

# Research on the Cooperation Network of China' Healthcare Big Data Policymakers

Xuezhong Leng\*, Guoyuan Han

Department of Public Administration, Harbin Engineering University, Harbin, China

\*Corresponding author: 2601963821@qq.com

**Keywords:** China, Healthcare Big Data, Policymaker Cooperation Network, Social Network Analysis.

**Abstract:** Based on China's healthcare big data policies jointly released by various central departments from 2009 to 2019, this paper uses social network analysis method and complex network analysis software Gephi 0.9 to measure the node attributes of major policymakers in the cooperation network, so as to analyze the evolution of their roles in different periods. It is found that the policymakers of healthcare big data in China are gradually diversified, and the scale of cooperation network is expanding, but the degree of cooperation between policymakers needs to be strengthened.

## 1. Introduction

Healthcare big data is an important basic strategic resource of China, it has also played an important role in China's response to COVID-19. The development of healthcare big data involves the new generation of information technology, medical information, population information, infrastructure construction, human resources, information security and other factors, which is a systematic and complex construction project [1-2]. To this end, Chinese government departments have issued a range of policies to promote the development of healthcare big data. Nonetheless, due to the differences in resources, responsibilities and interests, there is a problem of uncoordinated work among different government departments in promoting the realization of policy objectives, which is not conducive to the development of healthcare big data. Therefore, drawing on the research ideas of existing studies on the policymakers cooperation network [3-4], this paper studies the cooperation relationship between healthcare big data policymakers and analyzes the existing problems.

## 2. Research methods and data processing

### 2.1 Social network analysis

Social network analysis is a quantitative research method commonly used to analyze the relationship data between people or organizations in the field of social science, which can describe the relationship network qualitatively and fully reflect the relationship between each node [5]. Gephi is a complex network analysis software based on JVM, which can be used to measure the attributes of nodes in social networks [6]. The main node attributes of this study are as follows:

(1) Degree centrality: The higher the degree value is, the more nodes the node connects in the network. The calculation formula is as follows:

$$DC_i = \frac{k_i}{N - 1}$$

(2) Betweenness centrality: The greater the impact on the path of other nodes in the network, the more important the node is. The calculation formula is as follows:

$$BC_i = \sum_{s \neq i \neq t} \frac{n_{st}^i}{g_{st}}$$

(3) Closeness Centrality: The smaller the average distance between a node and other nodes in the

network, the more important it is in the overall network. The calculation formula is as follows:

$$CC_i = \frac{1}{n-1} \sum_{j=1}^N d_{ij}$$

(4) Eigenvector centrality: The importance of nodes in the whole network is expressed by the number of adjacent nodes. The calculation formula is as follows:

$$C_e(i) = \lambda^{-1} \sum_{j=1}^N a_{ij} e_j$$

## 2.2 Data collection and screening

Taking the official websites of the National Health Commission of China and the Chinese government as the retrieval platform, and taking healthcare big data as the keywords, this paper collected the healthcare big data policy texts issued from 2009 to 2019. After the search, the duplicate policy texts are deleted, and the irrelevant and weakly related policy texts are deleted on the basis of reading the policy literatures. The annual sample distribution is shown in Figure 1. Considering the construction process of healthcare big data and national institutional reform, the sample is divided into four periods: 2009.1-2013.3(Preliminary development of healthcare big data), 2013.3-2016.6(Healthcare big data policy officially released), 2016.6-2018.3(Healthcare big data policy increases rapidly) and 2018.3-2019.12(State institutional reform).

