

Optimization of Emergency Management in Urban Primary Care Organizations from a Resilience Perspective

Wang Bochen¹, He Changping²

1 School of Economics and Management, Shanghai University of Electric Power, Shanghai, China

2 School of Economics and Management, Shanghai University of Electric Power, Shanghai, China

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Abstract: Primary healthcare organizations play a crucial role in the event of disasters, shouldering important responsibilities such as disaster prevention and relief. However, emergency medical management in urban streets and communities faces great challenges during emergencies. From the perspective of urban resilience, this paper aims to combine the current situation of community health centers in Pudong New Area, Shanghai, by revealing the problems of chaotic structure and insufficient logistic support of urban primary healthcare organizations, and applying methods such as data mining, statistical analysis, key feature extraction, and risk assessment, we propose a series of strengthening precautionary measures to address the resilience attributes of urban primary healthcare organizations, and to provide a series of measures to enhance the resilience of urban primary healthcare organizations. "Using methods such as data mining, statistical analysis, key feature extraction and risk assessment, we put forward a series of measures to strengthen plans, refine processes, optimize resources and link up prevention and coordination. Through a multifaceted integration and synergy approach, it proposes an improved plan to regularize the prevention and control of emergencies, with the aim of exploring measures to enhance the primary emergency response organization system for resilient cities.

Keywords: Emergency management optimization, Primary care organizations, Resilience management

1. Analysis of the management and trend development of urban primary healthcare organizations

For a long time, natural disasters and public health emergencies have never ceased around the world, and human beings have summarized their experiences and lessons learned from the continuous struggle against them. In the Boao Forum for Asia, the discussion of "Risk Management and Sustainable Development" also signifies that the changes brought by emergencies to the global people have attracted great international attention. The essence of resilience management is to abandon "confrontational thinking" and replace it with "compatible thinking", i.e., to provide an absorptive and accommodating capacity, a kind of elasticity and resilience ¹.

Responding to the impact of sudden-onset disaster events on urban primary health care, domestic well-known databases and foreign Web of Science databases were selected by using methods such as data measurement and data mining². The literature was searched from 2019 to 2023, and the data resources related to primary care, health services, extreme weather, and public health emergencies were statistically analyzed through R language on R x64 3.5.2 software, and key features were extracted from the data using PageRank and other algorithms to mine the research patterns, clarify the dynamics of the research frontiers, and identify the focuses of the research, while TF-IDF was utilized to extract the key features of the data³. At the same time, the TF-IDF statistical method was used to assess the importance of the relevant word frequency, extract the key features of the high-frequency words, and analyze the research trends and time-series characteristics, as shown in Figure 1. Equations (1)-(2) represent the TF-IDF statistical method.

$$TF_{i,j} = \frac{n_{i,j}}{\sum_k n_{k,j}} \quad (1)$$

The numerator $n_{i,j}$ in the above equation is the number of occurrences of the word in the document, while the

Public health is a comprehensive effort to prevent disease and promote health, and primary health-care organizations are important implementers of public health tasks. Primary care organizations carry out health education, vaccination and disease screening at the community level to effectively control and prevent the occurrence and spread of disease. Management of urban primary care organizations needs to ensure comprehensive coverage and continuity of medical services to meet the basic medical needs of residents⁶. By establishing a sound management mechanism for urban primary care organizations, the continuity and stability of primary care services can be promoted to ensure that residents have timely access to medical services. There is a close correlation between the management of urban primary care organizations and resilient cities. Strengthening the management and service capacity of urban primary care organizations and improving the level of health services and health literacy at the community level can enhance the resilience of cities and make them more capable of coping with various shocks and challenges⁷. There is a close relationship between health management and the management of urban primary care organizations, which work together to promote the health of urban residents and the quality of health services. By strengthening the collaboration and integration between the two, the health level of urban residents can be enhanced, the quality of healthcare services can be improved, and more comprehensive and high-quality healthcare services can be provided to urban residents. Emergencies have put forward higher requirements for the management of urban primary care organizations, which need to have the ability to deal with various emergencies and carry out the work of plan formulation, resource reserves, rescue response, psychological intervention, etc., so as to ensure that the city is able to carry out medical rescue and prevention and control work in an effective and orderly manner during emergencies and to safeguard the lives, safety and health of urban residents. There is a close correlation between "public health, primary care, resilient cities, health management and emergencies" and the management of urban primary care organizations. They interact and support each other to promote the health of urban residents and the quality of medical services, and to ensure that the city can effectively and orderly carry out medical rescue, prevention and control work in the face of emergencies⁸.

