CPAR Chinese Public Administration Review
Volume 12 Issue 1, June 2021

Smart Urban Governance in Epidemic Control: Practices and Implications of Hangzhou

Wanxia Zhao*, Yonghua Zou†
* East China University of Political Science and Law, China
† Zhejiang University, China

Appropriate governance tools can facilitate urban governments' effective responses to crises. Supported by information and communication technologies (ICTs), e-government infrastructure can be employed to achieve smart governance in epidemic control. Examining the case of Hangzhou, this paper discusses the Chinese megacity's adoption of e-government infrastructure as a means of combating the COVID-19 epidemic and stimulating recovering of the economy. This paper also summarizes several policy implications that may serve as points of reference for other cities when formulating their crisis response strategies. The paper concludes that smart governance rooted in the use of e-government infrastructure has exhibited great potential for public health crisis management.

Keywords: e-government; crisis management; smart governance; epidemic control; COVID-19

INTRODUCTION

The outbreak of infectious disease and the epidemic potential present severe challenges for urban governance (Comfort, 2006; Campanella, 2006). Infectious diseases are characterized by rapid spread, long periods of incubation, and wide-ranging influence. Because they are constrained by information lag, traditional technologies are often difficult to employ in efforts aimed at controlling epidemics in cities. In response to this challenge, urban governments are increasingly employing information and communication technologies (ICTs) to enable smart governance in the prevention and control of epidemics.

When the COVID-19 epidemic broke out in early 2020, the Chinese government took many extreme measures to control the spread of the epidemic, including quarantining the more than 50 million residents of Hubei province. However, the coronavirus was still able to spread to China's major cities. COVID-19 is a highly contagious infectious disease, which can be transmitted between humans even before the infected individuals show symptoms. These factors make it more difficult to control epidemics in the high-density and high-mobility urban settings. Some urban governments have adopted many "low-tech" measures. For example, some governments have placed obstacles on roads to bar strangers from entering their jurisdictions, and some have organized people to monitor potentially infected persons and to even secure the doors to their homes. These extreme measures, however, can result in many social conflicts. Besides, these measures require the government to invest considerable manpower, and frequent physical contact among individuals will further increase the risk of cross-infection. Worse still, the lagging, inaccurate, or incomplete information collected via traditional methods is not sufficient to properly guide the government's intervention. In contrast, some local governments have mobilized ICT-based e-government infrastructure to implement smart governance aimed at epidemic detection, prevention, and control in a more expeditious way and at a lower cost.

Based on the case of Hangzhou, China, this paper examines the Chinese megacity's deployment of e-government infrastructure to achieve smart governance in epidemic control. Here, smart

Address correspondence to Yonghua Zou at yonghuazou@foxmail.com. View this article at cpar.net

governance refers to a government's ability to apply ICTs and intelligent activities in processing information and making decisions aiming at achieving better governance outcomes (Scholl & Alawadhi, 2016). As an innovative form of the production and delivery of government services through ICT-based applications (Ho, 2002), e-government can serve as an important infrastructure to deliver information and integrated services to citizens. E-government is regarded as infrastructure because it provides the basic systems and services for improving the efficiency of government operation in the information era. The e-government infrastructure includes a variety of facilities (such as computers, sensors, Internet of Things, 5G network, etc.), technical expertise (such as algorithms, computing power, etc.), and information platforms (such as management systems, databases, etc.). As a critical kind of public service, crisis management can benefit from the e-government infrastructure in numerous ways, including sharing information, developing governance tools, coordinating various stakeholders, and forming collective actions. Facilitated by e-government infrastructure, the government can partner with other stakeholders to respond to crises more effectively and result in better outcomes (Meijer, 2016).

The paper is structured as follows. The second section provides a brief review regarding the facilitation of e-government for crisis management. The third section suggests how e-government infrastructure may be applied in various scenarios associated with epidemic control. The fourth section examines Hangzhou's use of smart governance in epidemic control and economic recovery. The fifth section provides policy implications and a conclusion. This paper can serve to advance our understanding of how e-government infrastructure can be utilized to manage public health crises and to achieve smart urban governance.

