

# CAS Theory Perspective of Community Emergency Management Factors and Coping Strategies

-- Take 10. 21 In Shenyang Hotel Gas Explosion Accident for Example

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**Abstract:** With the rapid development of community culture and economy, people pay more attention to the frequent occurrence of community accidents. In order to protect the life and property safety of community residents and establish a safe and harmonious community, how to carry out rapid and effective emergency management of community accidents has become the focus of every community manager must think. Based on the theory of complex adaptive system, this paper discusses how to form the characteristic emergency management system for community by taking the gas explosion of Shenyang hotel as an example. The results show that in the community emergency management, in addition to the four management elements of human, material, environment and system, a dual emergency mode should be established with the community emergency response team as the leader and the fire medical support force to improve the emergency handling and response capacity of community accidents, and effectively reduce the loss of life and property of residents.

**Keywords:** Emergency management, Complex adaptive system theory, Crisis life cycle theory, Community safety, Collaborative governance.

## 1. Introduction

Community accident is a serious problem in the process of urbanization. To improve the urbanization rate of a country, it is necessary to transform and upgrade traditional communities to upgrade their structures and functions, so as to achieve type and scale development. However, the severity of community accidents has also been unexpectedly increased. With the development of modern social life, the differences between communities as local societies are becoming smaller and smaller. How to prevent and deal with community accidents in the general direction is also gradually regular to

follow, and targeted systems can be formulated.

In 1994, American Professor John Holland [1] proposed the Complex Adaptive System (CAS) theory. CAS theory believes that there is active interaction between the environment and the subject and between the subject and the subject, and they influence each other in the process of interaction, and finally generate new strategies for interaction with other subjects and the external environment to promote the evolution of the system [2]. At the same time, he also proposed that identification mechanism, building block mechanism and internal model mechanism should be used to participate in the research of CAS evolution process.

Table 1. Community accident cases

	Accident cases	Time	Site	The number of casualties
1	7·20 Civilian house explosion accident in Linyi City, Shandong Province	2011-07-20	Lanshan Street, Lanshan District, Linyi	1
2	7·20 Shenyang Hotel explosion accident	2015-07-20	Fenhe Street, Huanggu District, Shenyang	2
3	4-5 Shanghai community fire accident	2016-04-05	Laoshan Second Village, Pudong New Area, Shanghai	12
4	Dec. 9 Haifeng Community fire accident	2017-12-09	Pinggong Town, Haifeng County, Shanwei City, Guangdong Province	8
5	April 15: House fire in Changshu, Jiangsu	2018-04-15	Mocheng Street, Changshu City, Jiangsu Province	9
6	8·25 Harbin Hotel fire	2018-08-25	Beilong Hot Spring Hotel, Songbei District, Harbin	43
7	Oct. 22 Gas explosion accident in Heping District, Shenyang	2021-10-22	Taiyuan South Street, Heping District, Shenyang	5

The global scholars have introduced CAS theory into the field of emergency management, providing a new idea for solving the current problems of emergency management [3-4]. The interaction and mutual influence between different subjects and between subjects and the environment produce complexity, and subjects are also constantly adapting, which has become the main driving force for the continuous evolution of the system [5]. In other words, the process of mutual adaptation between subjects and the environment achieves complexity. At present, CAS theory is mainly applied in the study of earthquake disaster prevention system and emergency plan simulation system in emergency management, as well as in the field of health care.

Community emergency management involves a dynamic environment in which many different subjects interact and different emergency scenarios interact. Based on the complex adaptive system theory as the theoretical basis, the shenyang hotel gas explosion accident is analyzed, combining with the existence of accident hidden danger before the operation of the emergency response mechanism, after the accident, accident prevention, proposed in view of the community emergency management factors and coping strategies, in order to reduce the possibility of community accidents, improve the efficiency of accident emergency management, Reduce the loss of people's lives and property safety.