2. Emergency management system dilemmas faced by primary care organizations

2.1 Improper operation process

Community health service centers are the first threshold for disaster prevention and mitigation, but due to the deficiencies of community medical organizations in various aspects such as scale, environment, staffing, etc., patients cannot be treated quickly, and the improper operation process of community medical treatment is a key factor. The main problems that cause improper operation process are as follows: (1) Unstandardized diagnosis and treatment process, such as incomplete examination, inaccurate diagnosis and improper treatment. (2) Unstandardized drug management, such as irregular drug procurement channels, non-compliance with drug storage conditions, improper use of drugs, and so on. (3) Unstandardized medical records, such as incomplete, inaccurate and untimely records, resulting in incomplete or incorrect patient information. (4) Irregular disinfection and isolation, such as improper use of disinfectants, irrational setting of isolation areas, and inadequate protective measures, leading to increased risk of cross-infection and nosocomial infection. (5) Unstandardized use of equipment, such as improper operation and untimely maintenance of equipment, leading to equipment failure or damage and affecting medical quality and safety. These problems may have a negative impact on patient safety and the quality of healthcare services, so effective measures must be taken to correct them.

2.2 Unfavorable resource security

In the face of sudden extreme disasters, medical human and material resources are seriously lacking, the maximum use of limited resources is the key to disaster relief, for the primary medical organizations, the insufficiency of logistical support is one of the important problems, but often the primary medical organizations have insufficient staffing phenomenon, including doctors, nurses, administrators and so on, which will lead to the normal operation of the medical work in the emergency relief. At the same time, the lack of medical supplies and equipment also affects the quality and efficiency of medical services, thus failing to meet the needs of patients. Compared with the tertiary hospitals, the primary medical care technology and equipment are relatively backward, which may affect the timeliness of treatment in special cases and emergency treatment.

2.3 Timely transportation of supplies

Untimely transportation of materials leads to the inability of primary care organizations to obtain necessary medical supplies in a timely manner, which limits the ability of medical institutions to respond to emergencies or large-scale disasters, and prevents them from providing adequate protection and treatment measures, increasing the risk of infection and casualties among patients. Untimely transportation of supplies may also result in relief supplies not reaching the disaster area in a timely manner, delaying the timing of rescue operations. This can bring more harm and risk to the people in the disaster area, while also increasing the difficulty and risk of the work of rescue workers. Finally, the untimely transportation of supplies makes primary care organizations lack sufficient reserve and deployment capacity in emergency response. In the face of a large-scale disaster or epidemic outbreak, medical organizations are unable to quickly obtain the necessary supplies, which limits emergency treatment, prevention and control measures, and affects the effectiveness and response capacity of the emergency management system.

3. Strategies and Challenges for Primary Healthcare Organizations

Primary health service is the first and foremost to solve the health and disease problems of the people in the jurisdiction, in the primary health care system, the institutional mechanism, organizational leadership, supervision and evaluation and other aspects of the imperfections, but the most important is that the resources can not be maximized use, in the event of a sudden and extreme disaster test, often reveals a number of problems, which seriously affects the timeliness of the personnel rescue and treatment.

