Research Paper

Response and Reflection on Design of Urban Block Patterns under the Background of Public Health Emergencies

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Abstract

Major public health events have exposed the problems existing in the implementation of urban planning, and also promoted the development of urban planning. However, concept of physical space planning which still stays in the theoretical category can play very limited role in dealing with urban public health emergencies. As the spatial basis for epidemic prevention and control in the special period of COVID-19, the spatial form and management mode of urban blocks are the key issues to effectively block or reduce the spread of the virus and to curb the spread of the epidemic. In this study, by reviewing the promotion of public health events on urban block planning, from the perspective of construction area, we compared the patterns, boundaries and control modes of different urban blocks during the epidemic period. This study analyses the correlation and emphasis of the influencing factors in different stages of epidemic development and different spatial resolutions, and rethinks the responsiveness, adaptability and resilience of urban block patterns in the context of public health emergencies. This study reflects and explores the future urban block patterns and proposes strategies in the future block planning.

Keywords

Public health emergencies, Urban block patterns, Response and reflection

1. Background

On January 30, 2020, the World Health Organization (WHO) listed the novel coronavirus epidemic as a public health emergency of international concern (PHEIC). With the huge scale of the city and the complicated population flow, the epidemic spreads rapidly, covers a wide range and involves a large number of people, which has a great impact on the social life of the city, and also poses great pressure and challenges to the public safety and risk prevention and control of the city.

Since the outbreak of the epidemic, in order to effectively block or reduce the spread of the virus and curb the spread of the epidemic, Chinese cities have launched primary public health response mechanism. At the level of urban blocks, a series of key measures such as block closure, traffic control and community defense have been taken. Block closure has become the main epidemic prevention and control unit and spatial isolation unit in the city due to its clear spatial boundaries and access routes and orderly property management and control. In the face of this public health emergency, it is necessary to examine and reflect from the perspective of the urban block pattern, so as to provide a new response to ensure urban public safety.

2. Concept definition

2.1. Public health emergency

According to the Regulations on Response to Public Health Emergencies, public health emergencies refer to the sudden occurrence of major infectious diseases, mass unexplained diseases, major food and occupational poisoning and other events seriously affecting public health that cause or may cause serious damage to public health. Internationally, it refers to an unusual event that constitutes a public health risk to other countries through the international transmission of diseases and may require coordinated international response measures. Public health emergencies are characterized by the diversity of causes, the difference of distribution, the universality of dissemination, the complexity of harm, the comprehensiveness of governance, and the continuous occurrence of new events.

2.2. Urban block

As a high-frequency vocabulary in the field of architecture and planning, urban block is a meso level between the urban macro level and architectural micro level. In this paper, the urban block is defined as a complete and independent area with clear boundaries and it surrounded by streets or other boundaries, such as rivers, greening, etc.. It is a collection of plots and streets, including buildings, open spaces, facilities and other elements. Moreover, urban blocks have certain architectural, urban and social functional attributes, and can directly reflect the characteristics of urban mechanism, history and culture. It is the basic organizational unit of urban structure and urban life, and also one of the core elements of urban planning and design.

3. Promotion of public health events on urban block planning

In the development process of urban planning, every major public health event has promoted the renewal and iteration of new concepts, new methods and new standards and specifications of urban planning (Wang, J.G. 2020), and has also become an important factor to promote urban block planning.

A large-scale infectious disease occurred in London, England, from 1665 to 1666. More than 80000 people died in the plague. Finally, the big fire happened in London stopped the spreading of the plague in 1666. The rapid advancement of the industrial revolution led to the deterioration of the public health environment and brought a series of public health problems. In the 19th century, there were four large-scale cholera outbreaks in London (Mao, X.Y. 2018). In 1831 alone, cholera ravaged 431 cities and claimed more than 30000 lives (James, W. 1984). The outbreak of public health events has brought profound disasters to social and economic development. Under the influence of social, political, economic, health and other changes, the public's health demands and responses of urban block planning have also changed. Severe public health problems have become an opportunity for the formation of modern public health, and indirectly led to the birth of modern urban planning (Yang, R. 2018). At that

time, people firmly believed that public health problems were more attributable to environmental problems, and only through overall planning of morphology could we get rid of the difficulties in urban development.

