authority, Treasure and Organisation*. They state that *nodality* denotes the property of being in the middle of an information or social network (10). A high degree of nodality gives a player a strategic position from which he allocates information, and which enables him to draw in information. *Authority* is the formal and legitimate official power (11). That is the formal power to demand, forbid, guarantee, and arbitrate. *Treasure* gives the government the ability to exchange goods, using the coin of money or something that has a money-like property. Finally, *organisation* gives to a government the physical ability to act directly, using its own forces (10).

With the Serbian Health Insurance Act of 2005 (12) the Serbian government aimed at reorienting the health care system and transform it into a more decentralised organisation. These changes would hopefully offer to the insured population an opportunity for a greater self-management. As most of the relevant institutions are concentrated in the Serbian capital Belgrade, we used this example to investigate the applicability of the aforementioned methodological concept. With the disclosure of the players' nodalities that make up Belgrade's health care policy network, we envisaged to analyse to which degree the decentralisation of decision making has progressed since the legislation of 2005, extending our preliminary analysis (13). With the present step we focus on institutional players and their nodality only, without consideration of potentially influential individual players. The analysis of Belgrade's health policy network is a pilot project appropriate for testing the feasibility of a countrywide survey. This analysis was based on a questionnaire survey.

Methods

To break down the abstract notion of power and influence, different paradigms were used in sociology and political science: reputation approach, decision approach, or position approach (14). For a critical review of the approaches see Domhoff (14). In our understanding, influential actors can be best described by the position approach, i.e. a policy network. A policy network is described by its various players - public as well as non-governmental - their formal and informal connections and the specific boundary of the network under consideration. The links between the players are likely to be understood as communication channels for the exchange of information, expertise, trust and other policy resources (15). Depending on the scientific disciplines, e.g. coming from *community power research* (14), or *systems thinking* (16,17), various technical approaches and measures have been used to identify, describe and

analyse formal or informal networks within organisations. Necessary data can be collected by means of survey (questionnaires, interviews), observations, or by analysing secondary data. For economic reasons, a heuristic procedure as outlined e.g. by Vester (16) or Bryson (18) was applied and possible actors [so-called boundary specification (19, p. 77)] were enumerated in a brainstorming session listed in a "cross-impact matrix" of influences (16, p. 188). Finally, the strength and direction of their connections was estimated (16, p. 188) by the authors for the purpose of this methodological study. These are "soft data" (16, p. 22), but nevertheless they are based on experience, knowledge of the health care system and observations. As Newman points out, collecting data by directly questioning participants (or, players) does not necessarily provide a higher accuracy and is also a laborious endeavour (20). For visualisation of the network and a more in-depth analysis, we recurred to the analytic tools of Social Network Analysis (SNA). The concept of nodality corresponds well with the measures used in SNA and, basically, two viewpoints are possible: primarily focusing on a specific player (ego-centred) only, and analysing and evaluating the network as a whole, taking all connections and all players into account (socio-centred) (13).
On a *socio-centred level*, the network structure can be described by measuring density and centralization. *Centralization is defined as the variation in the centrality scores* of the nodes or players in the network. This variation shows the extent to which there is a centre - i.e., very central players - and a periphery - i.e., players with very low centrality scores (21). *Density is a basic network property* that reflects the overall intensity of the connected players: the more connected the network, the greater its density. A dense network is one where a lot of activity or a large number of strong ties exist among its members (22). On an *ego-centred (individual) level*, we focused on the players' importance. Importance reflects the visibility to other network members (23) and is broken down into indices like influence and prestige.

Measures of centrality
The concept of centrality is a crucial aspect when representing policy networks (24). Centrality measures will identify the most prominent players. These are the players who are extensively involved in relationships with other network members (25) without necessarily discriminating between formal or informal links (depending on the data collection approach). The most frequently centrality measures used include degree centrality, betweenness centrality, and closeness centrality. They reflect the view that information is transferred along the shortest pathways (26).

Degree centrality is an indicator of expertise and is measured by the sum of all other players who are directly connected to a specific player (25). Asymmetric networks are particular in that the distinction between *indegree-centrality* and *outdegree-centrality* has to be taken into account (13). Players receiving many ties (*indegree*) have a high prestige (23). Players with a high flow of outgoing connections (*outdegree*) are able to exchange with many others, or - at least - make others aware of their views (13). This means that players with a high outdegree centrality are said to be influential players (27).

