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Original Research Article

Redefining Urban Functional-Spatial Response Strategies to Covid-19 Outbreak in Iran With Emphasis on the East Asian (China) Experience*

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Abstract

Problem statement: The urban functional-spatial structure was developed in a historical process during which it faced numerous jeopardies. It has always played a fundamental role in reacting to crises, both as a damaged center and an emergency relief center. The structure defined for urban crisis management in Iran has been mainly formed based on the management of crises due to natural disasters such as floods and earthquakes. The experience of Covid- 19 has shown that in the face of the epidemic crisis, it lacked pre-conceived plans and strategies that offer practical solutions with an emphasis on the functional-spatiality of cities.

Research objective: The current study aims to find out how existing experiences can be used to improve cities' functional-spatial capability.

Research method: By the use of the content analysis method and analytical review of the experiences of China and other East Asian countries, the current study attempts to adopt the functional-spatial management of these countries. It has been done based on a framework including the introduction of a context for emergence, requirements of creation, continuity, and assessment criteria to investigate their feasibility for conditions of Iran based on the existing managerial structure and the trend of disease spread.

Conclusion: Based on the results, the establishment of an interventional system based on integrated urban management and governance is highly important to be able to help cities first concentrate their workforce and resources strongly and regularly before the epidemic reaches them. In uncontrollable epidemic conditions, it can provide services to homogeneous areas by forming a cluster structure. It can also divide the whole city into relatively independent areas to send medical and service personnel with emphasis on the local community. The most important functional-spatial strategies include spatial management based on the local community, temporal-spatial management, smart control management, and urban resilience and governance.

Keywords: *Functional-spatial reaction, Integrated urban management, Pandemic, Covid-19, Iran, China.*

*Some ideas of conclusions in this paper extracted from the practical research had done by A review of global experiences (with emphasis on China and the United States) on environmental control and urban planning strategies to prevent the

spread of the Corona virus; Identifying the underlying criteria for adaptation for the metropolis of Tehran

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Introduction

Natural disasters are among the important issues that have always affected the cities of the world. The sudden and unexpected nature of these disasters has led different countries, including Iran, to create an institution in the urban management system to make quick and correct decisions and conduct operations to reduce vulnerability before, during, and after the crisis. The crisis management structure in Iran is mainly based on managing crises caused by natural disasters such as floods and earthquakes. Despite the history of biological crises such as the plague, cholera, and flu in the country, this issue has never been seriously considered. At the same time, contemporary cities are places for the absorption and spread of biological diseases due to the density of the population and the technological complexities of urban systems, and failure in management can quickly turn into a catastrophe. A recent example of such disease is the Covid- 19 or coronavirus pandemic initiated in Wuhan, China, in late 2019 and quickly contaminated the East to West (Lu, Stratton & Tang, 2020), creating numerous challenges for urban managers and planners. It was followed by a wave of transformations in the social, cultural, and economic aspects in a way that it turned into a socioeconomic and, subsequently, an urbanism phenomenon from a medical one (Ghasemi, 2020). The World Health Organization (WHO), on January 31, 2020, mentioned this disease as “a global concern for the emergency of public health.” The high number of infection cases and death worldwide “revealed manifestations of the extent and depth of inefficiency of global management in various dimensions and pillars of development” (Deputy of Infrastructure Research and Production Affairs, 2020, 1), and it indicated that we have to revise the nature of the urban space and reconfigure the public spaces, transportation, urban communications, and the urban economy. From the beginning up to now, the countries have adopted different strategies in reacting to the spread of this crisis. Meanwhile, some emphasize general policy changes while

others enumerate basic planning issues such as strengthening the transportation system as a remedy. Others also emphasize the urban planning aspects, such as closing the streets to vehicles and allocating them to cyclists and pedestrians (Daneshpour, 2020). Local responses to the epidemic rely heavily on the ability of urban places to cope with crises. Using the ability of the functional-spatial structure of the cities and the method of spatial, temporal, and functional management at the time of the outbreak of the pandemics can increase the urban resilience to face such incidents and reduce their adverse effects effectively. It requires having capabilities and an efficient support system at the time of the outbreak of disasters and the capability of adaptation to the crises and flexibility in reacting to the crises (Gaspardini & Manfredi, 2016). To do so, the current study has aimed to find out how to increase the urban functional-spatial capabilities to confront such diseases based on the existing experiences and the use of content analysis and analytical review of experiences of China and other East Asian countries in terms of the Covid- 19 pandemic. Therefore, the current study has sought to adapt the urban functional-spatial management in the mentioned countries facing the Covid- 19 pandemic in early 2020 by generalizing the concepts relevant to the research question. It has been done based on a framework including the introduction of a context for emergence, the requirements for creation, continuity, and assessment criteria. The feasibility of such a framework for the Iranian situation, based on the existing management conditions and the disease spread trend can be also evaluated in this study.

To achieve the main objective, the current study first reviewed the related literature and evaluated them from the two dimensions of Covid- 19 outcomes for the city and the coping strategies. Then, using qualitative content analysis, it investigated and analyzed the documents, and extracted, categorized, and coded the concepts relevant to the subject of the study. In the next step, the experiences of China and other East Asian countries as successful and pioneer

countries in controlling the epidemic diseases, including Covid-19, as well as their strategies and measures were elaborated in a table, based on the extracted indicators and concepts. These strategies were compared to the coping strategies of Iran facing this disease. Finally, based on the conceptual model and with regards to the systemic view based on the three stages of preparation, response, and recovery, the proposed strategies are categorized into four categories of “community-based spatial management,” spatial-temporal management,” “smart urban control management,” and “urban resilience and governance” (Fig. 1). The strategies include changing the data into information that can be used for the public and reduction of urban travels and physical contacts, the use of the data by the urban management to intelligently and momentarily manage the situation and implement strategies such as isolation, and increasing the social trust and stress management by the use of existing local systems proportionate to the integrated urban governance structure

Meanwhile, it is necessary to model the Covid-19 outbreak process to investigate the individual or

group behaviors that affect the whole population's fate. The maps dynamically and momentarily help policy-makers estimate the effectiveness of each intervention approach (Pendar, 2020a). Since the long-term outcomes and solutions of this disease in the future are unknown, the current study is more of an estimate that investigates the probabilities to provide a definitive conclusion.

Review of Related Literature

In late 2019, a month before the Chinese New Year, a new virus named Covid-19 was reported in Wuhan, the center of transportation in Central China, and its human-to-human transmission was approved. On March 27, 2020, the Covid-19 conference was held at the WHO, during which the experiences, achievements, and successful policies of countries such as China, Japan, South Korea, and Singapore were presented (Malmir, Maher, Toghyani & Safari, 2020, 12). From the beginning until now, researchers have also tried to identify the underlying patterns of the pandemic and clarify its unanswered aspects (Sharifi & Khavarian-Garmshir, 2020). Although a great deal of research has focused on the medical

