

Wuhan Lockdown: Reflections on the Public Health and Urban Space of COVID-19 Epidemic

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Abstract: During the outbreak of COVID-19, Wuhan had been first imposed lockdown measures from January 23 to April 8, 2020. After that, no new cases emerged from Hubei Province, and China achieved the first-staged victory in containing the epidemic. As the COVID-19 became a pandemic, Wuhan lockdown has inspired countries around the world. Under the framework of China's public health system and urban space, this paper combines the data on responses in global affected areas, analyzes the global influence and inspirations of Wuhan lockdown, and compares and contrasts lockdowns and the compound systems in virus epicenter metropolitan areas in China with those in US, Italy and Japan. Finally, the paper proposes a new perspective of "Isolation of metropolitan areas" under the region-city-community networks, to discuss how to create a sustainable and healthy life for mankind by cooperation among the public health system, urban space and social value.

1. Introduction

In January 2020, the COVID-19 broke out in Wuhan, China. By March 11, 114 countries or regions around the world have reported cases. Therefore, Dr Tedros, as WHO Director-General, announced that COVID-19 can be characterized as a pandemic. According to the real-time data from Johns Hopkins University, by 8 May 2020, 3:46 CEST, the global aggregate confirmed cases have surpassed 3.84 million and the death toll 269,564. For there is currently neither vaccines nor specific drug treatments, a range of public health interventions have been utilized to contain the outbreak of COVID-19. In addition to public health systems, urban spaces have been another essential support for preventing and controlling the pandemic. Twenty-two scientists from China, US and UK conducted a research published in Science, and indicated that the combination of interventions implemented in China was successful in mitigating spread and reducing local transmission of COVID-19 [1]. The quantified evaluations demonstrate that China's drastic control measures reduce 96% of the total cases in China [2].

Joshua Lederberg, the winner of 1958 Nobel Prize for Physiology or Medicine, once said: "The single biggest threat to man's continued dominance on the planet is the virus." This paper is based on the belief that this threat can be explicitly reflected in health care systems and implicitly in emergency capability provided by urban space. Health and places offer mutual support because health forms the basis of space vitality and places can sustainably support healthy life. Therefore, under COVID-19 epidemic, this [4] study will focus on aspects such as healthy city [3], public health emergency responses, joint prevention and control mechanisms of city clusters, etc.

This paper is based on the spatio-temporal statistics of case reports and public health interventions. Starting from the positive impacts of Wuhan lockdown on containing COVID-19 outbreak, this paper horizontally compares and contrasts the effectiveness of responses in 13 countries and particularly lockdowns in the virus epicenter metropolitan areas in China, US, Italy and Japan. By doing so, the connection between public health and urban space is built.

2. Comparison and contrast of lockdowns in Wuhan and affected countries

In Chinese history, a few cities were locked down due to wars, natural disasters and plagues. Despite different causes, lockdowns were relevant to public health. To respond to COVID-19, on 23 January 2020, Wuhan was imposed lockdown measures, the unprecedented stringent movement restriction on a city with population over ten million in human history. Following that, Hubei Province was locked down from the inside out. Lockdown is a synonym for limiting personal freedom and disrupting economy in many countries. But since COVID-19 spread worldwide and China's responses achieved phased progress, the virus-stricken countries have gradually started to draw upon lessons from China and evaluated the suitability of lockdowns and relevant measures.

By 13 April 2020, 117 countries have declared a state of emergency or a nationwide lockdown. Every country issues their COVID-19 responses after deeply considering factors like public health care services, national economic development and social acceptability. Therefore, there are some differentiated expressions such as social distancing, lockdown and curfew. This paper concludes responses from 13 countries and sets six measures as assessment indicators of COVID-19 prevention and control. This study also analyzes the epidemic trends in seven countries and offers a relatively comprehensive evaluation of their responses to COVID-19.

