

Construction of a City Prevention Spatial Unit System for Epidemic Emergencies: A Reflection on a Healthy City Environment During Public Health Emergencies

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ABSTRACT: There are three key elements in the emergence of infectious diseases, namely, sources of infection, transmission routes, and susceptible populations. Early urban public health campaigns were committed to eliminating the source of infection by improving the urban physical environment. In recent years, the Healthy Cities movement has focused on promoting the physical activity of residents to strengthen the health and well-being of susceptible people. Nevertheless, there is often a lack of effective training in cutting off the routes of infectious diseases. In the present study, the current “epidemic war” in China was analyzed, and the “isolation-treatment-recovery” response measures in Chinese cities for epidemic prevention and control were summarized. In addition, the role of administrative and spatial units at the “city-district-community” levels, as well as lessons learned to improve the Healthy Cities movement, were discussed. It concludes that a better healthy city requires three perspectives of thinking: The first is how to effectively control the epidemic in a sudden outbreak. The second is adopting humanistic thinking by focusing on life support and the quality of life of residents in the context of the long-term impacts of the outbreak. The third is to strengthen spatial attribute thinking as part of the healthy city indicator system. Therefore, the idea of creating a healthy city epidemic prevention spatial unit system was proposed. At the city level, a “city-district-community” multi-level linkage is needed to strengthen epidemic prevention capacity and establish a resource distribution mechanism. At the community level, on a spatial scale that satisfies basic isolation and epidemic prevention management requirements, it is necessary to establish a support system that serves basic human life to ensure the health and well-being of residents during epidemic control.

KEY WORDS: healthy city; epidemic prevention spatial unit; emergency isolation; life support system; community

Introduction

In the mid-19th century, modern urban planning came into being due to the serious public health problems caused by industrialization [1]. In 1848, the United Kingdom passed the Public Health Act, which focused on reducing the potential media of infectious sources such as sewage and garbage through physical environmental construction measures to protect public health [1]. Subsequently, gov-

ernments around the world adopted urban planning as an important tool to address urban public health issues by controlling and guiding the development of physical space [2], eliminating the source of infection to prevent infectious diseases [3]. Thanks to the development of modern public health systems, most of the highly contagious diseases in cities had been effectively contained by the middle of the 20th century [3]. With the rapid increase in the

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level of urban traffic motorization and the proportion of office clerical employment, the increasingly serious problems of obesity and chronic diseases have become the primary challenge facing the health of modern urban residents. Therefore, the World Health Organization (WHO) launched the “Healthy Cities Project” in 1986, pushing the urban public health movement into a new stage.

The basic concept of WHO’s “New Public Health Movement,” marked by the Healthy Cities movement, is “Health for All.” This movement has received positive responses from all over the world, especially in Europe. The WHO European Region’s Healthy Cities Project started in 1988 and has gone through six phases. It is currently entering its seventh phase. According to the WHO National Healthy Cities Network, in the 6th phase from 2014 to 2018, Italy (with three first-class healthy cities), Spain (with five first-class healthy cities), the United Kingdom (with eight first-class healthy cities) [4] were the leaders in the European Healthy Cities movement. However, after the outbreak of the COVID-19 epidemic, by the end of May 2020, Italy, Spain, and the United Kingdom ranked as the first, third, and fourth countries with the highest COVID-19 mortality rates in the world, while also ranking as the seventh, fifth, and fourth countries with the highest number of confirmed cases, respectively [5]. Obviously, the Healthy Cities movement has not played a significant positive role in the prevention and treatment of this epidemic.

The emergence of infectious diseases depends on three basic links: sources of infection, transmission routes, and susceptible populations [6-8]. From this perspective, early urban public health was committed to eliminating sources of infection by improving urban public health, while the Healthy Cities movement since the 1980s focused on improving the physical fitness of susceptible populations by promoting physical activity among residents. In other words, the starting point (source of infection) and endpoint (susceptible population) of infectious diseases were controlled and protected, respectively, in the two urban public health campaigns. However, for the intermediate link of infectious diseases - cutting off the transmission route, the urban system lacked an effective emergency response

mechanism. In the context of highly concentrated urban populations and frequent global or regional connections in contemporary cities, “virus transmission routes” have become the most difficult to control of the three major links of infectious diseases.

