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ORIGINAL RESEARCH

The Evaluation of the Departmental Resources and Positions Within the Inter-Departmental Collaborative Networks: A Case Study on the Joint Prevention and Control Mechanism in China

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Introduction: This study examines the inter-departmental emergency response dynamics within China's Joint Prevention and Control Mechanism (JPCM). Departments' positions in the network are fundamental to understanding the overall structure and operation of the collaborative emergency response. Moreover, understanding the influence of departmental resources on departmental positions promotes efficient inter-departmental collaboration.

Methods: The study uses regression analysis to empirically investigate the departmental resources to departments' participation in the JPCM collaboration. The independent variable adopts the departments' positions by statistically presenting the departments' centrality using social network analysis. The dependent variables employ departmental resources, including departmental duties, staffing levels, and approved annual budgets based on data from the government website.

Results: The result of social network analysis shows that in JPCM inter-departmental collaboration, the Ministry of Transport, Health Commission, Ministry of Public Security, Ministry of Emergency Management, Ministry of Culture and Tourism, Ministry of Education, and Development and Reform Commission are mainly involved. The regression analysis result indicates that the department's engagement in collaborative actions is determined and influenced by the department's statutory duties. The more statutory duties department has, the more it is in a critical position and role for JPCM.

Discussion: The study can assist emergency management practitioners and academic departments in utilizing evidence-based approaches to justify the collaboration and involvement of participating departments. The analysis of the collaborative networks considering JPCM in China by the participation and organization logic is of fundamental significance for arguing for complementing COVID emergency management and inter-departmental emergency collaboration studies.

Keywords: Joint Prevention and Control Mechanism, inter-departmental collaboration, COVID, centrality, departmental resources

Introduction

In recent decades, studies have indicated that the emergency management system has progressively shifted from a centralized command and control framework to a more collaborative approach.[1–4] Among studies, emergency management studies have been approached from a multi-organizational collaborative perspective by public administration and social policy scholars.[5–15] In particular, what is the role of inter-departmental relationships in promoting collaboration within and between different levels of government? It is advisable to prioritize inter-departmental collaboration to implement policy decisions effectively.[9,16] Many studies have suggested that integrated, interdependent collaborations allow different departments to work together and develop new ways to solve problems too big for any one department to handle alone.[17–19] Moreover, a network that is characterized by increased dynamism and adaptability has been observed to facilitate collaboration among multiple departments,[9] including informal networks and mechanisms that aim to assist their residents in responding to and recovering from various crises.[20]

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According to scholars following China's most recent policy developments, the Joint Epidemic Prevention and Control Mechanism (JPCM) has become an essential component of COVID emergency management in this country.[21] The official definition of the JPCM is a multi-ministerial coordination working mechanism established by the State Council of China. The Chinese government has responded to the increasing scale of comprehensive emergencies by enhancing JPCM. This has entailed the establishment of inter-departmental collaborative emergency response networks, cross-level governmental interaction and coordination channels dedicated to COVID response, and development of extensive grassroots community mobilization capacities. JPCM operates at various levels of government hierarchy across the country, which are supported by the General Office (GO) (or called emergency rescue headquarters) as a standing department.[22,23] In this manner, cross-level collaboration entities have evolved into a loosen-structured mechanism that divides tasks and assigns them to JPCMs at different levels. Then each JPCM at a given level facilitates emergency health response tasks by promoting inter-departmental collaborations. As a critical case in emergency management, JPCM provides a complement for studying the advancing emergency management systems. Hence, there is a need for a differentiated investigation of how inter-department emergency collaboration of the JPCM enables speedy reaction during sizeable public health emergencies. It is worth noting that departments are basic units and elements within collaborative networks. A department's resources and position in the network play a fundamental role in understanding the overall structure and operation of the JPCM emergency response. For this reason, this paper aims to study how departmental resources can impact departmental positions within a network, such as departmental duties, staffing levels, and approved annual budgets. The study can assist emergency management practitioners and academic departments in utilizing evidence-based approaches to justify the collaboration and involvement of participating departments. This study takes the inter-departmental collaborative networks of The State Council level of JPCM as an example.

Many scholars have researched the inter-departmental emergency collaboration from various perspectives.