Table 1. Prevention and control measures of the COVID-19 epidemic in 13 countries

Country	Ban on Clusters	Movement Restrictions	Production Suspension	Cabin Hospitals	Medical Screenings	Big Data Tracing
CHN	✓	✓	✓	✓	✓	✓
ITA	✓	✓	✓	✓	✓	✓
ESP	○	✓	✓	✓	✓	○
IRI	○	○	✓	✓	✓	✓
USA	○	○	○	✓	✓	✓
GBR	✓	✓	✓	✓	✓	✓
GER	✓	✓	✓	✓	✓	✓
KOR	○	○	○	✓	✓	✓
AUS	✓	✓	✓	○	✓	✓
SIN	✓	✓	✓	✓	✓	✓
SRB	✓	○	✓	✓	✓	○
ARG	○	✓	✓	✓	○	○
RSA	✓	✓	✓	✓	✓	○

Sources: CDCs and HHSs, only country-level responses are selected, data as of 6 May 2020.

Combining measures in Table 1 and their implementation, this study considers that there are significant differences in countries that imposed lockdowns. It is obvious that the public health emergency responses greatly challenge the implementation and safeguarding functions of urban space. Ban on clusters and quarantining patients with mild symptoms in cabin hospitals reflect the replaceability of urban functional spaces. Restrictions on movement need the cooperation among grassroots facilities to ensure the normal life and implementation of social distancing. Unnecessary production is suspended and staff need working at home, which sets a higher standard of ecological living environment [5]. This paper believes that after coping with the COVID-19 challenges to urban space, living spaces can improve their epidemic prevention and control capacity, which will also give a positive feedback for sustainable development.

Based on Table 1, Figure 1 and Table 2, this study concludes that China has rallied the whole nation to take strict measures to quarantine confirmed and suspected cases, and conduct medical screenings and grading treatment to synergize their responses. According to *Coronavirus disease 2019 (COVID-19) Situation Report – 76* [6], China has moved from the containment phase into the mitigation stage and its experiences are helping countries that are currently at the start of the COVID-19 cycle to plan their responses better. At first, Europe and America reacted negatively to the epidemic. Later they imposed lockdowns gradually but failed to completely implement powerful isolation due to limitations of cultures, institutions, etc. Therefore, the epidemic has spiked since mid-to-late March. With strict regulation upgrading, Italy has flattened the curve of new infections

since early April. Countries with better responses like South Korea and Singapore did not impose lockdowns. But they took strong actions such as medical screenings, effective quarantine and testing with their advanced public health care systems in early time. Therefore, the epidemic in these countries has not grown significantly. But without stringent social distancing policies, infection sources cannot be cut off and the newly confirmed cases will fluctuate in long term [7].