Community is an important part of modern society. The security of community determines whether a society is stable and harmonious. Building safe community is an important part of building a well-off society in an all-round way, constructing a harmonious society and a peaceful and safe society, and also one of the important measures to implement the scientific development concept of people-oriented, comprehensive, coordinated and sustainable development. Community accidents are not only the biggest factor affecting community safety, but also the most unstable factor of community development. The causes of community accidents include but are not limited to meteorological disasters, man-made disasters and sudden changes of instrument quality. Frequent community accidents have brought serious loss of life and property to the people of the country (Table 1). Therefore, it is imperative to establish a replicable emergency management strategy for community accidents.

## 2. Emergency Management Analysis

### 2.1. Theoretical Framework of Crisis Life Cycle

The crisis life cycle theory divides crisis accidents into three stages: pre-crisis, in-crisis and post-crisis (Figure 1).

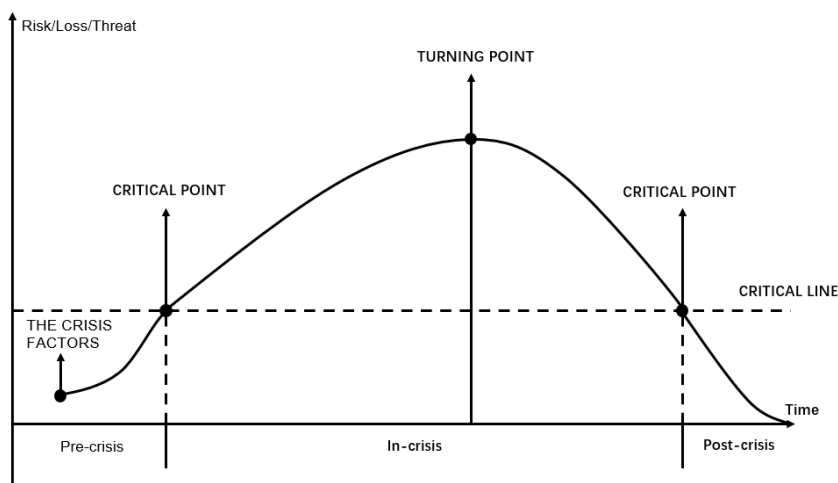


Figure 1. Crisis life cycle process diagram

Pre-crisis stage: before the occurrence of an emergency, it is often accompanied by the occurrence of accident omens, but these omens are generally difficult to be detected, which can be understood as the process of gradual accumulation of accident crisis factors. When the accumulation reaches a certain level, an emergency breaks out. Therefore, the establishment of preventive intervention system or measures in the prior stage can effectively avoid the occurrence of emergencies, or effectively reduce the probability of their occurrence.

In-crisis stage: this stage is the stage from the outbreak of an emergency to the control and the final extinction, and it is also the main stage that brings the safety loss of people's lives and property. Through the adoption of scientific and reasonable emergency response measures, timely handling of the accident, to eliminate the crisis at the same time to reduce or

avoid casualties and losses, to prevent the deterioration of the accident.

Post-crisis stage: after the emergency has been effectively controlled, the crisis has been alleviated and the event handling has entered the summary stage.

### 2.2. Summary of the Accident

On the evening of October 20, 2021, the municipal gas pipeline near Taiyuan South Street, Heping District, Shenyang city, Liaoning Province was repaired. The hotel was in a state of gas shutdown, and the gas supply was resumed on the morning of October 21. At 8:20 a.m., an explosion occurred at No. 222 Wang Erniu Roast Bone Shop (see Figure 2). A number of buildings at the intersection where the explosion occurred were badly damaged, with broken Windows and exposed steel bars. The accident

damaged power distribution lines at the site and cut power to surrounding residential areas.



Figure 2. Scene of action

After investigation, the scene was judged to be an explosion in the building. After 36 hours of continuous rescue, the search area has also been expanded from 500 meters to 1,000 meters. At 19 o'clock on the 22nd, the search and rescue mission was basically completed. Five people were killed; Three people with serious injuries were also treated. Site staff in the accident area door by door in line, and the formation of 5 people to protect the group, carefully resettlement of the masses.