Collaboration in Emergency Management

In general, many scholars have pointed out that the domain and vocation of emergency management have transformed into a more cooperative endeavor.[3,4,24] This involves tackling problems that have extensive magnitude, impact a substantial populace, or demand vast resources that have surpassed conventional hierarchical confines.[1,25,26] As Waugh and Streib (2006) point out, the traditional hierarchical, bureaucratic model has evolved into a more adaptable and dynamic network model that enables collaboration among multi-organizational, inter-governmental, and inter-sectoral collaboration.[15] Coordination requires that different positions or actors perform subtasks of the decision sequentially. An effective response to large-scale disasters requires horizontal and vertical collaboration, facilitating diverse forms of collaboration among federal, state, and local governments.[27] This leads to the work of O 'Toole et al (2003 and 2006), who point out that inter-governmental relations refer to the mechanisms employed to facilitate coordination and collaboration among different tiers of government, with a particular emphasis on inter-departmental collaboration aimed at the practical implementation of policy decisions.[14,17,19]

Networks in Emergency Management

In studying emergency response operations, the network perspective has interested disaster researchers.[28] Studies believe that establishing and maintaining emergency management networks are essential components of contemporary emergency management methodologies. Using networks and partnerships is a powerful policy instrument for mitigating natural hazards and disasters.[29] Scholars have utilized a social network analysis methodology to identify pivotal actors, scrutinize inter-organizational interactions, assess network structures, juxtapose formal emergency management plans with existing networks, and appraise the efficacy of emergency management networks.[6,30–35] The study reveals that agencies occupying central positions in communication networks wield more significant influence, and the degree of accuracy in the collective perceptions of network participants is significantly and positively associated with the centrality of the leading agency.[30] The placement of networks along a continuum is determined by their characteristics, which indicate the extent to which individual members maintain their independence and autonomy.[36] Also, Kapucul et al (2009) use networks, partnerships, and collaborations in inter-governmental relations in a disaster response mechanism.[9]

Entities in Emergency Response

As Mandell (2004) observed, organizations are highly interdependent in collaboration, to the point of creating a new entity out of the collaboration process.[36] In their research, Kapucu et al (2009) point out that certain regions utilize the Emergency Operations Center as the central hub for response operations. This facility serves as a venue for representatives from various sectors, such as public safety, fire and rescue, law enforcement, city, local health departments, and local water districts, to convene and guarantee the prompt dissemination of vital information.[9] Press conferences are convened to apprise the local populace of the prevailing state of calamity and furnish supplementary directives. Public, private, and nonprofit organizations establish alignment with each other based on their respective purposes and engage in coordinated efforts utilizing communication through the Emergency Operations Center to support the community.[9]

Although many studies have been conducted on the collaboration among emergency response systems, it has been observed that during public health crises such as the COVID-19 pandemic, numerous non-healthcare departments play a critical role in emergency collaboration despite their lack of expertise. As per Kapucu et al's (2009) research, the collaboration capabilities of a subject encompass the possession of requisite resources such as financial, technological, human, and time to participate in collaborative endeavors effectively.[9] Thus, have the departmental resources influenced and dominated departmental involvement and emergency capacity in collaborative response efforts? Moreover, what departments of different expertise have played essential roles in coordinating emergency response? Do departmental resources dominate these collaborative capacities? In order to ascertain this information, further analysis and discussion are required regarding the department's available resources and positions within collaborative networks. This study aims to examine the response collaboration capabilities of China JPCM by examining the involvement of various departments and the impact of departmental resources on departmental participation. Two main questions will be answered in the following text: (1) What are the positions and characteristics of the departments within the networks of JPCM emergency response? (2) Do department resources significantly impact department positions and participation in the JPCM network?

Data and Methods

Data

The data was collected from January 2020 to November 2022. The reasons are as follows: On January 25, 2020, the State Council of China issued an official document for the first time in the name of the Joint Prevention and Control Working Mechanism for the Novel Coronavirus Outbreak. China did not relax its stringent "dynamic zeroing" policy until December 2022, signaling a dramatic shift in its approach toward epidemic control. Therefore, this study focuses on the JPCM during these three years (Jan. 2020–Dec. 2022). In the investigation, data collection occurred on multiple levels. The official documents of JPCM were located on its website and the website of the National Health Commission. Documents were collected when the website was routinely updated, and new records became accessible online. Additionally, the author emailed the JPCM of the State Council in January 2022 and obtained additional information by requesting public disclosure. To obtain a comprehensive enumeration of the departments and their corresponding abbreviations associated with JPCM, please refer to Appendix 1.