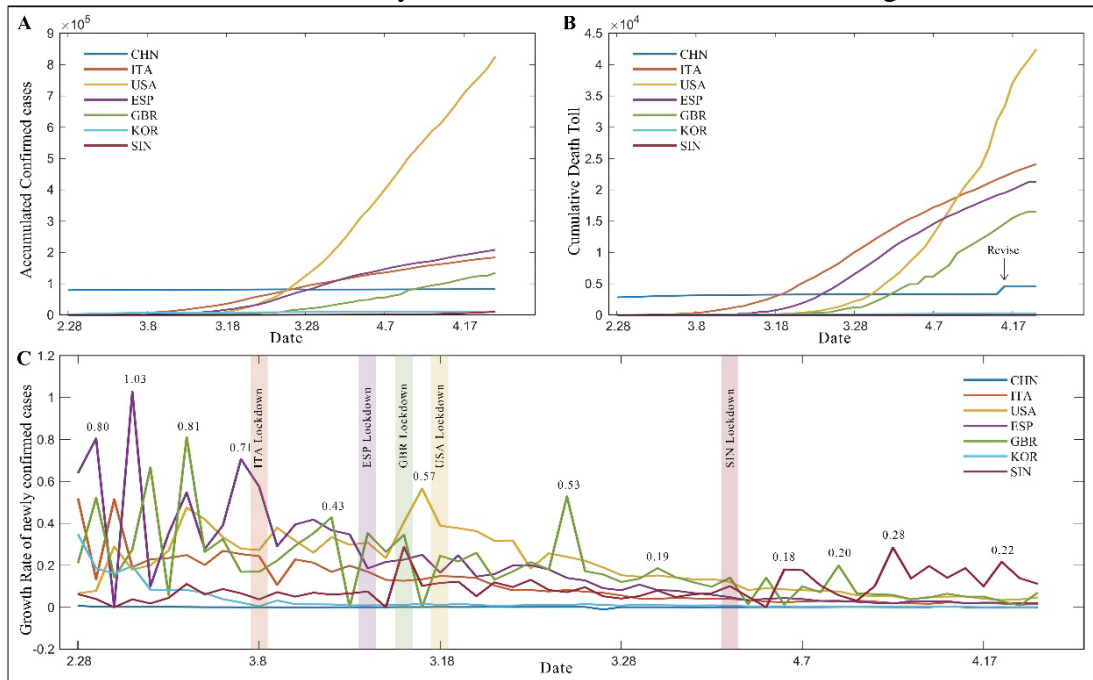


Fig 1. Epidemic curve of confirmed COVID-19 in 7 Countries, 2020 for A: Accumulated Confirmed cases, B: Cumulative Death Toll, C: Growth Rate of newly confirmed cases (note: data sources are from the databases of Johns Hopkins University and WHO Collaborating Centers (WHOCC), statistics as of 23 April 2020.)

Table 2. Growth multiples of newly confirmed cases in 5 countries first 50 days after lockdown

Countries	First ten days	Second ten days	Third ten days	Fourth ten days	Fifth ten days
CHN (1.23)	26.15	3.11	1.72	1.04	1.01
ITA (3.8)	6.04	2.88	1.60	1.28	1.18
ESP (3.14)	7.86	3.33	1.51	1.26	1.18
GBR (3.16)	7.09	5.19	2.26	1.51	1.31
USA (3.18)	18.42	3.94	1.89	1.50	1.29

Sources: Johns Hopkins University and WHO Collaborating Centers (WHOCC), data as of 4 May 2020

Through comparing and contrasting COVID-19 responses in countries and relevant statistics, China’s broad public health interventions such as lockdowns and the first-level public health emergency responses play an important role in prevention and control because they can effectively isolate the infection sources, cut off the transmission routes and protect the susceptible population [8]. In addition, this paper believes China has laudable performance in its “combat readiness” of urban space, but it still needs further improvement. In terms of epidemic conditions and responses, the key measures of China, South Korea and Singapore are timely actions on infection detection, quarantine, diagnosis and treatment. This paper believes that human could not be ahead of virus in terms of health care and nip unknown virus in the bud at the earliest. Individual and group health can only be guaranteed to the largest extent by ensuring living space can safeguard health.

3. Comparison and contrast of lockdowns in metropolitan areas

The epicenter of COVID-19 evolved from China to Europe and then to US. By March 22, the

virus-stricken Wuhan, New York State and Lombardy have imposed lockdowns. Tokyo, the most populous city in the world, started its Japanese-style lockdown on April 7. On the next day, Wuhan started to lift its 76-day lockdown. Since mid-April, Lombardy’s pandemic has shown a marked slowdown and New York State has entered a falling range.

Cities are gathering centers. Most of them undergo tough situations such as overwhelmed health care systems during the outbreak of COVID-19. To cope with the shortage of health care workers and medical resources, other parts in China have sent 99 medical teams to support Wuhan by 6 February 2020. This study believes that first, in terms of the cooperation between urban space and public health systems, high efficiency is essential, but low costs matter more. In the future, joint prevention and control mechanisms of city clusters need to be promoted to activate the epidemic prevention potential of surrounding cities, towns and villages to safeguard communities to the largest extent amid emergencies. Second, social distancing is the most direct and workable way to contain contagious diseases when people lack effective treatments. Based on these two ideas, this paper compares and contrasts the compound elements of Wuhan, New York, Milan and Tokyo metropolitan areas (see Fig. 2), analyzes the importance of implementing lockdowns in metropolitan areas as units and brings out new thoughts on “Isolation of metropolitan areas”.

