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Characterizing the patterns of China's policies against COVID-19: A bibliometric study

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ABSTRACT

Since the beginning of 2020, the Chinese government has implemented substantial policies to prevent and control the COVID-19 epidemic. This research attempts to reveal and characterize the patterns of China's policy against COVID-19. Bibliometric methods are applied for studying policy evolution, with the aim of discovering the transitions of the policies over time, the collaborations among policy makers, and the effects of the policies. A total of 366 policies of epidemic prevention are collected. Policy topic shifting, the cooperation of policy-issuing agencies, and the policy content of agencies are analyzed. According to the results, China's policies are implemented in four stages. Moreover, the policy's foci against COVID-19 shifted from medical support in the early stage to economic development in the late stage. Agencies involved in the policy-making can be categorized into three types: leading agencies, key agencies, and auxiliary agencies, with their corresponding administrative influence ranked in this order. Especially, the Chinese government adopted a multi-agency, joint epidemic prevention and control mechanism to ensure the efficiency of the policymaking cooperation. Furthermore, aside from ensuring cooperation among the policy-issuing agencies, they each had their own primary focus of policies in the early stage, but their foci were gradually shared as the epidemic situation changed. This research reveals how China responded to the public health emergency of COVID-19 from the perspective of policy making.

1. Introduction

Since early 2020, Chinese governments at all levels have issued various policies to prevent and control the COVID-19 epidemic. The outbreak of the epidemic occurred during the Spring Festival in China. Therefore, the government initially introduced policies to stop public transportation, such as aircraft and high-speed rail lines, in some areas to restrict population movement. On January 20, the Ministry of Health of China and 31 other departments established the Comprehensive Group of Joint Prevention and Control Mechanisms (GJPC). The GJPC, along with various government agencies, formulated a series of policies in various stages against the COVID-19 epidemic, such as public health defense, emergency relief, the orderly resumption of work, etc. With the joint efforts of multiple government departments, these policies were effectively implemented, and Wuhan's lockdown was lifted on April 8. This meant that Wuhan, as the main affected area by this epidemic, has effectively curbed the impact of the epidemic.

The public health emergency policies set a direction for proper health management and human behavior and contributed to the

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orderly conduct of society's daily activities (Zhang & Yang, 2019). When an emergency breaks out, quick and effective command-assignment is the crucial means to minimize the losses, and this generally depends on relevant policy documents, such as emergency plans, laws, and regulations (Rong & Jia, 2008). The problems and benefits in health emergency management can eventually be found through policy evaluation, which aims to ensure the achievement of effective prevention and control to the greatest extent possible (Wang et al., 2019). Evidence has been presented to indicate that credibility, transparency and explicitness in the decision-making process can improve understanding and uptake of policy decisions (Laura et al., 2013). Meanwhile, emergency management activities traditionally belong to the domain and responsibility of different levels of governments and agencies (Lettieri et al., 2009). Moreover, the components of the leadership structure and organizational factors can influence policy formulation and implementation, which must be reformed and modified when needed (Ayan et al., 2018). Therefore, the policy analysis is a useful tool in revealing how policies are formulated and implemented and how the agencies operate in health emergency management.

To address the scientific problems of making policies involving the COVID-19 epidemic, researchers all over the world have carried out some studies. Previous policy studies focused on specific policy themes. For example, (Evenett, 2020) characterized and assessed the current trade policy stance towards the imported goods used by hospitals and front-line medical professionals to tackle COVID-19. (Sowby, 2020) reviewed the policy statements for the US water sector and emphasized the importance of emergency preparedness. The policies related to a specific group of people, such as the elderly and disabled, have also been analyzed and evaluated (American Geriatrics Society, 2020; Béland & Marier, 2020; Jalali et al., 2020). In comparison, only a few studies have been conducted from China's perspective, specifically the policies issued in the country while managing the COVID-19 crisis.

To understand the process of policymaking in response to COVID-19 in China, it is important to characterize the foci and policy topic shifts of China's governments and explore the relationship of policy-issuing agencies. Therefore, this paper raises the following research questions:

Q1: How did the major policy foci evolve during the process of COVID-19 prevention in China?

Q2: How did the policymaking agencies cooperate to generate effective administrative influence?

These two research questions aim to analyze the epidemic prevention policies from the perspective of policy content and policy-issuing agencies. The first question illustrates the stages of policy implementation in China and the corresponding changes of epidemic situation. The second question reflects the linkage and joint epidemic control of policy-issuing agencies. It is found that China took rapid response at the beginning of the epidemic, and experienced four stages during the process against COVID-19. Chinese policies offered feasible guidance, diverse support and necessary guarantee to various objects. The majority of governments were involved in and cooperated with each other as well as all citizens, manifesting the spirit of "joint epidemic prevention and control". These findings can be generalized in other countries theoretically, but regarding their practical implementation, it needs to consider the corresponding cultural context and nation condition of other countries to ensure the rationality and feasibility of policies.

The remainder of this paper is organized as follows. Section 2 presents a review of previous studies related to the COVID-19 and methods of policy research. Section 3 describes the data and methodology used in this research. Section 4 presents the results and the discussions of the analysis. Finally, the implications of this work and recommendations for future studies are highlighted in Section 5.

2. Related work

A policy is a government-sponsored plan with certain targets, values and strategies (Lasswell & Kaplan, 2013). It is a political action taken by governments to achieve certain political, economic and social targets in a given period (Yang et al., 2020). Policy documents are the carrier of policy ideology, reflecting how the public system processes public affairs (Chao et al., 2017). Brewer & Deleon (1983) believes that policy process is a continuous cycle that the latter policy is made on the basis of the adjustment and amendment of the previous policy. According to Anderson (1990), policy change refers to one or more policies replacing existing policies, including adopting new policies and amending or abolishing existing policies.

In the following, we conduct a systematic review of policy document research from both qualitative and quantitative perspectives, and review previous research about the public health emergency, as well as COVID-19.

2.1. Qualitative research of policy documents

Qualitative document analysis (QDA) is a widely adopted approach to systemically discover the contexts, meanings, and implications of documents, and analyze relevant documents based on the researcher's knowledge (Ajani et al., 2013; Wach & Ward, 2013). Unlike quantitative content analysis which quantifies large-scale words and phrases, QDA focuses on contextual interpretation and description of words and phrases and their reflection in practice (Warshaw & Upton, 2018).

Recently, QDA becomes increasingly prevalent in policy document research due to its deep contextualization and thick description of complex cases. QDA has been widely applied in many policy-making fields such as water management and public health. For example, Jalam et al. (2020) analyzed relevant policy document on Nigeria's desertification control via QDA, and found that the integration of sustainable practice across the policy cycle is responsible for the participation of civil society organizations. Also, QDA on twenty health-related policy documents in Saudi Arabia indicated that inequity of healthcare in Saudi Arabia was quite serious, but lacked suggestions to improve health equity (Eklund Karlsson et al., 2020). To evaluate the implementation of national health policy for primary health care, Dominguez-Cancino et al., 2020 analyzed thirteen primary health care policy documents in Chile via QDA. In addition, QDA has been applied to analyze how the five Latin American countries responded to mitigate the spread of pandemic

together (Benítez et al., 2020).

In general, qualitative research can only deal with a small number of cases (Hudson & Kuehner, 2013). However, in practice, the government makes a large amount of policy documents. Second, qualitative research is not very suitable to systemically analyze complex network data. But the policy documents contain a lot of heterogeneous relations among elements, so quantitative research is applied to further understand them.

2.2. Quantitative research of policy documents

Quantitative analysis of policy documents can help find the evidence of holistic political processes, and depict policy evolution (Klüver, 2009). Bibliometric methods, such as co-word analysis and network analysis, are the most commonly used quantitative method for policy analysis. They have been adopted in literature research for a long time and later introduced into the research of public policy documents (Li et al., 2015). The bibliometric analysis in policy research aims to analyze the changes of policy topics, department functions and so on through information of the text contents, such as policy quantity, release time, and department distribution (Ren et al., 2017).

Especially, co-word analysis is used to analyze the association among themes in policy documents. By counting co-occurrence frequencies of political keywords, co-word analysis can discover the relationships between different documents. For example, co-word analysis is applied to map the topics of science and technology policies via manually labeling topics of each policy document and selecting high-frequency keywords (Huang et al., 2015). It was also used to visualize the interactions among different keywords from 136 prefabricated buildings policies to describe prefabricated buildings policy system over time (Wang et al., 2020). Zhou et al. (2020) explored the characteristics of policy evolution of China's new energy vehicles industry using co-word analysis based on 154 policy documents from Chinese central government.

Network analysis can capture network features of complex network composed by multiple policy elements. Actually, government's policies involve complex interaction among a large number of stakeholders. Previous literature has recognized the superiority of network analysis in policy documents research. Xiao & Zhang (2020) applied network analysis on 81 cross-border e-commerce industry policy documents to analyze the evolution of policy cooperation networks. Huang et al. (2018) studied citation network on policy documents to characterize different stages of education policy and reform. However, networks analysis usually ignores the semantic and linguistic features of policy documents.

2.3. Policy documents analysis on public health emergency

Before the outbreak of COVID-19, some researchers have carried out policy research to deal with public health emergencies. As early as 2006, MacPherson et al. (2006) analyzed a series of policies issued by Canada from 2000 to 2005 in response to the public health emergency caused by illegal drug abuse. And the concussion caused by youth sports in Colombia and the key developments in concussion-related policy and legislation were also examined (Baugh & Shapiro, 2015). To understand the policies dealing with H1N1, Wiesman et al. (2011) used a case study to analyze a series of processes, including the merger of five independent local public health agencies, the implementation of the policies responding to H1N1 in 2009 in America. Besides, Rosella et al. (2013) used the policy decision-making framework to analyze four related policies in Canada and interviewed forty public health officials and scientific advisors. They found that current models for public health decision-making failed to make explicit roles of scientific evidence in

Table 1.
Policy document analysis on COVID-19.