E-GOVERNMENT FACILITATES CRISIS MANAGEMENT: A BRIEF REVIEW

With the rapid development of ICTs, an increasing number of governments have employed e-government as an administrative reform strategy. Since its emergence in the 1990s, e-government has undergone several stages of evolution that reflect technological sophistication and interaction with users – from one-way communication (simple information dissemination) to two-way communication (request and response), and then to the integrated government services for efficiency, effectiveness, and user-friendliness (Moon, 2002; Smith & Teicher, 2006). E-government is expected to improve administrative efficiency, promote public participation, and establish a citizen-centered government function (Ayanso et al., 2011; Khan & Park, 2013).

Supported by ICTs, e-government has become critical to governments reinventing themselves, as it has changed the content and functions of government institutions and their interactions with other stakeholders (Ho, 2002). Because e-government allows citizens to access information through efficient processes, it not only enhances the quality of public service delivery, but it also enhances democracy by allowing more direct citizen participation (Ahn & Bretschneider, 2011; Pereira et al., 2018; Ho, 2002). This perspective suggests that e-government has brought more than a technological breakthrough in public service delivery; it has also has promoted a shift in philosophy regarding governance and in how governments operate (Dunleavy et al., 2006. Twizeyimana & Andersson. 2019; Ho, 2002).

E-government has been adopted in numerous functional areas, including crisis management. Researchers have demonstrated that e-government has great potential in managing various types of crises more quickly, with wider participation, and at a lower cost (Janssen & Estevez, 2013). First, e-government infrastructure is capable of providing common platforms for the development of crisis management tools due to its extensive databases and its ability to gather real-time data from a variety of sources. Considering that crises are most often uncertain and unique (Oscarsson & Danielsson, 2018), e-government infrastructure enables governments to adapt to evolving conditions and thus to deliver new functionalities to address the specific needs of specific crises at various stages (Devadoss & Pan, 2004). Additionally, e-government

infrastructure can provide relevant agencies with a collaborative system that permits them to exchange information quickly and efficiently, which is highly critical to crisis management (Turoff, 2002). Through utilizing the advantages of various advanced technologies to share information and form collective actions, e-government infrastructure facilitates the ability of the government to develop smart governance arrangements that can result in a more effective crisis management process and better outcomes (Scholl & Alawadhi, 2016; Meijer, 2016).

There has been considerable literature regarding how local governments at various levels employ e-government to facilitate daily administration and provide more integrated service to citizens (Ho, 2002; Moon, 2002), but research regarding how e-government is used for crisis management, especially epidemic control, remains limited thus far. An example is found in Devadoss and Pan (2004), who discuss how Singapore employed its e-government infrastructure to manage the SARS crisis in 2003, focusing on the systems of information dissemination and contact tracing. Considering that seventeen years have passed since the SARS outbreak, it is necessary to examine the new potential of e-government in crisis management in the context of new technological developments. As such, this paper attempts to narrow the literature gap between e-government and crisis management through analysis of the latest practice of the city of Hangzhou in employing e-government to cope with the COVID-19 pandemic.

SMART GOVERNANCE IN EPIDEMIC CONTROL: ICT USAGE SCENARIOS

The core idea behind smart urban governance lies in the notion that stakeholders can take advantage of ICTs embedded in the e-government infrastructure to solve urban problems and realize value for society (Zook, 2017). Smart governance is achieved through stakeholders' collaboration around the ICT applications, which can be used in numerous scenarios related to epidemic control and can facilitate a government's dynamic interventions within the complex urban environment (Massaro et al., 2019; Glasmeier & Christopherson, 2015).