Betweenness centrality counts how many times a player connects other players, who otherwise would not be able to reach one-another (25). It measures the potential for control, because a player who shows a high betweenness degree will be able to operate as a gatekeeper by controlling the flow of resources between the other nodes that are connected through him (25) - on shortest paths (28).

Closeness centrality is based on the concept of distance. A player who is close to all others in the network, e.g. having a distance of no more than one, is not dependent on any other to reach everyone in the network (25). Closeness centrality measures independence or efficiency (25). In the context of SNA, efficiency means that the higher the closeness centrality of a node, the shorter is its average distance to any other node, thus indicating a better position for spreading information (29).

Further centrality measures are hub function and authority. In directed networks, players that have important resources should get a high centrality score too. Newman defines it as follows: *"Authorities are nodes that contain useful information on a topic of interest; hubs are nodes that tell us where the best authorities are to be found"* (30, p. 179). In the framework of SNA, formal authority has to be differentiated from informal authority (11). Hubs are enablers of effective knowledge transfer (31, p. 225). A high hub player points to many important authorities (high outdegree) whereas a high authority player receives ties from many important hubs (high outdegree). They can effectively connect different sub-groups of the network and facilitate knowledge flows; removing them from the network can lead to its fragmentation (31, p. 225).

Study setting

For investigating the applicability of the methodological concept we chose a position approach as it best describes the potential of power and influence, combined with a heuristic data collection. To that end, the authors - all well informed about the Serbian health care system and the situation in Belgrade - listed 25 players, identified the links between the players and the perceived strength of their relationship together in an open process. As pointed out earlier (13), the links can point in one direction only (unidirectional), or include both directions (bidirectional). The strength of the relationship was rated on a scale ranging from 0 to 4. Very weak links with a value of 1 were put on a level with 0 for "no link" (13). The rating of the links reflects the averaged assessment of the authors. The resulting "cross-impact matrix" was exported to *Visone 2.9* (15) for further analysis. In some cases where the analytic toolset of *Visone 2.9* did not provide the calculation of specific indices, we used *UCINET 6* (32), and *KeyPlayer1.44* (33) instead.

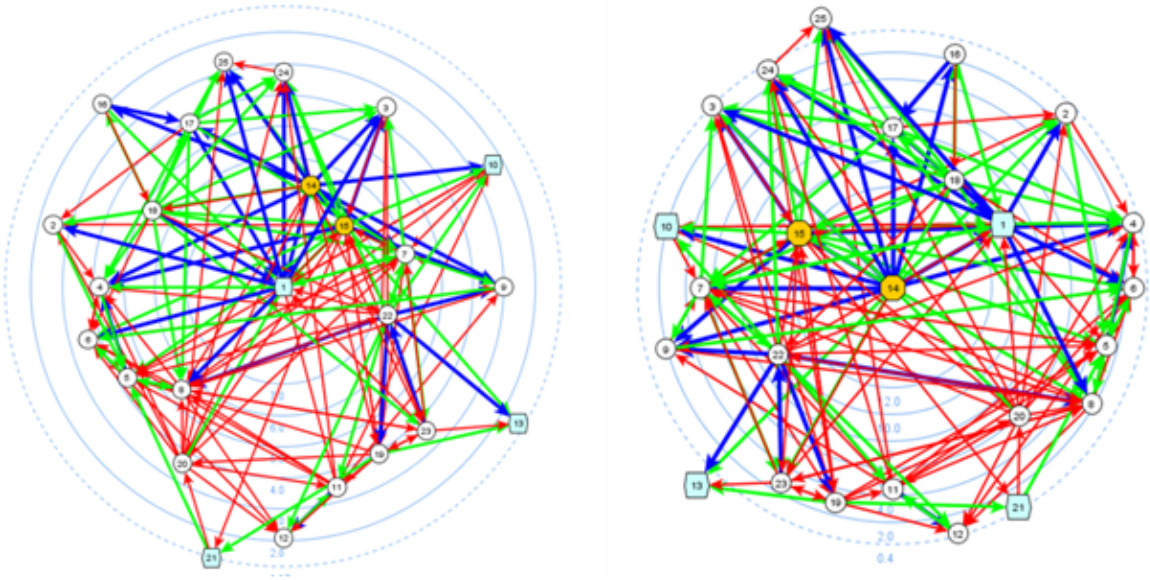
To visualise the analytical findings in an easily understandable format, we chose the design of a target diagram, which is also a built-in feature of *Visone 2.9*. In this diagram, the 25 players (nodes) are placed according to their scores. This means that the player with the highest score is positioned in the centre of the diagram; the others, according to their decreasing scores, are moved toward the periphery of the structure, correspondingly. To ensure a largely undisturbed view, the authors of *Visone 2.9* applied a specialized layout algorithm that aims at minimizing entanglement by reducing the number of crossing lines and occlusions determine the angular location. The different score levels are displayed as thin concentric circles. This allows comparing the scores of the players easily, without looking at the output table (15, p. 17). Brandes et al. (15) successfully used these diagrams to analyse local health policies and the underlying structure of the various players, e.g. to disclose the differences in the local drug policy of two German municipalities and the networks of players that form the basis of the policy making. Furthermore, to facilitate an overall perspective (holistic view) of the indices applied, we merged the results with the help of a Principle Component Analysis (PCA) diagram. PCA is a multivariate data analysis method which is used to reduce complexity by transforming a set of possibly correlated variables into a set of uncorrelated variables,

