JICA Ogata Sadako Research Institute for Peace and Development

Policy Paper

Resilience to COVID-19 from the "Quality Growth" perspective: A proposal of medical infrastructure investment

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Abstract

Resilience to external shocks is one of the pillars of "Quality Growth." This paper considers how we prepare for and respond to COVID-19, in particular, how medical recuperation facilities for infected persons with mild symptoms and asymptomatic carriers should be established, from the viewpoint of "Quality Growth." We specifically focus on "redundancy" which is one of the factors to strengthen resilience and discuss the preparedness of medical infrastructure, referring to example cases in Japan. Supposing there were no cost constraints, we would be able to prepare for infectious diseases to a maximum extent. However, in reality, there are constraints such as availability of funds and their balanced allocation with other purposes. In this context, preparing the reserve capacity means that available funds are not fully used effectively in normal times, which is negative for growth at least for the short term. Moreover, medical infrastructure by its nature is unlikely to have redundancy, unlike economic infrastructure. Considering these factors, it is desirable to utilize the facilities, which are used for other purposes than medical care in normal times, as a recuperation places for persons with mild symptoms and asymptomatic carriers to reduce the spread of infection. This promotes multiple uses of facilities. Furthermore, while the construction and provision of temporary recuperation facilities is one effective measure, such facilities can also be prepared and used as a temporary shelter in the times of natural disaster. This is another multiple use of social infrastructure. In conclusion, this paper proposes that from the "Quality Growth" perspective, people infected with mild symptoms and asymptomatic carriers should be accommodated in stages in the following order: (1) public facilities, (2) accommodation facilities, particularly those owned by the state, (3) temporary facilities, and (4) private homes, in response to the spread of infection. It is desirable to build a system that would make this possible.

Keywords

"Quality Growth," Resilience, COVID-19, Medical infrastructure, Mild symptoms, Asymptomatic

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1. Introduction

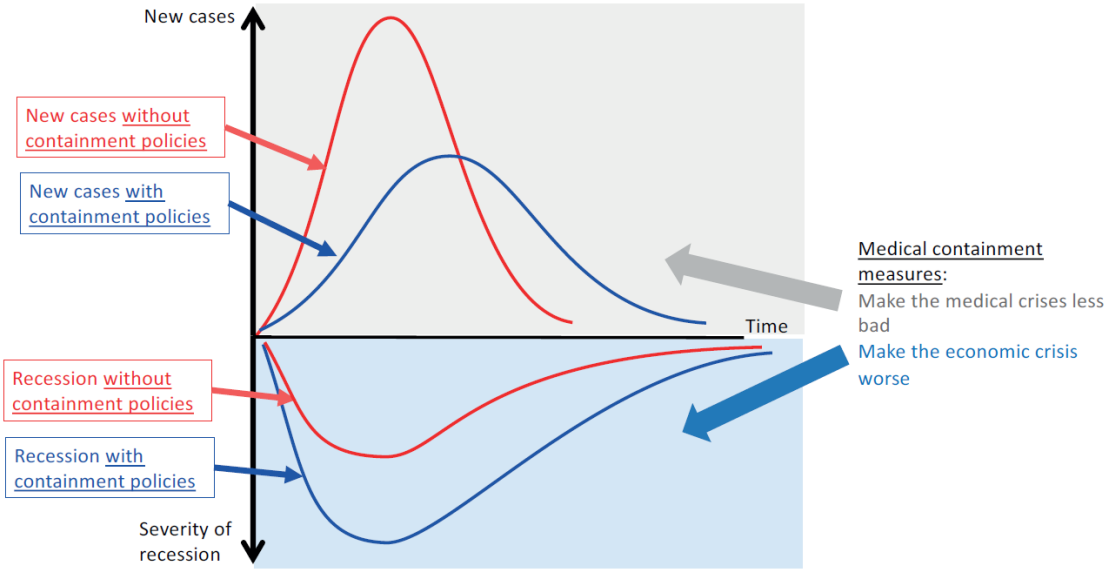
More than 800,000 people died from COVID-19 globally, and the cumulative number of cases has reached about 23,280,000 (as of August 24, 2020). Although we need to take into account the number of tests available as a constraint, the case fatality rate is 3.46% globally if we simply divide the number of deaths by the cumulative number of cases. Infections continue to spread. A global infectious disease is one of the largest external risks our society faces. This paper considers how we should respond to COVID-19 from the "Quality Growth" perspective. While policy responses to COVID-19 are required in various fields of health and economics, this paper specifically proposes how policies for medical infrastructure[1] should be promoted in developing countries in the future, referring to example cases mainly in Japan. According to the definition by the Government of Japan, "Quality Growth," which is used as a framework of our consideration herein, is a theory of growth that goes beyond merely pursuing a high economic growth rate, to realize inclusiveness, sustainability, and resilience alongside economic growth.[2]