In this gas explosion accident, the crisis factors mainly include the following two: First, the direct factor is recovering gas supply pipe gas is enough, the accident of Wang Erniu baked bones shop as a dining place, impressed by high temperature, oil and other factors, the gas using the environment is bad, is affected by any carelessness may cause gas leakage, explosion and other accidents, such as happened in jiangsu wuxi EHu town of double le cafe 10, 13 liquefied petroleum gas explosion accidents. Second, the indirect factor is that the merchants are careless and do not maintain the gas facilities in place. At the same time, there may be physical wear and tear of the pressure regulating valve and pipeline, which brings risks and hidden dangers to the use of gas.

## 2.3. Advantages and Disadvantages

### 2.3.1. Strong Rescue Force

After the accident, provincial leaders immediately made instructions and rushed to the scene to guide the emergency rescue work. Provincial Standing Committee Member Zhang Lei and Mayor Wang Xinwei also rushed to the scene to command the emergency rescue work. The command center immediately dispatched 25 fire engines and 110 fire fighters from the fire rescue station to the scene, as well as the full command, western command and peace brigade. Municipal emergency bureau, gas company, public security and other departments were timely on the scene. According to statistics, the relevant departments and local governments sent 307 rescue vehicles of various types, 1,054 rescue forces and 8 experts to participate in the rescue.

### 2.3.2. Transparency of Information

Explosion accident such a large accident, will cause the attention of the whole society, whether the transparency of information is one of the most concerned about the outside people. After the accident occurred, the official platform promptly notified relevant information of the accident, and the follow-up investigation information was also updated in a timely manner, ensuring access to the outside world and

avoiding the generation and dissemination of rumors, which caused damage to social stability.

### 2.3.3. Timely and Timely Settlement of the Aftermath

After the accident was handled, in order to restore people's normal life as soon as possible, relevant departments rushed to check and repair water supply and power supply facilities. As of December 22, all 10 suspended pumping stations had resumed operation, restoring water supply to more than 8,000 households, and power supply to 14,740 households outside the accident area had been restored. At the same time, the site staff in the accident area door by door, and the formation of 5 people to protect the group, carefully resettlement of the masses. Eleven of the 36 hotels were opened, accommodating 1,512 people, and the mood of the affected people was stable.

### 2.3.4. Deficiencies

As temperatures plummet and gas use rises, accidents are more likely to reach a tipping point. After the maintenance of the gas pipeline, the relevant units did not issue a warning to remind the use of gas, which indirectly led to the occurrence of the accident.

It can be seen from this that the gas explosion accident has been handled quickly and properly in general. Both the rescue speed and the post-treatment effect are commendable, but there are still areas to be improved, such as improving the early warning ability of the street community and enhancing the initial emergency response force of the community. Below I will combine the theory of complex adaptive systems to illustrate the measures that can be generalized to the community to establish emergency management system.

## 2.4. The Convergence of Community Accident Emergency Management and CAS Theory

This paper chooses CAS theory to study community accident emergency management, because there is a high degree of agreement between the two, for the following reasons:

1) Adaptive subject is an important part of interaction in complex adaptive system theory. The multi-subjects of community emergency management include community leadership, community emergency team, community management, community staff, community activity staff, fire medical staff and residents, which adapt to each other, support each other and develop cooperatively under the drive and support of the system. Under large communities of accident emergency management for local government and emergency management agency unit such as dominant, community related personnel and fire medical departments cooperate with each other, other scenarios such as fire, severe weather, leaking gas mainly through early warning report, the implementation of contingency plans, community organization and leadership and command more main body participation, relying on supervision, security, rescue multilateral coordination, Promote the coordination of emergency work and establish a tight emergency workflow.

2) The cumulative characteristics of complex adaptive system theory. Community accident emergency management elements and coping strategies must be constantly supplemented with the passage of time and updated with the progress of The Times. The emergence of more subjects, more possible accident types and more excellent emergency plans are indispensable elements in the formation of community accident emergency management system.

3) Community emergency management is a normative process from scratch, from small to large, from simple to complex, and gradually from single management to complex management. Emergency management also develops with the national situation. The complexity development process of environment, institution and personnel coordination is highly consistent with the theory of complex adaptive systems (receiving stimulus - responding - receiving feedback - modifying rules - improving fitness).

To sum up, the theory of complex adaptive systems can provide a basis for the construction of community emergency management system, which is reasonable and feasible.