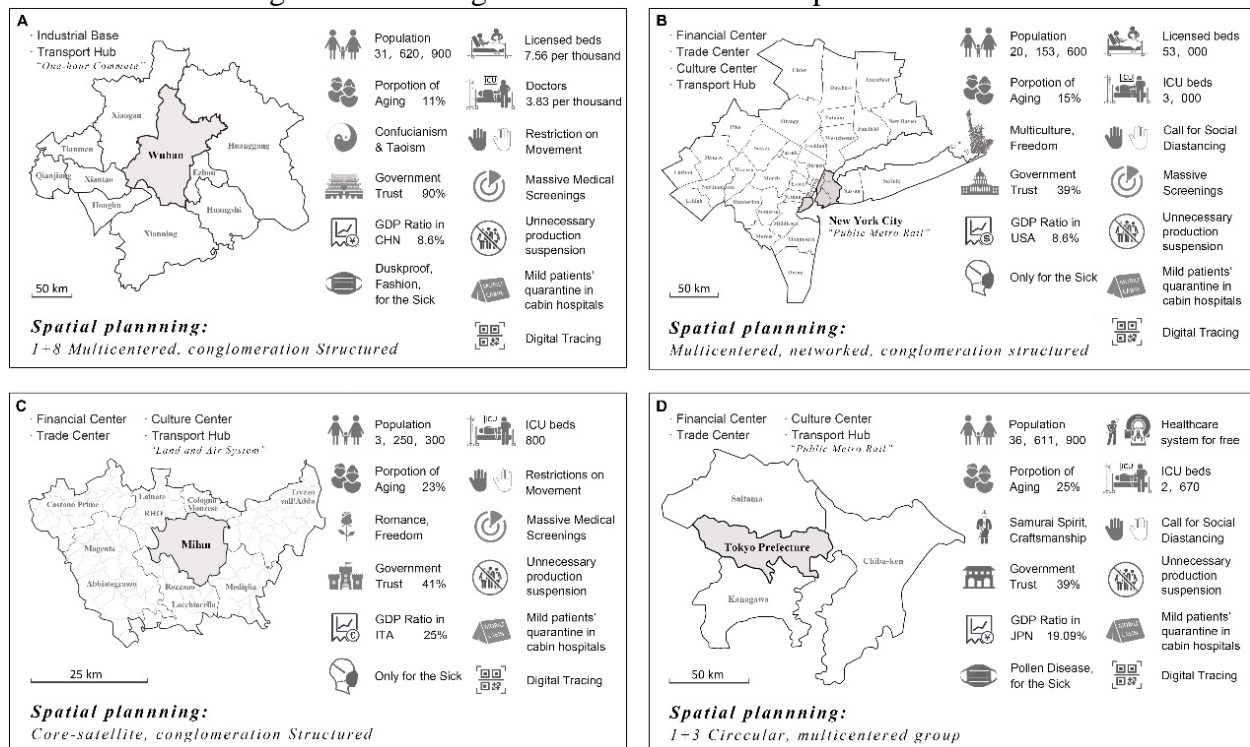


Fig 2. Comparison of metropolitan compound systems and lockdowns, 2020 for A: Wuhan metropolitan area, B: New York metropolitan area, C: Milan metropolitan area, D: Tokyo metropolitan area. (Note: data sources are from national bureaus of statistics and authoritative journalism; elements are updated by 2019, lockdown measures are updated by 6 May 2020.)

In terms of planning, the epicenter metropolitan areas in China, US, Italy and Japan adopt the multicentered, conglomeration structured layout and accessible transport networks, which can help evacuate and protect citizens during emergencies. However, amid public health emergencies, urbanization could accelerate the spread of viruses because they respect no borders. Wuhan, New York and Tokyo are not only metropolises with over ten million population, but also national or even international essential transport hubs. Thus, without vaccines and effective treatments, their comprehensive non-pharmaceutical interventions like lockdowns and isolation are crucial to containing the massive epidemic transmission within countries or even worldwide.

In terms of economy and industries, Wuhan metropolitan area enjoys massive industrial agglomerations. Therefore, despite the great shutdown of global manufacture caused by Wuhan lockdown, the agglomerated medical industry in Wuhan solved some problems brought by

insufficient medical resources. China's advanced logistics industry accelerated deployment and guaranteed its efficient operation to ensure a safe and stable supply of essential goods and needed supplies. This is also an important step to implement social distancing. From 23 March 2020, outlying towns and villages in Hubei Province began to lift lockdowns. On April 8, Wuhan joined them. Kissler et al. [9] think that intermittent social distancing may be necessary into 2022 to avoid the burden on health care systems. Based on that, this paper believes that it is urgent to construct isolation, evacuation and safeguarding systems of metropolitan areas in view of the current scale of metropolitan areas, neighboring towns and villages and relatively advanced industry chains.