3.1 Standardization of emergency medical assistance plans

In the event of sudden natural disasters and public health events, the premise is to make a complete rescue plan. First of all, it is necessary to establish a standardized emergency medical assistance plan process, including emergency response, on-site treatment, patient transfer, follow-up treatment and other links, to ensure that each link has a clear responsibility and operational standards. At the same time, standardized training should be carried out to provide standardized training for emergency medical aid personnel to ensure that they master the basic knowledge and skills of emergency medical aid, including first aid skills, trauma treatment, cardiopulmonary resuscitation and so on. Guarantee a standardized stockpile of medicines and equipment to ensure that the required medicines and equipment can be obtained in a timely manner during emergencies. Establish a standardized information reporting system to collect, organize and report relevant information so that correct decisions can be made in emergencies. Carry out standardized quality control of the emergency medical aid process to ensure that each link meets the standard requirements and improve the quality and efficiency of the entire emergency medical aid process. Establish a standardized evaluation mechanism to evaluate and give feedback on the emergency medical aid process in order to summarize the lessons learned and continuously improve and enhance the emergency medical aid capability. In conclusion, through efforts in standardized processes, training, stockpiling of medicines and equipment, information reporting, quality control and assessment mechanisms, the efficiency and effectiveness of emergency medical assistance can be further improved, and the medical assistance of the grassroots in responding to emergencies can be safeguarded.

3.2 Rigorization of process implementation

The standardization and standardization of the primary medical care organization process is of great significance for improving work efficiency and service quality, enhancing management effectiveness, and safeguarding community medical assistance. It is especially important when encountering sudden extreme disasters, so it is imperative for primary care organizations to implement strict medical processes.

First of all, the primary medical organization should establish a perfect system, including medical management, nursing management, drug management, equipment management, emergency management and other aspects, to clarify the process and standards of work, to ensure that the standardization of work, standardization. Secondly, primary medical organizations need to strengthen personnel training and improve the technical level and service consciousness of medical personnel. At the same time, it should pay attention to the emergency medical training of medical personnel to improve the medical treatment ability of medical personnel in the face of emergencies.

Finally, primary care organizations should establish a perfect quality control system to comprehensively monitor and manage the medical process and service quality, and to find and solve the existing problems in a timely manner. Focus on the continuity and systematic nature of quality control, and constantly improve the quality of medical care and service level. At the same time, it strengthens supervision and inspection, carries out regular or irregular inspections and assessments of all work, finds problems and makes corrections in a timely manner, pays attention to the comprehensiveness and meticulousness of supervision and inspection, and ensures standardization and standardization of all work. Through the implementation of process rigor, primary medical organizations can comprehensively improve work efficiency and service quality, as well as the ability to respond to sudden disasters in medical protection, and improve the timeliness of medical assistance.

3.3 Rapid guarantee of emergency resources

Health emergencies often occur in cities, such as food safety accidents and natural disasters. Primary medical institutions need to provide emergency medical services quickly. The rapid guarantee of emergency resources can ensure that medical institutions obtain necessary medicines, instruments and equipment, such as first aid kits, antibiotics, bandages, etc., in time to alleviate the condition and reduce the mortality rate. The importance of rapid safeguarding of emergency resources for urban primary care cannot be ignored. Only by strengthening the reserve and guarantee of emergency resources can we effectively improve the emergency response capacity of primary care organizations and protect the health and safety of urban residents. Take the work statistics of a street in Pudong New Area, Shanghai, in 2022 as an example: the primary health service center has set up five teams, delineating the regional counterparts to serve 32 neighborhood committees, and in the spectrum of the more common diseases in the clinic, the number of people with health management services: 7,482 people, and the rate of health management services: 73.97%. This is especially true for services for special populations.