i.e., principal components (34,35). This approach explains best the variance of data and helps to reveal the internal structure of the data.

Results

The network matrix was composed by 25 players and 158 directed and valued links or connections as determined - for the purpose of this methodological study - by the authors. The network density was calculated as 71% realized links out of all possible ones. A density greater than 50% is considered high (36). Therefore, we assumed here that the players in Belgrade were well connected. For valued networks (see Figure 1), the centralization score has to be calculated separately for outdegree and indegree centrality. The outdegree score here was 46.3% of all possible connections, whereas the indegree score was 19.1% (calculated with *UCINET 6*). This would disclose a distinct centralisation. However, the range of outdegree scores was larger than that of indegree scores, and the players showed a higher variability. The coefficient of variation was 93% for outdegree and 54% for indegree centrality, indicating that the network was less homogeneous with regard to outdegree centrality, or influence (27). The possible influence of the players in the network varied largely, i.e., the positional advantages were rather unequally distributed.

Figure 1: Target Diagram of Belgrade's Health Care Network with respect to 'Degree Centrality' and 'Hub Function'



1 a: Degree Centrality ***1 b: Hub Function***

The colours describe the strength of the links. Red colour corresponds to number 2, green colour to number 3 and blue colour to number 4. The hexagon symbols show the players that are indicators for a more decentralized system; the octagon symbols represent the Ministry of Health [15] and the National Government [14]. For the numeric codes see Table 3 in the annex.

The most important players – identified in terms of degree centrality (Figure 1a and Table 1) - were the National Health Insurance Fund [1], the Ministry of Health [15], the National Government [14], and the Medical Faculty, Belgrade [22]. The Health Insurance Fund [1] received most of the strongest [blue] links. The players with the highest indegree centrality or

prestige were the Clinical Hospital Centres, Belgrade [8], the Institute of Public Health, Belgrade [4], the National Health Insurance Fund [1], and the Clinical Hospital Centre of the Republic [7]. Players with the highest outdegree centrality or influence were the National Government [14], the Ministry of Health [15], the Medical Faculty, Belgrade [22], the State Revisor [18], and the National Health Insurance Fund [1].

Table 1. Ranking of players by centrality indices
(based on percentages – for the numeric codes, see Table 3 in the annex)

INDICES OF CENTRALITY						
Degree centrality	**Indegree centrality**	**Outdegree centrality**	**Betweenness**	**Closeness**	**Hub function**	**Authority**
1	8	14	8	14	14	3
15	4	15	15	15	15	8
14	1	22	22	18	18	4
22	7	18	7	22	1	7
7	3	1	19	19	22	23
8	5	17	1	7	17	1
18	6	7	20	1	20	25
5	23	20	11	20	7	9
4	25	19	23	23	11	2
17	9	11	5	17	19	10
19	15	23	6	11	5	15
20	23	8	9	16	23	6
23	2	5	23	8	8	23
6	10	16	18	10	10	5
11	22	9	12	3	9	13
3	12	6	17	9	16	17
23	19	10	3	23	6	16
9	13	4	4	21	2	19
25	17	2	10	12	4	12
2	11	12	2	5	23	22
10	20	21	14	6	21	20
12	16	23	16	2	12	11
16	21	3	21	4	3	21
13	18	25	25	25	25	18
21	14	13	13	13	13	14