Reference	Country	Policy	Research question	Method
(Chinazzi et al., 2020)	China	Travel restrictions in Wuhan	The impact of travel limitations on the national and international spread of the epidemic	Quantitative analysis
(Duczmal et al., 2020)	Brazil	Social distancing health policy	The impact of different strategies of social distancing	Quantitative analysis
(Yang et al., 2020)	China	The policy of national multidisciplinary healthcare assistance	Whether the policy is effective and sustainable to contain the COVID-19	Quantitative analysis
(Zhao et al., 2020)	China	Infection prevention and control (IPC) policies in Shanghai	Assess the impact of IPC policies	Quantitative analysis
(Yan & Zhao, 2020)	China	China's early policy in response to COVID-19	Describes the administrative mechanism of joint participation and cooperation during the early stages of the COVID-19 outbreak	Qualitative analysis
(Fantini et al., 2020)	Italy	The policy of school's closure and a total lockdown	Discuss whether school closure policies should be restored	Qualitative analysis
(Evenett, 2020)	Multiple countries	The trade policy response to COVID-19	Characterize and assess current trade policy stance towards the imported goods used by hospitals and front-line medical professionals to tackle COVID-19	Qualitative analysis
(Sowby, 2020)	America	The policy about water sector	Review the changes in the water supply and wastewater treatment policies of the professional association in response to COVID-19 in America	Qualitative analysis

relation to contextual factors. Then, the studies of policies have been also implemented to deal with Ebola virus. Garritty et al. (2017) described the newly established guidance for guideline developers at the World Health Organization (WHO), which was expected to develop a rapid advice guideline in the context of the 2014 Ebola epidemic, and it was found that there were important differences between a standard guideline and a rapid advice guideline.

Generally, before the outbreak of COVID-19, the policy research in the public health emergencies has attracted a lot of attention, but it lacked a systematic research framework at this time.

2.4. Policy documents analysis on COVID-19

The research of policy document analysis on COVID-19 gradually increased after COVID-19 outbreak. The earliest policy research on COVID-19 was the study on the effects of policies of travel restrictions and social distance. As shown in Table 1, the related work can be classified into two categories in terms of methods applied in the study. Regarding the methods, the quantitative and qualitative methods have been used to study the policies about COVID-19. For example, Chinazzi et al. (2020) used a global metapopulation disease transmission model to project the impact of travel limitations on the national and international spread of the epidemic. They found that the travel quarantine of Wuhan has a significant effect on the delay of the spread of the epidemic in China. Also, Duczmal et al. (2020) presented the SEIR-Net to evaluate the effect of the social distancing policy on the spread of COVID-19. It was found that the policy of merely maintaining social distance with the elderly was ineffective to contain the COVID-19 pandemic. Yang et al. (2020) used difference-in-differences to conduct empirical analysis on the effect of national multidisciplinary healthcare assistance policy in China and found that the number of recovered cases per day increased by 39.36 as a result of this policy. Zhao et al. (2020) used the system dynamics model to simulate the impact of infection prevention and control policies (IPC) on the spread of COVID-19 during work resumption, the study believes that conservative IPC policies can prevent a second outbreak of COVID-19 during work resumption.

Excepting for the quantitative analysis of COVID-19 related policies, some scholars have qualitatively analyzed some countries' early epidemic prevention policies or related policies from the policy-making perspective. Especially, Yan & Zhao (2020) constructed an analytical framework based on the theory of policy participation that included stimulus, setting, and position of policy participation. According to this study, there are three main stages that occurred during the early outbreak. The strategies of schools' re-opening should be led by a flexible approach in order to adapt to the local context in terms of epidemiological data and system capabilities (Fantini et al., 2020). Moreover, Evenett (2020) believes that trade policies restricting the export of medical supplies are harmful to enhance the effectiveness of national public health interventions. Also, Sowby (2020) reviewed several US policies to help

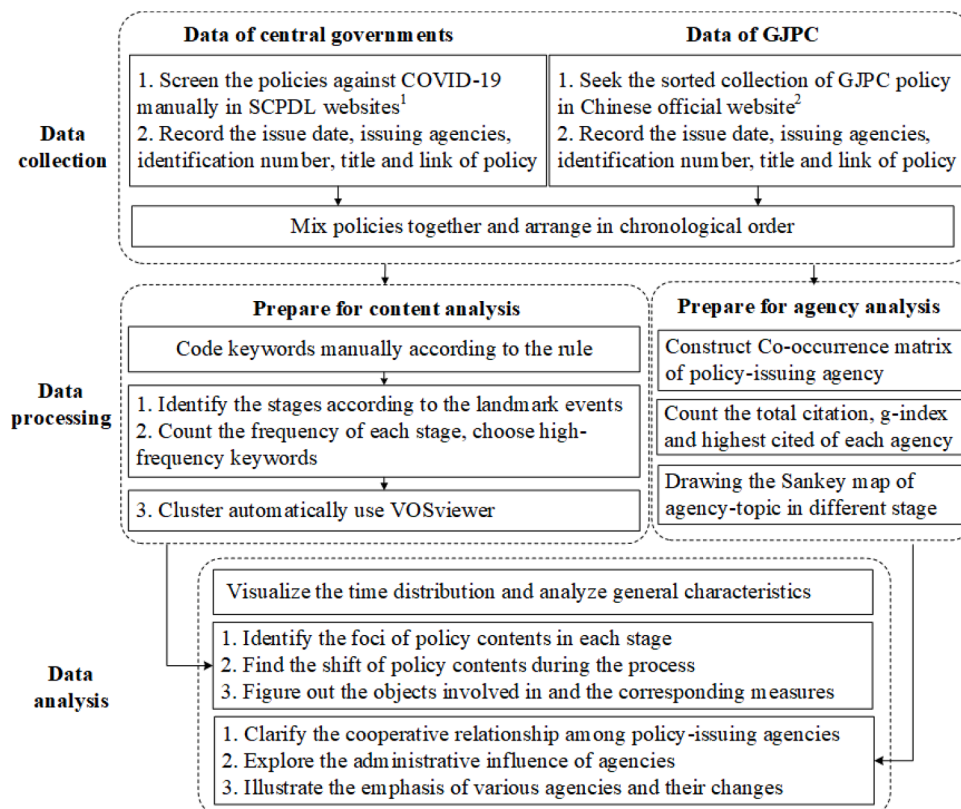


Fig. 1. Research framework.

waste water utilities respond to emergencies in the midst of the crisis. [Table 1](#) shows the above policy document analysis on COVID-19.

All in all, there are few research to conduct an overall analysis of China's COVID-19 policy. In fact, some scholars have realized the importance of using thematic analysis and other related methods for policy analysis of COVID-19 ([Mei, 2020](#); [Shao et al., 2020](#)). Therefore, it is necessary to analyze China's COVID-19 policies with a holistic perspective to find the generation of COVID-19 related policies.

3. Data and methodology

To characterize the patterns of policies against COVID-19 in China, we designed the research framework shown in [Fig. 1](#). The main procedures in this research included data collection, data processing, and data analysis. In general, we collected data from the State Council Policy Document Library (SCPDL) and the official website of the Chinese Central Government.

To address the two research questions raised earlier, in this paper, we provide insights into the process by which China responded to the COVID-19 epidemic through multi-angle and multi-layered analyses. Using the information collected from 366 policies, we applied the bibliometric methods of co-word and network analysis to characterize the policy patterns against COVID-19 issued by the Chinese central agencies until April 8. Moreover, the g-index was applied to measure the administrative influence of agencies. There were three steps of the process, which includes data collection, data processing and data analysis. In the first step, policy data were collected according to two requirements being issued by governments and related to COVID-19. The second step was preparations for policy analysis. For content analysis, keywords were coded for each policy and high-frequency keywords were chosen for clustering. For policy-issuing agency analysis, a co-occurrence matrix of policy-issuing agency was constructed. In the third step, this study analyzed policy foci and agencies to clarify how the major policy foci evolve during the process of COVID-19 prevention in China, and how the agencies cooperate to generate effective administrative influence.

3.1. Data collection

To analyze the policies of preventing COVID-19 in China, we collected the dataset from two data sources, the SCPDL and the official website of the Chinese Central Government. The SCPDL is a database that has compiled public policies issued by the Central Government in China since 2000. The central government is a broad organization, which includes the State Council (SC), the ministries, commissions, and bureaus directly under the SC, among others. Information on policies issued by these central agencies about epidemic prevention and control can be collected through the SCPDL. Meanwhile, as an agency that has been established provisionally, the GJPC has also issued policies to deal with COVID-19. These policies have their own unique policy identification numbers even though they are not included in the SCPDL. A total of 366 policies, including notices, announcements, opinions, schemes, guidelines, etc., were used in this research. The data collection methods are described below.

- (1) Manual collection of the Chinese governments' policies. There are two reasons why we manually screened the policies one by one to collect data instead of retrieving them in the library. On the one hand, the SCPDL does not support combined keywords retrieval. On the other hand, it is beneficial to ensure the comprehensiveness and accuracy of the research data collected. We excluded irrelevant policies and retained the policies whose contents involved words "COVID-19", "epidemic prevention and control", and other similar and related terms. Details about the screened policies were recorded, including issue date, issuing agency, identification number, title, and link. The collection of data from SCPDL has been checked out for the second time to eliminate the irrelevant policies. The epidemic prevention policies were continuously issued by these agencies since January 22nd, with a total of 331 issued until April 8.
- (2) Collection of data on the GJPC policies. The purpose of establishing the GJPC was to settle questions associated with COVID-19. Thus, policies in the sorted collection comprised our data sources; hence, they did not require screening. Similarly, we listed down the issue date, issuing agency, identification number, title, and link. The first policy issued by the GJPC was formulated on January 23. As of April 8, it has issued 35 policies in total.