Therefore, the promotion of public health events on urban block planning can be divided into three stages, as shown in Table 1. The development process is shown in Figure 1.

Historical stage	Time	Public demand	The relationship between public health and urban planning	Block planning initiatives
Origin in chaos	From the middle to the end of the 19th century (after the second industrial revolution)	Cut off the spread of infectious diseases and solve the public health problems caused by the industrial revolution	Public health promoted the origin of modern urban planning. As a technical tool, urban planning is the responsibility of the health department.	Since the 19th century, the United Kingdom has issued various rules and regulations to regulate the block size and construction standards. In terms of urban management, it has carried out urban environmental beautification, cured urban diseases and paid attention to urban transformation, such as the “Health Regulations” issued by the government in 1846, the “Amendment Ordinance” in 1864, and the “Public Health Bill” formulated by the parliament in 1848. In the middle of the 19th century, Ottoman followed the Baroque principle compatible with France to carry out the reconstruction planning of Paris. Through the modern, grand and unified urban transformation with prominent axis, Ottoman fought against the material and social texture of the middle ages, which were crowded, dirty and epidemic. At the end of the 19th century, the urban beautification movement led by the American middle class elites tried to restore the lost order in urban blocks and solve the public health problems by adopting the classical and Baroque style.
Independent development	From the beginning to the middle of the 20th century	Public health turns to clinic, urban planning turns to physical space form design and social and economic development	Public health and urban planning went their separate ways.	The ideal planning of modernism actively guides the social reform of mental health, pursues preciseness and efficiency, and advocates functional practicality. For the sake of safety, isolation and privacy, the closed structure with physical separation facilities such as fences and walls as the main characteristics is widely used. With the popularity of "neighborhood units" and "Athens Charter", the closed structure further led to the closure of blocks under the effect of the privatization trend. The urban block planning focuses more on the expression of the physical space morphology.
Cross collaboration	1960s to present	To explore a healthy and sustainable environment that conforms to human nature, from emphasizing the design of material space to paying attention to social science	Urban planning and public health integrated again.	The widespread rise of postmodernism has promoted the construction of individual, social and health systems, and emphasized the leading role of urban planning in health. Since entering the modern society, facing the challenge of urbanization to human health, the World Health Organization has proposed the global action strategy of "healthy city", and the urban spatial environment has become an important part of health support. Since 2003, China's planning circle has put forward many planning thoughts and suggestions to block the spread of epidemic disease in response to public health emergencies, such as urban form layout, human settlement environment, urban block structure, residential planning, etc. (2003)

Table 1. Promotion of public health events on urban block planning (Source: Author)