China’s Healthy Cities were established on the basis of the National Sanitary Cities that began in 1989. Compared with the Healthy Cities movement in developed European countries, there are obvious limitations. However, Chinese cities have performed well in cutting off the transmission routes for the spread of epidemics. This article will review and summarize the successful experiences and existing problems of Chinese cities in effectively cutting off the transmission routes of the COVID-19 epidemic that has affected the whole world, explore its inspiration for enriching the practice of healthy city construction, and help the Healthy Cities movement make new adaptive adjustments.

1 Chinese cities’ response measures to the epidemic and reflections on healthy cities

1.1 Chinese cities’ response measures to the epidemic

1.1.1 Isolation

After the outbreak, in order to effectively cut off the virus transmission route, Wuhan issued China’s first city lockdown order: From 10:00 on January 23, 2020, all city buses, subways, ferries, and long-distance passenger transport in the city will be suspended; citizens are not allowed to leave Wuhan without special reasons, and the airport and railway station exits from Wuhan will be temporarily closed [9]. Subsequently, many cities in Hubei began to implement “city lockdown” control. Cities across China also issued their own city isolation measures based on the epidemic prevention levels issued by the respective provinces. For example, on February 7, Shenzhen implemented the “strictest ever” community joint prevention and control measures in history, which included 100% enclosed management for all communities in the city, the establishment of inspection and registration cards at the entrances and exits of all residential areas and urban villages, and a mandatory 14-day hard isolation for residential building units where confirmed cases were detected, among 19 other

measures [10].

In this battle against the epidemic, following the principle of “strict prevention of imported cases and strict prevention of internal spread,” cities across the country generally adopted a “city-community” two-level isolation and control model with top-down coordination. First, as a complete administrative and control unit, the city quickly “blocked” the main traffic arteries and public transportation within the city, suspended work, business, and classes throughout the city, and restricted or stopped markets, gatherings, theater performances, and other activities involving large crowds. The community serves as the basic unit of urban prevention and control. It consists of a joint quarantine line composed of health and epidemic prevention departments, grassroots street offices, and community property management, which isolate citizens at home in the community, thus forming a frozen unit where the city’s population activities are suspended: residents can move around within the community but are not allowed to go out without permission. The “city-community” two-level isolation and control model effectively cuts off the channels for the spread of the epidemic and forms an efficient response and management model.

1.1.2 Treatment

In response to the COVID-19 pandemic, Wuhan City announced the first batch of 7 designated hospitals on January 22 and continued to increase the number of hospitals over the following month. In total, five batches of 55 hospitals were requisitioned, with all outpatient departments serving as fever clinics and providing beds to focus on treating all fever patients in the city [11]. Due to the rapid development of the epidemic, two temporary centralized treatment centers, “Huoshenshan” and “Leishenshan,” were quickly built to alleviate the pressure on treating severe and critical patients. At the same time, starting from the night of February 3, large public venues such as sports arenas and exhibition centers were transformed into makeshift hospitals for the treatment of confirmed mild cases [12]. With the commissioning of makeshift hospitals and the activation of community isolation points, the pressure on beds has been dispersed, a large number of patients with mild COVID-19 have been effectively admitted, and

the phenomenon of medical rush has been alleviated.

From the perspective of patient treatment, the “city-district” two-level system has played a positive role. At the city level, faced with the rising number of infections and the overwhelming strain on existing medical treatment facilities during the outbreak, quick decisions were made to expand emergency medical facilities, implement designated and centralized treatment, and adopt decentralized nearby isolation measures. The city’s designated hospitals treated severe, critically ill, and suspected critically ill cases; emergency spaces were opened as temporary centralized treatment centers to treat severe and critically ill patients. At the district level, large public activity venues were converted into makeshift hospitals to treat confirmed mild patients nearby. In the early days, community hospitals played the role of assisting the community in conducting follow-up observations as isolation points. After the establishment of the makeshift hospitals, the community no longer served as a decentralized isolation role.