3.2. Methods

Co-word analysis and social network analysis were applied for the analysis of policy topics and agency cooperation. We chose the g-index to measure the influence of agencies, because of the sensitivity of g-index to highly-cited policies ([Egghe, 2006](#)).

3.2.1. Keywords coding

Because there are no predefined keywords in Chinese policies, it is necessary to code keywords manually referring to the policy documents ([Huang et al., 2015](#); [Li et al., 2015](#)). There are three tasks during the coding process.

- (1) Preparing for the coding. Team members read each policy documents one by one before formal coding. It allowed us to have a preliminary understanding of policy contents. Besides, "The Subject Word List of the Official Documents" compiled by the [State Council of China was studied together for the coding \(1998\)](#). This list was used for coding documents that were issued by the State Council and its subsidiaries, and documents submitted by various regions and departments from all over the country.
- (2) Formal coding. Two researchers in our research group were selected to code 366 policy documents separately. They were expected to give keywords according to the policy contents and "The Subject Word". In terms that all policy documents were

generally related to “COVID-19” and “epidemic prevention and control,” these two terms were not coded as keywords. And there was no unified clear limitation of keywords number, but it should not be too many to reflect the topic clearly. The result indicated that the number of the keywords of each policy was two to six basically, which was consistent with the previous research (Huang et al., 2018; Zhang & Yang, 2019). What’s more, synonyms were merged for those similar terms as identical keywords per policy after coding.

(3) Resolving inconsistent coding. After coding, similar keywords among two coders were merged. Then, we used the coding consistency coefficient as the criterion of the final identification:

$$\text{coding consistency coefficient} = \frac{2M}{N_1 + N_2},$$

where M is the total number of identical codes between two researchers, and N_1 and N_2 are the respective code numbers of the coders (Zhang & Yang, 2019). The coefficient value was 86.3% in this research, which was acceptable. The inconsistent codes were discussed and determined by the two researchers and an expert invited specially majoring in policy research and has experience in policy coding.

3.2.2. Co-word analysis

Co-word analysis, which is first proposed by Callon et al. (1983), is a useful tool to reflect the connection strength among the information items from the perspective of content (Ding et al., 2001; Leydesdorff & Kasper, 2011). Zhang and Zhao et al. (2015; 2019) argued that keywords whose added frequencies account for more than 40% of the total keyword frequencies are called high-frequency keywords. Particularly, the critical values, two keywords with the same frequency, are all kept. In fact, based on the distribution of keywords frequency, low-frequency keywords looks like the long tail which can nearly not reflect the primary and key information.

So after the keywords were determined, the total number of keywords frequency was calculated. Then, we chose keywords whose cumulative frequencies over 40% of the total as high-frequency keywords. These keywords were used when clustering to determine the policy topics about COVID-19. The clustering process was based on a co-occurrence matrix and completed by VOSviewer automatically through three steps: (1) calculate similarity matrix based on the co-occurrence matrix; (2) construct map based on the similarity matrix; (3) translate, rotate, and reflect the previous map to generate the final one (Van Eck & Waltman, 2010).

3.2.3. Social network analysis

The social network analysis method concerns the structure and property of networks and is applied to measure the closeness of connections among items (Scott, 2000; Newman, 2010). We regard policy-issuing agencies as nodes, and the cooperation of two agencies as links to map the social network, thus allowing us to analyze the relationship among them. To determine the decisive influence of agencies, we used the g-index, which is sensitive to highly-cited documents and can evaluate their contribution to the publisher (Van Eck & Waltman, 2008). The policies issued against COVID-19 span a short period. Hence, the g-index can distinguish high and low citations sensitively and further identify the influence of the agencies.

4. Results and discussion

This section presents three parts. First, time distribution analysis shows the overall trend of policy issue and identifies the different stages of China’s COVID-19 crisis management. Second, policy content analysis reveals the major foci and topic shift of the policies. Moreover, objects involved in the policies are illustrated to identify which corresponding problems are addressed for the particular

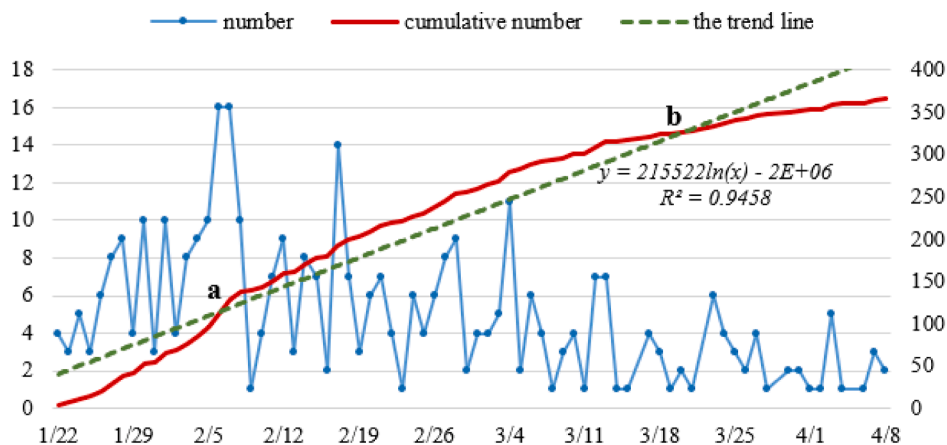


Fig. 2. Time distribution of policies against COVID-19.

objects. Third, the analysis of the policy-issuing agencies is conducted to clarify how the agencies influence and cooperate with one another and to determine the policy emphasis of various agencies in different stages.

4.1. Characteristics of time distribution

Fig. 2 illustrates the number of policies issued each day. Policies against COVID-19 were first issued on January 22nd, 2020. Since then, the number of policies issued per day has remained in a fluctuating trend, increasing before decreasing (Fig. 2). The blue line shows the issued daily number of policies, which sharply surges at a short time at first and slowly cuts back in the final in a fluctuating manner.

There were four earliest traceable policies, which were issued on January 22nd, 2020. Two of them were issued separately by the MOH, and one was jointly issued by the MOH and the State Administration of Traditional Chinese Medicine (STC). The MOH highlighted the strengthening of the medical treatment of severe cases infected with COVID-19 and released the Technical Guidelines for the Prevention and Control in Medical Institutions (Edition 1). On the same day, the MOH and STC also issued the Diagnosis and Treatment Protocol (Trial Version 3). Furthermore, the Ministry of Culture and Tourism (MCT) and the Cultural Relics Bureau (CRB) jointly issued a policy to reduce public gatherings. The first peak of the line, which is also the highest peak, appears on February 6 and February 7, with 16 policies issued every day. On the one hand, the policies released in these two days were concerned with the health-related aspects, such as epidemic prevention materials and strategies. On the other hand, several different emergency measures were formulated, because the COVID-19 disrupted the regular order of the nation, enterprises, and individuals.

The cumulative number line of policies (the solid red line) and its trend line (the green dotted line) are formulated to better portray the trends of policy release. The exponential function is typically used for document fitting, while the logarithmic function is selected to fit the line according to the trend of policy issuance. The cumulative number line of policies can be perfectly fitted by the curve $Y = 215522\ln(X) - 2E+06$, where the value R^2 equals 0.9458. These two lines have two intersections, marked a and b, respectively. The solid red line is located on the green dotted line between a and b, revealing that the country attached great importance to epidemic prevention and control, thereby releasing so many policies within this period. In the other periods, the red line is located below the green line. It is reasonable to judge that, in line with this phenomenon, China's epidemic prevention process shows different stages. Therefore, analyzing the different policy themes in varying stages is beneficial in better understanding the process by which China has prevented the spread of COVID-19.

The 366 policies present four stages according to the time points at which national and significant milestones occurred. Although the release of policies has a certain lag, this feature is relatively unobvious, because policies against COVID-19 are related to the public health emergency. The results of the four stages are presented in Table 2. As can be seen in the table, the number of policies in the last three stages show multiple decreasing trends.

4.2. Characteristics of policy contents

This part attempts to answer the first research question. As shown in Fig. 1, after data processing, the foci of the policy content can be identified by clustering using VOSviewer (Van Eck & Waltman, 2010; Pan et al., 2018). Furthermore, the shift of policy content was analyzed from the dynamic perspective. Policy objects were sorted out to illustrate the specific measures and strategies represented in policy content for various objects.

4.2.1. The different foci of the policy contents

4.2.1.1. *The initial stage of epidemic prevention.* The topic of epidemic prevention policies has changed in each stage. In the first stage, there are 18 high-frequency keywords involving three clusters: medical materials supply, medical strategy and personnel emergency (Fig. 3). The largest cluster is the red one related to the medical materials supply. In general, emergency responses to public health emergencies require an adequate supply of medical materials, such as masks, medical protective clothing, ventilators, etc. The policies issued by the Ministry of Transport (MOT) notes that the delivery of emergency materials and personnel should be prioritized on the road, hence, a "green channel" was opened for their transportation. The "green channel" was also opened for official funds and epidemic prevention materials donated from China and abroad, which maximized the supply of medical materials.

The blue cluster refers to the medical strategy related to the diagnosis and prevention of COVID-19. The prevention, treatment, and

Table 2.
Stages of policies issued in China against COVID-19.

No.	Stage	Timespan/day	Policy number of stage	Cumulative policy number	Milestone
1	1.22–1.30	9	52	52	As of January 30, 31 provinces in mainland China have launched the first-level response to public health emergencies.
2	1.31–2.23	24	169	221	As of February 23rd, many provinces in China downgraded their response levels against COVID-19.
3	2.24–3.16	22	96	317	The Beijing Xiaotangshan Hospital was opened on March 16th to cope with the risks of the imported COVID-19 cases.
4	3.17–4.8	24	49	366	Wuhan lifted its lockdown at zero on April 8th.