With respect to the betweenness centrality, the Clinical Hospital Centres, Belgrade [8] were the most central players. The Ministry of Health [15], the Medical Faculty, Belgrade [22], the Clinical Hospital Centre of Serbia [7], and the Serbian Physicians Society [19] seemed to be very close to each-other, but located more to the margin. Players with a high degree of closeness were the National Government [14], the Ministry of Health [15], the State Revisor [18], the Medical Faculty, Belgrade [22], and the Serbian Physicians Society [19]. The picture changed when we looked at hub functions. As pointed out, hubs are enablers of effective knowledge transfer, they can effectively connect different sub-groups of the network and facilitate knowledge flows; removing them from the network can lead to its fragmentation (31, p. 225). Considering the hub function, the National Government [14] was in the most

favourable position (see figure 1b), followed by the Ministry of Health [15]. The National Health Insurance Fund [1] moved more to the periphery indicating a loss of importance for knowledge transfer. The State Revisor [18] and the MOF Budget Inspection [17] also moved more to the centre of the diagram.

As Hannemann and Riddle note, the question of how structural positioning implicates power is still a matter of research and debate (34). To reduce the complexity, eventually sort out redundant information and get an integral view, we applied PCA which is displayed in Table 2 and Figure 2.

Table 2. Contribution of centrality measures to the dimensions of the PCA (percentages)

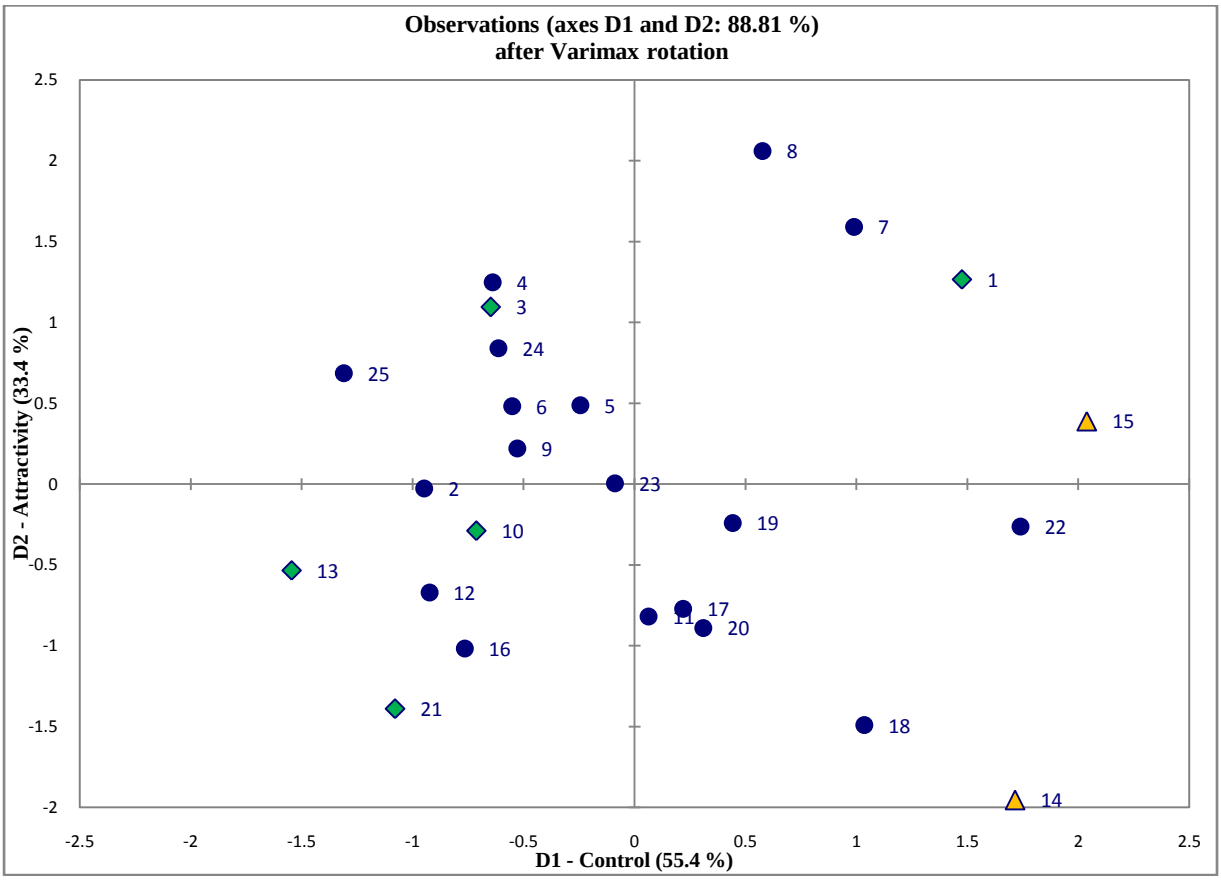
CENTRALITY MEASURES	D1 (Control)	D2 (Attractiveness)
Degree	**22.645**	3.186
Indegree	0.159	**40.837**
Outdegree	**22.820**	3.876
betweenness	12.246	7.907
closeness	**19.822**	3.205
Hub function	**21.654**	3.607
authority	0.654	**37.381**