1.1.3 Recovery

After the epidemic control showed results, the issue of how to restore social production and daily life emerged. On February 17, the State Council issued the *Guiding Opinions on Scientific Prevention and Control and Precise Measures for COVID-19 Epidemic Prevention and Control Classified by District and Level*, requiring all local governments to develop differentiated measures for county-level epidemic prevention and the restoration of economic and social order. On February 29, Guangzhou city issued the *COVID-19 Epidemic Prevention and Control Classified by District and Level in Guangzhou*, dividing the control areas based on counties (cities, districts), and categorizing them into four levels according to the current situation and development trends of the epidemic, implementing graded and classified prevention and control. High-risk areas were subject to strict management; medium-risk areas required reasonable designation of controlled locations and personnel; low-risk areas focused on strengthening health management for incoming key individuals [13].

Therefore, we see that a “city-district (county)” two-level management and control model is implemented to restore social order. Under the unified and strict defense

management of the city, the epidemic risk level is divided according to the district (county) based on a comprehensive assessment of population and incidence, and a clearly graded and classified prevention and control strategy is established. Low-risk areas implement the strategy of “prevention of imported cases” to fully restore normal production and living order; medium-risk areas implement the strategy of “prevention of imported cases and prevention of internal spread” to restore normal production and living order as soon as possible and in an orderly manner; high-risk areas implement the strategy of “prevention of internal spread and prevention of exporting cases, and strict control” to gradually restore production and living order according to the epidemic situation. The city should dynamically adjust the list of low-risk, medium-risk, and high-risk areas (counties) within its jurisdiction, ensure the smooth operation of the transportation network, guarantee the supply of protective materials for transportation companies and employees, and maintain the order of passenger and logistics operations.

1.1.4 Experience and shortcomings

After the emergency response was launched, cities across the country moved forward through exploration, learning from each other, and quickly formed a set of urban response methods for the COVID-19 epidemic. These response methods have left valuable experiences for the future, including: In terms of isolation, the city was blocked, work was suspended, and the community was isolated at home, forming a “city-community” two-level prevention and control management unit. Strict control was exercised over cities and communities, transmission routes were quickly cut off, and an effective emergency spatial isolation and prevention system was formed; in terms of treatment, the city’s designated hospitals admitted patients with severe and mild symptoms, and the district admitted and isolated asymptomatic confirmed patients. Different levels of medical facilities were fully utilized to promptly treat patients and place them under isolation, forming a spatially graded treatment and emergency rescue plan with strong human-centered care. In terms of recovery, the “city-district (county)” two-level management and prevention model was adopted. Districts (counties) were monitored

dynamically for risk levels, and prevention policies were adjusted accordingly, forming a spatial organizational management strategy for safely and orderly restoring social and economic activities. Under such large-scale and instantaneous control measures, the Chinese government effectively halted the spread of the epidemic, gradually resumed work, production, and schooling, and conducted social and economic activities in an orderly manner. The achievements in epidemic control have attracted worldwide attention and received high praise from the WHO.

However, these powerful emergency response measures also revealed some shortcomings.

(1) Medical overcrowding occurred in the early treatment phase. Due to the rapid spread of the epidemic, there was a temporary shortage of medical resources in the early stages. Firstly, during large-scale outbreaks of respiratory infectious diseases, city-level hospitals, and specialized hospitals, which were originally allocated based on the regular population, had insufficient bed capacity. Under the influence of panic, a large number of fever patients flooded into designated hospitals in a short period of time seeking treatment, leading to overcrowding in these hospitals and an initial shortage of medical resources. Secondly, there was insufficient infrastructure for on-site isolation of infectious diseases. The construction of Huoshenshan and Leishenshan hospitals in Wuhan, as well as the transformation of large public facilities in various districts into emergency treatment and isolation points, revealed a lack of planning for isolation medical facilities. Lastly, grassroots medical and health facilities were weak, with limited scale, material supplies, and staffing in community medical institutions. They completely lacked the necessary facilities and emergency response capabilities for infectious disease isolation and protection.