Information Collection, Sharing, and Dissemination

Real-time and accurate information is critical to the improved efficacy and efficiency of emergency response tasks. In the governance of epidemic control, stakeholders need continuous access to all manner of information so that they can appropriately plan, make decisions, and allocate resources (Drapalova & Wegrich, 2020) Furthermore, information sharing and dissemination are important for stakeholders' collaborative efforts in the preparation, response, and recovery stages of epidemic control (Gao et al., 2008). To meet this demand, it is necessary to use ICTs embedded in e-government to handle information in a systematic, collaborative manner (Meijer & Thaens, 2018).

Modern ICTs have shown great potential in the collection, sharing, and dissemination of epidemic-related information. For instance, as the spread of disease is strongly associated with spatial factors, the government and public need to identify which areas are at higher risk of the spread of contagion. This can be achieved via the Web-based GIS, which can provide a real-time and dynamic way to represent epidemic information on maps (Gao et al., 2008). Furthermore, considering that infectious diseases are related to human mobility, mobile phone data, and other sources of big data can be used to trace an epidemic spread pattern. The information associated with disease outbreak can both suggest useful recommendations to officials and inform the public such that people are more alert and less panicked.

Surveillance and Diagnosis

If an outbreak occurs, effective surveillance serves as a means by which stakeholders can respond quickly to threats, which in turn enables greater prevention of the spread of disease (Massaro et al., 2019). For instance, it is mandated that people suspected of being infected with COVID-19 must be quarantined for 14 days in a quarantine area or at home. ICTs can continuously surveil those people's activities and health conditions. They can also track the infected person's travel

trajectory and identify the people with whom the infected person may have been in contact (Heymann, 2020). ICTs also effectively reduce labor costs and human-to-human contact in epidemic control; for instance, an infrared thermometer mounted on a drone and robots can be used to check body temperature and to allow for food delivery to quarantine areas, which reduce non-infected individuals' exposure to environments likely to be infected.

ICTs can also play a role in medical diagnosis and psychological counseling. For example, many people have symptoms, such as fever and cough, but they are not necessarily infected with coronavirus. If those people all flock to the hospital at once, they could exhaust the hospital's available medical resources and may cause cross-infection. An online diagnostic system capable of determining whether the patient should go to the hospital for further treatment could help to prevent such a situation.

Risk Assessment and Trend Prediction

ICTs have great potential in epidemiological risk assessment and trend prediction (Massaro et al., 2019). For instance, the government can assess the risks associated with various types of gatherings, which can then permit it to arrange for appropriate medical resources to ensure the potential risks can be managed in the best possible way (Heymann, 2020). Analysis and modeling based on big data and artificial intelligence can also predict epidemic development trends. For example, considering that there is significant population flow between cities, the government can use big data stemming from ticket purchases and mobile payments to predict where people will flow to and from and where they will gather, which would, in turn, enable the government to predict where epidemic outbreaks are most likely to occur (Massaro et al., 2019). Risk assessment and trend prediction can provide real-time guidance for the future direction of public intervention.

THE PRACTICE OF HANGZHOU

Hangzhou and Its Achievements in Managing the COVID-19 Crisis

Hangzhou, the capital city of Zhejiang Province in southeast China, is a megacity with a population of 10.36 million people. Over the past few decades, Hangzhou has experienced the rapid growth of the Internet industry, earning a reputation as "China's E-business Capital" and spawning a host of high-tech enterprises, including Internet giant Alibaba. The boom in the digital economy and emerging industries has made Hangzhou a magnet for migrants – in 2019, Hangzhou had a net population inflow of 554,000 (Zhejiang Bureau of Statistics, 2020), ranking first among China's megacities.

