

Precise Community-Based Public Health Management: Crucial Experience Responding to COVID-19 in Wuhan, China

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Introduction: Facing a grim public challenge caused by COVID-19, many countries decide to live with it for a long time, whereas China continues to enforce precise community-based public health management. This paper summarized China's approaches and aimed to provide illumination for health services decision-makers.

Methods: We systematically reviewed the construction of precise community-based public health management from three aspects: organizational structure, service content, and flexible adjustment, and summed up four essential elements for success. Then, we selected 9 typical countries to compare their non-pharmaceutical strategies and daily new cases.

Results: China's community-based public health management has a clear four-level organizational structure. It has worked on infection control, surveillance for new cases, management of contacts, health education, medicare service, outdoor environment disinfection, and living material supply in different stages, and the daily new confirmed cases in Wuhan sustainedly declined to zero. The outbreak was relatively well contained in China, Italy, and Germany as of June 2020, as they adopted stricter movement restrictions, social distance, and patient tracking.

Conclusion: China's experience has proved the feasibility of non-pharmaceutical strategies responding to COVID-19. The precise community-based public health management strategy can be considered, as it's pretty much the same as public health and social measures (PHSMs) advocated by WHO.

Keywords: COVID-19, public health management, community, pandemic response

Introduction

As an emerging infectious disease, coronavirus disease 2019 (COVID-19) has posed catastrophic risks for both life health and social stability. In particular, comeback waves of the pandemic as well as a higher risk of hospital admission,¹ more severe health consequences (stomach pain, nausea, vomiting, loss of appetite, hearing loss, and joint pain),² not fully covered vaccinated, clusters transmission changed to community transmission, sustained influence by Delta variant,³ and more contagious of Omicron variant, have once again become a front-page issue worldwide. Facing the situation, many countries believe that the SARS-CoV-2 virus will not be eradicated but endemic, and decide to live with it for a long time.

However, in China, precise community-based public health management is continued to be enforced, together with the dynamic zero-case policy. Different from global tense epidemic situations, China's overall epidemic remains stable and under control, while national production and life are going smoothly. Some of the Internet speeches said that China is one of the safest countries under the COVID-19 storm, and The World Health Organization (WHO) even commended China's implements in response to the outbreak. Against the resurgence of the pandemic around the world as well as the

decreased protective efficacy of vaccines, approaches used in different countries are depending on governmental organization on territory and on a balance between the need to contain COVID-19 and the limits imposed by constitutional rights, so it's difficult to assess what is right and what is wrong. However, we thought that the summary of Chinese experiences in constructing community-based public health is necessary, and it might at least provide illumination for health services decision-makers to deal with future COVID-19 outbreaks.

The Construction of Community-Based Public Health

Community (the equivalent of a village in rural areas) is the basic unit of modern Chinese administration, and it is closely related to every aspect of people's life. To make better advantages in life guaranteeing, health serving, science educating, society managing, and public participating, China proposed community-based public health management responding for COVID-19 epidemic.

As an important control measure and a solid foundation of medical assistance after Wuhan lockdown, the construction of community-based public health fulfilled several key principles and supportive conditions. There are three dimensions to this, involving a clear and accurate personnel organization structure, a comprehensive and scientific service content, and a well-regulated and flexible adjustment, which are detailed below.

Organizational Structure

As mentioned before, the public health management was mainly conducted on the level of basic community (or village in rural areas), and it was pushed forward by local government and municipal Centers for Diseases Control and Prevention (CDC). Specifically, the multi-sectoral cooperation and involvement of the whole society were established — regional CDCs and community health centers were embraced to contact tracking, to find infected cases, as well as to provide basic medical services; community administrators, property managers of residence, party members, cadres, community policemen, and volunteers participated in providing sufficient supplies like food, medicine, masks, and disinfectant. (See details