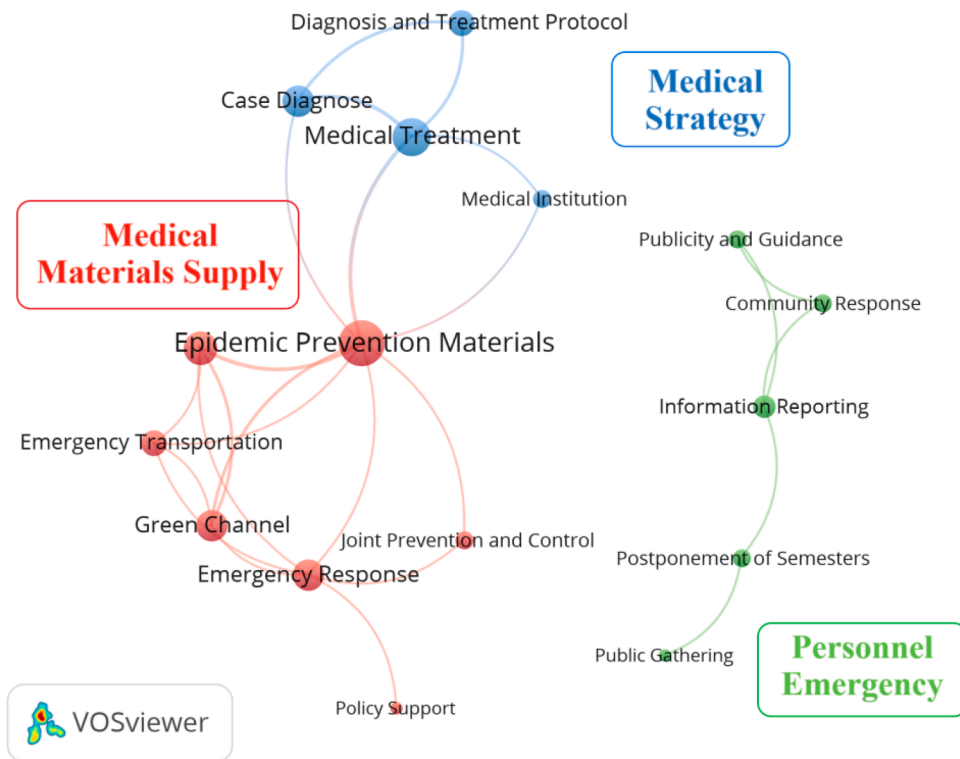


Fig. 3. Topics of policies against COVID-19 in the first stage.

recovery related to COVID-19 gained much attention at the beginning. Correspondingly, different diagnosis plans were formulated describing the clinical characteristics, diagnostic criteria, treatment methods, and so on. The formulated policies regulate the process of carrying out the work to be done in primary medical and health institutions or in rural areas and implementing the transport of medical cases. The policies about how to prevent and control the epidemic in relation to the elderly population were also issued.

The other cluster is not medical related (the green one) and shows the direct response to public emergencies. Due to the spread of

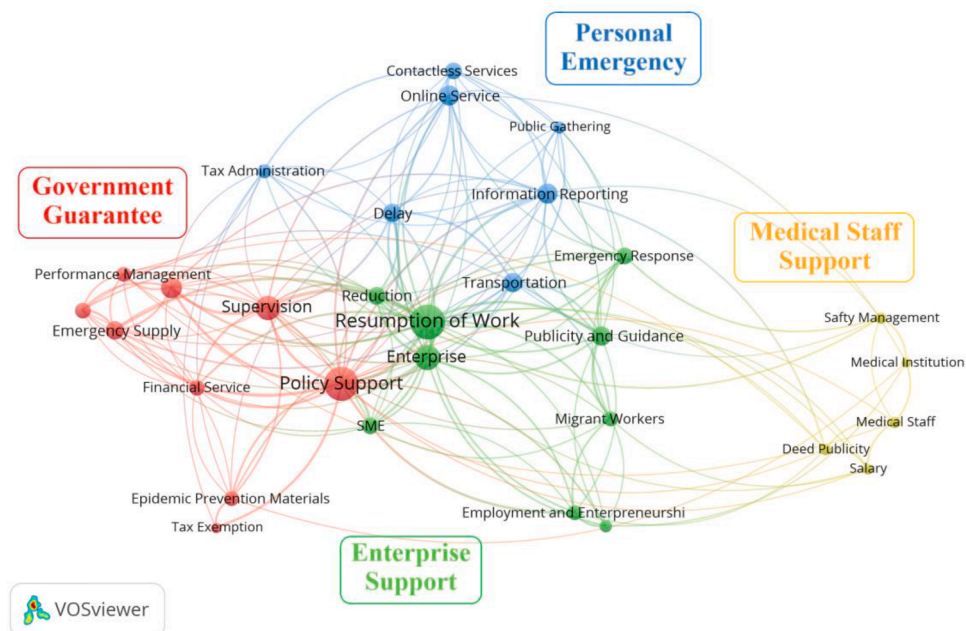


Fig. 4. Topics of policies against COVID-19 in the second stage.

COVID-19, a highly contagious disease, people have to be isolated at home to reduce the likelihood of infection through human contact. Thus, various organizations and personal activities had to be halted or cancelled indefinitely. For example, the SC issued a notice to extend the Spring Festival holiday in 2020 on January 27th. Then, schools, enterprises, various examinations, and projects were all suspended or extended. Apart from that, the valid period of preferential policies issued by the nation was also extended (e.g., free rides for small buses).

4.2.1.2. The strengthening stage of epidemic prevention. In the second stage, which can be called the strengthening stage, more comprehensive and targeted epidemic prevention policies were issued (Fig. 4). This stage has 30 high-frequency keywords. During this period, personnel emergency is also prioritized (the blue one). Due to the uncertainties regarding how long the epidemic will last, it would be unrealistic to continue to extend or suspend all activities indefinitely. Thus, online activities, a new model, had to be introduced. In terms of school, the Ministry of Education (MOE) proposed the “suspension of classes without suspension of learning”, suggesting that students should study at home through cloud platforms or other online applications. As for government services, applicants were encouraged to adopt various methods, such as the online declaration, mailing materials, telephone consultation, etc., to avoid contact via manual transactions.

As the backbone of epidemic prevention, the medical personnel is the main objects of policy issuance (the yellow one). These front-line healthcare workers have heavy work tasks, high infection risks, and high work pressure. The most representative policy related to medical staff was issued by SC on January 22nd. This policy proposed several measures to protect and care for medical staff, such as increasing the salary and treatment of epidemic prevention personnel, strengthening personal protection, making timely psychological adjustment and counselling, praising martyrs, etc.

Another type of policy was related to enterprises (the green one). In order to achieve the orderly resumption of work, the Ministry of Finance (MOF), the National Development and Reform Commission (NDRC), the Ministry of Industry and Information Technology (MIT), the Ministry of Commerce (MOFCOM), the Ministry of Human Resources and Social Security (MOHRSS), and other government agencies issued several policies. The policy contents related to enterprises can be categorized into the following aspects:

- (1) Public finance support. The government provided financial funds for epidemic prevention, and SMEs can apply for interest discount and tax benefits according to these policies. Taxes and administrative fees were reduced or exempted in accordance with laws and regulations, such as deferring payment of taxes temporarily or returning social security contributions appropriately.
- (2) Banking support. This type of policy mainly relied on financial institutions. For SMEs with development prospects but were temporarily affected by the epidemic, financial institutions were suggested to appropriately reduce loan interest rates and increase credit loans and medium or long-term loans. If it was difficult to repay due loans, these should be extended or renewed.
- (3) Aid and stabilize posts. How to handle the labor relations in enterprises in the particular period was critical in overcoming difficulties. First, enterprises were encouraged no or fewer layoffs as much as possible. Second, for workers, enterprises were expected to arrange working hours flexibly. When employees cannot return to work, enterprises should pay wages referring to relevant national regulations. Moreover, free online training should be provided for enterprise workers.
- (4) Cut costs of enterprises. There is no income without production, thus contributing to little extra finances to meet costs. Thus, state-owned enterprises, state-owned institutions, real estate developers, and entrepreneurial parks are encouraged to reduce or exempt rents for SMEs. In relation to this, the NDRC issued a series of policies to reduce the cost of electricity and gas at the same time.
- (5) Other forms of support. First, contactless services, such as online services or telephone services, were required. Thus, the MIT attached great importance to the construction and maintenance of the country’s online network. Furthermore, individual support was implemented for the catering and tourism industries. Policies related to foreign trade enterprises are also issued particularly.

The last cluster involved government guarantee (the red one). These policies were issued for ensuring financial funds and material support and the supervision of the policy implementation to maintain the orderly operation of the whole society. These goals were achieved through several measures.

- (1) Financial funds guarantee. MOF and relevant departments have issued specified policies about subsidies for patients’ treatment costs, medical staff participating in prevention and treatment, and the special equipment for protection, diagnosis, and treatment. Moreover, education funding was allocated to schools in key areas of emergency to improve their ability to prevent and control the epidemic.
- (2) Material support guarantee. The support of medical materials is crucial; the supply of blood, disinfectants, and protective equipment for enterprises also need to be taken seriously aside from general medical materials. Apart from that, all of the primary living materials must also be met. Thus, several policies were issued referring to the production and supply of meat, eggs, milk, coal, chemical fertilizer, and other basic supplies.
- (3) Inspection and supervision. In terms of financial funds for epidemic prevention and control, special funds must be used exclusively. Thus, enterprises who are prioritized in terms of support and relevant financial aid should consciously accept the inspection and supervision of audit departments. Moreover, the General Administration of Market supervision (GAM) issued

policies to investigate and deal with illegal acts of inflating prices, including medical and basic living materials, to maintain the market order.