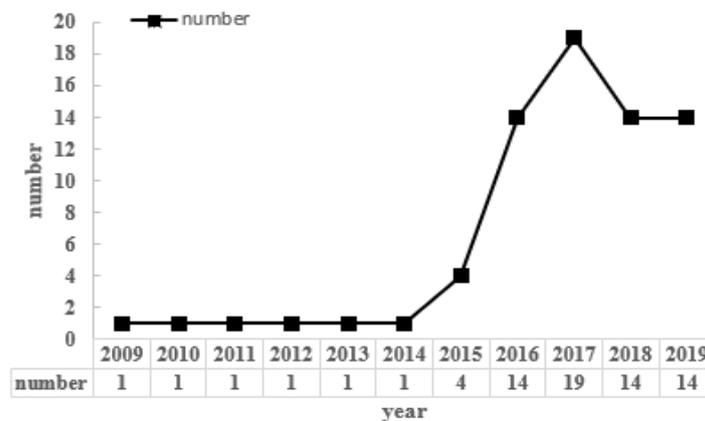


Figure 1. Number of policies jointly issued by multiple departments

## 3. Results

In the cooperation network of policymakers in each period, the corresponding network node size of each policymaker is based on the total number of independent and joint documents issued by the policymaker. The larger the network node is, the more the policymaker participates in the formulation and release of policies. The path between network nodes indicates the cooperation times of policymakers. The more cooperation times between different policymakers, the thicker the connection between the corresponding network nodes. Through the statistical calculation module of Gephi, the overall network indicators of the policymakers cooperation network in four periods are obtained, as shown in Table 1. Overall, the number of healthcare big data policymakers in China is increasing, and the cooperation network density among policymakers firstly increases and then decreases. From the perspective of the average path and diameter of the cooperation network, the cooperation relationship between different policymakers is relatively loose, and the level of effective cooperative governance has not yet been achieved.

Table.1. Healthcare big data policymakers cooperation network attribute

Period	2009.1-2013.3	2013.3-2016.6	2016.6-2018.3	2018.3-2019.12
Graph density	0.22	0.288	0.230	0.20
Average path length	1.24	1.488	2.332	1.99
Clustering coefficient	0.91	0.884	0.844	0.84
Network size	14.00	28.00	45.00	47.00
Network path	32.00	190.00	333.00	354.00
Network diameter	2.00	2.00	4.00	5.00

During the period from January 2009 to March 2013, China's healthcare big data policy network is relatively closed, and few policymakers participate in policy formulation and release. The core policymakers are Ministry of health, National Development and Reform Commission, Ministry of finance, the State Council, Ministry of industry and information technology and so on (Table.2). During this period, the connections between network nodes are sparse, and the number of policies jointly issued is small. Big data has gradually entered the social field after 2008, and all aspects about it are still in the exploration status. The combination of big data and healthcare has just entered the policymakers' thoughts. The development of healthcare big data starts from the gradual promotion of medical informatization. As the key work of the 12th Five Year Plan medical and health system reform, the construction of medical informatization has gradually developed.

Table.2. Main policymakers in the first period

Policymaker	Closeness Centrality	Degree Centrality	Betweenness centrality	Eigenvector centrality
Ministry of health	1.00	1.00	4.00	1.00
National Development and Reform Commission	0.83	0.90	0.00	0.77
Ministry of finance	0.83	0.90	0.00	0.77
the State Council	1.00	1.00	1.00	0.03
Ministry of industry and information technology	1.00	1.00	0.00	0.02

During the period from March 2013 to June 2016, China's healthcare big data development gradually received more attention of the relevant policymakers. In this period, the cooperation network path of policy subjects gradually becomes more and more, and the policymakers participants also improve. The core policymakers are Ministry of human resources and social security, Ministry of Finance, Health and Family Planning Commission, National Development and Reform Commission, Administration of traditional Chinese Medicine and so on (Table.3). The number of policies jointly issued has not increased significantly, but the network scale and network path have been greatly improved, which reflects that the policy attention of healthcare big data has further increased.