(2) The supply of basic materials was insufficient. Our urban construction often takes the city as a unit to organize and connect external regional transportation and internal urban transportation. Such a construction and management model has effectively controlled the flow of people under the “one-size-fits-all” traffic control adopted during this emergency epidemic, but it has also cut off logistics channels, resulting in a shortage of epidemic pre-

vention supplies and daily necessities. At the beginning of the outbreak, the Wuhan Red Cross Society was instantly overwhelmed by the huge logistics and distribution requirements. In particular, when supplies donated by all sectors of society had already arrived and were arriving in Wuhan in large quantities, many supplies were reported to be stuck in the “last mile,” with logistics unable to enter the city and the transportation system struggling to reach communities directly. For a period of time, the supply of daily necessities for residents in grassroots communities in Wuhan and other major epidemic-affected cities became a major problem.

(3) Basic living was not guaranteed. This epidemic was unique, and starting from February, cities required all villages, communities, and settlements to implement strict closed management. As a result, each village and community marked a physical boundary to define the actual scope of control, and people began living in isolation. During the months-long isolation period, people’s living area was limited to a small area, but many communities serving as basic isolation units were unable to meet basic living requirements. Some lacked sports venues, some didn’t even have basic space for activities, and some shared community green spaces that were usually accessible were then inaccessible. Under the restrictions of long-term intense isolation and social distancing measures, residents were unable to ensure their daily activities and exercise, which could easily cause psychological and physical problems. This posed a huge challenge for ensuring the basic lives of urban residents.

1.2 Reflection on the concept and indicator system of “Healthy Cities” in the face of the outbreak of the epidemic

From the perspective of the city’s response measures to the outbreak, timely isolation of patients, cutting off urban transportation networks, and restricting residents’ travel have produced good results in blocking the virus’s transmission routes. The “city and district (county)” two-level system has also generally been able to coordinate effectively. However, issues such as insufficient grassroots medical prevention and control resources, inadequate supply of basic materials, and lack of basic living security

have also emerged. During the execution of epidemic prevention measures, governments and organizations at various levels often encountered disorder and confusion. On a deeper level, these problems expose the shortcomings in urban planning, construction, and management under the guidance of the concept and indicator system of Healthy Cities, allowing us to see areas that need reflection and improvement in healthy city construction.

1.2.1 The healthy city construction at the urban level lacks a hierarchical coordination mechanism

In 1980, the WHO began to advocate for the “Health for All” movement, focusing on how the physical environment, society, economy, and policies affect the health and well-being of the population. The 1986 *Ottawa Charter for Health Promotion* proposed a health promotion framework centered on “place-based development.” Subsequently, different forms of healthy places emerged in Europe and even around the world: healthy cities, healthy islands, healthy schools, healthy workplaces, healthy communities, healthy hospitals, healthy universities, and healthy markets. Among them, “healthy cities” is the most successful and largest-scale method of promoting health in places, and is closely related to whether the city has complete decision-making and resource control capabilities. The WHO’s concept of building healthy places, combined with the city’s decision-making system, has led to the rise of the Healthy Cities movement around the world. European and American countries have gradually made “health promotion” one of the important goals of urban planning [14], cities such as Beijing and Shanghai in China have followed suit. However, these healthy city construction efforts are generally led by city governments. Although they are efficient in mobilizing citywide resources, they ignore participation at the community level. The theories and methods of healthy place construction we see today all take the city as an integral unit, such as emphasizing compact development, mixed-function land development models, and encouraging bus-oriented transportation [15, 16], etc. However, administrative entities at different levels within the city face very different problems of different scales, and the authority of administrative entities at all levels to mobilize administrative resources also varies

greatly, resulting in chaos in the allocation of resources for epidemic prevention and control at the community level when facing public health emergencies. Therefore, when the epidemic broke out, and the city was under unified lockdown and control, the city's bus-oriented public transportation system, which had been vigorously promoted, was suddenly paralyzed as a whole, transportation channels were suspended, and the supply of daily necessities in the community was worrying. In addition, due to fears of crowded places facilitating the spread of COVID-19, the once vibrant, compact, and mixed-functional urban public spaces have become places that people avoided.