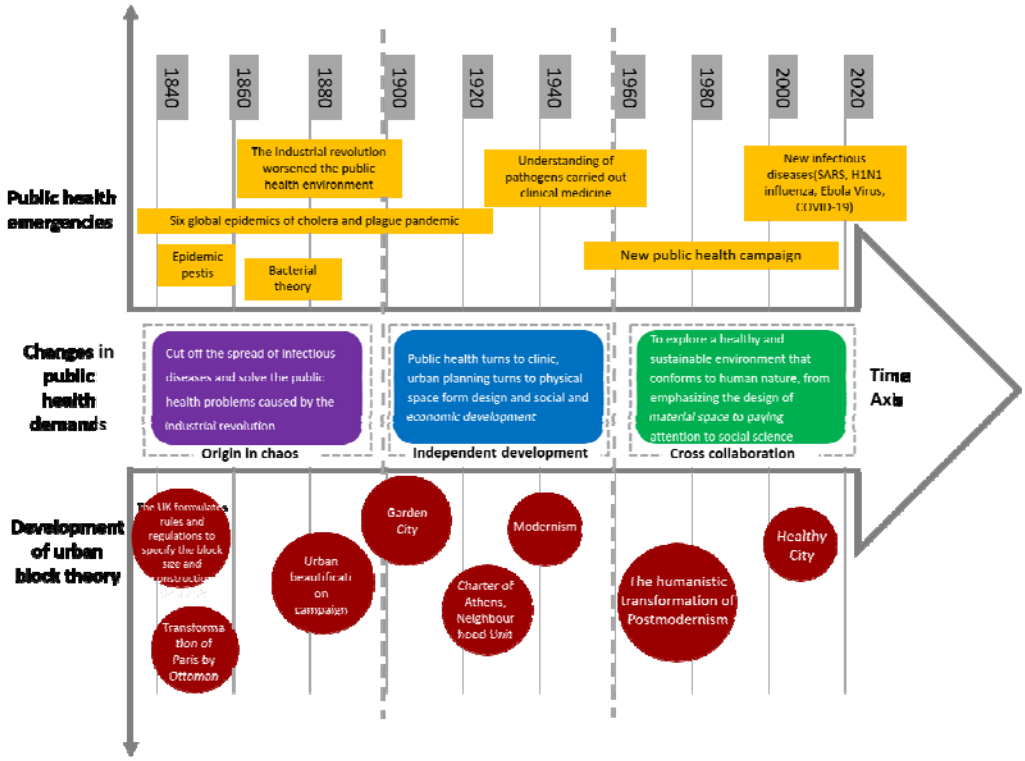


Figure 1. Public health events and development of urban block theory (Source: Author)

4. Response of urban blocks under the epidemic situation of novel coronavirus

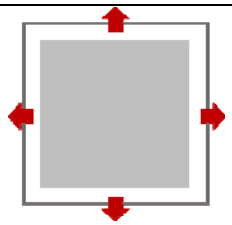
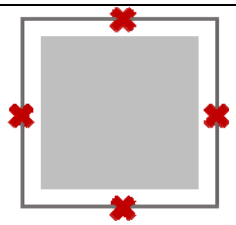
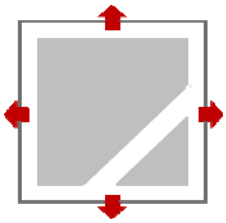
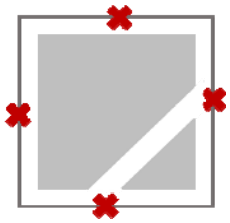
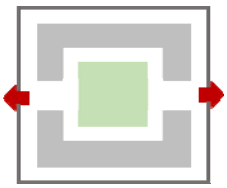
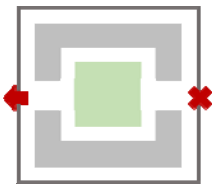
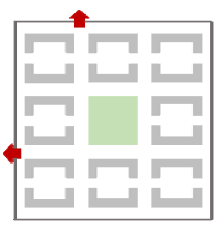
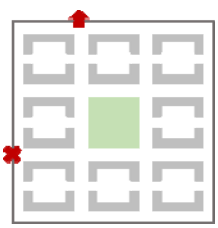
Since the outbreak of SARS virus in 2003, China has attached great importance to public emergencies, systematically established the national emergency response system of "one case, three systems", and successively promulgated “Master State Plan for Rapid Response to Public Emergencies”, “Act on Tackling Emergency Affairs” and other relevant laws and regulations.

However, after 17 years, the current urban development background has changed greatly compared with the past. China's urbanization rate has increased by nearly 20% over the past decade. The transportation system has developed rapidly, and the city operates at a high speed and has efficient communication. However, the awareness of urban public safety crisis is relatively weak. The emergency response system has not been adjusted in time with the advancement of new technologies and new situations, and there is a lack of refined and small-scale response mechanism. In terms of urban planning, although it can not completely prevent the occurrence of public health emergencies, urban planning can play an important role in how to reduce the harm caused by the epidemic.

In response to this public health emergency caused by novel coronavirus, all 31 provinces, municipalities and autonomous regions in China launched the first level response to major public health emergencies, and issued a number of policies and regulations in succession. At the level of urban planning, many cities have adopted the measures of traffic blockade, restriction of public transport, community closure to conduct comprehensive investigation and control on the basis of communities, and closed communities have become important units for epidemic prevention and control. Open blocks, by contrast, have added temporary fences and temporarily blocked the branch roads and back streets in order to overcome such

difficulties as fuzzy spatial boundary, large number of entrances and exits, difficult management of floating population, insufficient management hardware conditions and property resources.

The epidemic has prompted reflection on how to build a safer block pattern. China's "closed city + closed community" management mode has made outstanding contributions to the fight against the epidemic, and the closure of blocks has played a buffer role. From the perspective of construction area, according to the exchange and communication between the block and the surrounding environment, the block can be divided into closed block and open block. The closed block can also be divided into single closed block, inner street closed block, courtyard closed block and group closed block. From the perspective of epidemic situation, it seems that open blocks are not as safe and easy to manage as closed blocks. However, due to differences in block patterns, boundaries and control methods, different closed patterns are adopted in different blocks. Table 2 lists the closed management modes in different block forms.