In terms of health care, Italy is endowed with first-class medical resources in the world. But in recent years its medical budget has been cut. The 23% aging population is another burden. Amid the epidemic, Italy did not implement stringent prevention and control measures at early period. As of 6 May, the fatality rate in Lombardy reaches 18.30%. Wuhan has rich and advanced medical resources but still faced severe health-care squeeze in the early period of the outbreak. It solved this problem by building and using massive makeshift hospitals and gradually establishing the grading diagnosis and treatment system. Medical teams sent from other areas in China and combination of traditional Chinese medicine (TCM) and Western medicine also worked. Wuhan's cure rate is 92.31%. Through analyzing these cases, this study concludes that not a single city can undertake the multi-pronged functions of epidemic responses. At least the joint prevention and control mechanisms in the level of metropolitan areas should be activated. Only by doing so can the government effectively evacuate and safeguard citizens during sudden emergencies, and support each other within metropolitan areas to gradually resume social & economic activities after stabilizing epidemics.

4. Discussion

From Paris, London to Tokyo and New York, people witnessed how cities are gradually shaped and improved in fights against viruses and urban space has been an important support for healthy life. Therefore, discussing the governance and service of urban public health under COVID-19 epidemic is conducive to a series of urban renewals, standardizing public health and establishing a disease surveillance system. These actions can help cities have a "vaccine" against viruses. Based on previous sections, this paper offers new thoughts of the cooperation among public health system, urban space and social value, under the framework of region-city-community networks, to create a sustainable and healthy life for mankind from the perspective of "Isolation in the metropolitan areas."

4.1 Regional level - integration of prevention, control and evacuation

4.1.1 Big data monitoring, evaluation and management

Through reasonably selecting indicators to establish a "preventable epidemic index" evaluation system, a bidirectional "public health-spatial planning" data platform can be built based on monitoring more disease types, refining community-level statistics, and sharing analysis and data. During the outbreak of the epidemic, this system can quickly and effectively integrate information, dynamically monitor and warn the epidemic development [10]. Classifying the susceptible, exposed, infectious, and removed states of people and flexibly and properly classifying affected areas and community responses, which contribute to precise planning of grid-based epidemic responses and urban renewal [11].

4.1.2 Joint prevention and control mechanism

Urban population size and spatial pattern are the key issues for urban development. The problems of fast spread of COVID-19 and responses have exposed the over-aggregation of urban population and resource space to some extent. This paper agrees that regions should build a "multi-node cooperative deployment" epidemic prevention system with large and medium-sized cities as cores involving land use, urban transportation and other aspects, and form effective prevention and control deployment for the distribution pattern of special population and space. Wuhan metropolitan area

with "one-hour commute" [12] is the case where people explore the joint prevention and control mechanisms of city clusters. They regard the epidemic prevention of surrounding as a support and try to achieve urban security and organic evacuation amid emergencies.

4.2 Urban level – independence and resilience

4.2.1 Independent prevention system

Each city needs an independent health and epidemic prevention system to provide a strong guarantee for medical care and public health capacity, including sufficient beds and other infrastructure related to controlling infection. Based on *Shanghai's Plan for Medical and Health Facilities*, three types of functions need to be emphasized. One is to promote the grading diagnosis and treatment system to realize "first option at the grass-roots level, two-way referral, slow partition, the classification system of upper and lower linkage"; second, to establish a public health and epidemic prevention system including infectious disease hospitals and specialized hospital such as TCM hospitals; third, to establish a pre-hospital emergency system with first aid centers as cores. These measures integrate regional medical resources, provide equal medical services and achieve reasonable medical treatment order.

4.2.2 The redundancy of city resilience

City resilience encourages redundancy. In other words, cities need to increase the complexity of the urban systems, so that it has more repeated functions or alternatives to handle with explosive disasters [13]. Cabin mobile hospitals are important weapons for China to fight against COVID-19. In the future, cities should also have a series of plans on special infectious treatment facilities away from downtowns. Once an epidemic occurs, patients can be collectively quarantined in a short time to avoid spreading infection. These plans reflect the "combat readiness" function to cope with public health emergencies. They are different from the function division of urban hospitals. They can effectively avoid health-care squeeze.