As a megacity with high population mobility, Hangzhou has achieved outstanding records in managing the COVID-19 crisis, which is reflected in the low infection rate and rapid economic recovery. First, Hangzhou successfully controlled the epidemic within a short period and maintained a very low infection rate and zero mortality rate. In Hangzhou, the first COVID-19 case was reported on January 19, 2020, that is, four days before Wuhan was locked down. As of the writing of this paper, the latest local case (except for imported cases) was reported on February 29, meaning that Hangzhou successfully contained the virus in about one month. During this period, Hangzhou reported 187 domestic cases in total (Hangzhou Health Commission, 2020). It means that its infection rate is only 1.8/100,000, one of the lowest among major Chinese cities. Most of these cases were related to Hubei province, suggesting that COVID-19 did not spread on a large scale in Hangzhou. Even more impressive is that Hangzhou's COVID-19 mortality rate is zero (Hangzhou Health Commission, 2020), the best record among the megacities of China. Second, during the outbreak. Hangzhou quickly achieved economic recovery and social normalization. This is reflected in the city's economic recovery level – in the first quarter of 2020 when the epidemic was at its worst, Hangzhou's GDP still reached a nominal growth rate of 4.61% (Hangzhou Bureau of Statistics, 2020), ranking second among the top ten cities with the strongest economies nationwide. Hangzhou is a city that worked early on to seek a balance between epidemic control and social functioning (Cheng et al., 2020). When the epidemic was most severe, residents

were still able to rely on the innovative health code (to be discussed in Section 4.3) to maintain urban mobility, which effectively decreased social conflicts.

Hangzhou's achievements can be attributed to the city's ICT-based governance tools supported by the e-government infrastructure. In recent years, to realize its pursuit of becoming "the Leading City of China's Digital Economy," the Hangzhou municipality has heavily invested in e-government infrastructure, including the city-wide digital governance platform that can provide databases, computing power, and algorithms for various domains of urban affairs. Hangzhou utilized its epidemic management system to effectively control the epidemic and invented a series of governance instruments such as health codes to promote economic recovery. Both the epidemic management system and the health codes are developed based on the city's digital governance platform.

In China, numerous other cities have adopted Hangzhou's practices that led to the successful mobilization of its e-government infrastructure to combat COVID-19, and the central government has implemented some of these practices throughout the country. This perspective suggests that Hangzhou is a suitable case via which to examine how e-government infrastructure can be applied to public health crisis management. In this case study, we focus on Hangzhou's practices aimed at addressing two severe challenges: epidemic control and economic recovery.

Epidemic Control

Before the government officially announced the epidemic on January 23, 2020, tens of thousands of Hubei people, many who were potentially infected, had flowed into Hangzhou. In response to this crisis, Hangzhou has taken full advantage of its strong digital infrastructure. On January 26, 2020, the local government and Alibaba jointly developed the country's first Public Service and Management Platform (PSMP) for the prevention and control of the COVID-19 epidemic. With the city's e-government infrastructure and Alibaba's technical supports, this platform was completed in just one day. PSMP serves various functions, such as information collection, resource optimization, surveillance, and diagnosis.

Real-time collection, reporting, analysis of information is a prerequisite for the prevention of an epidemic outbreak in a city. In the early stage of an outbreak, the government urgently needs access to a plethora of detailed and complex information such as potential patients' locations and trajectories, and data regarding whom the potential patients might have contacted or will contact as well as other clues. A total of 9,810 close contacts had been traced in the city by June 24, 2020 (Hangzhou Health Commission, 2020). Furthermore, a primary advantage of PSMP is that it can collect and report multi-channel information in real-time, which can avoid information lag and distortion resulted from the traditional reporting methods. Also, PSMP can optimize the distribution of medical supplies. For instance, an online mask reservation system can allow for the distribution of masks to those who need them most, and this ensures that resources are distributed fairly.

PSMP also improves the efficiency of surveillance and diagnosis. The surveillance regarding home quarantines is usually a labor-intensive task. In Hangzhou, for example, up to tens of thousands of people per day were quarantined at home. If traditional methods of surveillance are employed, a large number of workers will be required, which could lead to cross-infection. Through PSMP, quarantined people can report their health status, and this has greatly minimized the physical contact between the quarantined individuals and the health workers. This platform also permits the public to check to see whether they have come into contact with patients based on their travel trajectories. In addition, the public can consult with doctors and psychologists online to receive early diagnosis and guidance. In short, PSMP has facilitated the formation and implementation of reasonable intervention and stabilization of social emotion via real-time, accurate, and dynamic epidemic-related information.