### **3. Analysis of Operation Mechanism of Community Accident Emergency Management**

The operation mechanism of community emergency management relies on the system to realize the close relationship between the main bodies, so as to achieve the goal of institutionalization. According to the theory of complex adaptive systems, the operation mechanism can be divided into identification mechanism, building block mechanism and internal model mechanism. For community emergency management, emergency management and community identification mechanism is behavior to distinguish between the accident and emergency management main body (i.e., community management personnel) aggregated, show the unique characteristic of emergency management, community building block mechanism will ever accident treatment plan summarizes in the emergency management of actual combat experience, as a different form of building block combination, Promote the creation of internal model mechanisms.

#### **3.1. Identify Mechanism**

##### **3.1.1. Policy Identity**

The development of China's emergency management in 2003 SARS incident as a milestone, is the beginning of China's modern emergency management. After this incident, the state finally decided to "one case three system" as the core of emergency management construction. In 2018, the Ministry of Emergency Management was established to take charge of China's emergency management, greatly improving the country's ability and efficiency in responding to emergencies. With the support of policies, emergency management has also realized the spiral development from "single and tedious to diversified and efficient" [6].

##### **3.1.2. Emergency Identity**

Emergency response is the core consciousness of community emergency management. Combining the theory of crisis life cycle, through interpretation of anticipation before the crisis stage, improve on the sensitivity of the incident, in an emergency situation has occurred or predicted imminent, community emergency response teams need to respond immediately, and clear the disposal process, on-site evacuation and rescue work, as the other emergency management main body, support for the precious time, At the same time, it also provides a good environment for emergency management to establish emergency consciousness.

##### **3.1.3. Aid Identify**

Efficient rescue is one of the goals of emergency management. In community emergency management, it is

necessary to do a good job in the prediction of emergencies, timely transfer of the injured, rescue personnel docking, so as to ensure timely treatment of the injured, to ensure that the loss of public life and property is reduced; In case of serious accidents, it is necessary to ensure the protection of surrounding residents and communities.

##### **3.1.4. Restoring Identity**

The aftermath and recovery after an emergency is one of the characteristics of emergency management. Assess the situation after an emergency, and compensate and recover for the organizations, personnel, equipment and environment involved [7], so as to control and eliminate the adverse impact of the accident as much as possible and further optimize community management.

##### **3.1.5. Cultural Identity**

It is a big step for the development of emergency management to take the knowledge and culture of emergency response as a cultural symbol and root in the hearts of people through publicity and education. The emergency management process accompanied by the outbreak of past risks and accidents will be recorded in written form, and the summary is the concrete embodiment of the emergency management culture. Selecting relevant cases in the community to form an emergency culture in line with community characteristics, which is recognized by community activists and residents, is the best mechanism for emergency prevention and self-emergency response.

#### **3.2. Building Block Mechanism**

Building block mechanism for the formation of community building block mechanism of accident emergency management characteristics, community will experience and the system is regarded as the combination elements, through the analysis of the carding, program list and effect factors of ways, such as the coupling of different combination of emergency management as the main bodies of foundation, to build up the community emergency management mechanism. Building block mechanism is not only the foundation of community emergency management system construction, but also a necessary factor for each link to play a role. In the face of the impact of a new round of emergencies, the subject can recombine the existing building blocks according to experience and judgment to form a targeted new emergency system to deal with new emergencies from the outside [2]. The building block mechanism should make an in-depth analysis of community emergency management from four perspectives of prevention, preparation, response and recovery, and build an internal model.

##### **3.2.1. Emergency Prevention**

Through the degree of accident prediction and personnel flow prediction, to effectively deal with emergencies, rapid rescue to provide good rescue conditions, belongs to the environmental block.

Accident degree prediction. After the accident, the establishment of priority evacuation and rescue special channel, and the accident situation assessment, on the possible deterioration of the accident of all kinds of pre-treatment. For example, according to whether the weather is strong wind (fire), whether there are dangerous items in the accident site (explosion), how many people flow (mainly evacuation or prevent the deterioration of the accident) and so on.