The PCA provides evidence of two dimensions (Figure 2); they explain 88.81% of the data. The first dimension consists of degree, outdegree, closeness, and hub function. The second dimension consists of indegree and authority. The first dimension D1 represents the capacity for "Control"; the second dimension D2 depicts what we called "Attractiveness".

The main players: The Ministry of Health [15] - apart from the formal aspect i.e. legal authority and organisation - was highly ranked on the first dimension of control. On the second dimension of attractiveness, it was ranked just above the average. This picture was confirmed in the classification by hub function and authority. The Ministry of Health was a hub as well as an authority in this analysis, whereas the hub feature was more pronounced. This would mean that it was connected to many popular players and received links from important players. The National Government [14] was likewise highly ranked on the first dimension, but showed the lowest score on the second dimension. This means that control was high but the attractiveness was low. On the other hand, the National Government [14] was also a hub, which means that it was connected to many very important players, and its influence might be based on this feature, primarily. The National Health Insurance Fund [1] showed less potential of control [first dimension] than the Ministry of Health [15], but had a higher score on the attractiveness axis [second dimension]. The National Health Insurance Fund [1] was a hub and an authority too. The hub score was lower than that of the Ministry of Health or the National Government, but its authority score was very pronounced. This means, its authority feature - receiving links from important players – in our pilot study was more important.

According to this analysis, effective decentralisation would require more autonomy for institutions like the National Institute of Public Health [3], the National Drug Agency [10], the National Health Council [13], and Non-Governmental Organisations [21], all ranking with the exception of the National Institute of Public Health [3] towards the end in Table 1 and low on both dimensions in Figure 2. But, also the Chambers of Health Professionals [11, 12] could play a more important role as well as the trade unions [20] and the branches of the National Health Insurance Fund [2].

Figure 2. The position of players by two dimensions



Legend: The yellow triangles mark the National Government and the Ministry of Health; the green diamonds signify the players focussed in the analysis; the blue circles represent the remaining players. For the numeric codes, see Table 3 in the annex.

The National Institute of Public Health [3] ranked below average on the first dimension (control) and was positioned above average on the second dimension (attractiveness) that is players were seeking contact. Its high authority score confirmed this, but as a hub it ranked very low (Table 1). According to Borgatti, such players are primarily mediators (37).

Discussion

It is a widespread view in the literature that no single or generally accepted method for measuring decentralization exists (38); there are many different definitions, understandings of the concepts and diverse measurement instruments (39). Thus, measuring centralization or decentralization is mostly based on analyzing the financial autonomy or regulatory mechanisms (39,40). Independent of the underlying "intellectual tradition" (41), disciplinary and language differences, and the way the various indices were constructed, these approaches focus on formal aspects. Informal ways of influence and power are not taken into account. However, these informal relationships may superimpose the formal balance of power, supporting or even hindering structural changes or specific policy-making, and possibly will underestimate the real balance of power. The concept of nodalities, used here, is based on relationships (links). These links cannot only indicate subordination but can also stand for information

channels. Insofar, mapping the nodalities, is complementary to the approaches mentioned above and will round off the picture.