Methods

The study uses regression analysis to empirically investigate the departmental resources and departments' participation in the JPCM inter-departmental collaboration. The independent variable adopts social network analysis (SNA) to present the departments' participation in the collaboration statistically. The departments' position in a network is stated through the SNA method to describe the "status" of JPCM participating departments in the collaborative network. In SNA, the indicators for node centrality include "closeness centrality", "betweenness centrality", and "eigenvector centrality". Closeness centrality represents the sum of all distances to a department and the degree of centrality of the department in general. Betweenness centrality measures the position of a department that serves as a bridge from one node of a network to another, indicating the amount of influence a node has over the flow of information in a network. Eigenvector centrality is a standardized measure to describe node centrality. A department with high eigenvector centrality may be associated with few departments; however, it could be associated with some essential

departments.[37,38] The node centrality index reflects the situation and importance of the department's participation in the collaborative network to a certain extent.

The study employs departmental resources as the independent variables, including departmental duties, staffing levels, and approved annual budgets. The independent variable is based on data from the government website. The principal component analysis (PCA) is carried out for the independent variable to analyze the datasets containing different dimensions per observation. Then, the principal components with eigenvalues greater than 1 were taken as the main factors. A varimax rotation was used to simplify the expression of factors. According to the coefficient of the component score matrix, component 1 positively correlates with the number of internal divisions, so the number of internal divisions is set as a component factor.

Moreover, to test the convergent and differential validity, first of all, we need to determine whether the sample data are suitable for factor analysis. We need to conduct Kaiser-Meyer-Olkin (KMO) and Bartlett's sphericity tests on the sample data of each question item corresponding to each proposed variable. A KMO value greater than 0.5 is considered that the data are eligible for doing factor analysis; a Bartlett sphericity test with a p-value < 0.05 indicates a correlation between the variables, and the factor analysis is valid. Correlations between variables were examined before conducting regression analysis, and Pearson correlation analysis was performed on the independent variable of departmental resources and the dependent variable of eigenvector centrality. This study evaluated the network parameters with Ucinet 6.232 and conducted the statistical analysis with SPSS 26.0.

Results

Descriptive Analysis

According to the results in Table 1, MOT, CAA, and NRA are at the center of the network, followed by HC, with closeness centrality values of 1310, 1311, 1312, and 1711, respectively. Regarding the overall structure of the network, the mean value, maximum value, and standard deviation of closeness centrality are 2.346%, 3.435%, and 0.29%, respectively.

Results of betweenness centrality showed that HC, with a betweenness centrality value of 15.236, was in the center of the collaboration network, followed by MSS, with a betweenness centrality value of 0.611. The next group included MCT, MHS, MOT, MEM, MOE, and DRC, all of which had betweenness centrality values of 0.361, followed by MOJ, and MCA, which had betweenness centrality values of 0.25. The mean value and standard deviation of betweenness centrality for these nodes are 0.025 and 0.114, respectively. As is shown in in Table 1.

Eigenvector centrality analysis showed that HC and MOT, which had eigenvector centrality values of 0.138 and 0.133, were the two most essential departments in the core position of the collaboration network. The average value of eigenvector centrality for the entire collaboration is 0.11, and the standard deviation is 0.098, indicating disparities amongst nodes. Table 1 displays the "closeness centrality", "betweenness centrality", and "eigenvector centrality" indicators for nodes. The indicators of the department's eigenvector centrality serve as the explanatory variable.

In the descriptive statistics of departmental resources in Table 2, the departments have a maximum number of statutory duties of 20 and a minimum of 6. Regarding staffing levels, the maximum staff size is 2000, and the minimum is 23; the maximum number of internal divisions is 32, and the minimum is 5; the maximum number of directly affiliated agencies is 114, and the minimum is 0. Moreover, the departments' maximum approved annual budget reaches 47,576,548 million yuan, and the minimum is 7460 million yuan.

The eigenvector centrality passed the SW test. The dependability of the indicator variables is good, as indicated by Cronbach's alpha of 0.736. The KMO and Bartlett sphere test results are 0.525 (greater than 0.5) and 0.000 (significance level less than 0.05), respectively, showing a substantial correlation between the factors. An explained degree of an overall sample variance of 61.69% indicates that the three factors set by the departmental resources have good validity. The value of the standard normal distribution is obtained as the variable "N number of internal divisions", reflecting the departments' resources. The data processing is shown in Table 2.