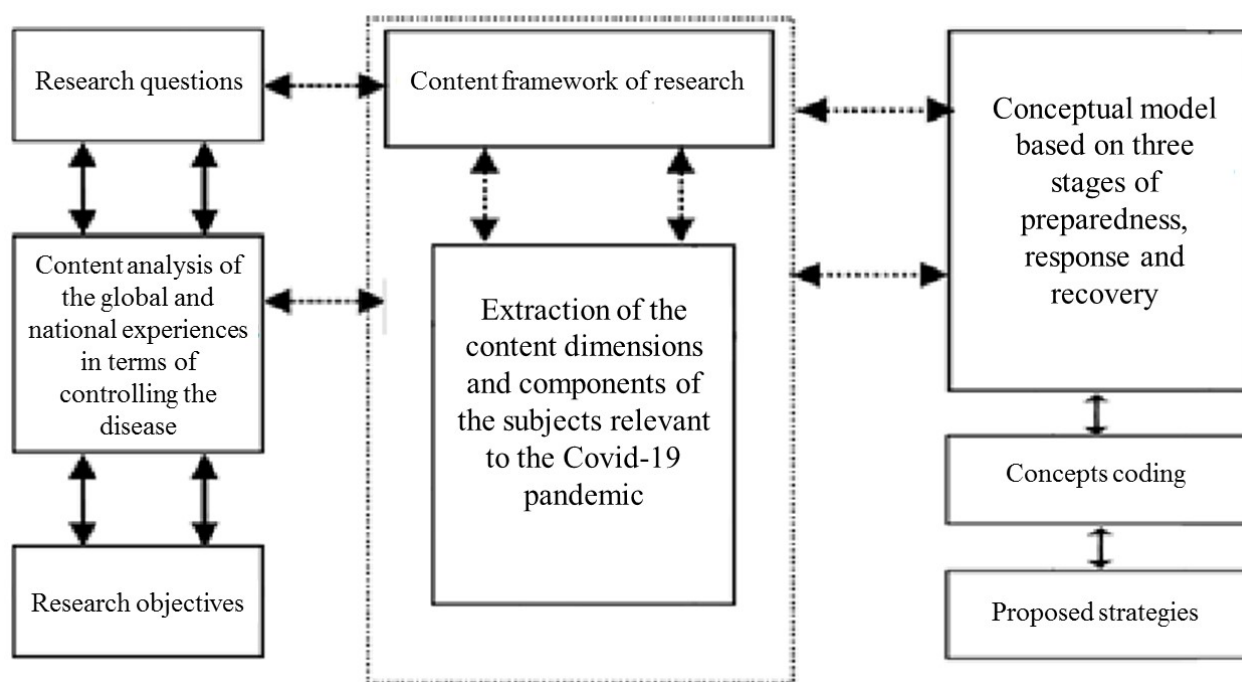


Fig. 1. Explanation of the proposed strategies for the confrontation of Covid-19 by the use of qualitative content analysis. Source: Authors.

issues relevant to the diagnosis and treatment of this disease (Harapan et al., 2020), the effects of the pandemic on cities were considered from the very beginning. They raised discussions about the cities' vulnerabilities when exposed to biological crises (Matthew & McDonald, 2006). That is why much research has been done in this field. The current study sought to pave the way for the provision of some solutions, using the qualitative content of these studies that include international documents and articles about the Covid-19 pandemic. Generally, the qualitative content of the studies relevant to the subject of the current study can be categorized into two categories: 1) documents that have addressed the challenges and outcomes of Covid-19 in the cities and investigated them from different aspects, and 2) documents that have provided strategies correspondent to the outcomes and challenges (Table 1). The strategies indicate that integrated urban management and governance and urban smartification can effectively reduce the outcomes of the pandemic and urban resilience. These studies show that the integrated urban governance through multi-level systems has enabled some countries, such as China and East Asian countries, to successfully prevent the spread of the virus by fast detection of the infected people by increased testing and monitoring, and timely quarantine and social distancing measures (Duggal, 2020; Thoi, 2020).

It is obvious that, finally, the decision about the selection and utilization of strategies should be based on the specific situations of the cities of our country to ensure the maximum response capacity. However, the current study has aimed to prevent the error and trial and waste of time (which is vital) by investigating the strategies adopted by different countries, especially China and the East Asian countries, and their adaptation to the current pandemic situation in Iran. These countries have successfully controlled pandemics such as SARS and H1N1 Flu and have recently managed to actively minimize the destructive effects of Covid-19 by learning from the past (Dugal, 2020). Besides, they

are among the first countries hit by Covid-19 and have something in common with Iran. Also, the Chinese researchers have prepared documents such as City Guides to Deal with Covid-19 and to transfer their successful experiences, which have been considered in the current study. This document entitled "Urban Function-Spatial Response Strategy for the Epidemic" focuses on the emergency adaptation of urban functional-spatial measures in the face of the pandemic outbreak.

Research Method

The current study is qualitative and tries to identify the problem through in-depth research and content analysis of the documents relevant to Covid-19. This qualitative study has used two main sources: the domestic and foreign literature and national and international documents (especially those from East Asia), purposefully selected from health care organizations and other related institutions. The qualitative research describes or explains a phenomenon with the greatest possible details. A theoretical saturation criterion is thus considered in which collection of the maximum information about the subject of the study and indicators of duplication is the endpoint and adequacy of document review. To use authentic documents, the document selection has been done purposefully and based on the JUPP's four criteria based on authenticity (being correct and original), credibility (accuracy), representation (representing all documents in their category), and meaning (what it says) (Mostafavi et al., 2016). To do so, from among 182 identified documents in one year (February 20, 2020, to February 20, 2021), in the primary and secondary screening, 106 and 68 authenticated documents that were more related to the subject of the current study in terms of content, were extracted. At this stage, the concepts were refined, and the relationships between the concepts were obtained; the content analysis became operational by coding or categorizing the concepts. After operationally defining the concepts, some principles are formulated to categorize the

Table 1. Challenges and strategies affecting the functional-spatial situation of the city. Source: Authors.