Table 2. Statistics on Special Populations

Special Population Groups	Number (persons)	Percentage of Street Population (%)
Hypertension (high risk)	1528	1.06
Diabetes (stage 4~6)	792	0.56
Post-stroke	235	0.17
Pregnant women	1002	0.71
Poor people	905	0.64
Mental Illness	478	0.34
Disabled people	2528	1.78
Tuberculosis	14	0.01

Sudden disasters can cause harm to special populations, as well as cause these Table 2 on the complications, the threat to the lives of people, and for this reason we counted the health status of special populations throughout the street as shown in Table 2 Special Populations Statistics, we have a better understanding of the health status of the entire street population. Therefore, in emergencies, a large number of emergency supplies need to be quickly delivered to primary medical institutions to ensure that medical services can be carried out in a timely manner and minimize casualties and deterioration of conditions. In order to realize the rapid delivery of emergency supplies, it is necessary to establish an efficient mechanism for stockpiling and deployment of supplies, and to set up a channel for rapid deployment of emergency supplies. This requires the establishment of a close cooperative relationship between relevant departments and organizations so that materials can be quickly distributed from central or local stockpiles to primary medical institutions in the shortest possible time. At the same time, modern logistics technology and information systems are used to promote rapid distribution and tracking of supplies and improve overall transportation efficiency.

3.3.1 Modeling of rapid guarantee of emergency supplies

Constructing a model for rapid safeguarding of emergency supplies can improve the disaster resilience of a city or

region. Through rational material security and deployment, it can respond to disasters more quickly and accurately, reduce losses and risks, and improve the resilience of communities and residents. This helps to improve the overall community's ability to respond to disasters and survive in emergencies. The modeling can accurately assess the material needs during disasters or emergencies through data analysis and forecasting, so that material resources can be better planned and deployed. This will greatly improve the efficiency of emergency response and enable supplies to be quickly delivered to where they are needed to meet the basic needs of people in disaster areas.

Problem description: when an emergency occurs, we need to determine the number of emergency material demand points in time, as well as the quantity of emergency material demand, which is difficult to be supplied in time due to unfavorable factors such as the capacity limitation of means of transportation and the urgent rescue time. In order to the lag of emergency supplies, we can establish a suitable model of rapid guarantee of emergency supplies, so much so that we can guarantee the safety of people's lives and properties.

Decision-making problem: Facing an emergency, with a known number of medical demand points, how to deploy material transportation vehicles so that the materials can be quickly distributed from the central or local stockpile to the primary medical institutions in the shortest possible time.

The specific set meanings are shown in Table 2.

Table 3. Meaning of sets

Set	Meaning
$n, n' \in N$	Gathering at the point of need for supplies
$k \in K$	Vehicle assembly
$o(k)$	Central or local pools of reserves
$e(k)$	virtual endpoint collection

The meaning of specific decision variables is shown in Table 3.

Table 4. Meaning of decision variables

variables	Meaning
$\beta_{n,n',k}$	Indicates the arrival of demand point n' by vehicle k from demand point n then 1, otherwise 0
$\gamma_{n,k}$	Indicates the time of arrival of vehicle k at demand point n
$\alpha_{n,k}$	denotes 1 if demand point n is served by vehicle k and 0 otherwise
$t_{n,n'}$	denotes the time consumed to reach the demand point n' from the demand point n

Objective Function.

$$\min \sum_{k \in K} \sum_{n \in NU\{o(k)\}} \sum_{n' \in NU\{e(k)\}} \beta_{n,n',k} t_{n,n'} \quad (3)$$

$$s. t. \sum_{k \in K} \alpha_{n,k} = 1, \forall n \in N, \quad (4)$$

$$\sum_{n' \in NU\{e(k)\}} \beta_{n,n',k} = \sum_{n' \in NU\{o(k)\}} \beta_{n',n,k} = \alpha_{n,k}, \forall k \in K, n \in N, \quad (5)$$

$$\sum_{n \in NU\{o(k)\}} \beta_{n,e(k),k} = \sum_{n \in NU\{e(k)\}} \beta_{o(k),n,k} = 1, \forall k \in K, \quad (6)$$