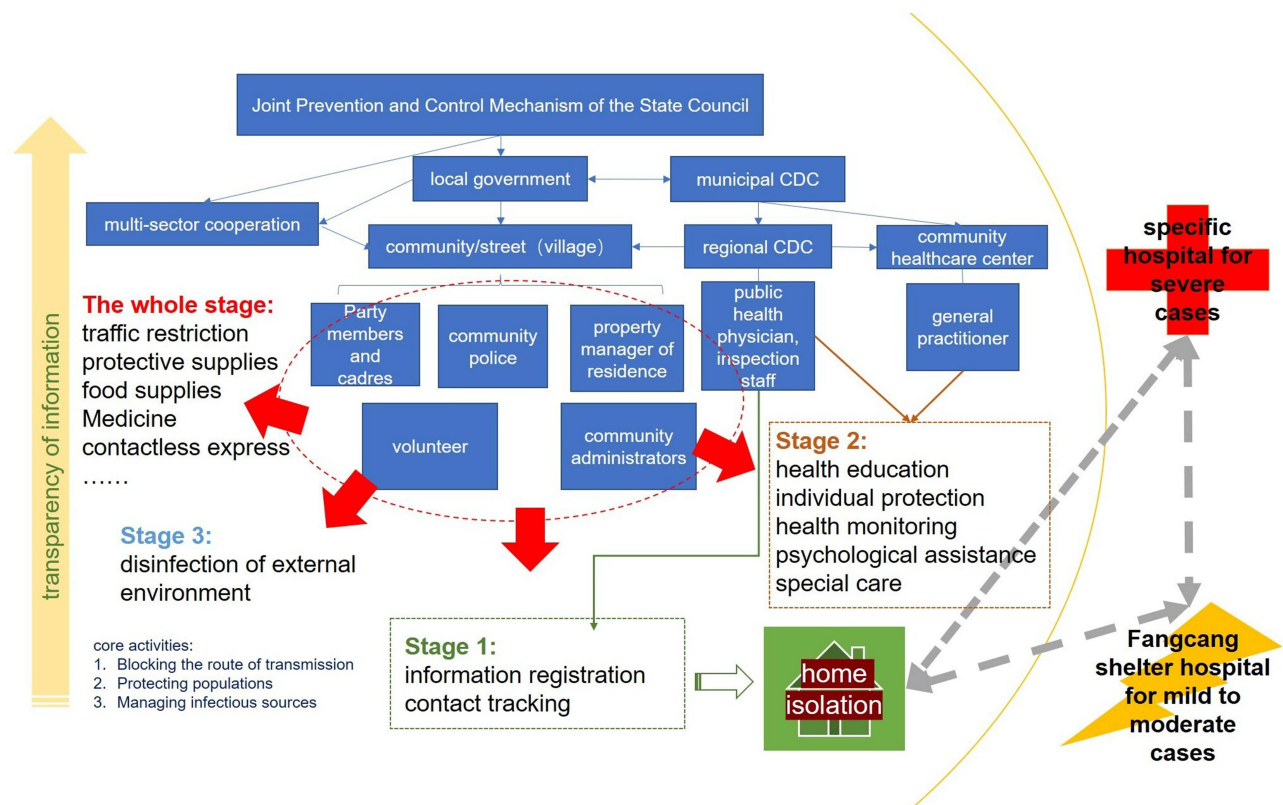


Figure 1 Organizational structure and service content of community-based public health management.

in Figure 1) To better coordinate COVID-19 epidemic control, the Joint Prevention and Control Mechanism of the State Council was also established to guide government sectors. Through such a four-level organizational structure, infection transmission was fully interrupted while family life was minimally affected in China.

Service Content

The service contents and core activities focused on the reservoir of infection, route of transmission, and susceptibility of the population. As a result, the top priority was to find out confirmed or suspected patients and their close contacts.

In the first stage, a three-day investigation and information registration combined with dynamic spatiotemporal data were launched to track potentially infected cases and separate them from healthy people. Every severe case showed positive nucleic acid would be arranged to designated hospitals (including specialized and general hospitals) for medical treatment and isolation, while the cases with mild or moderate symptoms were in Fangcang shelter hospitals.^{4,5} Those uninfected close contacts and their family members were under a 14-day medical observation separately in their home. Dynamic information reporting to local district CDC and corresponding measures taking are supposed, once they were tested positive or developed any uncomfortable symptom.