1.2.2 The healthy city indicator system that emphasizes lifestyle guidance lacks bottom-line thinking

At present, many relatively mature indicator systems and evaluation standards have been developed for healthy cities, such as the "10 Criteria for Healthy Cities" announced by the WHO in 1996, the *Healthy Communities Program of the Centers for Disease Control and Prevention* launched in the United States in 2003, and the *Healthy Community Standard of the International WELL Building Institute* released in 2014. The evaluation system and construction standards for healthy cities focus on the creation of three major environments: social environment, sanitary environment, and built environment. The transformation of the built environment focuses on land use, compact development, and architectural design [17]. These health city indicators tend to focus on the macro natural environmental level and the micro spatial design level, with the goal of promoting people's health and well-being, but they lack consideration of bottom-line standards for maintaining residents' basic health—referred to as the "life support system." Taking the *Healthy Community Standard of the International WELL Building Institute* as an example, the standard does not mention the requirements for grassroots health services, community immunization, and emergency preparedness. In terms of community immunization, it only proposes the promotion of seasonal influenza prevention and vaccination programs, but does not take into account the impact of new infectious diseases. The emergency preparedness section also does not propose health protection measures to deal with infectious disease out-

breaks and measures to ensure basic living [18]. The lack of bottom-line thinking has made it impossible for the basic concept and indicator system of healthy cities to provide constructive suggestions for urban management and residents' lives under public health emergencies. They failed to withstand the test of the extreme pressure conditions of this epidemic.

1.2.3 Healthy city construction criteria focus on social attributes but lack spatial attributes

The involvement of the urban planning in healthy city construction is mainly to improve the built environment through land use planning and design. On the one hand, this is achieved through specific design, and more importantly, it is achieved by stipulating the main indicators and principles of the built environment, such as mixed land use, green space and openspace layout, and the per-thousand-person standard for public facilities [19], but these indicators lack clear spatial attributes.

In order to clarify the spatial attributes of living service facility indicators, the 15-minute living circle may be an effective optimization approach. Standards such as the *Beijing Healthy Community Guidance Standards* and the *Shanghai 15-Minute Community Life Circle Planning Guidelines* propose to closely link service demands at different levels with the resources that can provide services, creating a radiating area centered on residential points, where citizens can access services within a 15-minute walk. This promotes the full coverage of multi-functional supporting facilities like public services, sports facilities, markets, and bus stations in the community. However, these standards only have service scopes, while the methods for defining community boundaries have yet to be improved and clarified, thus restricting the determination of the spatial attributes of the indicators. The spatial scope of the living circle is still under discussion and exploration in academia [20]. Existing demarcation methods with spatial measurement aligned with administrative boundaries fail to comprehensively account for micro-scale geographical variations, residents' behavioral patterns, or localized demand characteristics [21-24]. Or the data granularity is too large, the cost is too high, and the spatial parameters are difficult to determine, so it is difficult to promote it at

the community scale [25]. Moreover, although Chinese communities are built on the basis of closed community units, in recent years, various life circle planning has imitated open blocks, focusing on advocating overlapping and sharing between life circles [26], which has facilitated the lives of residents but is not suitable for the isolation and control requirements under the background of the epidemic. Therefore, the algorithm for the scope of living circles that takes into account both human nature and the effectiveness of prevention and control during the epidemic needs to be improved, and there is still some distance to go before the measurement results can be combined with administrative boundaries for promotion and implementation.

In terms of management mechanisms, in China, the street offices manage several communities. A community is a large collective formed by various social groups or organizations gathered in a specific area, where individuals are interconnected in their daily lives[27]. It has social attributes but lacks physical attributes. Once isolation and epidemic prevention are implemented during the epidemic, it is necessary to define villages, communities, or settlements into units with clear physical boundaries for management and control. Some communities will lack basic facilities, or lack shops, or lack sports venues. Although community indicators and guidelines are relatively specific, it is unclear how to build and operate them within the spatial scope. In addition, these guidelines do not reflect the integration of community-level facilities into the overall planning of city-level health service facilities, nor do they demonstrate the supportive role of community-level health facilities within the city's facility system. The spatial attributes of healthy city and community indicators are mostly merely expressed as a step-by-step decomposition based on their respective areas and populations, which cannot ensure the basic supply of all communities, and the spatial attributes of facility supply are unclear.