Applicable functions	Names	Typical block pattern under normal conditions	Management measures during epidemic period	Advantages and disadvantages
Mainly used for commerce , business, public service and other functions	Single enclosed block			Take management measures of closing buildings and inner streets except for daily necessities. Advantages: it can effectively prevent large-scale gathering of people, and some buildings are changed into temporary hospitals, so as to achieve the combination of peace and disease. Disadvantages: large scale of closure may cause the decline of the block economy and vitality
	Inner street closed block			
Mainly used for government units	Courtyard closed block			Take management measures of reducing entrances and exits. Advantages: effectively control the personnel and vehicles in and out of the unit community. Disadvantages: fewer entrances and exits will increases travel distance and may cause short-time clustering in a specific time period
Mostly used for residential function	Group closed block			Take management measures of reducing entrances and exits. Advantages: effectively control the personnel and vehicles in and out of the closed community. Disadvantages: fewer entrances and exits will increases travel distance and may cause short-time clustering in a specific time period

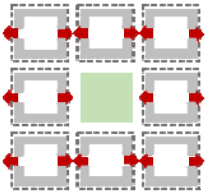
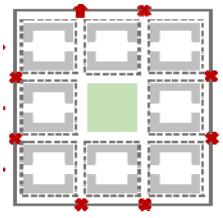
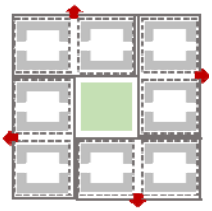
Mixed-function Open Block		Pattern A	Advantages: reduce enclosed area as much as possible without affecting the travel status of the original block Disadvantages: the scale of the closed block is too small, and the community service workload is greatly increased, resulting in a waste of human, financial and material resources
		Pattern B	Advantages: centralized control of access personnel and vehicles Disadvantages: large scale of the closed block makes it more difficult to manage, and the function of the closed residential area is single. During the epidemic period, reducing the number of the entrances and exits will increase residents' travel distance and on the contrary, easier to cause the flow of people
		Pattern C	The scale is appropriate, which combines the advantages of the above two management modes and effectively overcomes their shortcomings

Table 2. Management modes during epidemic in different block patterns (Source: Author)

There is no doubt that block closure is more effective for virus isolation during the epidemic. However, the actual situation proves that the closed unit community management mode is not the most effective way. Take the Baiwanzhuang community in Beijing and Yixing community in Harbin as examples. Both of them are old and open communities. After the first round of epidemic, both communities adopted closed measures, as shown in Figure 2 and Figure 3. However, the residents of the two communities hold different view. Residents of the Baiwanzhuang community are usually troubled by the safety, parking, sanitation and other problems of open community, so they hope that the community can remain closed after the epidemic. On the contrast, residents of Yixing community have more complaints because of the unconvenience caused by the closed measure. The Baiwanzhuang community actually adopts pattern C, while Yixing community adopts pattern B of the open block. The difference in scale of both blocks causes different effects of the same measure. Therefore, the block size should be appropriate. The block opens the urban interface to open the urban traffic vein. The inner group of the block can still be closed. A proper block size can not only provide residents with supporting service facilities and activity space, but also forms a good block atmosphere. It can better implement closed management by relying on residents' autonomy.

In a word, the "overall opening and local closure" block space pattern with mixed functions is a feasible solution for urban block planning in the post epidemic period. However, the specific block pattern should be determined according to the actual situation and the influencing factors. The correlation and focus of

the influencing factors may vary in different development stages and different spatial resolutions of the epidemic. Figure 4 lists some influencing factors under different development stages and different material space forms of the epidemic.