4.2.1.3. The tamping stage of epidemic prevention. There are 23 high-frequency keywords grouped into three clusters in the third stage (Fig. 5), including economic development, enterprise support, and government guarantee. This stage places more emphasis on the implementation of policies and ensuring continued economic development. The clusters, enterprise support (the green one), and government guarantee (the blue one) appeared in the second stage and were introduced in detail. Meanwhile, the policies related to these topics were further emphasized in terms of implementation with titles containing certain words, such as “implement,” “further strengthen,” “further standardize,” and “advanced optimized,” to name a few.

One topic that emerged during the epidemic prevention process was economic development (the red one). The appearance of the keyword “Economic Development” indicates that changes have occurred in this stage. On the one hand, the meeting on coordinating epidemic control with economic and social development was held on February 23. The Chairman of China affirmed the country’s achievements in fighting against COVID-19, and highlighted the fact that the economy and society are a dynamic circulatory system that cannot be shut down for a long time. On the other hand, China has set great goals for building a moderately prosperous society in a comprehensive manner and for completing the 13th Five-year Plan in 2020. Owing to these two reasons, several policies in this stage focused on economic development while continuing to manage the spread of the disease.

4.2.1.4. The continuous stage of epidemic prevention. There are 18 high-frequency keywords involving two clusters in the fourth stage, namely, epidemic prevention strategies and economic development (Fig. 6). This stage prioritized guidelines related to the development of the social economy while paying attention to continued epidemic prevention. In the green cluster, the keywords “Region-Specific Prevention” and “Health Reporting” show the basic and critical strategies against COVID-19. Meanwhile, the epidemic situation abroad shows a trend of accelerated spread, which increases the pressure of imported cases in China. Thus, the SC proposed that the country should “prevent imports externally and prevent rebound internally”. Meanwhile, the emergence of the keywords “Supervision”, “Aid and Support” and “Publicity and Guidance” is the concrete manifestations of government function. This is the main reason why this stage is called the “continuous stage”.

The red cluster reflects the particular focus in the fourth stage. In this stage, policies were mainly based on the conference mentioned in the previous stage, which emphasized the significance of economic development. The keywords “Policy Support”,

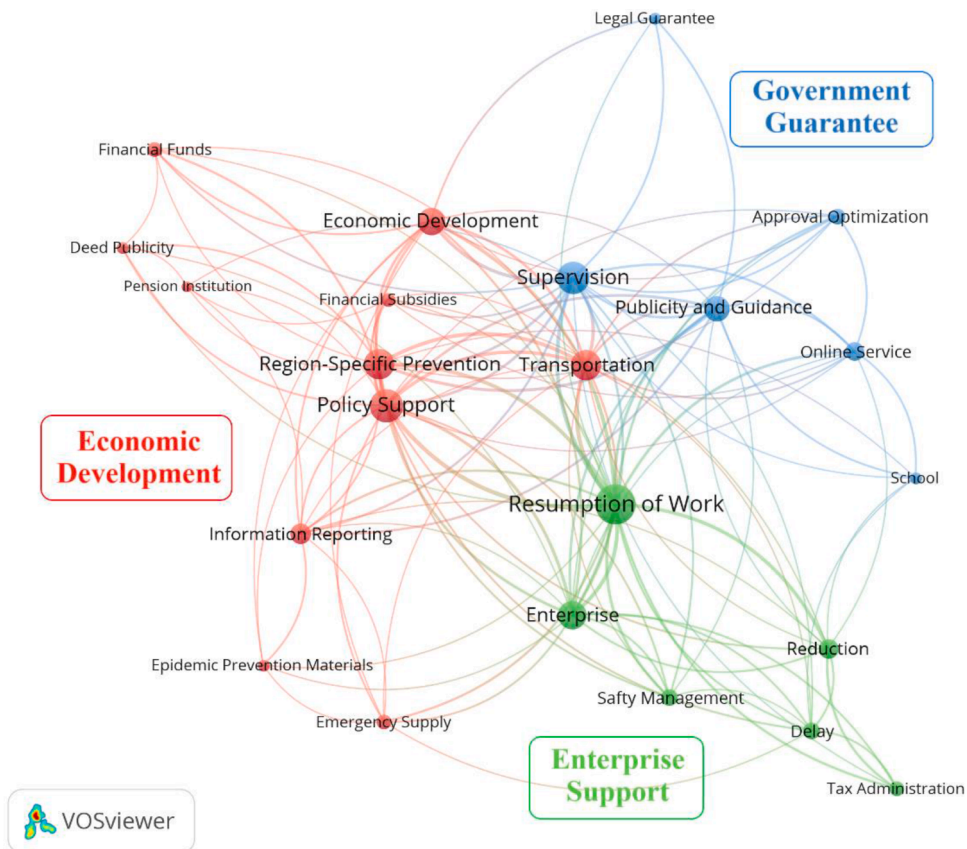


Fig. 5. Topics of policies against COVID-19 in the third stage.

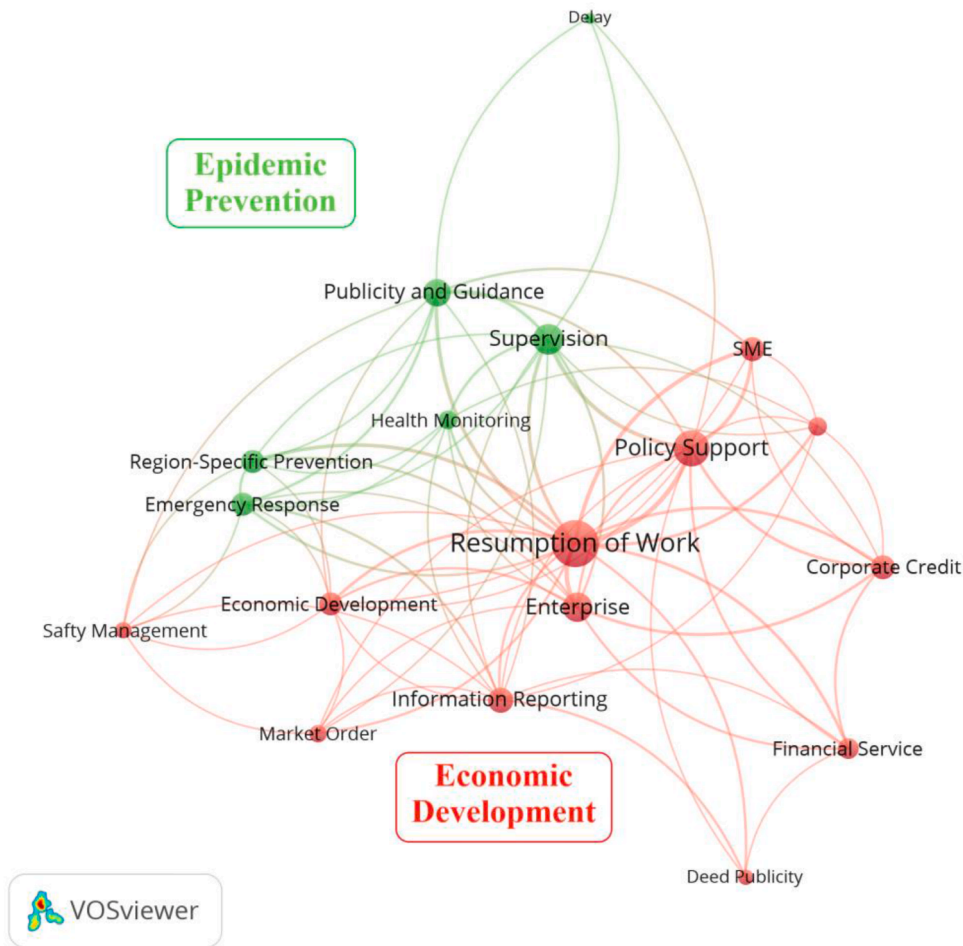


Fig. 6. Topics of policies against COVID-19 in the fourth stage.

“Enterprise”, “SME”, “Resumption of Work” all indicate vital factors ensuring economic development. Effective epidemic prevention and control can provide a suitable environment for the resumption of work and economic development, thereby restoring the order of production and normal daily life. Conversely, it can also provide a more robust material guarantee and financial support for epidemic prevention and control. These two parts complement and promote each other.

4.2.2. The shift of policy contents

Fig. 7 shows the evolution and shift of policy contents. In this figure, the keywords of each stage are regarded as the flows, and the frequency of keywords are reflected by the width of the flows. Hence, the continuity of the keyword-flow represents the change of policy focus over time, and the width of the keyword-flow indicates the degree of emphasis in the same stage. Furthermore, the position of keywords in a certain stage is dependent on the degree of emphasis, such that the higher level the degree, the higher the position of the keywords.

In general, the broad keyword-flow tends to have strong continuity spanning at least two to three stages. This feature means the focus of policy content shows consistency on the whole. Furthermore, the later the stage, the fewer new keywords, which reveals the concentration of emphasis as the situation changes.

There are four keywords that appear in all four stages: “Policy Support”, “Publicity and Guidance”, “Information Reporting” and “Delay”. “Publicity and Guidance” and “Information Reporting” get much attention, thus reflecting the main epidemic prevention strategies in the policy. “Policy Support” appeared in the first stage, but did not occupy a dominant position thereafter. Since the second stage, it has mutated into an important keyword, suggesting the status of policy during the epidemic prevention process. The persistence of the keyword “Delay” is a direct reflection of the public health emergency of COVID-19.