4.2.3 Urban planning & design

Faced with the threats to infrastructure and personal safety posed by emergencies, this study offers five recommendations. One is to properly control the floor area ratio and building density, and enhance the assessment of public health security surveillance and emergency prevention and control; second, appropriately increase the mixed degree of land use and create a livable city with more social and environmental quality; third, advocate ped & bike system planning, reshape pedestrian-oriented life circle, reduce pendulum traffic to reduce cross infection; fourth, improve urban ventilation, use urban wind corridors to effectively regulate air flow, and reduce the duration and concentration of pollutants in the city; fifth, take an early attention to the municipal water supply and drainage system to ensure the safe drinking-water supply and effectively inactivate viruses in sewage, curb the aerosol and fecal-oral transmission.

4.3 Community level – public health units

Public health units, which can flexibly promote health and emergency responses related to urban space, are designed based on the "15-minute community life circle". To realize public health units, from residential area level, relevant planning should enhance the grassroots facilities and space controllability, equip retail industry, community clinics, sports parks, logistics industry and so on to satisfy residents' daily needs, so as to truly implement social distancing. At the level of residential community, it is necessary to ensure the comfortable housing, public activities spaces [14], and also reserve a certain number of temporary entrances, exits and land for emergency facilities. At the residential unit level, it is indispensable to improve the accessibility design of buildings and reduce the use of enclosed spaces such as elevators.

4.4 Social value – health in all policies

The essence of urban public health is to safeguard citizens' health. In 2013, World Health Organization proposed the development concept of integrating health into all policies (HiAP) based

on the principles of population health and health equity. It calls on countries to pay attention to the health impact brought by public policy-making and advocates inter-departmental cooperation to reduce health risks. Urban planning that adheres to the purpose of public health should work more with relevant departments to propose feasible prevention and control measures from the perspective of spatial planning and urban-rural governance to provide environmental well-being.

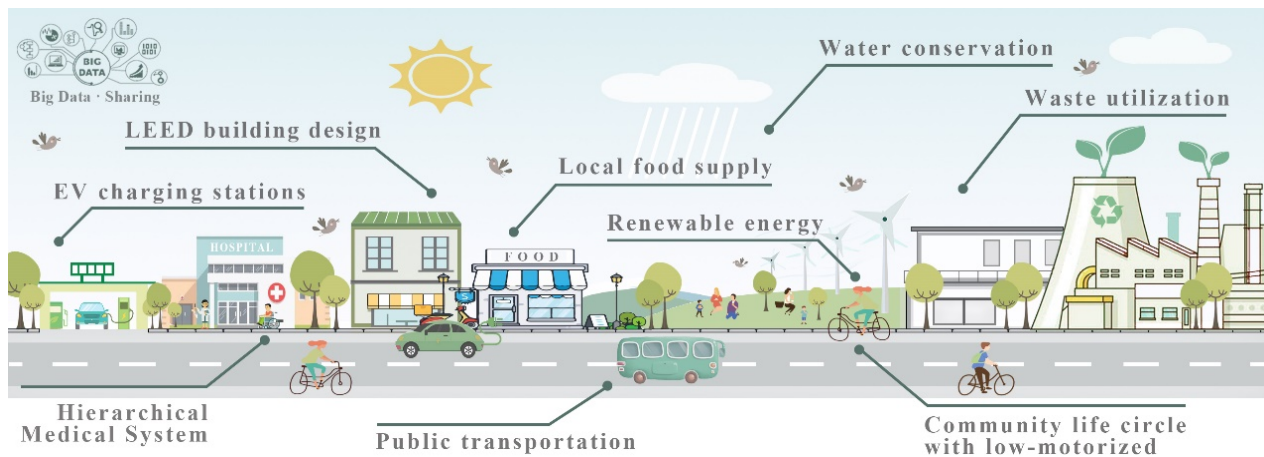


Fig. 3. City Intention of "Health in All Policies"

5. Conclusion

During the COVID-19 epidemic, no man is an island. A series of public health interventions such as lockdowns have been proven to be effective to contain the epidemic. However, in order to improve the governance and services of public health from the basis, it is still necessary to promote the public health system to work together with urban space and social value to integrate health in all policies under the framework of metropolitan compound systems.