Economic Recovery

Once the epidemic was better controlled, Hangzhou began focusing on economic recovery. As Hangzhou's

foreign trade economy constitutes an important part of the global production chain, resumption of production is particularly important for the city. Moreover, since COVID-19 hit the Chinese economy pretty hard, the resumption of production in other areas became important to the support of the Hubei province after it was under quarantine. Many local governments, however, have been reluctant to let business resume production due to fears that the outbreak might rebound. To quickly promote economic recovery, Hangzhou proposed a smart solution that consists of three innovative governance instruments including "a code," "a map," and "an index."

"A code" is the health code used to dynamically monitor workers' potential risks of becoming infected with the virus. Businesses have been eager for workers to return to their factories and offices since the Lunar New Year Holiday, but it remains difficult to identify the risks associated with the workers, who are from all over the country and maybe infected. A traditional health certificate, which indicates a person's health status, is paper-based, and the information on the certificate can easily become invalidated. For example, if a worker holding a paper health certificate comes into contact with an infected person, the information on the certificate will no longer be valid. Therefore, cities do not mutually recognize paper health certificates. Hangzhou addressed the problem of workers' across-jurisdiction movement with a dynamically updated health code. In an APP developed by Alibaba, a person will be given one of the three types of QR codes – red, yellow, and green codes – based on big data, which includes information about the worker's health status, the worker's place of departure, and the worker's contact with potentially infected people. The red code suggests that workers, such as those from hard-hit areas or those who have had close contact with infected people, are at the highest risk. The yellow code indicates slightly lower risk than the red code, while the green code is given to people who are not at risk of infection. People with red and yellow codes are required to be isolated from the general population for a certain number of days, while those with green codes can flow freely from one location to another. Based on the color of the health codes that are displayed via workers' cellphones, and which are updated in real-time, the government and businesses can determine whether it is appropriate for workers to return to work. This innovative instrument not only provides a flexible mechanism to generate an individual-based solution for epidemic control but also links community organizations' groundwork with governments' micro-level management (Cheng et al., 2020).

"A map" is the epidemic map used to dynamically assess each jurisdiction's epidemic risk, and in turn determine whether it is safe to resume work at businesses based on their locations. Stratified according to the assessment results, each jurisdiction is rated very high risk, high risk, secondary risk, low risk, or very low risk; these ratings are represented on the map by red, orange, yellow, blue, and green, respectively. In high-risk jurisdictions, epidemic prevention and control should continue to be the top priority; in low-risk jurisdictions, businesses are encouraged to resume work.

"An index" refers to the smart traffic patency index, which is used primarily to measure the flow of traffic within a jurisdiction. The normal operation of a business cannot be separated from the flow of labor, raw materials, and products. Due to the epidemic, many checkpoints have been set up between jurisdictions to check travelers' temperatures and other symptoms; some jurisdictions even shut down highways to bar workers from entering. Based on the smart traffic patency index, local governments can adjust the intensity of epidemic prevention and control promptly. As a result, many checkpoints along highways were closed to ensure that traffic could flow well.

Thanks to these measures and the relative guarantees they provided, Hangzhou became the city with the highest COVID-19 cure rate; it was also one of the earliest cities to successfully recover its economy. These systematic and dynamic solutions cannot be achieved without the supports of the e-government infrastructure. Hangzhou's smart governance model, which aims to reduce the spread of disease and enable economic recovery, has been adopted by many other

Chinese cities, which were quick to learn the specifics of the model.