Personnel flow estimation. When the accident occurs, the

accident location and nearby personnel flow is estimated, deployment of emergency personnel, and diversion and diversion of nearby residents. Equipped with the monitoring authority of each area of the accident site to detect the dynamic situation of people flow at the accident site; At the same time, the establishment of early warning system, when an accident occurs in a community, early warning, effective control of uninformed people into the accident site, to ensure that the fire support force unimpeded, to ensure the safety of passers-by at the same time to reduce the difficulty of rescue.

### **3.2.2. Emergency Preparedness**

To provide reliable technical support for emergency management, including ensuring the safety of rescue workers, optimizing the classification of emergency procedures, medical treatment of the injured and public emergency education. This layer of blocks has the characteristics of multiple subjects, and due to the need for specialized technology, the previous experience will show considerable importance when assembling.

Clear management structure. Form a linear leadership structure at the community level from community leaders, emergency teams, community workers and residents to improve the coordination and adjustment efficiency of all subjects in the emergency process.

Classification of emergency scenarios. According to the statistics of community accidents and the current situation of social environment, they can be divided into four categories: meteorological disaster emergency, man-made disaster emergency, safety emergency, epidemic rebound emergency. Meteorological disaster emergency includes lightning strike, typhoon, hail, high temperature and other inclement weather accidents, man-made disaster emergency includes fire, gas leakage, dangerous goods explosion, drinking water safety, etc. To complete reasonable sorting of scene classification is to lay a good foundation for formulating emergency plan.

Establish emergency plans. According to the previous practical experience of similar emergency work, and in combination with relevant policies, the emergency plans for meteorological disaster, man-made disaster, security incident and epidemic rebound event were established.

Actual combat exercises. Conduct regular exercises for emergencies (such as fire, explosion and other accidents), improve the emergency handling ability of emergencies through actual combat operation, ensure the response ability of all levels of the community, and constantly improve the implementation effect of the plan in practice, to ensure the scientific nature, flexibility and operability of the community accident emergency plan.

Publicity and education. This part focuses on strengthening the publicity and education of emergency knowledge to the residents, which is conducive to the prevention and rescue of emergency management and the formation of emergency management culture. Through microblog, wechat public account, propaganda column and other means to publicize the knowledge of emergency response to residents, improve the autonomy of the masses and enable them to play a cooperative role in self-help rescue, event warning, rescue cooperation and other links, which symbolizes that the purpose of propaganda and education has been achieved.

### **3.2.3. Emergency Response**

In this link, the community emergency response team needs to make a reasonable preliminary judgment on the situation

of emergencies and launch the emergency response plan in a targeted manner. The building blocks of the emergency response team include reporting the status of the accident, rescuing the accident and transferring the injured. The emergency response team needs to coordinate well.

Emergency reporting. In community emergencies, the timeliness of information is an important factor affecting the accident handling, so the report of the accident status should be completed quickly, and the timely report often plays a decisive role in the accident response. Establishing emergency management reporting mechanism on site as soon as possible after an accident is to lay a foundation for rapid emergency preparation and response.

Send out emergency rescue teams. After an accident occurs, the community emergency response team takes the lead in rushing to the scene and controlling the situation. According to the severity of the accident, the community emergency response team communicates and cooperates with the fire emergency response force, paving the way for calling for support force. The first thing is to protect the safety of public life and property and properly handle the accident.

Start the emergency transfer mechanism. Establish a transport mechanism for the injured to be treated quickly, coordinated by the medical staff of the community health center and assisted by the community emergency response team. The injury may be poisoning, burn, organ damage, fracture and other injuries, which can provide ideas for emergency prevention and preparation stage.

### **3.2.4. Emergency Recovery**

This stage is the improvement and optimization stage of emergency management, and promoting the construction of Internet community and intelligent community is the main content of this stage.

Promoting the construction of Internet communities. Improve the Internet community system and supervise its implementation, give full play to the role of the Internet community, expand the influence of the Internet community, provide a network platform for community residents and workers to know the dynamics of the community (emergency), and improve community Internet services.