Compared to other European countries, Serbia is among the most centralized systems (42). It ranks second on a list of thirteen countries (38). The analysis of the degree and appropriateness of decentralization, however, is not an end in itself. It is a means to achieve a broader spectrum of goals (43) or, more generally speaking, it is an important component of good governance (38). Very often it is emphasized that decentralization is a very significant step in promoting democracy (44,45). With decentralization essential goals should be achieved, such as effectiveness and efficiency, fairness, quality, financial responsibility, and respect for local preferences (43,45). Decentralization is one of the most important issues on the agenda of health care reform in many countries. However, there is little information from research that can show the likely correlation between the degree of centralization and health outcomes, i.e. the health of the population (40). Furthermore, observations and case studies indicate that, if inadequately planned, and implemented, i.e. too rapidly or inconsistently, decentralization can have serious consequences on the provision of health services to the population (43). For that reason, appropriate planning, and considering corresponding experiences in other countries, may prevent disappointment and slow-down of processes. Decentralization also will shift the role of the Ministry of Health, from direct management and decision making toward formulating health care policies, technical counselling and assistance, as well as monitoring and evaluation of programmes and activities.

Decentralization represents the transfer of authority and responsibility for public functions from the central to subordinate levels and/or to the private sector (43,45). The essential task, then, is to define the adequate level of decentralization (45) by entities, i.e., regions, districts, and municipalities, and by appropriate forms of bureaucratic autonomy, i.e. deconcentration, delegation, and devolution. Any consideration on whether decentralization is necessary and how much will be feasible has to undergo a detailed examination in the context of a (rational) organisational structure (46); this is very often perceived a common place, and ignored with associated consequences. Certain aspects of decentralization deserve closer attention. For example, the possibility of local authorities to adapt to local conditions should be carefully balanced against a common vision and the goals of the health care system (4). For this reason, the policy of decentralization should include mechanisms of coordination, since the local political interests grow as more responsibilities are transferred to that level (47). Furthermore, decentralization bears the risk of fragmenting responsibility for different types of health care (specialist hospitals, general hospitals, primary care etc.) between the levels of regional and municipal government (43). In this context, it is indicative that the coordinative and integrative potential of the National Health Council of Serbia [13] seemingly is not used. This body could include Non-Governmental Organisations [21] in the field of health, as well as trade union representatives from the most important health institutions.

The limitations of our approach relate to its validity and reliability. A valid model has to be isomorphic, thus representing a true picture of the system to be modelled. The level of isomorphism can be disclosed in analogy to the revision of 'validity of structure and processes' (48), or 'expert concurrence' (49). However, in this study the boundaries and the links remain to be crosschecked as a next research step, especially as the present dataset relies only on the author's evaluation of the situation. Missing data, i.e., the absence of players and/or links can also have an important impact (50,51) on the 'application validity'. Another criticism that raised concerns relates to the shortest paths-based measures as they do not take into account

diffusion along non-shortest paths (52). However, the modelling algorithms used here are consistent with validated standard computer software.

In order to challenge the appropriate level and structure of a health care system and to control any process of reorganisation, it is essential to be fully familiar with the positive interaction of the various players. In this context, it is an important cornerstone to know the nodality of the health care network, in our example that of Belgrade hosting most of the national health institutions. The network depicted would also provide a basis for what-if-scenarios to anticipate the likely effects of intended changes. Furthermore, the methodology used for the network and its description, which examines the system from a relatively high level (bird's eye view), can be adapted to specific decision-making situations, and tailored to support specific planning processes.

Conclusion

The advanced methodologies used here to analyse the health care policy network in Belgrade deliver consistent results indicating that the intended decentralization of the health care network in Belgrade may be incomplete, still with low participation of civil society representatives. With the present study we hope to prepare for a broad-range survey-based data collection and to apply the methodology piloted in Belgrade.

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ANNEX

Table 3. List of Players and their corresponding codes

Work Code	Full name
1	National Health Insurance Fund
2	NHIF, Belgrade Branch
3	National Institute of Public Health
4	Institute of Public Health, Belgrade
5	Secretary for Health, Belgrade
6	Primary Health Care Centres (17), Belgrade
7	Clinical Hospital Centre of Serbia
8	Clinical Hospital Centres (4), Belgrade
9	National Accreditation Agency
10	National Drug Agency
11	National Chambers of Health Professionals
12	Chambers of Health Professionals, Belgrade Branches
13	National Health Council
14	National Government
15	Ministry of Health
16	Ministry of Finance
17	MOF Budget Inspection
18	State Revisor
19	Serbian Physicians Society
20	Trade Unions
21	Non-Governmental Organisations
22	Medical Faculty, Belgrade
23	Council of the Medical Faculty, Belgrade
24	Special Hospitals, Belgrade
25	Tertiary Medical Institutes, Belgrade