Context	Challenges	strategies
Social	<ul style="list-style-type: none"> - The impact of social inequalities on the structure of societies on the epidemic of minorities and people who are economically and socially in the lowest range. Due to lack of social distance and lack of access to medical care and basic services such as clean water (Wade, 2020; Kihato & Landau, 2020; Duggal, 2020; Biswas, 2020; Wasdani & Prasad, 2020; Finn & Kobayashi, 2020; Zhang, 2020). - Increased social and psychological tensions between the displacement of immigrant communities, increased racist sentiments, increased self-centered behaviors, and depression caused by “stay at home” orders (Castillo & Amoah, 2020; Kihato & Landau, 2020; Finn & Kobayashi, 2020). 	<ul style="list-style-type: none"> - Strengthen the spirit of voluntary participation in aid delivery (Mendes, 2020; Thoi, 2020; Leonard, 2020) - Social movements and community-based activities to combat social inequalities) (Zhang, 2020; Kihato & Landau, 2020).
Economical	<ul style="list-style-type: none"> - The Impact of Covid 19 on Citizens' Income, Small and Large Businesses, Tourism and Hospitality, Food Supply Chain, Migrant Workers, and City Tax Income (Earl & Vietnam, 2020; Rutynskyi & Kushniruk, 2020; Napierała, Leśniewska & Burski, 2020; Qian & Fan, 2020). 	<ul style="list-style-type: none"> - Reflect on current mass tourism policies and redefine tourism development paths in line with sustainable development goals (Gössling et al., 2020; Batty, 2020; - Changes in the food supply chain and urban agricultural movements and increasing urban self-sufficiency by increasing local food (Pulighe & Lupia, 2020) - Provide stimulus plans and tax deferrals) Kunzmann, 2020; Bherwani, Nair, Musugu, Gautam, Gupta, Kapley & Kumar, 2020
Urban management and governance	<ul style="list-style-type: none"> - Population density in cities (Wei et al, 2020). - Scattered government, with different priorities and conflicts between different levels of governance over limited resources (limited local independence and high reliance on the central government to coordinate actions (Connolly, Ali & Keil, 2020). - Lack of trust in the government and its initiatives (Thoi, 2020; Earl & Vietnam, 2020). - Lack of mechanisms for citizen participation (Thoi, 2020). - Lack of cooperation between cities and villages and lack of communication between cities and countries at the global level to support each other and share experiences (Rich, 2020). 	<ul style="list-style-type: none"> - Integrated urban governance strategies include long-term vision, pre-event planning, adequate investment in primary health care systems, early warning, and coordination of activities of different departments and stakeholders) Duggal, 2020; Thoi, 2020). - Improved ability to quickly identify infected individuals through increased testing and monitoring, timely measures, and social distancing (Duggal, 2020; Earl & Vietnam, 2020). - Increase urban resilience by setting, absorbing, retrieving, and adapting long-term and appropriate programs - Top-down management through multi-level governance systems to coordinate activities - Learning from past experiences. - Strengthen non-governmental organizations (NGOs) and community-based initiatives . - Rural-urban connections and the desirability of strengthening global networks of cities to share experiences and mutual support)Kunzmann, 2020; Connolly et al., 2020; Acuto, 2020; Rich, 2020). - Comprehensive spatial-temporal basic data dynamics through the production of accurate, real-time, and extensive data (Xu, Gutierrez, Mekaru, Sewalk, Goodwin, Loskill & Kraemer, 2020).
Urban transport	<ul style="list-style-type: none"> - Population displacement and transportation infrastructure, which increase inter-city and inter-city communication, are key factors in the spread of epidemics (Connolly et al., 2020). - Negative attitudes toward public transportation and preference for individual travel modes (increased investment in suburban development and thus increased reliance on personal vehicles. 	<ul style="list-style-type: none"> - Utilization of non-motorized transportation systems and improvement of infrastructure for cycling or walking (Teixeira & Lopes, 2020; Biswas, 2020). - Adopt “responsible transportation” measures and policies during the post-Covid recovery period . - Disease screening, distribution of masks and continuous disinfection, guiding people through signs and colored lines on the floor to observe social distance and reduce the number of passengers on airplanes and trains (Deputy Minister of Infrastructure and Production Research, 2020) - Smartening the city to minimize human-to-human contact, identify infected individuals, predict emission patterns, and facilitate quarantine measures (James, Das, Jalosinska & Smith, 2020).

categories to place the intended units in the related categories. Regarding the problem and objectives of the current study, the coding here is done inductively. To do so, predetermined categories are avoided, and their categories and names are extracted from the

data. The starting point of coding is based on the research question and objective. Then, the codes were categorized based on their similarities and differences, and finally, evidence from the text's content was cited per each concept. It should be

noted that the data analysis process is started with open coding and continued through a reciprocal process between theoretical sampling and continuous data matching between and within the extracted categories. “Spatial management based on the local community,” “spatial-temporal management,” “smart urban control management,” and “urban resilience and governance” are the key phrases of the current study. Some codes are extracted from these phrases, each with subcategories and categories. The qualitative content analysis of these concepts and their relationship is depicted in Fig. 2.

The concept coding shows that controlling the pandemics such as Covid- 19 requires local governance, apportionment, and scheduling of the measures by smart urban control and preparation of the urban mosaic, and it is feasible through integrated and multi-level management in the country.

Review of the Related Literature and Analysis of the Measures Adopted in the Face of the Covid- 19 Pandemic in Experiences of the Countries such as China, East Asian Countries, and Iran

• china and East Asian Countries

The successful and pioneer experiences of China and

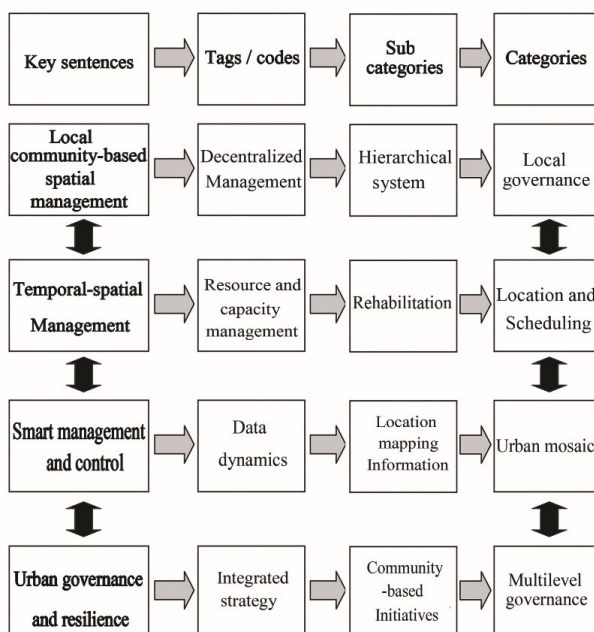


Fig. 2. The process of coding and classifying Covid- 19 coping strategies. Source: Authors.

other East Asian countries in terms of confrontation with pandemics such as Covid-¹⁹ caused the strategies and solutions adopted by them to be considered in various research (Azman & Luquero, 2020; Xiaodong & Yong, 2020; Aikman & Chan, 2020). According to many researchers, the success of China and countries such as Vietnam and South Korea in the face of Covid-¹⁹ is derived from the integrated approach of these countries in urban management when top-down, and government-based measures have accompanied the specific levels of bottom-up and community-based measures in a city to coordinate activities in different cities and provinces (Sharifi & Khavarian-Garmshir, 2020). A combined top-down/bottom-up approach was used against this pandemic during the whole process in China. Different government departments, medical facilities, cities, and communities all work together effectively and quickly to fight against the epidemic, using all possible resources (Guangzhou municipal education bureau, 2020). The modeling and simulation based on the cellular automata is a proper method to investigate the effects of individual behavior (or units) on the fate of the whole population. Recently, live and dynamic maps prepared for the policy-makers in some countries to enable them to estimate each intervention method would have which preconditions and effects indicate the importance of the right choice in this regard (Pendar, 2020). Chen, Marvin and While (2020) have enumerated the use of smart technologies to minimize human-human contact in the provision of services to be important, and expressed China’s experience in using drones for automatic delivery of medical and commercial equipment during quarantine or clinical care and computed tomography scans performed by artificial intelligence to reduce direct contact between treatment staff and patients as a successful strategy. China has taken a “techno-centric” approach to control Covid-¹⁹ by disciplining citizens and controlling the free flow of information through the top-down application of smart technologies (Kummitha, 2020). Today, China, more equipped than before, has provided strategies relevant to sick city governance by using a system of direct pandemics reporting, which is

hierarchically started from the macroscales beyond the city and includes the tiniest biological such as the residential units.