POLICY IMPLICATIONS AND CONCLUSION

Hangzhou's practices demonstrate that e-government infrastructure can permit a city to effectively combat COVID-19. At the time of writing of this paper, the COVID-19 pandemic continues to plague the world. Given this, it is worthwhile to analyze Hangzhou's experiences and lessons learned to assess how they might apply to and benefit the world's cities. Of course, Hangzhou is subject to circumstances that make it unique and have thus lent to the city's success related to the pandemic. First, unlike those associated with many Western democratic countries, China's governments possess greater power to mobilize the resources required by the e-government infrastructure. Second, unlike the countries that prioritize individual liberty (Cheng et al., 2020), Chinese people are influenced by Confucian culture and thus tend to believe in collectivism, which facilitates case tracking and surveillance during outbreaks. Despite the political and cultural differences among countries, however, Hangzhou has had some fairly generic experiences that may prove valuable to other cities throughout the world. Neither political and ideological barriers should hinder countries' or cities' fight against the COVID-19 pandemic, as the virus is capable of spreading and posing similar challenges within the different countries, and no country can respond to such a huge crisis alone (Cheng et al., 2020; Yang, 2020). Since technology is not limited by national boundaries, different countries can adopt suitable technologies to strengthen their respective e-government infrastructure to respond to COVID-19. Per this perspective, Hangzhou's practice can yield certain policy implications, which can be used as a point of reference not only for Chinese cities but also for other countries and cities seeking to develop their crisis management strategies.

First, ICTs and data should be developed via the notion that they are part of a city's important e-government infrastructure necessary to crisis management. Hangzhou's advantage in epidemic prevention and control is largely due to its long-term investment in and maintenance of smart city facilities and data. A major e-government infrastructure in Hangzhou is the City Brain, which is one of the earliest ICT-based urban governance platforms in China. Supported by various ICTs, including 5G construction, Internet of Things, artificial intelligence, cloud computing, and other technologies, this e-government infrastructure provide a solid capacity for developing instruments for data collection, instrument development, and computing in crisis management. The e-government infrastructure provides a common platform, through which various innovative governance instruments can be developed quickly. A piece of evidence is that the development of PSMP was completed in only one day and the development of Hangzhou health code only took seven days. Without the support of the e-government infrastructure, these two critical governance instruments could not have been completed in such a short time. Besides, smart governance in epidemic control is inseparable from the extensive database provided by the e-government infrastructure and its ability to obtain real-time data from multiple channels. For instance, the City Brain of Hangzhou can collect more than 80 million pieces of data per day; this data comes from eleven government agencies, including police, transportation, tourism, health care, etc. (Hangzhou Municipality, 2019). During the epidemic control, the data collected by PSMP and the health code can link the dataset of the City Brain, which can analyze the data and feed the results back to the relevant government agencies. Therefore, if the epidemic were to take root in any of these places, the government could respond quickly and implement innovative governance strategies. In this way, the e-government infrastructure enables various agencies to work in a more coordinated manner and facilitate the development of smart governance to respond to the crisis more effectively.

Second, in addition to hardware and data, there is a need to create a favorable institutional environment in which to use e-government to control epidemics. ICTs can shape institutions by enabling them to overcome institutional inertia; however, ICTs alone cannot guarantee benefits without proper institutional safeguards (Yang, 2003; Yang, 2020). Hangzhou's

practices demonstrate that a sound institutional framework can allow e-government infrastructure to reach its full potential. Before this epidemic, Hangzhou had launched many digital governance projects, including the "visit once at most" project that aims to use ICTs to optimize efficiency among government agencies and enhance public service capabilities (Huang & Yu, 2019). Hangzhou has also established a Data Resources Administration Bureau, which aims to promote cross-departmental collaboration regarding data sharing and complex public issues solutions (Waugh & Streib, 2006; Liu & Zheng, 2015). Driven by these endeavors, an institutional environment conducive to smart governance has been formed.