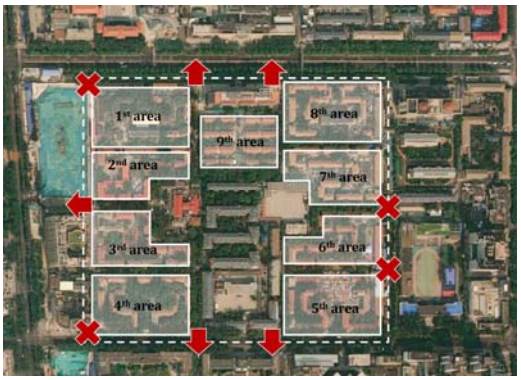


Figure 2. Closure of Baiwanzhuang community in Beijing during the epidemic period (Source: Author)

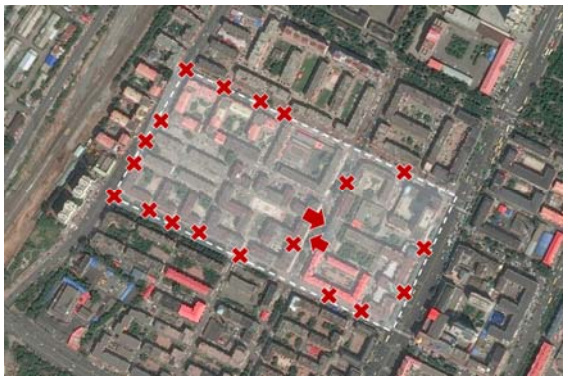


Figure 3. Closure of Yixing community in Harbin during the epidemic period (Source: Author)

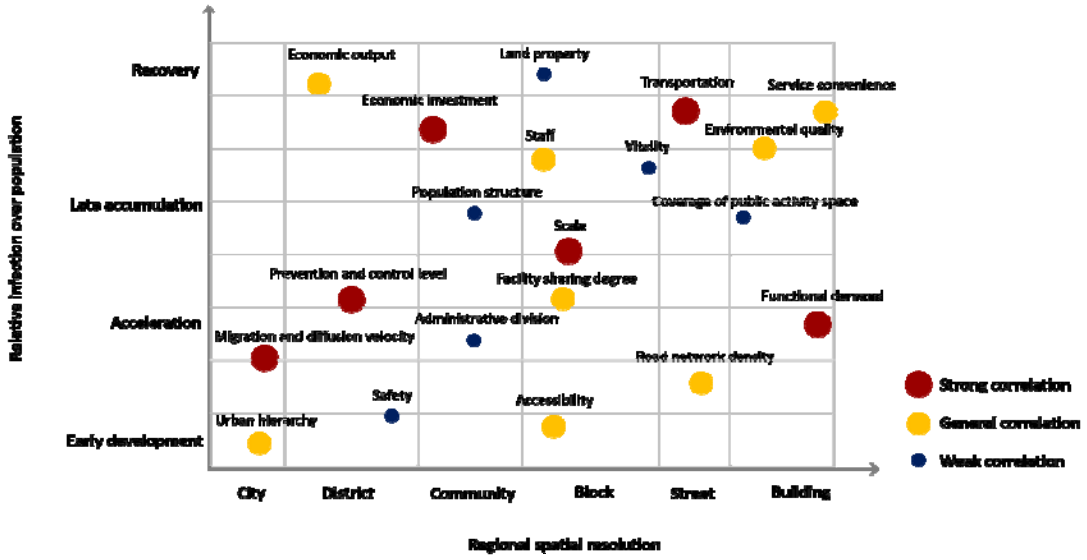


Figure 4. Correlation between selection of block pattern and influencing factors (Source: Author)

5. Thoughts on the future of urban block planning

The novel coronavirus epidemic has provided an opportunity for reflection on urban block planning. Based on the contradiction among the practical closed measures, the open planning theory, and the demands for consideration of daily life and special periods, this paper proposes four aspects of future thinking.

5.1. Refined spatial countermeasures

The quality of urban spatial environment is inseparable from public health. Urban planning and architectural design can guide public health through shaping spatial environment. At present, China is gradually entering the era of urban micro renewal. Urban planning should not only provide macro guidance at the regional and urban levels, but also conduct spatial intervention and fine design for blocks,

places and other spaces, and shift from traditional spatial design to fine design and risk management. For example, after SARS in 2003, Hong Kong, a typical city with intensive and high-density development mode, paid more attention to the construction of urban ecological environment, issued a number of technical notices and design guidelines of air circulation, and implemented them at the level of block planning, urban design and architectural design. In view of the high-temperature heat wave disaster, the United States proposes passive cooling and climate adaptive design measures at the block and building levels. Aiming at the problem of garbage pollution, Shanghai has carried out the whole process system coordination for garbage treatment.