• Iran

Infectious diseases have always been a basic challenge among medical issues and socioeconomic policy-making in Iranian history. With the entrance of Iran into modernity in the 13th Hijri century (19th century AD) and the expansion of the global trade and the increase in communications between the cities and villages, infectious diseases such as cholera, plague, smallpox, typhoid, and malaria became more prevalent than ever before (Dehghannejad & Kasiri, 2010). The very basic health facilities and people's unawareness of the prevention of diseases led to numerous deaths (Jafari & Foroughi, 2015). There are numerous documents about the prevalence, the volume of casualties, individuals and groups involved in the disease, macro policies to prevent the spread and treatment of the disease, and the short-term effects and long-term consequences of the pandemics (Parghou & Alipour Silab, 2017; Flore, 2007; Dehghannejad & Kasiri, 2010; Sorna, 1985; Pollock, 1982). Iran was the second country to report two cases of death from Covid-19, 50 days after China's outbreak (Zhan, Tse, Fu, Lai & Zhang, 2020). The new epidemic entered Iran under specific economic, social, and political conditions (Ghasemi, 2020). Due to managerial reasons in the macro-levels of society, complete quarantine was not possible. The commercial, economic, and social exchanges and the closure of educational and cultural centers activated the traditional networks of social relations and traveled with an unexpected volume, albeit not as much as before. Thus, socioeconomic processes posed another shape and form in the space (ibid.). Health is not merely a biological matter but a subject linked with politics, society, and the economy. Therefore, the countries' ability to manage Covid-19 is highly affected by their socioeconomic conditions can be both an advantage and a threat (Verheul & Van de Pas, 2010). The unpreparedness of urban, social, and economic infrastructures, along

with the lack of timely access to health items and diagnostic kits promptly due to US sanctions against Iran during the Covid-19 outbreak, led to a severe outbreak of the disease and a sharp increase in the new cases in Iran despite closure and suspension of all educational facilities, sports activities, public places, and all crowded centers. However, one of the most important positive measures of Iran in terms of diagnosis and treatment of this disease was increasing the capacity of the reference laboratories and equipping the state and private hospitals in different cities. Using mobile applications to check people's health conditions without referring to the health centers in person, using public and Basij forces, and media for people awareness were among the primary measures for controlling the disease.

• Conclusion of experiences of china and other East Asian countries and comparing them with Iran based on the extracted theoretical framework

Perhaps, it can be said that the centralized and national decision-making system during this crisis has shown its weak points in controlling Covid-19, compared to the East Asian countries. The fact that the endangered provinces and metropolises do not have the required authority for preventive and control measures has demonstrated such a claim. In addition to multiplicity in the disease control system, it has also created challenges for society, such as putting people against each other. In the current situation of East Asian countries such as Singapore, with the empathy between the executive and intellectual elites, a single and precise approach has been taken to eradicate the coronavirus. While the Iranian government, which is indeed under severe economic and social conditions, has intended to express its own opinions as facts, more than talking from the viewpoint of the experts. These conditions have made a situation in which it is felt that there is no uniform practice between the executive and intellectual elite. The most important manifestations of such a situation are the controversy in the explanation of the origin of the virus, the

determination of a time for the end of the pandemic, ending the closure of universities and religious places, and the way of coping with the coronavirus, and so on. It seems that the collection of the therapeutic and preventive measures adopted have not been along with each other and based on careful planning, but across each other and daily, according to the conditions of the time (Shafei Seifabadi & Bagheri Dolatabadi, 2020). While, the measures taken by the East Asian countries have been methodical, based on plans, and a result of the unity of the officials of these countries, so far. Studying the operations and reactions of these countries indicate that with a timely diagnosis, accurate and targeted monitoring of affected people, review and collection of their information, awareness, and quarantine of patients, have been able to get their endangered country out of the corona crisis to a large extent. Despite all infrastructural, economic, social, and... differences between Iran and the East Asian countries, it seems that Iran's problems in coping with Covid- 19 depend on the management method, the coordination between the organizations, supervision laws, the way the citizens abide by the government recommendations, and finally, the quality of punishments administered against the lawbreakers, more shortage of the facilities. The strategies and measures taken by China and other East Asian countries to control Covid- 19 have been presented in Table 2. As seen here, there have been no precise and regular planning and measures in Iran compared to other countries.

Provision of the Theoretical Model

From the WHO's point of view, when faced with an infectious disease such as Covid-19, the urban managers and governors should timely make correct decisions and, most important of all, select based on the common interests of the community. The pandemic can be effectively eradicated only if the city and the individual will and power form a common force. With the global experience of the Covid- 19 prevalence, different strategies have been suggested in cities coping with the pandemics through which the outcomes of these diseases can be reduced, and a situation can be

provided to manage such crises by the use of cities' functional-spatial system. Generally, the biological crisis management in the cities can be administered in three main methods: 1- Management of people movements and access to detect and treat the disease by the use of location mapping data in the public areas and spaces of the city by the urban managers, 2- Management of the medical centers and services based on the instantaneous capacities, and 3- Spatial-temporal management by the city's management and relevant organizations including the population separation, appropriate and efficient location of services and distribution of uses and multi-stage process related to waste management, management of events resulting from the involvement of individuals and families and other issues related to urban resilience such as building trust and effective participation of people and NGOs, etc. Such interventions effectively slow down the invasion of the virus to new places.

Integrated management and entrusting some decision-making and execution to the local layers require considerations for the political, social, economic, and political layers. It would be operational in the framework of integrated management in the regional scales and local measures based on the contextual coordinates and the use of participation opportunities in controllable scales. The strategies in each stage can be divided into 12 layers (Table 3).

Utilization of the global strategies in Tehran (adaptation based on scale, geographical-climatic and cultural location) requires the consideration of a systemic view based on the three stages of preparation, response, and recovery based on the Covid- 19 virus spatial-temporal coordinates, end in a matrix of strategies in each stage during the three stages of diagnosis, treatment, and recovery.

Proposed Strategies based on the Functional-Spatial Conditions in the Iranian Cities based on the Proposed Theoretical Model

The strategies can be specifically defined for each city based on the subjects such as the scale,

Table 2. Covid- 19 coping strategies in China and other East Asian countries and their comparison with Iran (the cases with asterisks are indicative of the commonality between Iran and the mentioned countries). Source: Authors.

Strategy	Measures taken by China and other East Asian countries in terms of controlling the Covid-19	Iran
Local community-based spatial management ¹	1. Centralized treatment approach and decentralized community management	
	2. Demographic surveys by local communities and under the guidance of local physicians	
	3. Identifying local individuals and groups for the partnership	*
	4. Community search, quarantine, tracking, and centralized treatment at the neighborhood level	
	5. Relying on the principle of “focus of patients, specialists, resources and treatment” through the overlap of medical centers.	*
Spatial-temporal management	1. Defining measures related to recovery and rehabilitation in the short, medium, and long term	
	2. Locating, planning, and equipping medical centers to complete the network of intensive care and preventive quarantines following the process of disease spread in urban areas	*
	3. Setting up a complete response system in the shortest possible time	*
	4. Provide spatial information for the management of vital resources, the use of social capacities, participatory management, and the centers of self-help and public mobilization;	*
	5. Establishment of a three-level system, including a- urban health center, b- an epidemic prevention area at the regional level, and c- an epidemic prevention area at the local community level.	
Urban smart control management	1. Management of urban layers and more public use of system-mapping information related to the spatial spread of the virus by equipping the system and online database.	
	2. The possibility of outputting information in a format usable in GIS software to the main platform of the city or designated areas in the form of urban mosaics ² to analyze the layers of the GIS;	
	3. Minimizing human-to-human contact, identifying infected individuals, predicting spread patterns	
Urban governance and resilience	1. Learning from past experiences	
	2. Providing patients with facilities to return to normal life at the beginning of the epidemic process	
	3. Coordinating the main treatment facilities and transformation in the city as well as creating new medical facilities for the rational allocation, quarantine, and treatment of outpatients and critically ill patients	*
	4. Reorganization of the urban transportation system by blocking some internal thoroughfares, restricting public transportation operations	
	5. Regulating public transportation in an emergency logistics system to ensure the transport of various materials to different “epidemic areas” and reduce population mobility to lower levels.	
	6. Organizing the transportation of medical staff, police, and other frontline workers for transportation, medical equipment, civilian equipment, emergency personnel (such as patients infected with other chronic diseases), other emergency patients, pregnant women, etc.	
	7. Use of large public facilities, dormitories, hotels, sports centers, public green space, etc. and their rapid conversion into temporary treatment points under the criteria of admission and treatment	*
	8. Strengthening warehousing facilities and urban procurement for storage, transportation, distribution of necessities, medical equipment, and other items during quarantine	
	9. Strengthening, monitoring, and supporting community care institutions such as the elderly	

geographical location, physical features, density, residential culture, and other layers of life, despite the commonalities in some layers. For example, the crisis management approach in a city with a high human density is different from those in medium and small cities and requires the definition of a method and practice proportionate to the spatial features. Correct basic information, a logical

and scientific reality-based analysis, and correct application of the output information are among the fundamental pillars of planning in urban and rural areas. Reviewing the global experiences in this regard and adaptation of the results obtained in the country also requires recognition of the software and hardware facilities and the existing legal and informational layers, especially the network

Table 3. Matrix of Proposed Procedural Dimensions and the Three Elements of Preparedness, Response, and Recovery. Source: Authors.