2 Thoughts on building and improving the epidemic prevention spatial unit system in healthy cities

The Healthy Cities movement, which has been booming around the world since the 1980s and involves multiple fields such as society, environment, and public health,

has exposed its shortcomings in the face of the current COVID-19 epidemic. Only by fully absorbing and summarizing the existing experience and lessons can the price paid be meaningful.

The COVID-19 epidemic presents two characteristics that deserve attention. The first is the “emergency nature”. In highly densely populated cities, the virus infects a large area in a short period of time, often catching city governments off guard. Many prevention and control measures are, on the one hand, too strict and incrementally intensified, and on the other hand, inadequately considered and poorly coordinated. The second is the “long-term nature.” The duration of this epidemic far exceeded initial expectations. Long-term isolation has caused great suffering to people's bodies and minds, which has increasingly aroused people's demand for a more humane living environment. In fact, many of the problems that have arisen in the epidemic prevention and control mentioned above are mostly due to insufficient response to the sudden outbreak and insufficient anticipation of its long-term consequences.

The inspiration for healthy city construction is that it is necessary to establish three mindsets: first, the effectiveness of rapid isolation and treatment for sudden outbreaks; second, the human-centered thinking that focuses on life support and quality of life in the context of long-term epidemic impacts; and third, the spatial attribute thinking that fully considers the differences in epidemic risks and control models at different scales and regions.

2.1 Establish a multi-level epidemic prevention system oriented towards effective emergency isolation

The key to the effective implementation of epidemic prevention work lies in the effective control and dispatch of many public resources such as medical and health resources, military and police forces, transportation and municipal facilities, public service facilities, and public places. From the reflection on the effectiveness of this epidemic prevention and control mentioned earlier, it is not suitable for city governments to implement “one-size-fits-all” control over all public resources. Except for public resources that require citywide control, such as medical and health epidemic prevention personnel and materials, military and police forces, transportation facilities, municipal

facilities, and municipal public service facilities and venues, most of the public service facilities and commercial outlets in the city are decentralized and have localized characteristics, and people's activities are limited to a small area near their homes. Obviously, spaces of different scales face different problems, administrative entities at different levels have different powers to control public resources, and their management models also vary greatly. A "one-size-fits-all" comprehensive control will make prevention and control measures inflexible, bring great inconvenience to residents' lives, and inevitably cause specific confusion at the execution level. Therefore, establishing a system in which "city-district-community" performs its respective duties and coordinates prevention and control will help improve the effectiveness of emergency isolation work (Figure 1).

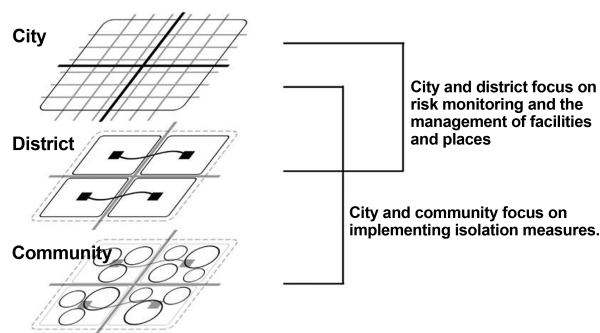


Figure 1 Schematic diagram of the city-district-community three-level epidemic prevention division system

Among them, the city government has the greatest authority and ability to control public resources. It can implement "city lockdown" in extreme cases and is responsible for implementing citywide isolation measures. Community grassroots organizations have basic public resource control capabilities, such as organizing community epidemic prevention inspections, and can also implement "closure" of the community in extraordinary circumstances, restricting the entry and exit of people. They are responsible for implementing grassroots isolation measures. More importantly, compared with home isolation, using the community as the smallest isolation unit is a more humane approach. On the one hand, the community can meet the epidemic prevention and control requirements in most cases. Once the epidemic risk in the community increases, the community can be immediately closed and

managed to prevent the spread of the epidemic outside the community, while concentrating medical resources for treatment. On the other hand, the community can provide people with necessary daily outdoor activity venues and maintain a minimum social network, which is especially important for people who have to be isolated for a long time during the epidemic.