Table 1 The Centrality of Departments Involved in JPCM Emergency Response

Rank	Department	Closeness Centrality	Betweenness Centrality	Eigenvector Centrality
1	MFA	1981	0	0.115
2	DRC	1980	0.361	0.119
3	MST	1980	0	0.116
4	EAC	1980	0	0.116
5	MSS	1980	0	0.116
6	MOJ	1980	0.25	0.119
7	MHS	1980	0.361	0.108
8	MEE	1980	0	0.116
9	MOT	1310	0.361	0.133
10	MAR	1980	0	0.116
11	MCT	1980	0.361	0.119
12	MVA	1980	0	0.116
13	PB	1980	0	0.116
14	MND	1980	0	0.116
15	MOE	1980	0.361	0.119
16	MII	1980	0	0.116
17	MPS	1980	0.611	0.121
18	MCA	1980	0.25	0.119
19	MOF	1980	0	0.116
20	MNR	1980	0	0.116
21	MHD	1980	0	0.116
22	MWR	1980	0	0.116
23	MOC	1980	0	0.116
24	HC	1711	15.236	0.138
25	MEM	1980	0.361	0.119
26	NAO	1980	0	0.116
27	GAC	1981	0	0.115
28	AMR	1935	0	0.116
29	AOS	1980	0	0.116
30	IDC	1980	0	0.116
31	CO	1980	0	0.116
32	STA	1980	0	0.116
33	NRT	1980	0	0.116
34	BOS	1980	0	0.116
35	HSA	1980	0	0.128
36	GOA	1980	0	0.116
37	MB	2070	0	0.003
38	BIR	1981	0	0.012
39	NRA	1312	0	0.017
40	CAA	1311	0.125	0.018

Regression Analysis

As is shown in Table 3, it can be seen that the eigenvector centrality of the department has a significant positive correlation only with the statutory duties of the departmental resources. Multiple linear regression was further used. Regression analysis was performed on the independent and dependent variables, and all independent variables were included in the model, and the whole model passed the F-test. Further, through the stepwise regression method, Model 2 was selected as the final regression equation, which had an adjusted R^2 of 19.6%, the VIF values of all variables were greater than 0 and less than 5, and there was no multi collinearity problem between the variables.

According to the P-P plot, the standardized residuals are not significantly different from the standard normal distribution. The critical value of the table lists for DW of model 2 is 1.382–1.597 (significance level of 0.01), 1.062

Table 2 The Descriptive Statistics of the Explanatory Variables

Variables	Factors	Minimum	Maximum	SD	Skewness		Communality[a]	Component Score Coefficient Matrix[b]
					Total	Std. Error		
Departmental duty	Statutory duties	6	20	3	−0.155	0.378		
Departmental size	Staffs	23	2000	357	1.920	0.378	0.677	0.823
	Internal divisions	5	32	7	−0.073	0.378	0.819	0.905
	Affiliated agencies	0	114	25	1.716	0.378	0.355	0.596
Departmental budget	Annual budgets[c]	7460	47,576,548	9,194,732	3.683	0.378		

Notes: Cronbach's Alpha = 0.736; KMO = 0.525; Bartlett's Test of Sphericity = 0.000. [a]In PCA; [b] Component 1; [c] year of 2020.

Table 3 The Correlation Analysis

	Eigenvec	Statutory Duties	Internal Divisions	Annual Budgets
Eigenvec		(0.367)	(−0.077)	(0.015)
		0.022*	0.642	0.905
Statutory duties	(0.367)		(0.534)	(0.472)
	0.022*		0.000**	0.002**
Internal divisions	(−0.077)	(0.534)		(0.225)
	0.642	0.000**		0.048*
Annual budgets	(0.015)	(0.472)	(0.225)	
	0.905	0.002**	0.048*	

Notes: **p < 0.01; *p < 0.05.