A series of measures that included health education and social mobilization was taken to protect the susceptible populations in the second stage. The service aimed to enhance public hygiene consciousness and develop healthy habits like frequent hand-washing, mask-wearing, proper social distance, and regular temperature monitoring.

The achievable goal in the third stage was to reduce harm from external environments. All residents were advocated to clean and sterilize inner living spaces by themselves, and the public places and external environments were regularly disinfected by health authorities.

Based on consolidation and collaboration among departments, relatively sufficient food supplies, living materials, epidemic preventions, and medical appliances enclined every community or village at all stages. Residents could take the form of “online ordering + offline delivery” or “specific-site procurement” to satisfy their daily life, and sometimes they would even receive donations filled with vegetables, masks, and disinfectants for free.

Flexible Adjustment

As seen in Figure 2, interventions of the epidemic in Wuhan experienced 5 periods since a first case was found. On February 11, Wuhan Headquarter of COVID-19 Prevention and Control released a NO.12 document on the closure of

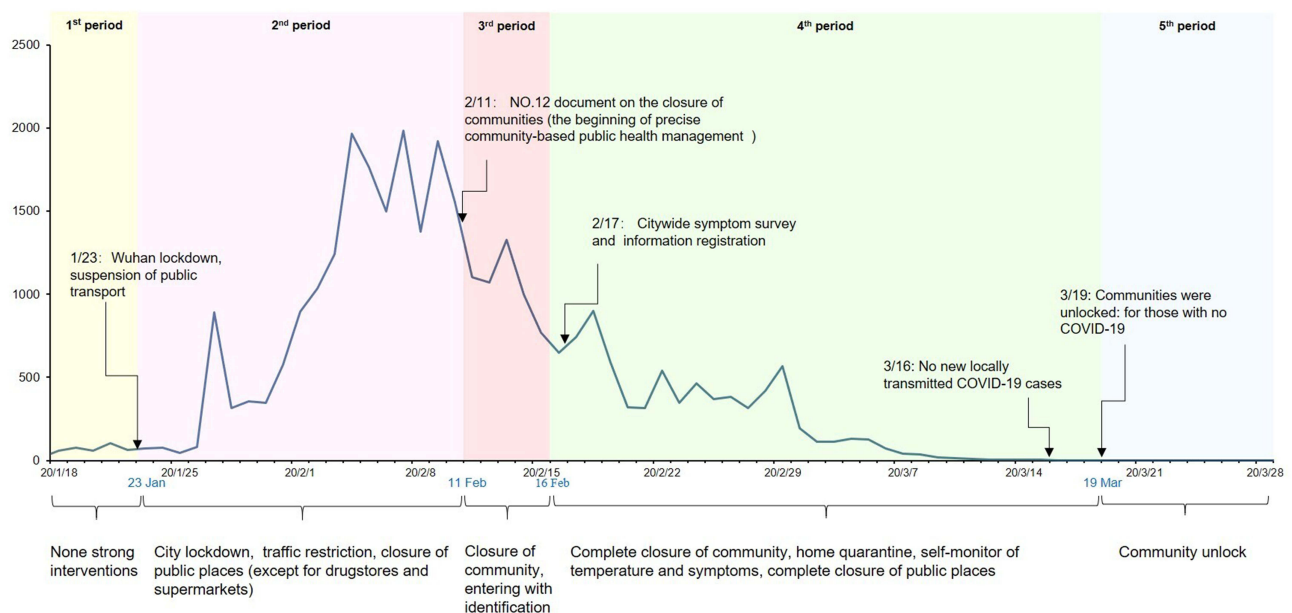


Figure 2 Daily new cases across different periods in Wuhan.

communities, beginning the precise community-based public health management. Between February 11 and 16, one resident per household could go in and out of the community with an entrance permit to purchase food and medicine, and all residents were asked to stay at home since a complete closure of the community was launched on February 17.

According to “COVID-19 Prevention and Control Plan (7th Edition)”, a high-risk area corresponds to a situation with more than 50 cumulative confirmed COVID-19 in the preceding 14 days, a moderate risk area represents a situation with no more than 50 cases or a situation with no occurrence of cluster transmission even exceeding 50 cases in the preceding 14 days, and a low-risk area is a situation with no confirmed or new cases in the preceding 14 consecutive days. Based on it, each community (village) adjusted the risk level of the epidemic flexibly and updated it on time. The risk level would directly influence managerial degrees and the unlock time for each community.