For intermediate-level administrative entities represented by administrative districts, isolation is not their primary responsibility. Instead, they focus on controlling the use of various facilities and places and human activities within their jurisdiction. For example, according to the local epidemic risk level, they open or close public service facilities and places such as markets, gatherings, sports, theater performances, construction sites, etc., in a timely manner within their jurisdiction, and control the number of visitors through appointment systems and health codes. At the stage when the epidemic situation tends to stabilize and people's travel activities begin to resume, risk monitoring and facility control at the district level are particularly important.

2.2 Form a multi-level life support system with people at the core

The WHO report points out that maintaining a healthy and good living environment should be a multi-scale support-system [28]. In the innermost circle are the elements that are most closely related to people's living conditions, namely lifestyle, community social networks, and local economy. Various activities in the city, the built environment, the natural environment, and even the global economy are in the outer circles. It can be seen that for humans to maintain a relatively normal living state, at least a minimum support system is needed. This support system has certain spatial scale requirements. During the pandemic, when strict prevention and control measures isolate people at home, we should realize that the size of a single house is not enough to support normal living conditions. Once the isolation time is prolonged, people will experience various physical and mental health problems. For this reason, it is necessary for us to reserve a support system with spatial scale attributes to maintain people's quality of life in the event of an epidemic (Figure 2).

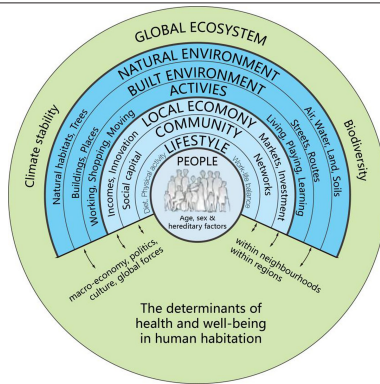


Figure 2 Broader determinants of health and well-being related to urban and territorial planning of human settlements

The first circle centered on people is the community. The community is the physical and social space closest to residents, and should also be the smallest unit of epidemic isolation and the “epidemic prevention cell.” In urban planning and management, full consideration should be given to the shaping of the “minimum life support unit” at the community scale. On the one hand, this basic unit must meet the requirements of effective isolation and should include three key spatial elements, namely, control boundaries, closed control points, and the entry and exit routes of personnel and materials during the closure. These three spatial elements should be incorporated into urban planning, and regular prevention and control drills should be organized accordingly; on the other hand, within the community unit, urban design and environmental construction at the community level should be carried out, such as opening up green open spaces at street corners, setting up sports facilities, and improve building facades and the environment, so as to continuously promote the improvement of the quality of the venues that are most “intimate” to community residents, and help residents maintain a relatively comfortable living state during the isolation period.

The second circle is the service supply system. The basic service supply coordinated by the district mainly includes: first, the public service and commercial network system, especially the community-level network, which helps to disperse the pressure of household consumers pouring into large supermarkets and shopping malls; second, the express delivery and takeaway delivery system, especially addressing the inconvenience of receiving express delivery and takeaway in large living communities,

by further setting up contactless centralized pick-up points; third, the configuration of public activity venues, especially efforts to increase the number of community outdoor sports venues as much as possible.

The third circle is the material supply system. Learning from the lesson of external supplies being congested at highway toll gates during the early stages of Wuhan’s lockdown, it is essential to consider in advance the setting up of storage points for external supplies during special periods. This will ensure that materials entering through highways, railways, airports, and shipping channels can quickly reach their destinations and be easily stored, counted, and distributed. Additionally, an emergency plan should be developed to expand medical space resources and critical material transport channels under emergency conditions, in order to improve the community’s public health and epidemic prevention capabilities, material supply capacity, and emergency response efficiency.