At the same time, various practical measures taken in this epidemic also provide an opportunity to re-understand, utilize and optimize the development mode of urban blocks in China. As the spatial basis of epidemic prevention and control in special periods, any measures conducive to epidemic prevention should become the conscious behavior of all citizens. At this time, the physical space shape of blocks does not mean that the closed block is better than the open block. The block closure is only a measure in the process of epidemic prevention and control. It is a means of spatial isolation, not a once and for all spatial planning measure. The open block does not mean demolishing walls roughly but represents not only material space planning, but also a system and situation. Open blocks divide the original large-scale urban block into several open blocks with appropriate scale for development, appropriately reduce the block size, promote the decomposition and reconstruction of the block clustering, form a small system in the form of clustering and incorporate it into the city, connect the internal structure of the urban block with the overall structure of the city, and achieve the linkage development between the city and the block.

The refined regional management concept in the form of clusters should adhere to and promote the spatial development mode of clusters in the development process of block patterns, draw on the advantages of closed blocks and open blocks, and build resilient blocks on the basis of resilient cities. The concept should carry out strategic space reservation, take into account the daily opening and sharing of block space and staged prevention and control in special periods, achieve high-quality and sustainable development in block scale, functional composition and layout structure, and create a new block pattern that can respond to and resist the impact and challenges brought by public health emergencies.

5.2. Intelligent technical countermeasures

During the cholera epidemic in London in 1854, Dr. John Snow marked the number of deaths in each building on the urban map with all the roads, houses, drinking water wells and other contents in the cholera epidemic area, and obtained the distribution map of the living location of the cholera victims. Through records and analysis, it was found that the source of cholera was the unclean drinking water. According to Dr. Snow's analysis and appeal, the government closed the water intake and effectively curbed the spread of the epidemic. This method of using spatial statistics to draw maps and analyze epidemic professional information has become a basic research method in medical geography.

In today's era when Internet digitization is more popular, relying on modern scientific and technological means such as big data informatization and the combination of space and data, it plays an important role in assisting public security prevention and control. In view of the novel coronavirus epidemic, the "epidemic dynamic monitoring map" has been set up and implemented in the whole country and various cities. The map can update the distribution, quantity, change trend and other epidemic data of various cases in the epidemic in real time, providing authoritative and accurate epidemic dynamic information for the public and providing data support for epidemic prevention and control. For example, Shaanxi, Sichuan, Shanxi, Fujian and other places provide information such as epidemic distribution, epidemic change trend, medical institutions and resource support through an intuitive and visual "epidemic map". Tools such as "epidemic statistics and situation awareness system" with finer spatial granularity have also

emerged, which can accurately count the detailed information of confirmed cases and collect the epidemic data of people in different regions. The analysis report on the population flow law and the temporal and spatial evolution law of the epidemic based on big data also puts forward prediction suggestions on the spread trend of the epidemic.

Facing public health emergencies, it is an important development direction of urban planning to integrate information with space as a carrier and establish the relationship between information. However, reflecting on the spatial information integration in the process of epidemic prevention, the spatial information at the urban level is relatively perfect at present. As the main constituent unit of the city, urban blocks should also make good use of intelligent means such as big data in future planning to build a correlation system between residents' health and block space. Firstly, the data generated by the multi-channel system can be used to overlay and correlate maps, depict the urban "disease map" from the aspects of "core, trajectory, density" (Li, X.Y., Zhu, J.H. 2020), and change the single spatial information map into a multi-disciplinary overlay map. Secondly, by refining the statistical data of the neighborhood and associating it with personal digital health, the high-risk areas, high-risk groups and high-risk events of epidemic spread are predicted from time and space, and the status quo analysis changed into dynamic early warning and intelligent decision-making. Finally, we can couple the relationship between block space and public health diseases, arrange the public health emergency treatment medical system in a balanced and reasonable manner, and change the fixed medical service into the reserved temporary emergency medical facilities. With the continuous expansion of urban planning technology and methods, promoting intelligent epidemic prevention and control at the level of urban block planning will help improve the foresight and accuracy of its decision-making.