The Essentials of Community-Based Public Health

Chinese community-based public health management has four essential elements that make it well suited for responding to COVID-19 epidemics.

It Grasps Chinese Administration Characteristics and Makes Full Use of Them

Because communities are critical places to implement population-wide health services and education, stay-at-home orders coupled with prompt material supply make it acceptable, thus helping to cut off transmission chains, avoiding cluster infections, and saving medical resources. As shown in [Figure 2](#), the daily new confirmed cases in Wuhan sustainably declined since the precise community-based public health management was conducted.

The Degree of Measures Was Adjusted to Reality

Despite being under closed management, more strict control measures would be conducted if some of them were labeled with a higher risk level with close contacts of confirmed patients, suspected patients, or fever cases of unknown origin in it. Once the risk level changed, the strategy of prevention and control accordingly changed.

It Emphasizes Government Affairs Transparency and Privacy Protection

The number of newly diagnosed and suspected cases would be published timely, and the risk level of communities would be updated dynamically. To ensure people’s privacy, the information would not extend to specifying personal names and residential addresses.

Big Data

The big data concerning personal spatiotemporal mobility played a decisive role in community-based public health management, as it acquired the information on transport, railways, airways, and highways to quickly trace infected cases and their close contacts.

COVID-19 Non-Pharmaceutical Strategies Comparison

Due to different levels of public health service, national economic development, and social acceptance, governments around the world rolled out different non-pharmaceutical strategies before a mass vaccination campaign. We selected 9 typical countries to compare their non-pharmaceutical strategies before July 2020, and divided the strategies into five categories. They included movement limits (like lockdown, curfew, and roadblock), physical and social distancing (like stay-at-home order, home isolation, no gathering), patients tracking (like tracking confirmed patients, suspected patients, and close contacts), similar patterns of Fangcang shelter hospital (triage patients according to the severity), and big data (tracking technology).

As shown in [Table 1](#) and [Figure 3A](#), stricter movement limits were launched in China (city lockdown in January), Italy (national stay-at-home order on March 9), and Germany (national stay-at-home order on March 20), while tracking patients and keeping social distance were simultaneously conducted. We call this pattern “movement restriction + social distance + patient tracking”. With the help of it, China’s epidemic was completely controlled in March, meanwhile, the daily new occurrence in Italy and Germany was controlled at a low level by end of May.

Table 1 Comparison of Non-Pharmaceutical Strategies Against COVID-19 in 2020

County	Movement Limits	Physical and Social Distancing	Patient Tracking	Similar Patterns of Fangcang Shelter Hospital	Big Data	Effect
China	✓	✓	✓	✓	✓	Controlled
Germany	✓	✓	✓	✓	×	Occurred at a low level
Italy	✓	✓	✓	✓	×	Occurred at a low level
Japan	×	×	✓	✓	×	Basic controlled (before July 2020). A new round started.
South Korea	×	×	✓	✓	✓	Basic controlled (before April 2020). A new round started.
Singapore	×	×	✓	✓	✓	Controlled
The United Kingdom	✓	✓	×	✓	×	Confirmed cases were stable (before September 2020). A new round started.
Sweden	×	×	×	✓	×	Upward trend
United States of America	×	✓	✓	✓	✓	One of the severely affected countries

Countries involving Japan, South Korea, and Singapore adopted the pattern “almost no movement restriction + social distance + patient tracking” in responding to COVID-19. Illustrated in Figure 3B, physical and social distance (February 29) and patient tracking (March 9) were strictly conducted in South Korea, however, working at home (March 12) was a mere recommendation rather than a legally mandatory restriction. Japan did the same work since February 25. Singapore additionally promulgated national stay-at-home order on April 7. Finally, the epidemic in South Korea and Japan was controlled basically in April and June separately, while it was controlled in Singapore.