In terms of public health, this paper believes that there is an urgent need to build the region-city-community networks to improve the epidemic prevention and control capacity. To improve public health is no longer to formulate a set of technical specifications, but to respond flexibly to different emergencies and disasters, and integrate with the big data platform to improve the grading system of security surveillance, and prevention and control cooperation.

At the urban space level, it is urgent to reorganize the fusion and blocking mode of urban space, explore the joint prevention and control mechanisms of city clusters supported by the prevention potential of surrounding cities, towns and villages that can effectively respond to emergencies. This study believes that an independent epidemic prevention system is the cornerstone of urban epidemic prevention. Resilience and redundant space can effectively improve cities' responses to emergencies. Planning and design guidelines and regulations will truly improve the ecological living environment.

In terms of social value, a joint force should be formed to provide environmental well-being for public health. Health is not just a problem of individuals, a community or a city. Only when the entire society establishes united health values and forms a joint force by policies can individual and group health be safeguarded to the greatest extent.

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References

[1] Kraemer M U G, Yang C H, Gutierrez B et al. 2020. The effect of human mobility and control measures on the COVID-19 epidemic in China. *Science*, doi:10.1126/science.abb4218.

- [2] Tian Huaiyu, Liu Yonghong, Li Yidan et al. 2020. An investigation of transmission control measures during the first 50 days of the COVID-19 epidemic in China. *Science*, doi:10.1126/science.abb6105.
- [3] Li Yu. 2016. Urban Space Susceptibility Theory. *Chinese Architecture & Building Press*.
- [4] Ding Lei, Cai Wei, Ding Janqing. Et al. 2020. An interim review of lessons from the Novel Coronavirus (SARS-CoV-2) outbreak in China. *Scientia Sinica Vitae*, Vol. 50, No. 3.
- [5] Chen Yiyong, Liu Xiaoping, GAO Wenxiu Et Al. 2018. Emerging social media data on measuring urban park use. *Urban Forestry & Urban Greening*, doi:10.1016/j.ufug.2018.02.005.
- [6] World Health Organization, Coronavirus Disease 2019 (COVID-19) Situation Report – 76 (WHO, 2020)
- [7] Bhatt S, Gething P W, Brady O J, et al. 2013. The global distribution and burden of dengue. *Nature*, doi: 10.1038/nature12060.
- [8] Lai Shengjie, Ruktanonchai N W, Zhou Liangcai et al. 2020. Effect of non-pharmaceutical interventions to contain COVID-19 in China. *Nature*, doi: 10.1038/s41586-020-2293-x.
- [9] Kissler SM, Tedijanto C, Goldstein E et al. 2020. Projecting the transmission dynamics of SARS-CoV-2 through the post-pandemic period. *Science*, doi:10.1126/science.abb5793.
- [10] Zhou Chenghu, Pei Tao, Du Yunyan et al. 2020. Big Data Analysis on COVID-19 Epidemic and Suggestions on Regional Prevention and Control Policy. *Bulletin of Chinese Academy of Sciences*, Vol. 35, No. 2.
- [11] Kassam-Adams N, Kenardy J A, Delahanty D L et al. 2020. Development of an international data repository and research resource: the prospective studies of Acute Child Trauma and Recovery (PACT/R) Data Archive. *European Journal of Psychotraumatology*.
- [12] Dong Quanlin. 2012. Construction Conceive of Disease Prevention and Control System in Wuhan City Circle. *Chinese Journal of Social Medicine*, Vol. 29, No. 4.
- [13] Huang Qiqi. 2020. Inspirations of the Wuhan lockdown on global urban public health under the outbreak of COVID-19 epidemic. *Sustainable Development*, Vol. 10, No. 3.
- [14] Chen Yiyong, Liu Tao. 2016. Exploring the factors that attract people to visit public spaces of communities. *Architectural Journal*, 2016(2).