Recovery	Response	Readiness	Procedural dimensions (12 layers)
Treatment and consolidation and use of infrastructure	Establish a recovery care infrastructure	Identify and form infrastructure and implement readiness	Step-by-step development and implementation of platform and sector coordination
			Creating basic databases: collecting, registering, screening, and validating data
			Capacity assessment of medical centers (temporal monitoring - location of need - response)
			Spatial analysis of GIS data: preparation of spatio-temporal maps and production of up-to-date policy maps
			Create 4030 medical systems and related layers
			Preparation of epidemic scenarios (analysis of spatial information and preparation of urban health maps)
			Traffic and access management (ambulance organization, safe patient transfer systems, and services)
			Development and equipping of places (hospital and medical architecture)
			Distribution of services (medicine and support packages)
			Tracking and quarantine
			Facilitation and resilience of neighborhoods
			Monitoring, performance-economic evaluation

related to the health and medical centers. Many urban planners believe that the rate of public health facilities plays an important role in controlling or transmitting a pandemic, and mutually, the outbreak of a pandemic directs the urban management towards the creation of some changes in the cities. Considering the “area of pandemic prevention” as the main functional-spatial unit for treatment and responding to the requirements of different stages of pandemic in Tehran, it can create a three-level system including the urban medical centers, “areas of pandemic prevention” at the regional level, and “areas of pandemic prevention” in the local levels to prevent the pandemic. If possible, it is better to first expand the “areas of pandemic prevention” at the local community level and stop or restrict the disease chain from the beginning. To do so, it is required to create an effective emergency transportation system and, at the same time, block some side road networks so that the traffic flow, supplies, and pedestrian flow can be controlled, even if it leads to some restrictions for the citizens. Thus, the urban functional-spatial management is the same as temporary and hierarchical settings of urban management and

the spatial functions related to it in emergency conditions. Also, this issue increases the treatment standards in a focused manner and simultaneously preserves the normal life in the community. The integrated strategies of urban governance include the long-term vision, pre-incident planning, adequate investment in primary health care systems, early warning and coordination of activities of different departments and stakeholders, and raising urban resilience through regulation, recruitment, recovery, and adaptation of long-term and appropriate plans. The top-down management through multi-level governance systems for coordination of the activities, strengthening the NGOs, and community-based measures, as well as the urban-rural links and optimality of the reinforcement of global networks of the cities to share the experiences and mutual support, are also useful in this regard. Another layer that needs planning is the maintenance and development of urban zones in emergencies and after emergencies, which can be defined with measures related to revitalization and rehabilitation in the short, medium, and long periods. Provision of the facilities for the inflicted to return to normal

life is among the measures requiring attention from the beginning of the emergency management process. When the pandemic spreads all over the city, urban managers should decide based on the specific situation in the shortest time possible. In this regard and based on the conceptual model proposed, and according to the disease spread conditions and lack of spatial database, three main strategies can be considered for the Iranian cities as a matrix made of the outbreak stage (pre-, mid-, and post-pandemic) and its strategies (prevention, preparedness, response, and recovery) (Fig. 3). By implementing these strategies, the database layers and their adaptation and spatial analysis for the confrontation of the Covid-19 outbreak and its relevant strategies to the critical cities' functional-spatial management would be feasible.

• Local community-based spatial management

Increasing the social trust and stress management by the use of existing local systems proportionate to the local governance structure can be associated with the educational layers from the lowest and most public levels to the specialist levels, e.g., the local councils can adopt production and the smart use of the spatial data through informing and educating to increase the

social trust and efficacy of the urban and local resilience and the life expectancy. Meanwhile, the cluster-core scattered model can be effective, i.e., a collection of the local medical clinics are organized as the cluster based on the urban structure and the way of distribution of human communities, and a high number of these clusters are formed in the city to act as “an area of pandemic prevention.” In this regard, multi-level pandemic prevention is formed for the whole city. This system can be based on a city-community structure or a three-level region-city-community structure. Daily and weekly services such as food, hygiene services, and other basic goods can be managed through this system. For example, the ambulances and online taxis can link to this system to safely distribute and provide the services to the people in the shortest time and highest efficacy, in a way that instead of individuals exiting and increasing the risk of virus transmission, the required services can be provided with the minimum transportation (Fig. 4).

• Smart urban control management

- Collecting, recording, screening, and categorizing the Data for Functional-Spatial Management

There are numerous daily data about the Covid-19 virus at the time of its pandemic. Thus, collecting,

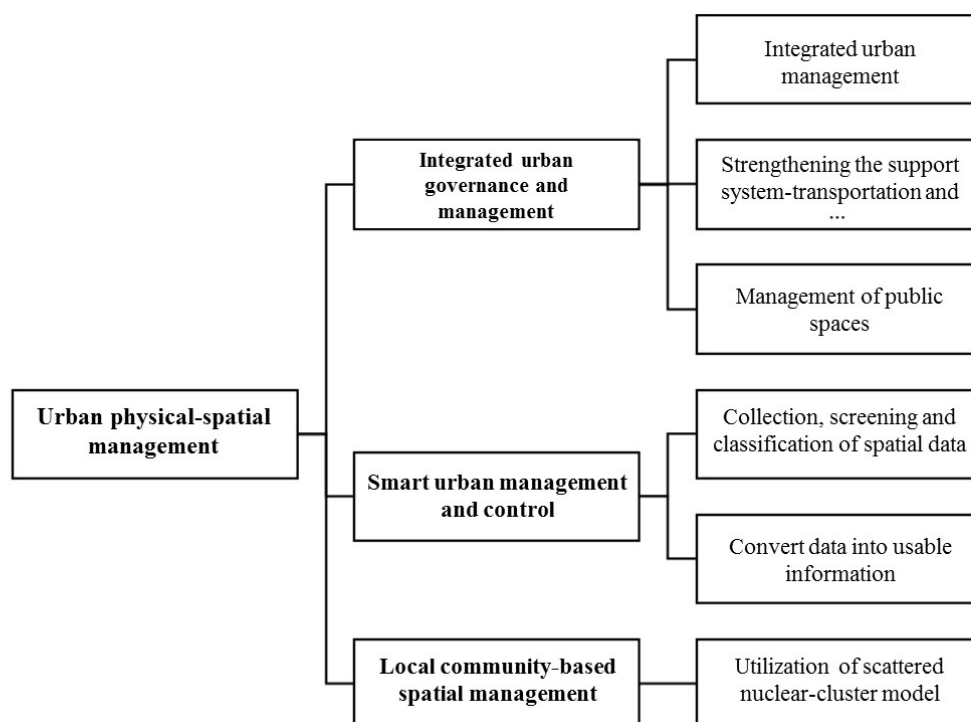


Fig .3 .Chart of physical-spatial management strategies of the city during the epidemic .Source :Authors.