By contrast, the epidemic situation was not optimistic in the UK, Sweden, and the USA. Facing the pandemic, UK and Sweden adopted the pattern “inactive movement restriction + inactive social distance + patient tracking”. Outlined in Figure 3C and Table 1, UK and Sweden tracked patients at an earlier time (the UK on March 17 and Sweden on March 16). The UK recommended working at home on March 20, and then promulgated national stay-at-home order on March 26. The

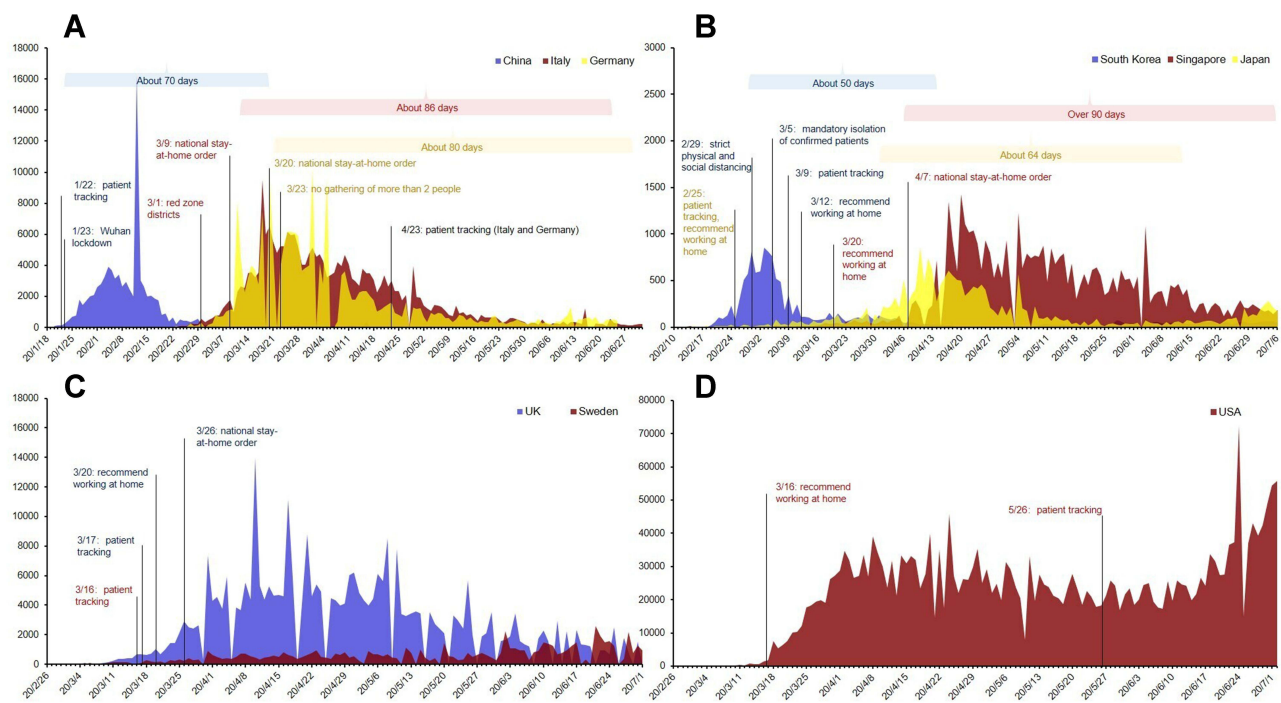


Figure 3 Daily new confirmed cases with different non-pharmaceutical strategies. (A) Daily new cases in “movement restriction + social distance + patient tracking” pattern. (B) Daily new cases in “almost no movement restriction + social distance + patient tracking” pattern. (C) Daily new cases in “inactive movement restriction + inactive social distance + patient tracking” pattern. (D) Daily new cases in “almost no movement restriction + inactive social distance + inactive patient tracking” pattern.

USA government adopted an “almost no movement restriction + inactive social distance + inactive patient tracking” pattern to deal with the pandemic and started patient tracking on May 26 (See details in [Figure 3D](#) and [Table 1](#)).