Take smart emergency measures. In the context of epidemic prevention and control, the introduction of smart access control and smart gate machines and other facilities in communities is a necessary measure during the emergency recovery period. Informationization capacity will be applied to epidemic prevention and control and risk prevention, so as to move forward the risk threshold and achieve the purpose of establishing intelligent community entrance prevention and control system. Intelligent prevention and control functions include temperature detection, health code, face recognition, etc. At the same time, big data can be rationally used to reduce the workload of community workers.

## **3.3. Internal Model Mechanism**

The whole life cycle of emergency management includes four stages: pre-prevention, pre-warning preparation, emergency response and post-recovery [8]. The internal model mechanism is constructed according to the accident occurrence, emergency reporting, main body efficiency, rescue process, social impact and other aspects, so as to form a comprehensive operation mode of emergency subject, process and object community.

## 4. Construction of Operation Mechanism of Community Accident Emergency Management

### 4.1. Establish the Overall Operation Model

Based on the complex adaptive system theory, by accident emergency management mechanism from the identity of the

community mechanism, the building block mechanism, the mechanism of internal model three angles is analyzed, the main body, a variety of emergency scenario, the interaction between different emergency measures, formed the community emergency management operation system (Fig. 3), aims to fully prevention, rapid response, collaborative management, reduce the loss.

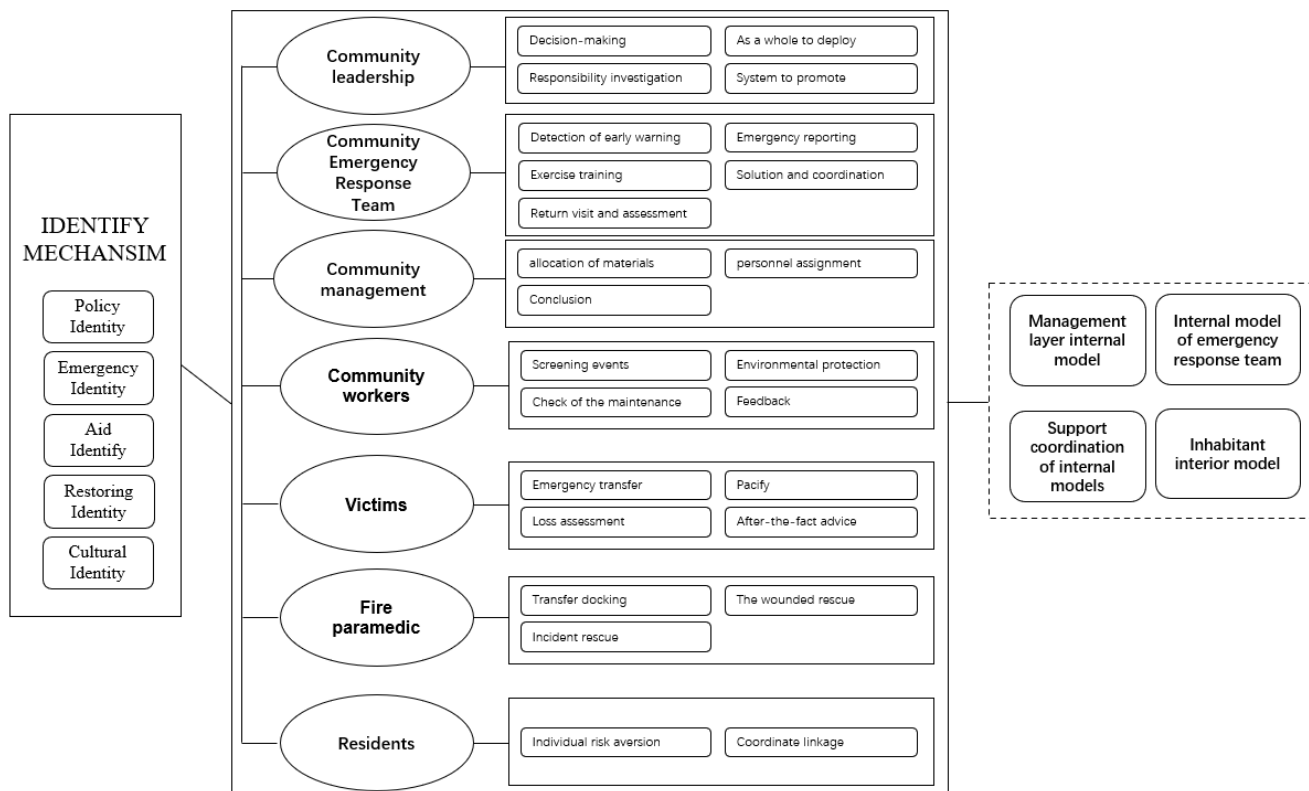


Figure 3. Residents internal model community emergency management operation mechanism