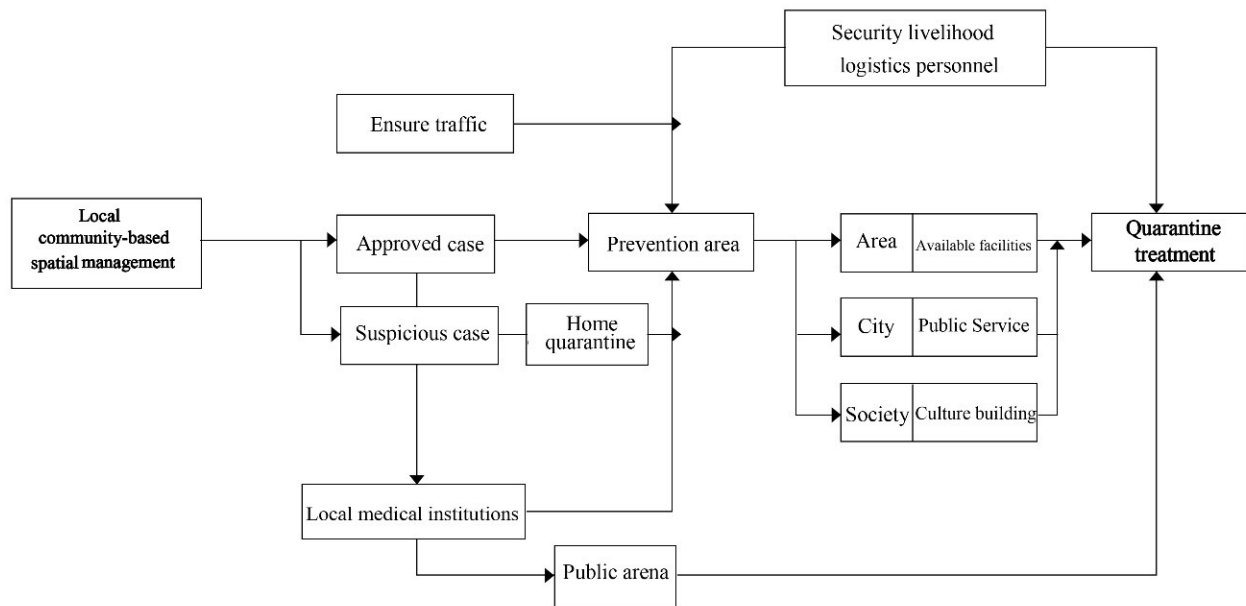


Fig. 4 .Diagram of how to manage space based on the local community to achieve treatment .Source :Authors.

screening, and using this data is difficult. The experiences of countries such as China have proved that equipping an online system and database of spatial information relevant to the spatial spread of the virus to locate, plan, and equip the medical centers for completion of the intensive care network as well as the preventive quarantines proportionate to the disease spread trend in the city regions allow for the use of them with the purpose of urban layers' management by the experts and even more public uses by the people. Therefore, the online investigation and review of the spatial layers for isolation of urban regions and residential neighborhoods allows for data outputting in a usable format in the form of urban mosaics to analyze the GIS layers in this stage. For example, the two telephone systems 4030 and 1666 can be used simultaneously to respond to citizens, and by recording the spatial information of individuals by a fleet of trained physicians who are virtually visiting patients, produce a spatial database at the level of each defined urban mosaic to be even used on the preparation therapies scales. In this telephone system, based on previous training, each physician can participate in this process by guiding patients so that each patient knows which type of medical centers he/she should refer to.

Each patient also receives spatial recommendations besides primary medical recommendations in this process. Registering his/her address in the city can refer to a type of the allocated centers based on the initial visit and diagnosis and his/her condition. The patients are provided with the lowest distance and safest route, so many unnecessary and fruitless trips will be avoided. As mentioned, the categorization of the medical centers and determination of the different types of centers in the treatment process after positive diagnosis and before it based on the different diagnostic process steps can greatly help reduce face-to-face contacts and urban trips. To do so, the medical centers can be categorized as intensive care centers and treatment centers for patients with non-acute clinical conditions to centers intended for isolation of patients with high risks and the homeless in the city as well as other layers that require services, none of which being at the same level of service and protection needs. Moreover, based on the initial diagnosis, the individuals can be directly guided to the most appropriate level of service. Urban management can also use the temporal-spatial data in such a way that at any time, depending on the prevalence of the disease in each place, places can be equipped based on one

of the known types, from fully specialized medical centers to maintenance and quarantine centers, in any particular mosaic or urban area. On the other hand, by momentarily observing the disease trend and the map of its spatial prevalence and futuristic scenarios in this field, urban management can implement local and city governance-based solutions, including controlling entry and exit points and quarantining parts of the city. Due to managerial divergence in the crisis-related layers, such as waste management, public areas management, roads, traffic department, work centers, and residential neighborhoods management, it can be used as a base for integrating spatial-temporal information of individuals and demographic groups and intra-layer analyses. Although the global experience of the city-scale immunization and isolation program has not been used in Iran for several reasons, by using simultaneous and integrated information, such services can be provided to different scales of neighborhood units, residential neighborhoods, and some parts of the city. An up-to-date smart meter can track the city's capacities for pandemic management, help construct safer urban centers, and minimize the risk of global and community spread. Detection of the gap in urban planning and the main socio-economic factors in public health can also help with more effective stimulation sources flow in the vulnerable regions. The degree of a city's preparedness depends on its ability to prevent, detect, and react to disease and care for patients, which means having practical plans, staff, and a budget for quick reaction. The mayors are also committed to reaching at least 83% vaccination coverage, decreasing the incorrect information spread, improving health literacy, sharing information about preventive measures, and decreasing the prevalence of infectious diseases. Also, cities play an important role in preparing for pandemics, reducing them, and adapting to them.

- Changing the Data into usable Information in the Public Level of Community and Reduction of Urban Trips and Physical Contacts

The environmental considerations to prevent

the coronavirus spread is specially related to the urbanism concepts. The constructed environment is a collection of environments made by humans, such as buildings, cars, roads, public transportation, and other environments made by humans. Since most human beings (more than 90%) live their daily lives in constructed environments, perception of the dynamism of the potential transmission of Covid- 19 in the constructed ecosystems and the human behaviors, the spatial dynamism, and the construction of operational factors that potentially promote and reduce are necessary. The higher density of residents and increasing activity level in the internal space usually lead to increased interaction and social relationships through direct contact between the individuals and contact with the environment through non-living surfaces (e.g., fomites). The digital tools are currently helpful to the citizens: distance working, online training, and online purchase of essential appliances and goods. It can be beneficial to the elderly and other vulnerable groups. Also, they can help prevent the complete disconnection of people. Thus, traditional communicative tools such as the radio, telephone, and posters become important. Currently, the continuity of social links is needed more than ever, and with the help of these tools, this disconnection can be controlled. A part of it may be the creation of buildings that can change use quickly. One of the subjects that led to the increase in fruitless and unnecessary trips in the city during these times is the lack of treatment center capacity. The awareness of the degree of each center capacity based on the type of measures that can be taken in them can be very useful for the users in a way that each user knows which centers can provide services to him/her at what distance so that he/she would not face confusion and crowdedness, which is the main cause of the disease prevalence (Fig. 5).