Third, the government should work closely with businesses, social organizations, and residents to achieve smart governance. For instance, Hangzhou's smart governance in epidemic control would be difficult to realize without the cooperation of the local flagship company Alibaba. Alibaba is the government's partner of the Hangzhou City Brain project, as well as the main developer of PSMP and the health code. It not only provides technical supports for various smart solutions but also serves as a bridge between the government and the public via its Alipay, which most Hangzhou residents use. Other private businesses and social organizations have also participated in smart governance throughout the outbreak. For instance, many e-commerce businesses have implemented contactless services to reduce the risks of cross-infection, and many social organizations and volunteers have put in considerable effort to help residents who are unable to use smart devices. As a result, via the e-government infrastructure, Hangzhou has formed a cooperative means of governance comprised of diverse subjects, achieving a triple win for the government, businesses, and residents.

Hangzhou's practice of using e-government infrastructure to manage crises has also shed light on problems that need to be addressed, such as the digital divide, public surveillance, data privacy, and information security (Clark et al., 2003). For example, some elderly people are incapable of using mobile phones to get health codes; also, putting such a massive amount of data in the hands of private firms creates significant information security risks (Yang, 2020). These problems notwithstanding, Hangzhou's experience indicates that the rapid deployment of ICTs in e-government can change the way urban problems are understood. In addition, the ICT-based e-government infrastructure has exhibited great potential to facilitate cities to assume greater control over the epidemic, which ensures that they will be able to achieve smart urban governance and will thus be more resilient when confronted with unexpected shocks.

REFERENCES

Ahn, M. J., & Bretschneider, S. (2011). Politics of e-government: E-government and the political control of bureaucracy. *Public Administration Review*, *71*(3), 414-424.

Ayanso, A., Chatterjee, D., & Cho, D. I. (2011). E-Government readiness index: A methodology and analysis. *Government Information Quarterly*, *28*(4), 522-532.

Campanella, T. J. (2006). Urban resilience and the recovery of New Orleans. *Journal of the American planning association*, *72*(2), 141-146.

Cheng, Y., Yu, J., Shen, Y., & Huang, B. (2020). Coproducing responses to COVID-19 with community-based organizations: lessons from Zhejiang province, China. *Public Administration Review*, *80*(5), 866-873.

Clark, B. Y., Brudney, J. L., & Jang, S. G. (2013). Coproduction of government services and the new information technology: Investigating the distributional biases. Pu*blic Administration Review*, *73*(5), 687-701.

Comfort, L. K. (2006). Cities at risk: Hurricane Katrina and the drowning of New Orleans. *Urban Affairs Review*, *41*(4), 501-516.

Devadoss, P., & Pan, S. (2004). Leveraging E-government infrastructure for crisis management: Lessons from managing SARS outbreak in Singapore. *AMCIS 2004 Proceedings*, 253.

Drapalova, E., & Wegrich, K. (2020). Who governs 4.0? Varieties of smart cities. *Public Management Review*, *22*(5), 668-686.

Dunleavy, P., Margetts, H., Bastow, S., & Tinkler, J. (2006). New public management is dead—long live digital-era governance. *Journal of Public Administration Research and Theory*, *16*(3): 467-494.

Gao, S., Mioc, D., Anton, F., Yi, X., & Coleman, D. J. (2008). Online GIS services for mapping and sharing disease information. *International Journal of Health Geographics*, *7*(1), 1-12.

Glasmeier, A., & Christopherson, S. (2015). Thinking about smart cities. Cambridge *Journal of Regions, Economy and Society*, *8*(1), 3-12.

Hangzhou Bureau of Statistics, 2020. Economic statistics for the first quarter of 2020 (Government report).

Hangzhou Health Commission, 2020. The reports of new confirmed case of COVID-19 in Hangzhou (Government report).

Hangzhou Municipality. 2019. The Practice and Thinking about the Hangzhou City Brain (Government report).

Tat-Kei Ho, A. (2002). Reinventing local governments and the e-government initiative. *Public Administration Review*, *62*(4), 434–444.

Heymann, D. L. (2020). Data sharing and outbreaks: best practice exemplified. *The Lancet*, *395*(10223), 469-470.