$$\gamma_{n',k} \geq \gamma_{n,k} + t_{n,n'} - M(1 - \beta_{n,n',k}), \forall n' \in N \cup \{e(k)\}, n \in N \cup \{o(k)\}, k \in K, \quad (7)$$

$$\alpha_{n,k} \in \{0,1\}, \forall n \in N, k \in K, \quad (8)$$

$$\beta_{n,n',k} \in \{0,1\}, \forall n \in N \cup \{o(k)\}, n' \in N \cup \{e(k)\}, k \in K, \quad (9)$$

$$\gamma_{n,k} \geq 0, \forall n \in N \cup \{o(k), e(k)\}, k \in K, \quad (10)$$

Equation (3) in the model is the objective function, and Equation (3) indicates that the total time of all emergency material demand points in the vehicle lane is minimized. Formula (4) indicates that each demand point can only be served by one vehicle. Equation (5)-(6) indicates the limitation of the number of vehicles arriving at the demand points. Equation (7) indicates the time limit for vehicles to reach the demand point. Equations (8)-(9) denote 0-1 integer variable constraints. Equation (10) represents the time limit for vehicles to reach the demand point.

3.3.2 Strategies for the rapid securing of emergency supplies

First of all, the above 3.3.1 emergency supplies rapid security model through $\alpha_{n,k}$ and $\beta_{n,n',k}$ to set, for the rescue vehicle rescue path has a suitable setting, and then $\gamma_{n',k}$ and $\gamma_{n,k}$ for the time setting, and finally by the emergency supplies rapid security model of the objective function of the $\beta_{n,n',k} t_{n,n'}$ solution, we can find out how to deploy the material transport vehicles when the urban primary medical organizations when faced with emergencies, in the case of the known number of medical demand points, in order to be able to quickly distribute the materials from the central or local reserve to the primary medical institutions in the shortest possible time. It can help primary care organizations to quickly distribute emergency materials to the affected points and safeguard people's lives and properties.

Secondly, through the establishment of the above emergency materials rapid security model, the demand and distribution can be predicted in advance, optimizing the planning of reserves and transportation channels, reducing rescue time and improving rescue efficiency. The emergency material rapid security model can scientifically and reasonably formulate the emergency material deployment plan according to the actual demand and time limit, and reduce the pressure of the government in responding to emergencies. The establishment of emergency supplies rapid security model is of great significance for rapid security. It can not only improve rescue efficiency and reduce casualties, but also strengthen social stability and reduce government pressure, providing a solid backing for safeguarding people's lives and health. The model can determine a reasonable amount of material reserves and storage locations based on historical data and risk assessment, and can quickly deploy materials to where they are needed in the event of a disaster. This avoids the problem of overstocking or shortage of supplies and improves the utilization rate and response speed of supplies. Through the establishment of the model, various departments can share information, strengthen communication and coordination, and form an efficient emergency material deployment mechanism to improve the effectiveness of overall emergency management.

Finally, the establishment of the emergency material rapid guarantee model can improve the disaster resilience of the city or region. Through reasonable material security and deployment, it can respond to disasters more quickly and accurately, reduce losses and risks, and improve the resilience of communities and residents. The construction of emergency material rapid guarantee model is of great significance to improve the level of emergency management and protect public safety.

4. Summary

As natural disasters and public health events continue to intensify, the work of primary medical organizations as the first line of disaster prevention and relief, streets, community neighborhood committees and health service centers under the jurisdiction of the work has become more and more important, optimize resources, make up for the shortcomings, to improve and improve the coordination force of grassroots medical organizations has become an inevitable trend, and to strengthen its resilience management capacity has also become the main means to strengthen the health care emergency management, through the grassroots organization of the continuous exploration and practice of emergency management system and mechanism, medical resources reserve, medical rescue capacity, community linkage, information reporting system and supervision and feedback mechanism have an important role to play in improving the capacity and level of urban response to emergencies.

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