• Integrated urban management and governance

- Integrated urban management and control

The integrated urban functional-spatial management can be executed with two main objectives: first,

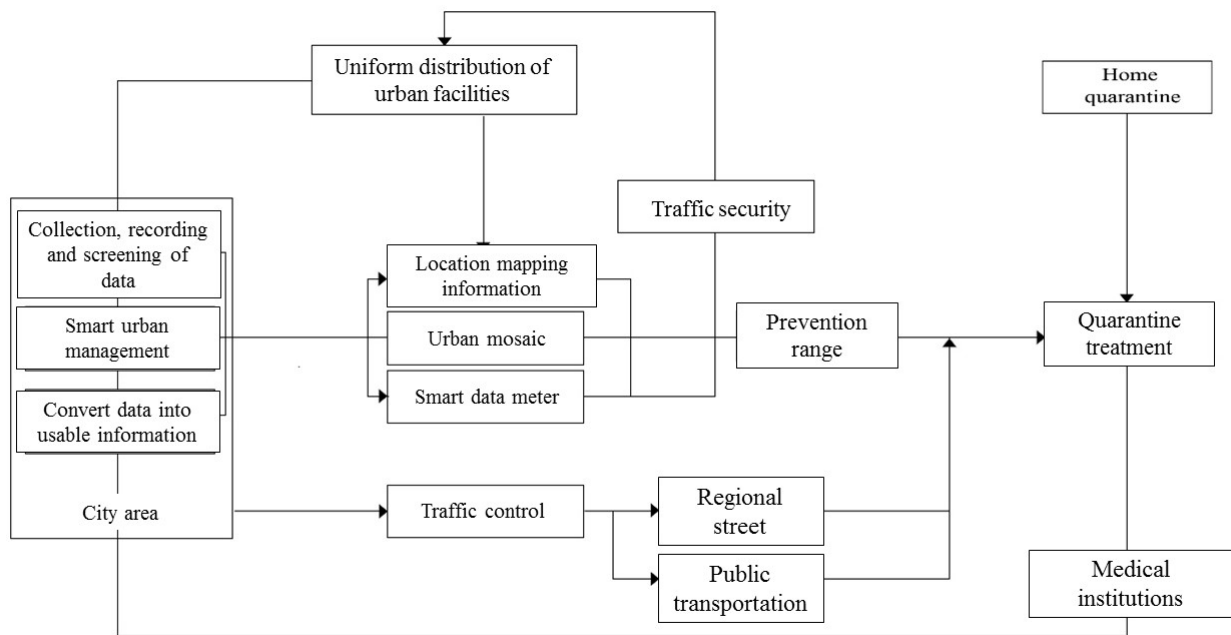


Fig .5 .Diagram of how intelligent urban management from data collection to management and treatment .Source :Authors.

the people's movement and access management to diagnose and treat the disease with the use of the location map data in the public and urban spaces, and second, management of the medical centers and services based on the temporary capacities and needs along with the processes related to the management of the contaminated waste, empathetic management of individuals and families involved and other issues related to urban resilience such as building trust, effective participation of people and social and non-governmental organizations. In this regard, paying attention to three phases is highly important: The first phase can be the preparation of an integrated platform and the threefold network of people, medical staff, and the supplementary social institutions of this process for data registry and screening. In this regard, creating the primary infrastructure and linking the people and health and medical network to each other, linking people to the equipment and medicine network, quarantine capacities, and follow-up of the cured patients and the home patients are necessary. In the pandemic situation, the city should be divided into different areas based on the neighborhood, regional, or functional systems, and special attention should be

paid to preserving the strong links between them and medical and service personnel in the places they are most needed. During this time, specific places should be determined to house the suspects and infected people. If there are not enough hospitals and clinics, some public facilities such as parks, fields, sports fields, and schools should be equipped as temporary points or mobile hospitals for patients. The second phase can analyze the spatial information and adaptation for purposeful and preplanned location and placement of the facilities and equipment needed by the residents. The third phase is also the geographical-temporal analysis of the information and using them in urban health management. The use of social capacities, self-help core, and public mobilization are among the urban resilience layers and require planning in coordination with the other departments and organizations in charge of crisis management. This integrated and smart urban management-based structure should be formed based on the existing platforms containing macro-data since the preparation of a new platform in the short term is impossible. This database allows for combined data in different layers of urban management, including the traffic department, road

management, management of use, daily and weekly services, and hygiene and medical services management. Among the features of this structure are its gradual and step-by-step evolution, which requires the analysis, collection, and categorization of the basic information.

- Strengthening the support-transportation system, public facilities, facilities supply, and other infrastructures

The urban transportation system also needs reorganization. To do so, it is necessary to block some internal thoroughfares, restrict public transport operations and set it up in an emergency prevention system to prevent pandemics and ensure the relocation and transfer of various facilities, and reduce population mobility to lower levels. The suburban traffic junctions should be carefully controlled, and the implementation of traffic and stopping the use of air and rail transportation and the use of some highways by ordinary people should be applied. The creation of quarantine points and emergency evacuation spaces around the train stations and the airports ensures that the safe entrance and exiting of the personnel are also necessary. The allocation and categorization of the emergency vehicles (such as taxis, cars, buses, and cargo trucks) and organization of the medical and police staff transportation as well

as the other frontline workers for the transportation, medical facilities, non-military equipment, emergency personnel (such as the patients infected by other chronic diseases), and other patients in need of immediate assistance, pregnant women, etc. should be performed. It is necessary to actively guarantee the daily life of the residents and protect the normal functioning of urban infrastructures such as water, electricity, gas, housing, and livelihoods. Meanwhile, urban drainage systems also need to be monitored.

- Public spaces management

Reconstruction of urban public services as a medical facility support system in the pandemic is an effective strategy. Some large public facilities should be changeable to temporary medical points fats in accordance with the admittance and treatment criteria. Different markets should continue the provision of services to the residents to continue daily living on the condition of eradicating the virus and controlling the scale. The dormitories, hotels, etc., can be used as temporary residences for the people or the medical staff (Fig. 6).

Discussion

In the current analysis, the literature related to the

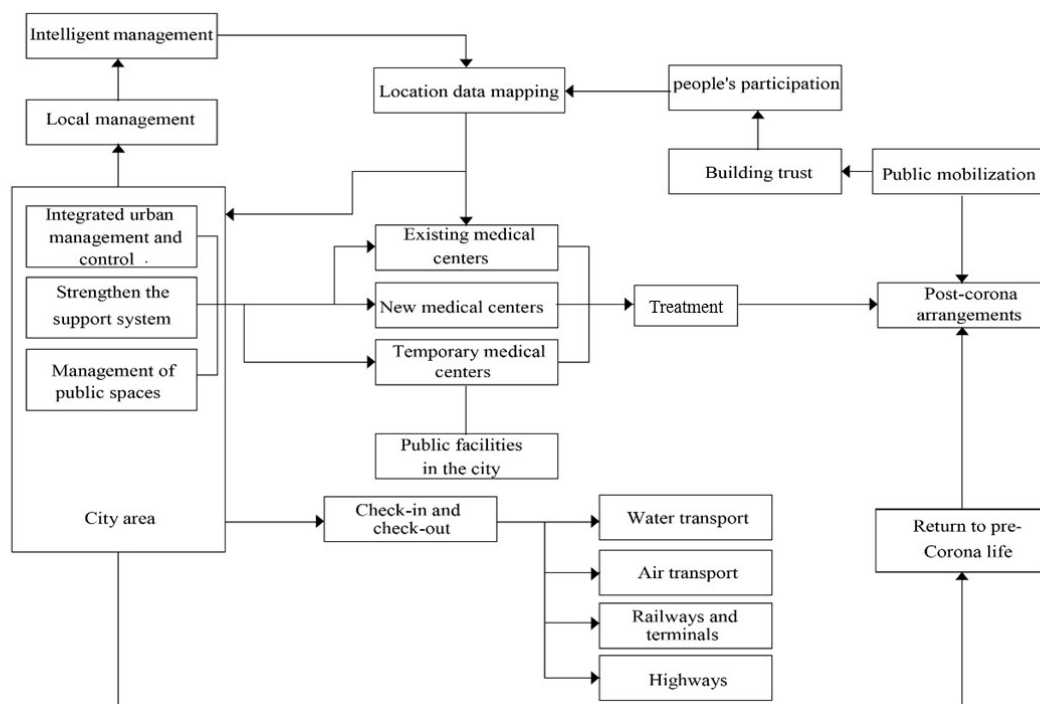


Fig. 6. Diagram of how integrated urban management during and after the epidemic. Source: Authors.