Table.3. Main policymakers in the second period

Policymaker	Closeness Centrality	Degree Centrality	Betweenness centrality	Eigenvector centrality
Ministry of human resources and social security	1.00	1.00	26.13	0.92
Ministry of Finance	1.00	1.00	26.13	0.92
Health and Family Planning Commission	1.00	1.00	26.13	1.00
National Development and Reform Commission	0.83	0.89	11.05	0.80
Administration of traditional Chinese Medicine	0.73	0.82	5.30	0.66

From June 2016 to March 2018, China's healthcare big data policymakers cooperation network has changed significantly. The main cooperation paths are 333. On June 21, 2016, the guidance of the general office of the State Council on promoting and standardizing the application and development of medical big data was officially released by the State Council. The focus of medical and health informatization has changed from the construction of population health and medical information data platform to the deep integration of healthcare and big data. With the development of telemedicine and residents' electronic health information card, the policy-making at this period has promoted the development of medical and big data, precision medicine and other medical and health undertakings, and the degree of social benefits is deepening. In this period, the cooperation network has a trend of gradual diffusion, network cohesion is 0.230, compared with the previous period, the number of policymakers has increased obviously. However, with the increase of the number of policymakers, the cooperation relationships among policymakers have gradually weakened (Table.4).

Table.4. Main policymakers in the third period

Policymaker	Closeness Centrality	Degree Centrality	Betweenness centrality	Eigenvector centrality
Health and Family Planning Commission	0.42	0.52	286.00	0.04
Ministry of Finance	0.63	0.77	136.06	0.97
National Development and Reform Commission	0.53	0.72	41.45	1.00
Ministry of human resources and social security	0.61	0.75	105.45	0.95
Administration of traditional Chinese Medicine	0.48	0.63	13.87	0.54

From March 2018 to December 2019, the number of healthcare big data policymakers main cooperation network paths are 354. In this period, the core policymakers are National Health Commission, Logistics support department of the Central Military Commission, Ministry of Education, Ministry of Finance, National Development and Reform Commission and so on (Table .5). The National Health Commission, as a new institution in the most recent Chinese national institutional reform, plays an important role in the healthcare big data policymakers' cooperation network, which also reflects the requirements of China's efficient administration.

Table.5. Main policymakers in the fourth stage

Policymaker	Closeness Centrality	Degree Centrality	Betweenness centrality	Eigenvector centrality
National Health Commission	0.82	0.90	134.44	1.00
Logistics support department of the Central Military Commission	0.58	0.67	128.00	0.48
Ministry of Education	0.77	0.86	68.11	0.91
Ministry of Finance	0.75	0.84	57.11	0.90
National Development and Reform Commission	0.71	0.80	56.31	0.78

#### 4. Conclusions

The policymakers of China's healthcare big data is gradually diversified. The cooperation network density of policymakers is quite small, and the cooperation relationship among different policymakers is sparse. In the four comprehensive analysis period, the National Health Commission, the national development and Reform Commission and the Ministry of finance are the core policymakers of China's healthcare big data policy. In order to promote the effective formulation and implementation of healthcare big data policies, we can consider establishing a policy oriented

learning and communication mechanism among different policymakers. Through this mechanism, each policymaker can reasonably divide existing resources, departmental interests and administrative responsibilities.

### **Acknowledgements**

The authors gratefully acknowledge the financial support from Key research subject of economic and social development in Heilongjiang Province (19041) & Fundamental Research Funds for the Central Universities (3072020CFT0903)

### **References**

- [1] Chen Hui, Shen Minghui, Li Jiayuan, et al. Policy analysis of health informatization construction in China based on policy tools [J]. *Modern preventive medicine*, 2020,47 (17): 3151-3153 + 3169
- [2] Liu Lihang, Yue Xin. How can local government policies promote the construction of Medical Alliance: a study of policy texts based on grounded theory[J]. *Chinese Journal of Health Policy*, 2019,(09):19-24.
- [3] Cullerton K, Donnet T, Lee A, et al. Joining the Dots:The Role of Brokers in Nutrition Policy in Australia[J].*BMC Public Health*,2017,17(1):307-307.
- [4] Peters D, Raab J, Grêauxk K, et al.Structural Integration and Performance of Inter-Sectoral Public Health-Related Policy Networks:An Analysis Across Policy Phases[J].*Health Policy*, 2017, 121(12):1296-1302.
- [5] Freeman L C.A Set of Measures of Centrality Based on Betweenness[J]. *Sociometry*, 1977, 40(1):35-41.
- [6] Ken Cherven.*Network Graph Analysis and Visualization with Gephi*[M]. Packt Publishing, 2013.