Discussion

It was the first time for Wuhan to implement such a draconian lockdown with precise community-based public health management to block SARS-CoV-2 transmission. The strict measures not only delayed the peak and reduced the final size of the epidemic in Wuhan,⁶ but also delayed the arrival in other cities by 2.91 days in China.⁷ These strict prevention and control measures have also greatly interrupted COVID-19 spreading globally,⁸ decreasing international imported cases by nearly 80% until mid-February 2020.⁹

Nonetheless, at least for a counter-argument, some research thought Wuhan lockdown possibly created health inequities, overwhelmed the healthcare system, and worsened the outbreaks.¹⁰ Blockade strategy was not the first in history, as John Snow set a good example of shutting down street water pumps to block the outbreak of Cholera in 1854.¹¹ On the contrary, Surat's miserable epidemic of pneumonic plague in 1994 was mainly ascribed to the lack of any restriction on people's movement.¹² It's noteworthy that all of China's strategies are essentially for infectious sources, transmission routes, and population susceptibility to eliminate public health hazards, more than the external representation of traffic barring. Since Wuhan firstly introduced precise community-based public health management on February 11, the daily new increasing curve and the estimates of the effective reproduction number (R_t) sharply declined to zero.¹³

No matter how the virus mutates, non-pharmaceutical strategies, including maintaining social distance, wearing masks, and washing hands, would still be the most critical and effective against all emerging variants. WHO advised strengthening public healthcare capacity¹⁴ and advocating public health and social measures (PHSMs) to mitigate the overwhelming medical burden brought by the SARS-CoV-2 virus.¹⁵ It pointed out that PHSMs could be implemented by the lowest administrative level from the aspects including personal protective measures, environmental measures, surveillance and response measures, physical distancing measures, and international travel-related measures. All of these are much pretty the same as precise community-based public health management —what has been done in China. China's current COVID-19 management strategy, characterized by prompt response to tackle new outbreaks and cut off the transmission, has been successfully applied in localized outbreaks in Beijing, the northeastern region, Guangzhou, Shanghai, Zhengzhou, Shenzhen, etc. In terms of the cost-effectiveness of COVID-19 prevention and control, early and strict lockdown prevented infection spreading, whereas long-term public health management is conducive to stabilizing the society and consolidating the achievements. By the most conservative estimates, the strategy has averted 47.8 million infections and 950,000 deaths in China.¹⁶ Therefore, it might be more suited for a continuous race with COVID-19, as it performed well at balancing society, economy, and life health.

Precise community-based public health management could be applied in conjunction with containment, suppression, and mitigation strategies according to the actual conditions. Among the three strategies have so far utilized, Wuhan used containment and suppression together in the early and ongoing community transmission stage,¹⁷ namely the city lockdown and community-based public health management; whereas in the case of Guangzhou, partial communities were managed in a semi-closed state and residents were asked to stay at home or not according to the risk level. From specific operation processes, basic communities should be given recognized roles to implement population-wide PHSMs and contribute to the mitigation of the social and economic impact of certain measures, as said by WHO.¹⁵ For example, once occurred COVID-19 epidemic in China, several rounds of citywide nucleic acid testing were conducted on the level of community-based and family-based networks. High-tech facilities like big data and artificial intelligence were additionally introduced to identify those who have been to medium-risk areas and become close contacts of confirmed cases.¹⁸ The feasibility of community-based public health management implemented in other countries needs more practice, but we thought communities might at least be a good alternative of generalizing compulsory use of masks whether coexisting with the virus or declaring free of it.¹⁹

Conclusion

Precise community-based public health management is a crucial experience in China, which flattened the COVID-19 curve successfully. Because it was similar to PHSMs advocated by WHO, we summarized the approaches and intended to provide illumination for health services decision-makers in other countries.

Data Sharing Statement

The datasets generated for this research are available on request to the corresponding author.

Ethics Statement

This study did not require ethics approval, as it does not involve human and animal participants.

Author Contributions

All authors made a significant contribution to the work reported, whether that is in the conception, study design, execution, acquisition of data, analysis and interpretation, or in all these areas; took part in drafting, revising or critically reviewing the article; gave final approval of the version to be published; have agreed on the journal to which the article has been submitted; and agree to be accountable for all aspects of the work.

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Disclosure

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