### 4.2. Establish A Safeguard Mechanism

#### 4.2.1. Linkage Mechanism

Through the on-site command of the emergency, the community leadership, community emergency team, community management, community staff, fire medical personnel, residents, etc. are integrated into the whole event, cooperate with each other, clarify their respective responsibilities and tasks, and ensure the efficient and reasonable disposal of the emergency; A linkage mechanism should be formed to ensure that the accident is dealt with in the first time and the injured get help in the first time.

#### 4.2.2. Management Mechanism

Through learning the experience of emergency management, the community management takes the formulation of emergency plans as a means to establish an emergency management mechanism with community characteristics from the aspects of system formulation, implementation, effect and evaluation, and establish the "prevent-prepared-response-recovery" mode of emergency management. The emergency quality control and supervision system should be implemented synchronously, and the dynamic indicators of emergency management evaluation should be removed to improve the training ability and rescue effect of emergency rescue.

#### 4.2.3. Immediate Response Mechanism

After the accident, the community as the first scene, must

immediately report, immediate response, emergency team immediately launched preliminary rescue operations, quickly rushed to the scene to control the situation of the accident, and the community office unified supervision and management, arrange the staff to open a green channel, to ensure the seamless insertion of emergency management rescue.

#### 4.2.4. Big Data Early Warning Mechanism

Based on big data platform, promote intelligent community construction and strengthen community resilience; Through big data analysis, managers can be provided with scientific, dynamic and timely feedback, so as to do a good job of traffic early warning and safety early warning when accidents occur in communities, and improve the ability of community workers to prevent and manage emergencies.

#### 4.2.5. Mechanism for People to Return Visits

After the completion of the accident treatment, for the accident affected by the loss of business, residents or other subjects, for these personnel to objectively evaluate the operation effect of emergency management overall strategy and existing problems, and record, in order to further optimize the process and improve the mechanism.

#### 4.2.6. Organizational Growth Mechanism

Strengthen the emergency knowledge training of community personnel, especially the staff, and familiarize themselves with the emergency process through emergency drills to strengthen the emergency handling ability of the staff. In

order to solve the lack of composite thinking and vigilance awareness of the masses in emergencies [9], the community platform publicized emergency knowledge to visitors through public accounts, publicity boards, lectures and other forms to increase the coverage of emergency knowledge.

### 4.3. Community Emergency Management System Can Be Extended

Community emergency response has the characteristics of large flow of people, regional closure and strong transference. Starting from these characteristics, it is easy to find that many places are similar to them, and relevant emergency measures can also be corresponding to the replication: such as schools, shopping malls, museums, cinemas, parks, amusement parks and other public places. Once an emergency occurs in these places, the consequences are very serious and must be handled urgently and rescued in time. Efficient emergency management can reduce unnecessary losses. However, the special feature of community accidents is that they are highly interlocking. Once they are not properly handled, the accidents will directly endanger the life and property safety of other residents and staff in the community (such as the scope of the gas explosion).

## 5. Conclusion

With the help of complex adaptability theory, this paper makes a comprehensive analysis of the gas explosion accident in Shenyang hotel, and obtains the emergency management elements and coping strategies of community emergency emergencies as an example, and combines the rich experience in dealing with previous community accidents into theoretical blocks to form the internal operation model of community emergency management. Explores the community leadership, community emergency response teams, community management, community activities and community work personnel, fire staff, residents adaptation, the content of the synergy between link, and then by using the community

policy, strengthen the emergency response plan, improve the relief system, to return characteristics methods such as masses, promoting community emergency management towards specialization, institutionalization, wisdom, It has guiding significance to the disposal of community accidents in the future, can speed up the timely response of community emergency time, and improve the community emergency management ability.

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