Huang, B., & Yu, J. (2019). Leading Digital Technologies for Coproduction: the Case of "Visit Once" Administrative Service Reform in Zhejiang Province, China. *Journal of Chinese Political Science*, *24*(3), 513-532.

Khan, G. F., & Park, H. W. (2013). The e-government research domain: A triple helix network analysis of collaboration at the regional, country, and institutional levels. *Government Information Quarterly*, *30*(2): 182–93.

Liu, X., & Zheng, L. (2018). Cross-departmental collaboration in one-stop service center for smart governance in China: Factors, strategies and effectiveness. *Government Information Quarterly*, *35*(4), S54-S60.

Massaro, E., Kondor, D., & Ratti, C. (2019). Assessing the interplay between human mobility and mosquito borne diseases in urban environments. *Scientific Reports*, *9*(1), 1-13.

Meijer, A., & Thaens, M. (2018). Quantified street: Smart governance of urban safety. *Information Polity*, *23*(1), 29-41.

Moon, M. J. (2002). The evolution of e-government among municipalities: rhetoric or reality?. *Public Administration Review*, *62*(4), 424–433.

Neiderud, C. J. (2015). How urbanization affects the epidemiology of emerging infectious diseases. *Infection Ecology & Epidemiology*, *5*(1), 27060.

Oscarsson, O., & Danielsson, E. (2018). Unrecognized crisis management—Normalizing everyday work: The work practice of crisis management in a refugee situation. *Journal of Contingencies and Crisis Management*, *26*(2), 225-236.

Pereira, G. V., Parycek, P., Falco, E., & Kleinhans, R. (2018). Smart governance in the context of smart cities: A literature review. *Information Polity*, *23*(2), 143-162.

Sandoval-Almazan, R., & Gil-Garcia, J. R. (2014). Towards cyberactivism 2.0? Understanding the use of social media and other information technologies for political activism and social movements. *Government Information Quarterly*, *31*(3), 365-378.

Scholl, H. J., & AlAwadhi, S. (2016). Creating Smart Governance: The key to radical ICT overhaul at the City of Munich. *Information Polity*, *21*(1), 21-42.

Smith, R. F. I. (2016). Improving governance and services: can e-government help?. *Chinese Public Administration Review*, *3*(3/4), 62-70.

Turoff, M. (2002). Past and future emergency response information systems. *Communications of the ACM*, *45*(4), 29-32.

Twizeyimana, J. D., & Andersson, A. (2019). The public value of E-Government–A literature review. *Government Information Quarterly*, *36*(2), 167-178.

Waugh Jr, W. L., & Streib, G. (2006). Collaboration and leadership for effective emergency management. *Public administration review*, *66*, 131-140.

Yang, K. (2003). Neoinstitutionalism and e-government: beyond Jane Fountain. *Social Science Computer Review*, *21*(4), 432-442.

Yang, K. (2020). Unprecedented Challenges, Familiar Paradoxes: COVID-19 and Governance in a New Normal State of Risks. *Public Administration*

Review, *80*(4), 657-664.
Zhejiang Provincial Bureau of Statistics, 2020. Major population data of Zhejiang Province in 2019 (Government report).
Zook, M. (2017). Crowd-sourcing the smart city: Using big geosocial media metrics in urban governance. *Big Data & Society*, *4*(1), 2053951717694384.

ABOUT THE AUTHORS

Wanxia Zhao is an Association Professor at the School of Political Science and Public Administration, East China University of Political Science and Law, Shanghai, China. Her research interests include public policy and sustainable development. She obtained her doctoral, master's, and bachelor's degrees from Indiana University, Tsinghua University, and Peking University, respectively. She can be reached via hzzwx0619@163.com.

Yonghua Zou is a ZJU100 Young Professor at the School of Public Affairs, Zhejiang University, Hangzhou, China. His research interests include urban governance, housing policy, and healthy cities. He received his doctoral degree in Urban Studies from Temple University, and master's degrees from Indiana University and Tsinghua University. He can be reached via yonghuazou@foxmail.com.