effects of the Covid-19 pandemic on the public space, transportation, communication, and economy has been investigated, and some strategies were formulated corresponding to each problem. Despite commonalities in some layers such as urban infrastructure management, these solutions can be specifically defined for each city based on subjects such as the scale, geographical location, physical features, density, residential culture, and other layers of life. For example, the crisis management approach in a city with a high population density is different from that of a medium or small city and requires the definition of a method and procedure proportionate to its spatial features (Pendar, 2019). Correct basic information, a logical and scientific reality-based analysis, and correct application of the output information are among the fundamental pillars of planning in urban and rural areas. The city scale is an important factor in determining spatial strategies in the management of virus disease spread. Meanwhile, the short, medium and long-term strategies relevant to urban planning and how the metropolises are divided into safe and controllable areas can help reduce the effects of the spread and prevalence of pandemics. In this regard, the medium and small cities may adopt a different approach from the metropolises. Inside the metropolises, the different regions and areas may adopt different approaches based on the pandemic conditions and the specific facilities and situations in each region or area. Besides, today, the cities' preparedness is different worldwide. The cities' development level and socioeconomic factors of their population play a critical role. The cities with a high level of urban poverty and deep inequalities are potentially more vulnerable than cities with better economic resources, lower populations, and more pervasiveness. Tehran metropolis strategies in terms of the reduction of spread and exposure of the citizens to the coronavirus can also be categorized in a wide range of subjects such as the function and activity, provision of services at the work and living space, mobility and access,

and public areas of the cities. On the other hand, controlling the Tehran metropolis in the crisis also requires a general and methodical plan that can be implemented in smaller urban units such as regions, neighborhoods, and even residential units. Therefore, the strategies relevant to the sick city governance have to be started hierarchically and from the macroscales beyond the city and continue to the tiniest biological units such as the residential units. The coordination of the measures along with official and public training to activate the local communities in the form of self-help strategy can be a shortcut to the spatial-temporal management in such emergencies since the preventive opportunities before the outbreak and expansion of the danger are golden times at the onset of the outbreak and also very important at the time of local stabilization of transmission. Indeed, although this virus pandemic crisis is developing and its long-term consequences are unknown and require further studies in the future, the adaptive review of the cities and countries which have experienced an outbreak of the disease and have passed or are in the process of suppressing the disease to determine and extract the influence coefficient of the contextual measures and considerations that affect the type and speed of decision-making would be very useful. In addition, a comparison of the pandemics peaks in different cities would be useful for selecting more effective policies before such a situation (Pendar, 2020b). In this regard, the urban management experts and authorities can predict the probable future needs by the establishment of scientific and research flows and participation of the academic and professional experts as well as investigation of all global dimensions and experiences in controlling the pandemics, and provide advice on how to prepare for a smart crisis management network in the form of integrated urban governance.

Conclusion

Finally, to answer the research question, by using the existing experiences, the functional-spatial

capability of the cities in the face of such diseases can be increased by the following measures. Timely action to prevent the spread of the virus and decrease its negative economic and social consequences by using the functional-spatial power of the cities requires integrated governance accompanied by a long-term vision, strong leadership, and the stakeholders' participation and trust. The experience of this period of the prevalence of Covid-19 virus in the world has indicated that high level of trust in the government and the decisions it makes, along with mechanisms for the voluntary participation of citizens in the dissemination of information and public awareness, disinfection, and support for vulnerable groups in society during quarantine, while raising awareness, also raises the prospect of their executive measures. At the same time, the development of information and communication technology, by cutting or reducing human-to-human contact, can provide intelligent solutions to solve pandemic crises, such as increasing attention to distance working, telemedicine, remote education, monitoring, and business. Also, besides detecting infected people, such smart technologies can identify the spread patterns and facilitate quarantine measures. Regarding the very important role of urban and interurban transportation in the spread of pandemics such as Covid-19, smart mobility restrictions such as restricting trips to/from high-risk cities are necessary. Also, to prevent higher reliance on personal vehicles, the public transportation systems should be revised. The psychological management of the city and its citizens is a matter that requires attention and training in emergencies. Self-control and empathetic behavior training, indeed, away from unnecessary fears such as possible forms of fear of the open environment and xenophobia, are among the necessities of this layer of urban life. Matters such as the participation and cooperation of the citizens with the urban management in this process and the citizens' rights at the time of the outbreak of the crisis also require special attention

and participation of urban sociology and law. Therefore, our country's need for a network of crisis management and an independent and self-sufficient national and local relief and rescue is an important lesson that should be learned from this experience for crisis management, especially in terms of the provision of the needs relevant to the citizens' life; for example, the "production-distribution" networks and chains of essential materials such as disinfectants and health supplies that must be indigenous and self-sufficient. In addition, the crisis management authorities and experts should study all aspects and dimensions of the experiences in the confrontation of the Covid-19 epidemic and its relevant crises all over the world and predict the probable needs in the future with the establishment of scientific and research flows and advise on how to prepare for a smart crisis management network. It would not be realized except with a strong will and a national determination for independence and smartification of the science-oriented crisis management institution and localization of the required methods and facilities which should not be satisfied with a less than one hundred percent realization.

Endnote

1. This method of preventing pandemics requires sufficient medical resources and sufficient space for treatment. However, for some developing countries, medical and space resources may not be able to provide centralized treatment. In this case, a scattered cluster-nuclear model may be an option. That is, a set of local medical clinics are organized as clusters according to the urban structure and distribution of the community, and a large number of these clusters are formed in the city as a "field of prevention of all." - Catch »act. Based on this, a multi-level mechanical pandemic prevention system can be established for the whole city. This system can be based on a city-community structure or a three-level regional-city-community structure. The basic tenets of the "epidemic prevention" system are shortening the response time, improving the efficiency of medical treatment, saving on operating costs, and gaining public support. Therefore, the idea of "early detection, early reporting, early quarantine and early treatment" can be considered as a wise strategy in the Covid 19 epidemic.
2. Determining the size and classification of these operational units based on indicators such as physical and human density, morphology, existing facilities and the like can be done and the basis of studies in the theoretical literature and previous studies can be any of them. It has a population of about 5,000 people. Urban mosaics can be parts of a neighborhood that, by connecting to an independent medical unit (defined in terms of space available in the mosaic can be a clinic or clinic) other services independently by the social services unit Covid 19 detection stations can also be identified based on these mosaics, and this area as an information unit will enable integrated management throughout the city.

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