There is strong continuity in the second to the fourth stage. “Resumption of Work”, “Supervision”, “Enterprise”, “Deed Publicity” and “Safty Management” are all new keywords in the second stage and have continued to the fourth stage as essential foci of the policy. Moreover, “Resumption of Work” and “Supervision” are the top priorities of stages two to four, as illustrated in the figure, because their flow widths are much larger than those of other words. In addition, the keyword “Epidemic Prevention Materials” is the

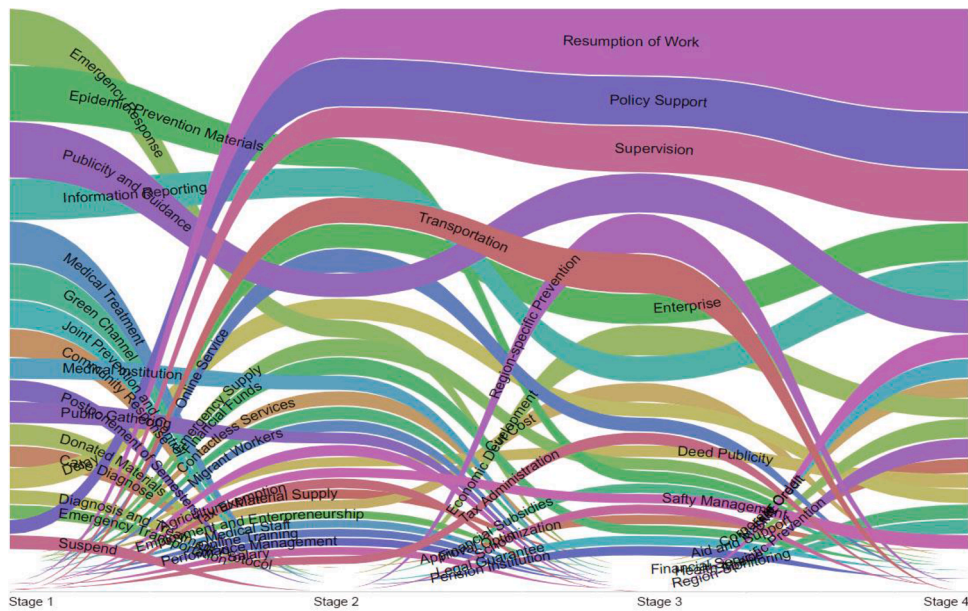


Fig. 7. The shift of policy content against COVID-19.

emphasis of the policies in the first to third stages; it has attracted more attention in the first stage while gradually decreasing in importance from then on, finally disappearing in the fourth stage. The shift of this term implies the effectiveness and progress of the epidemic prevention.

4.2.3. Objects of policy contents

When making public policies, the complex problems of the current situation are deconstructed to find the fundamental problems that can be solved under the interaction of multiple elements, namely, the object-oriented problems (Mi & Wang, 2009). The policy objects intersect with other elements to shape the enactment and outcomes of policies (Sin, 2014). In other words, each policy is oriented towards some specific objects in order to address the corresponding questions. Needless to say, the objects of policies play important roles in policymaking and implementation (Lister, 2007).

To further understand policies issued by the government agencies during these critical times, related objects were sorted out for analysis. This step enabled us to determine problems' corresponding objects. There are four main policy objects, namely, medical-related, groups, industries, and enterprises, which are listed in Table 3. Among them, Enterprise-related policies have been explicitly described in the "Enterprises Support" cluster in the second stage.

The results show the pertinence, sociality, temporality, timeliness, and contemporaneity characteristics of epidemic policies. Different policies target different objects, and there are various subordinate classifications of diverse objects. Distinct policies (e.g., diagnosis plans) reflect the changes in treatment measures over time. Overall, the analysis reveals that the government agencies have implemented a rapid response at the beginning of the epidemic, especially in relation to the supply of medical materials and implementation of relevant strategies. Moreover, policies about the office and education online offer flexibility, which is appropriate for the present era.

There are three conclusions that can be drawn regarding China's management of the COVID-19 crisis. First, the shift in policy topics coincided with the stage of development. The numbers of daily changes in newly diagnosed and cured cases in China according to the official data published by the MOH are illustrated in Fig. 8. Since January 21st, the MOH has collected and published daily data in various provinces across the country. On February 18th, the number of newly cured patients (1824) exceeded the diagnosed cases (1749) for the first time, which was located at the end of the second stage.

According to the previous analysis, after initially focusing on medical-related matters, the government issued a series of comprehensive, diversified, and useful policies since the second stage. Under this premise, the epidemic situation in China shows the characteristic of rapid change in the early stages and slow change in the latter. Owing to the international and domestic conditions, China has been and will continue to be in a situation wherein the goals of economic development and epidemic prevention would exist simultaneously for a long time. Finally, the government agencies in China have shown powerful functions of guidance, support, and guarantee in light of the challenging large-scale emergency brought on by COVID-19, allowing the country to overcome the crisis in the shortest possible time.

4.3. Characteristics of the policy-issuing agencies

This section answers the second research question. Here, we analyze the cooperative relationship, administrative influence, and

Table 3
Policy objects and the details of epidemic prevention.

Objects	Details	
Medical-related	Medical materials	Production and use of protective clothing Management of medical protective equipment Management of medical wastes Quality supervision of medicine and equipment Use of a range of common medical protective equipment Adequate supply of medical materials
	Medical institutions	Management of fever clinics Prevention of infection in medical institutions Supervision of radiation safety
	Diagnosis and treatment	Diagnosis and treatment plan (first to seventh versions) Operation guidelines of disinfection for public transport Prevention guidelines of infection in pension agencies, mental health and welfare institutions, public places, etc. (different versions)
	Medical process	Isolation and observation of suspected patients with mild symptoms Follow-up of discharged patients Transfer of cases Psychological crisis intervention of patients Management of asymptomatic infected persons
	Groups	Children and maternal Disease treatment and safe midwifery of pregnant women Assistance and protection for children who lack guardianship Prevention in the field of child welfare (e.g., child welfare institutions, relief and protection institutions, etc.) Migrant workers Service guarantee for going back to cities for the purpose of employment Setting "green channels" in the highways for chartered buses Addressing the problem of wage arrears Students Employment and entrepreneurship support of graduates Enrollment work of colleges and universities Financial aid for students facing financial difficulties Organization and management of online teaching Online training and educational services Medical staff Notes on time arrangement of school schedules (open or defer) Protection of front-line medical staff and their families Ensure the safety and maintenance of good medical order Measures for caring about physical and mental health Ensuring living security The elderly The propaganda of touching deeds Medical treatment for the elderly in pension institutions Services in primary medical and health institutions Care services for the elderly with particular difficulties Prevention and control of infection
Industries	People in need	The government bailout of the medical treatment and basic living expenses
	Transportation	Epidemic prevention in passenger stations and means of transport in the urban and rural areas Financial support for charges of water and land transportation Management of special transport (emergency materials, wildlife, relevant personnel entering or leaving Hubei Province, materials for agricultural production, etc.) Management of emergency transport support personnel Return peak transport service
Enterprises	others	Support for the aquaculture industry, apiculture, fisheries, coal mining industry, communication industry, energy industry, retail and catering, etc.
	Financial support	Interest discount and tax benefits Defer payment of taxes temporarily Return social security contributions appropriately
	Banking support	Reduce loan interest rates Increase credit loans and medium or long-term loans Extend or renew due loans
	Aid and stabilize posts	Encouraged no or fewer layoffs Arrange working hours of workers flexibly Pay wages for employees staying at home Provided free online training
	Cut costs	Reduce or exempt rents for SMEs reduce the cost of electricity and gas
Others	Provide contactless services during working Construct and maintain online network Special support for tourism and foreign trade enterprises	

policy contents issued by agencies to better characterize the patterns of policy-issuing agencies.

4.3.1. Cooperative relationship among agencies

The formulation of epidemic prevention policies involves almost all governments. According to statistics, 62 central agencies

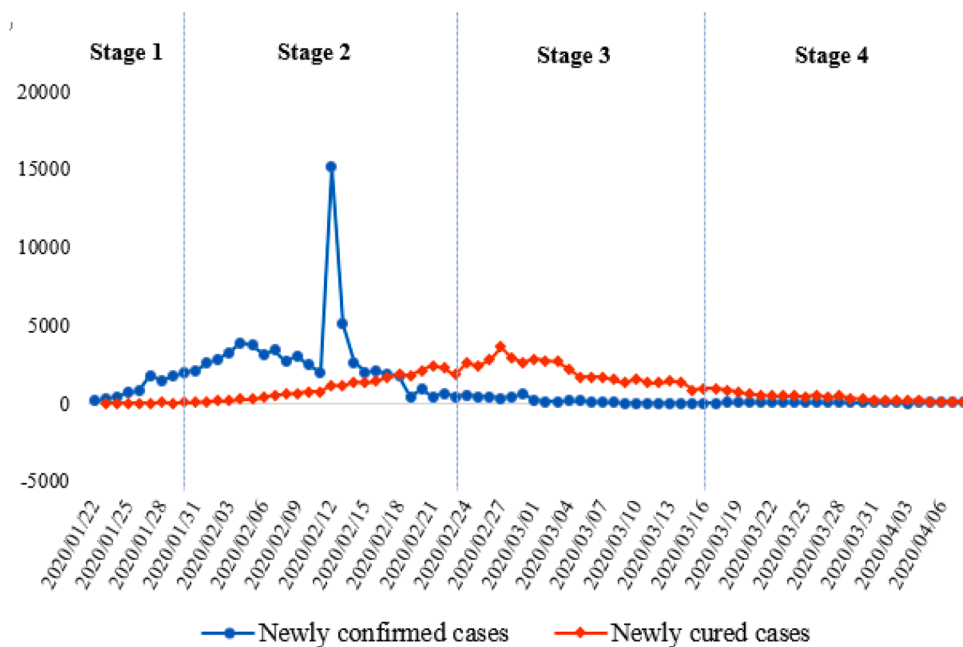


Fig. 8. The changing trend of new diagnosed and cured cases every day.

participated in the formulation of the anti-epidemic policies. In some cases, a single policy is formulated and issued by multiple agencies (Fig. 9). The policy that was implemented with the largest number of cooperative agencies was issued by 16 institutions (NDRC being the main issuer) and was officially called “Notice on the Production and Supply of Chemical Fertilizer for Spring ploughing in 2020 with the Prevention and Control against COVID-19”. This policy involved the production, transportation, reservation, import and export, service support, and marketing supervision of agricultural materials and raw materials. It is a typical case of coordinated relations among multiple agencies to achieve a common goal. Meanwhile, all policies issued separately account for 77.42%, which means that each agency also focused on meeting their respective primary responsibilities and making precise arrangements while cooperating with others.