Table 4 The Multiple Linear Regression

Model [a]		Adjusted R^2	F	Durbin-Watson	Standardized Coefficients	*p*
1	Statutory duties	0.111	0.022[b]			0.077
					0.367	0.022
2	Statutory duties	0.196	0.007[c]	1.062	0.570	0.002*
	Internal divisions using Blom's Formula				−0.381	0.033

Notes: [a]Dependent: eigenvec; [b]Predicted: statutory duties; [c]Predicted: statutory duties. *p < 0.05.

is in the range of 0→dl, representing the existence of positive serial correlation in the linear model of the statutory duties and internal divisions, and according to the scatter plot of standardized regression residuals and standardized expected values, the residuals are randomly distributed around the value of 0, which can exclude the existence of heteroskedasticity in the model.

Table 4 findings demonstrate a significant positive link between departmental statutory duties and the eigenvector centrality of the department in the collaboration network and a negative correlation between the number of internal divisions and feature eigenvector centrality.

Discussion

First, from the statistical data of departments participating in JPCM inter-departmental collaboration, MOT, HC, MPS, MEM, MCT, MOE, and DRC are mainly involved. The frequency of events involving HC and MOT was much higher than those involving other departments, while those involving MB were relatively small. MPS, MEM, MCT, HC, MHS, MOE, and DRC interact with other departments frequently.

Second, the results of the closeness centrality of collaborative network departments show significant differences in communicating collaborative instructions and data between departments participating in JPCM. However, the

conclusions of the betweenness centrality differ from those of the closeness centrality measure. The betweenness centrality analysis among departments indicates that the inter-departmental collaboration network is organized around specific central nodes, given the significant variations observed among nodes. Therefore, for departments with a centrality of 0, information flow has probably halted at this node. Moreover, these departments need to play a more crucial role in encouraging inter-departmental interaction.

Third, in the correlation analysis of the centrality and resources of the department in the network, it is found that the position of the department is significantly related to the statutory duties of the department and the statutory duties of the department are significantly related to the number of internal divisions and approved annual budgets. The department's engagement in collaborative actions is determined and influenced by the department's statutory duties. Through multiple regression, it is further verified that the more statutory duties the department has, the more it is in a critical position for JPCM inter-departmental collaboration. Furthermore, the model could not determine a significant effect of the department's annual budget on the department's network position. The explanation may be that the overall department budget covers the budget of their sending agencies and divisions. As departments with large budgets are likely to have higher financial expenditures for their sending agencies and divisions, they are optional for collaboration.

Conclusion

The Chinese JCMP study revealed that the current collaborative response approach involving departments is primarily based on their statutory duties. Departments achieve the maintenance of collaboration continuity across an emergency system through the appropriate execution of their statutory duties. This sheds some light on future emergency response collaborative practices. On the one hand, the efficient and professional operation of emergency systems is ensured by the reasonable participation of departments. Effective health emergency management in nations can be attained through coordinating various departments with distinct statutory duties, thereby enhancing and augmenting the scope and responsiveness of emergency networks. On the other hand, a significant level of integration entails consolidating authority and a robust alignment of accountabilities. In order to ensure efficient collaborative management across diverse statutory duties and positions within a network, it is essential to prioritize communication and information dissemination in emergency management. This can be achieved through the creation or integration of groups or by technology (see Yin et al (2020 and 2021) studied the role of the innovation of big data intelligence and industrial sectors in preventing and resolving major public health crises in China),[39,40] which are specifically responsible for liaison and communication, as well as by monitoring the activities of those departments located in the Network Information Exchange.

There are areas for improvement in the study. First, the study applied only the departmental resources, including departmental duties, staffing levels, and approved annual budgets, as independent variables. However, inter-departmental communication further impacts departments' roles in JPCM inter-departmental collaboration. Graph theory techniques can further illustrate the communication and information flow between departments. Future works by the author will supplement the discussions on the topic. Second, the centrality of departments indicates the significance of the department's participation in JPCM collaboration. There are additional vital roles in the collaboration, such as the role of the intermediary bridge, which may significantly affect the collaboration network as a whole. There is no additional discussion. This is because the study design highlighted the importance of the centrality of nodes in a collaboration network. The future will require more scholarly work.

Data Sharing Statement

Official JPCM documents are obtained from the JPCM's website. The corresponding author will provide the datasets used and/or analyzed during the current work upon reasonable request.

Ethics

This research does not require ethical approval because it utilizes accessible public information. And informed consent for further analysis of datasets has been obtained from disclosure when the original data was collected.

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Disclosure

The author declares no conflict of interest.

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