5.3. Flexible management countermeasures

In China, urban blocks are generally divided according to administrative areas, and most of the management responsibilities are undertaken by communities. In this epidemic, the community management level played a basic role and became the main space control unit in the city. The access control community, which has been criticized, has also become an important control tool for epidemic prevention. However, in the actual operation process, communities of different sizes and categories are prone to situations like "one size fits all". The flexible management should focus more on how to accurately monitor, to control and cut off the spread of virus in the right place and in the right way, and effectively rectify and eliminate the epidemic (Ouyang, P. 2020). For this purpose, it is necessary to establish partition space isolation according to local conditions. Based on Japan's experience in preventing and controlling the secondary earthquake disasters, the epidemic situation can be divided into severely affected areas (neighborhood circle), key epidemic prevention areas (daily life circle) and general protection areas (administrative region circle) according to different density and frequency (Zhang, C. 2020), and the epidemic prevention space network can be established at different levels for management. In addition, on January 18, 2020, Professor Toshihiko Kobayashi form the medical welfare support center of Hamamatsu Medical University Hospital in Japan proposed the idea of "the real-life circle should be regarded as the medical circle" from the perspective of the reorganization and integration of medical institutions. Because the actual life circle of residents is not always consistent with the life circle defined by the state, when the medical circle is regarded as the life circle, the geographical background, population density and the appropriate travel time of each disease should be considered in the scope of the region. This is very enlightening for our country. To carry out the grid management of epidemic prevention in depth, we can use the life circle as the carrier and combine it with health and epidemic prevention. To refine the community based on the population distribution and functional layout, and use spatial grouping and decentralized management can not only strive for the time and opportunity for medical treatment, but also share the treatment pressure of the central hospital.

5.4. Social countermeasures with advocacy

In the face of public health emergencies, the most important thing is to build an urban emergency risk management system integrating awareness, responsibility, system and education, which requires the cooperation of the government, society, market and the public. The proposal of "social governance community" further innovates and enriches the connotation of grass-roots social governance. It is an advocacy social strategy and community construction based on common destiny and civic awareness. In the face of the epidemic, everyone has a responsibility and should be responsible. We should sink the urban space governance to the neighborhood level, rely on the action command role of the community, transform the community of interests into a community of destiny, cultivate the public's stronger sense of responsibility and ability to fulfill responsibilities, and give full play to the self-organizing power of the community from the bottom up. First of all, we should improve the public's awareness of public health events and ecological environment awareness, and advocate and practice a green lifestyle. Secondly, the construction of disaster emergency management mechanism should be included in community governance and education. Public health science should be popularized and community disaster emergency management system should be established to enhance the public's ability to respond to public health events. In addition, we should also provide care and support to vulnerable groups, such as the elderly, children, the disabled and other special groups. Social governance is the result of the collective action of multiple roles. Promoting the construction of social governance community can maximize the enthusiasm, initiative and creativity of public participation, and ensure social stability and orderly development.

The public's cultural cognition is the spiritual core of shaping urban blocks. The diversity of public social activities determines the diversity of urban block functions and the maintenance of diversity is the source of urban blocks vitality and an important guarantee for the development of urban blocks. In order to help the economic recovery and development during the epidemic period, Chengdu, China, in March 2020, issued the "five permits and one adherence measures to coordinate epidemic prevention and control and promote economic development of urban management of Chengdu ". It is stipulated that, on the premise of ensuring safety, not occupying blind roads and fire passages, not infringing on the interests of others, it is allowed to set up temporary street stalls and night markets in certain areas and carry out mobile trading in certain areas on the premise of epidemic prevention and control and sanitation. It can be predicted that the epidemic in 2020 will normalize many temporary measures, and the highly praised measures are likely to remain. The development of urban blocks will eventually move from closed to open, from traditional to modern, and from regional to global. "The scenery of people’s normal life is the most comforting thing in the world".

6. Conclusion

The novel coronavirus epidemic has provided a direction of thinking and efforts for the urban planning discipline to deal with public health emergencies. Urban block planning should also reflect on the response ability, adaptability and recovery ability under the background of public health emergencies, further consider the dialectical relationship between block opening and health and safety to study the corresponding planning methods. It is a strong guarantee for the safety and sustainable development of urban blocks to correctly understand the epidemic risk, establish a management policy adapted to local conditions through scientific data guidance, profoundly understand and apply the thinking method of fine design, organically combine the opening and sharing at ordinary times with the closed and isolation at epidemic time, and improve the social governance ability.

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