Fig. 10 presents the collaboration network of all agencies. As can be seen, 48 agencies cooperated with others, while the remaining 14 agencies issued policies separately. The connecting agencies account for 77.42%, thereby indicating adequate cooperation among agencies and reflecting the consistent spirit of “joint epidemic prevention and control.” The dominant and auxiliary organizations in each cluster can be seen according to node size and position, with the MOH, MOF, and MOHRSS serving as the critical nodes in each cluster. As can be seen, the agencies paid more attention to medical (the blue one), financial (the green one), and personnel (the red

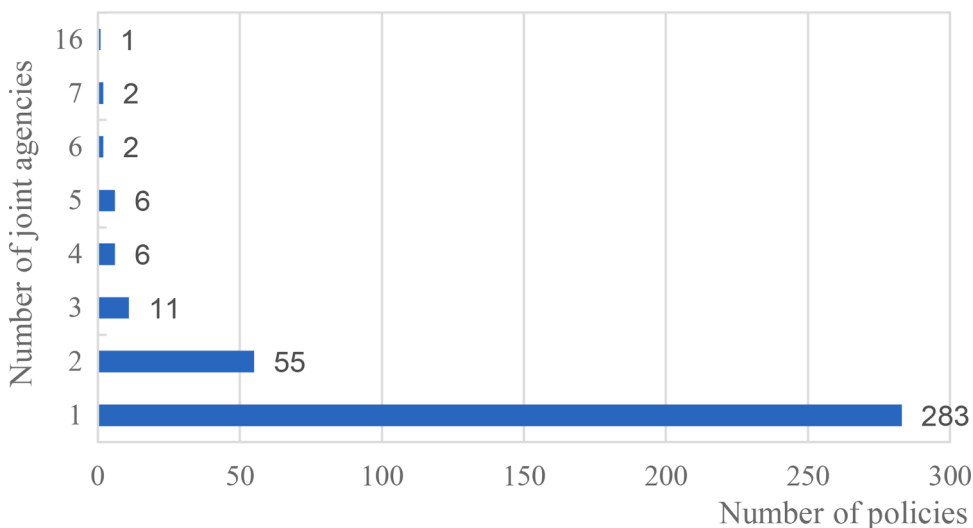


Fig. 9. Distribution of agencies cooperation.

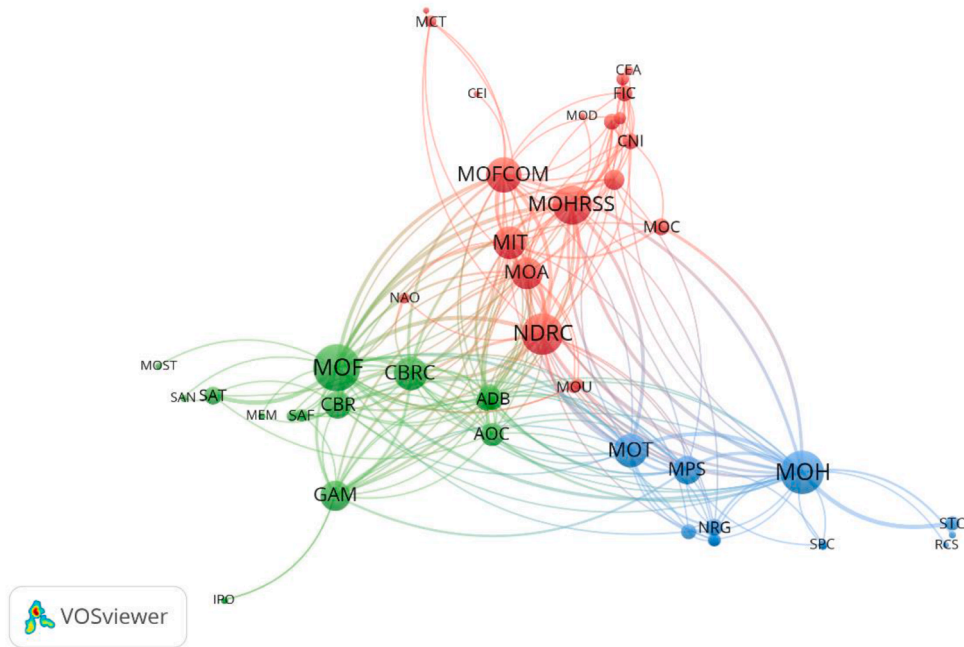


Fig. 10. The cooperative network of policy-issuing agencies.

one) matters. In other words, the MOH, MOF and MOHRSS are the key subjects of responsibility for these three aspects.

In detail, the blue cluster (12 items) shows that the MOH with MOT, the Ministry of Public Security (MPS), the National Railway Group (NRG), and other institutions are responsible for the supply and supervision of medical material matters. In the green cluster (16 items), the MOF is located at the core position surrounded by the China Banking Regulatory Commission (CBRC), the China Banking Regulatory Commission (CBR), the Agricultural Development Bank (ADB), the General Administration of Customs of the People’s Republic of China (AOC), and GAM. This indicates that such agencies issued policies about financial support and its supervision. The red cluster is the biggest one with 20 items. The agencies represented by the MOHRSS, MOFCOM, NDRC, MIT, the Ministry of Agriculture and Rural Affairs of China (MOA), etc., participated in the support provision and arrangement of personnel. Notably, the NDRC is located at the junction of the three clusters, which is the center of the whole cooperative network. This clearly indicates the collaborative nature of the process of epidemic prevention and control practiced in China.

We counted the number of policies issued separately and jointly by agencies and graphed the agencies with more than ten policies (Fig. 11). The results demonstrate that a small number of agencies issued a substantial number of policies: only 14 agencies issued



Fig. 11. Statistics on the issued separately and jointly of agencies.

73.37% of all policies. According to the figure, the MOF and NDRC generally issued policies jointly, and the MOT and MOC typically issued policies separately. Other institutions are balanced with the distribution of policy issuance, except the SC and GJPC. These phenomena are related to the functions and responsibilities of the organizations. The SC, the supreme leading organization in China, and the GJPC, an especially established organization to tackle the COVID-19 crisis, issued all policies individually, thus conforming to their mechanism independence.

4.3.2. Administrative influence of agencies

Although plotting the cooperative relationship highlights the involvement of government agencies, this does not indicate their levels of influence during the process of epidemic prevention. To address this problem, we analyzed the administrative influence of agencies. The administrative influence of policies is defined based on how frequently they are referred to (cited by) other policies; thus, the administrative influence of agencies can also be measured by policy citations. After our analysis, we found that policies issued by 28 agencies are cited 242 times. We calculated the total citations, g-index, and the highest cited policy of each agency and listed the related information with g-index over 1 (Table 4). The table was sorted from high to low, with rules of g-index first and total citations second. If the highest cited policy in the table is not mainly issued by the listing agency, the mark “issued jointly” is placed at the title end.

The SC and GJPC issued all their policies separately according to the previous section; however, this does not mean that they had nothing to do with the other agencies. Two indicators (g-index and the highest citation) of SC are highest with total citations second, and the GJPC follows closely behind. The policies issued by the SC and GJPC are generally treated as the reference and basis of other government agencies’ policies, so we call them leading agencies. On the next level, the MOF, MOHREE, and MOH, which are key nodes of the cooperative network, also have a strong influence on the other agencies. Significantly, the total citations of the MOF and MOH are equally the highest, representing their crucial roles in the process of epidemic prevention. The institutions of this kind are called key agencies and others are called auxiliary agencies. Hence, the ranking of the agencies’ influence is in descending order as follows: the leading agencies, the key agencies, and the auxiliary agencies.

The highly cited policies are all in line with the agency function to some extent. For example, as the supreme leading organization in China, the SC’s highest cited policy is made from an overall perspective. However, the policies issued by the MOF, MOH, MOT, and MOC are related to taxes, medical protective appliances, passenger terminals and transportation means, and pension institutions, which are more targeted and specific. Considering the cooperation and citation relationship, we found that the Chinese government shows a strong consistency of goals with close inter-agency collaboration.

4.3.3. Policy content analysis of agencies

Responding to public health emergencies requires the participation of multiple agencies. According to the previous study results, the SC, GJPC, MOF, MOH, and MOHRSS all play essential roles in the fight against COVID-19, so we correspond the topics of four stages to these agencies in order to analyze the policy contents of these agencies (Fig. 12).

The SC, GJPC, MOF, MOH and MOHRSS issued most of the policies related to the COVID-19 crisis, thereby showing dynamic importance as the stages progressed over time. In the first stage, the policies issued by these five agencies account for more than half of the total. In the next three stages, the proportion decreased by nearly a third as more and more agencies began to pitch in and help. At the beginning of the epidemic, the sub-level departments of the SC (e.g., the MOH and MOHRSS) were the ones that responded quickly

Table 4
The information related to agency citations (g-index over 1).