2.3 Construct an epidemic prevention space unit based on the community and highlighting the spatial attributes

In response to the need for rapid isolation and treatment during sudden epidemics, as well as the consideration of life support and quality of life in the long-term context of the epidemic, we believe that communities are both the smallest spatial unit for epidemic prevention and isolation and the essential life support unit for residents. Therefore, in order to better integrate the epidemic risk management models of different scales and regions into actual community management, it is necessary to change the current practice of using vague population-based indicators, address the technical difficulties in defining the 15-minute living circle [25] and move from theoretical exploration to practical implementation in planning. This will enhance the spatial attributes of health city indicators and solidify the role of communities as the foundation of health city epidemic prevention units.

As the key basic spatial unit of a healthy city, a community must meet the functional requirements of both epidemic prevention and control and life support systems. Its basic spatial attributes need to include six aspects: spatial scale, boundaries, logistics interfaces, entrance and exit control, medical facilities, and service facilities. First of

all, from the perspective of the city's isolation and control system, the community is the smallest isolation unit designated by the city for epidemic prevention and control. Therefore, communities need to have physical boundaries that allow for closed management, with entrances and exits where pedestrian flow can be controlled, temperature checks can be conducted, and disinfection stations can be set up. In emergency situations, the community should have facilities for supplying medical and other emergency materials, as well as backup isolation and observation facilities (to provide for individuals who may be infected and cannot leave immediately), infectious disease patient transport corridors (to ensure the safe transport of infected patients to specialized hospitals for isolation and treatment), and dedicated waste (such as masks) collection and disposal facilities, all of which should be implemented at

the community level in relation to epidemic prevention and control. Second, from the perspective of the human life support system, the community should be a life support unit that can meet basic needs. Within this community unit, entrances and exits should be equipped with enhanced dynamic monitoring for safe entry and exit. In addition to the facilities specified in the existing relevant standards, what is most needed are facilities such as shops that can meet people's basic living needs, express delivery and takeaway reception points, as well as green spaces and open spaces for basic activities, fitness trails, and other sports facilities to support people in carrying out corresponding fitness and health activities. This will form the smallest spatial unit that can effectively implement isolation and control while maintaining a human-centered life support system (Table 1).

Table 1 Elements of a community as the dual system of epidemic prevention and control and life support

Elements	Epidemic prevention and control system	Life support system
Spatial scale	The smallest unit for isolation and epidemic prevention	The basic unit that supports life systems
Boundary	Closeable physical boundaries	The required elements contained within the boundaries
Logistics interface	Emergency supply points for medical and other resources	Community supermarkets (convenience stores, vegetable stores) and other basic materials supply points, takeaway and express delivery reception points
Exit and entry control	Crowd control, temperature measurement, and site disinfection	Dynamic monitoring
Medical facilities	Backup isolation and observation facilities	Daily healthcare supply facilities (pharmacies)
Services and Facilities	Garbage (masks, etc.) collection and disposal	Green and open spaces
	Infectious disease patient transport corridors	Fitness trails and other sports facilities

Conclusion

Human beings will never be entirely free from the threat of sudden infectious diseases. Although now modern urban planning has made remarkable achievements in improving the urban public health environment, the Healthy Cities movement, through advocating for healthy lifestyles, has continually brought positive impacts on the improvement of physical fitness for modern urban residents. With the increasingly robust modern healthcare system, the likelihood of sudden infectious disease outbreaks has been greatly reduced. However, as the highest form of human habitation, cities, with their ever-growing populations, increasingly facilitate the spread of infectious diseases. This forces us to never underestimate the catastrophic consequences that sudden epidemics may cause and to

make ample preparations for such situations. Merely advocating for a healthy lifestyle is far from enough. Being truly prepared means ensuring the efficient and orderly allocation of public resources during extraordinary times, while also incorporating humanitarian care, and striving to maintain a good state of existence and quality of life. This is clearly a system with high technical requirements for detail. This article views communities as fundamental spatial units that interface between epidemic prevention systems and daily living systems. It advocates for more implementable spatial planning elements, such as boundaries, facilities, and venues, to help cities make material-spatial preparedness, thereby enhancing the resilience of modern cities and their residents when facing epidemics.

Sources of Figures and tables

Figure 1: and Table 1: drawn by the authors;

Figure 2: reference[29].

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