Issuing agency	Abbr.	Total citations	g-index	Highest cited	Policy title of highest cited
The State Council of China	SC	30	4	7	Guidelines for the Epidemic Prevention and Control Measures for Enterprises and Institutions when Resuming Work
Ministry of Finance of China	MOF	33	3	3	Announcement on Tax Policies to Support the Prevention and Control against COVID-19
Ministry of Human Resources and Social Security of China	MOHRSS	23	3	4	Notice on Further Epidemic Prevention and Control Work against COVID-19
Comprehensive Group of Joint Prevention and Control Mechanisms	GJPC	18	3	4	Notice on Strengthening Community Prevention and Control against COVID-19
Ministry of Health of the People’s Republic of China	MOH	33	2	3	Using Guidelines of Common Medical Protective Appliances during the Prevention and Control against COVID-19
Ministry of Transport of China	MOT	23	2	3	Notice on Epidemic Prevention and Control of Passenger Terminals and Transportation by Scientific Means via Regions
Ministry of Civil Affairs of the People’s Republic of China	MOC	14	2	4	Guidelines for Epidemic Prevention and Control in Pension Institutions against COVID-19
National Development and Reform Commission	NDRC	13	2	2	Urgent Notice on Strengthening the Financial Support for Key Guarantee Enterprises of Epidemic Prevention (issued jointly)
State Administration of Taxation	SAT	12	2	3	Notice on the Exemption of Corporate Social Insurance Periodically (issued jointly)
Ministry of Industry and Information Technology of China	MIT	7	2	2	Notice on Supporting and Encouraging Workers to Participate in Online Vocational Skills Training (issued jointly)

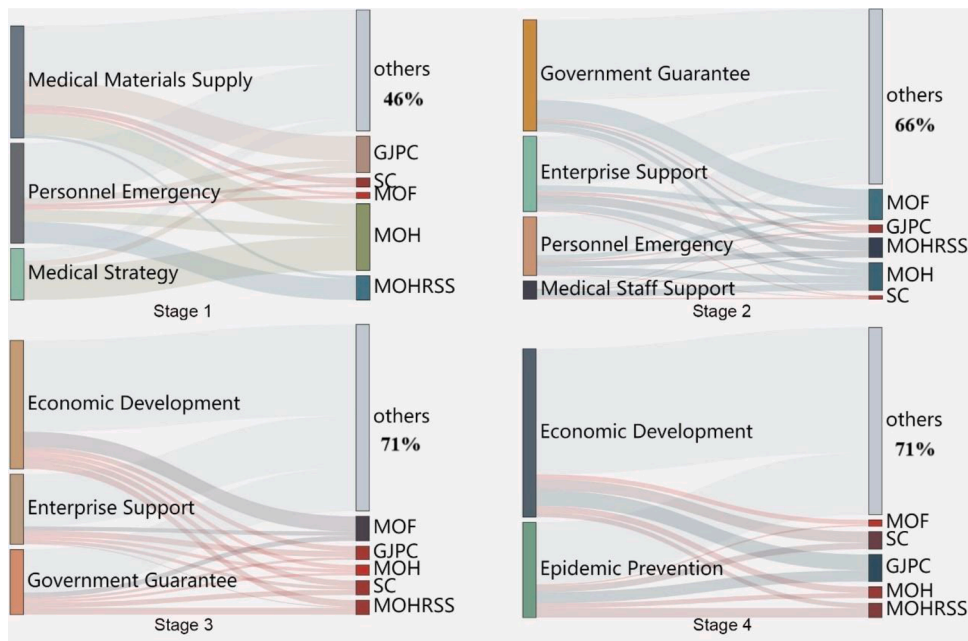


Fig. 12. Sankey diagram of policy content-linkage of agencies in four stages.

and developed emergency policies in their respective areas. As the epidemic situation was gradually relieved and a new stage emerged in which economic development was prioritized, the principal functions of the SC and GJPC slowly emerged. During the epidemic prevention practice, the proportions merely reflected the high or low of participation instead of the degree of responsibility.

In detail, the foci of agencies varied in different stages, and they jointly undertook the task of epidemic prevention. The length of the left column strips in the figure represents the focus of each stage, in which the longer the strip, the higher the cluster’s attention. In general, agencies focused on topics that gained higher attention. For example, the GJPC separately focused on the “Medical Material Supply” and “Economic Development” in the first and fourth stages. The MOF separately focused on the “Government Guarantee” and “Economic Development” in the second and third stages. However, the functional departments also played the role of their orientation, which can be observed in the first stage where the MOH emphasized the “Medical Strategy” and the MOHRSS emphasized the “Personnel Emergency”. As far as the agencies’ emphases are concerned, it can be concluded that the later the stages developed, the weaker their focus tendencies. In other words, the foci of the agencies became commonly shared over time.

5. Conclusions

5.1. Key findings

In this study, we present the patterns of epidemic prevention practice against COVID-19 in China by characterizing the patterns from three aspects: the time distribution of policy issuance, the policy content, and the policy-issuing agencies.

First, the number of policies increased sharply at the beginning of the epidemic, while it showed multiple decreasing trends in the following period. 366 policies were distributed into four different stages according to the time points at which national and significant milestones occurred. The second stage (1.31-2.23) issued the most policies of all, when many provinces in China downgrading their response levels against COVID-19 at the end of this stage. It was a signal for China revealing a containment situation against COVID-19. From the time distribution, it is easy to find that the governments take rapid response at the beginning of the epidemic.

Second, the four stages of the process referred to various topics, such as medical material supply, personnel emergency, government guarantee, enterprise support, economic development, etc. The topics shifted as the process continued, showing rapid changes in the early stages and slow changes in the later stages. Chinese policies responding to COVID-19 mainly issued for medical material supply at the beginning of the epidemic, and shifted to economic development gradually. Besides, there were multiple policy objects, including medical-related, groups, industries, enterprises, etc. In general, Chinese policies offer feasible guidance, diverse support and necessary guarantee facing various objects.

Third, we found that 62 agencies were involved in epidemic prevention, with the SC, GJPC, MOH, MOF, and MOHRSS playing important roles throughout the process. Correspondingly, these representative agencies also had high levels of administrative influence throughout the collaboration of agencies. With 62 agencies involving in and cooperating, China’s practice is the concrete manifestation of “joint epidemic prevention and control”.

5.2. Theoretical implications

This study contributes some theoretical insights. First, it enriches the policy research in the public health emergency area. In recent years, public health emergency has caused lots of losses on lives and properties to the society. How to prevent these emergencies effectively from policy-making perspective has a very important significance in society and academic research (Rong & Jia, 2008). The study of COVID-19, one of the severe epidemics broke out recently and spread rapidly, gives a supplement to the public health emergency research from policy-making point of view.

Second, bibliometrics opens up a new perspective of the policy study. To a certain extent, quantitative policy analysis has some advantages over qualitative analysis. It can avoid misjudgment of value preference subjectively and supplement with the evolution undiscovered in qualitative research (Li et al., 2015; Ren et al., 2017). In this study, co-word analysis is applied to discover the policy foci and their changes. Social network analysis is used to reveal the linkage and cooperation among policy-issuing agencies. These methods make the multi-angle and multi-layered analyses possible, and they are applicable to other policy research.

5.3. Practical implications

This study also provides several practical implications. For China itself, the strategies drawing from the practice against COVID-19 are beneficial to respond the public health emergency in the future. Based on the policies making and implementation in the context of China, this research goes beyond analyzing any single aspect or a specific policy and clarifies what policies are issued, how the policy foci change, what the relationships among agencies are, and how their influence is evolving during the process. These findings are valuable experiences to address evolving challenges in the future.

For other countries suffering COVID-19, this study offers some feasible tactics in response to the public health emergency. As early as April 18, *The Lancet* (2020) has recognized the quick containment of COVID-19 in China, which sets an encouraging example for other countries. According to three key findings, there are three suggestions for governments. First, they should respond quickly at the beginning. The lockdown of regions and social distancing are the most effective measures for preventing an infectious epidemic. Second, governments should undertake the responsibilities to offer support and guarantee for various objects, such as sufficient medical materials supply, powerful financial support, transparent information disclosure, etc. Third, the national agencies should work together in order to ensure the policy implementation comprehensively and effectively.

China is earlier than other countries to find cases of COVID-19. The rationality and feasibility of key findings and three suggestions have been verified partly in the practice of epidemic prevention in other countries. Many countries took positive measures as soon as possible, such as Korea and Japan. Similar to China, Korea tested and treated cases as much as possible, while Japan tended to arrange severe cases at the beginning to relieve the pressure of medical system. Every country basically issued policies to support their medical system, economic development, etc. Notably, Sweden announced that it would "no longer count the number of confirmed cases nationwide" on March 13. Though it was inconsistent with information transparency, it was the result of multiple factors such as geographical location and national conditions. Moreover, the spirit of the "joint epidemic prevention and control" practiced in China not only involved governments but all citizens. The measures taken by Italy were most consistent with China, for example, attaching great importance to COVID-19 in the beginning, becoming the first country to lockdown cities in Europe and construct places like "Vulcan Mountain", etc. However, the situation was not very optimistic subsequently due to the difficulty of implementing home quarantine and the lack of essential medical teams from all over the country. The cases like Sweden and Italy indicate that any policy implementation divorced from national context is of little significance.

5.4. Limitations

This research reveals how China responded to the public health emergency of COVID-19 from the perspective of policy content and their issuing agencies. However, there are some limitations to this study. For a more accurate exploration, policies with a small scale samples only delineate a certain part of the process. Furthermore, measuring the administrative influence using the g-index is open to discussion, given that policies issued earlier are more likely to be cited than those issued later during a short period of time. Finally, this study is designed from a quantitative analysis perspective, so it is difficult to get a sense of the qualitative nature of these policy documents. Further research could combine the qualitative and quantitative methods for a more comprehensive analysis of the policies.

Authors statement

Jiang Wu: Conceptualization, Methodology, Supervision, Writing - review & editing. **Kaili Wang:** Data curation, Software, Visualization, Writing - original draft & editing. **Chaocheng He:** Data curation, Software, Visualization. **Xiao Huang:** Data curation, Software, Visualization. **Ke Dong:** Conceptualization, Methodology, Supervision, Writing - review & editing.

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