The spread of COVID-19 not only threatens people's lives, but also largely restricts economic activities. By taking measures to contain infectious diseases, the economy is affected negatively in both aspects of demand and supply in the short term. IMF (2020) expected that the global economic loss would be more than five trillion US$, far exceeding two trillion US$ during the 2008 financial crisis. Therefore, measures against COVID-19 have two pillars of health and economic policies in any country. The policies announced by Japan have been promoted in these two areas as well. In principle, there is a trade-off relationship between health policies, such as containment, and economic activities. Baldwin and di Mauro (2020) indicate such a relationship as shown in Figure-1. In other words, as we take stronger containment measures to lower the number of newly infected persons, the economy is more adversely affected. Since it is a life-threatening matter for people, what we need most would be strong health policies to contain infections and prevent the medical care system from being overwhelmed. A medical infrastructure is one important factor for health policies as well. Besides that, macroeconomic policies are also necessary to mitigate the impact to economy. Such recognition has become widespread, as pointed out by World Bank (2020) and others, and economic measures have been actually taken on an unprecedented scale in many countries, including Europe, Japan, and the U.S. Further, this trade-off relationship is not limited to the event of a crisis. How much the society is affected in the event of epidemic of an infectious disease largely depends on the society's resilience developed during normal times, as will be described later. To strengthen society's resilience in normal times requires additional expenditure, which has a negative influence on economic growth at least on a short-term basis. Therefore, strengthening the resilience to infectious diseases has to be considered while paying an attention to growth. This paper considers how we prepare medical recuperation facilities for infected persons with mild symptoms and asymptomatic carriers of COVID-19, as one example of strengthening reslience, while considering the effect on growth.

[1] This paper defines medical facilities such as hospitals and clinics as medical infrastructure and does not include medical systems and institutions.

[2] Refer to Hirota (2016). Asia Pacific Economic Cooperation (APEC) saw "Quality Growth," of which the components are balanced growth, inclusive growth, sustainable growth, innovative growth, and secure growth, as the ideal growth we should pursue in the 2010 Economic Leaders' Declaration. The Government of Japan defined growth with inclusiveness, sustainability, and resilience as "Quality Growth" in the Development Cooperation Charter determined by the Cabinet in 2015.

Figure-1: Containment policy for COVID-19 and macroeconomic policy



(Source) Baldwin and de Mauro (2020)

As of around April 2020, when the state of emergency was declared in Japan, there was concern that Japan would face a shortage of medical workers and beds, and the medical care system would be overwhelmed. There are several subjects of discussions in medical facilities, which are largely divided into (a) critically infected persons that would be treated in ICU, (b) infected persons with moderate symptoms who need hospitalization, and (c) quarantine of infected persons with mild symptoms and asymptomatic carriers.[3] According to the relevant laws of Japan, in principle, COVID-19 patients should be admitted to beds in medical institutions designated for infectious diseases. However, in an emergency or other unavoidable circumstance, they are allowed to be hospitalized in medical institutions other than those designated. In this crisis, while the number of cases kept increasing, the acceptance of patients in beds other than those designated for infectious diseases increased. Later, as the situation worsened, it was determined that infected persons with mild symptoms and asymptomatic carriers should quarantine at home. As cases of death among patients recuperating at home emerged, there was a growing concern over the risk of household infection. Once the state of emergency was declared, governors of respective local governments negotiated with private hotels to organize a system so that infected persons with mild symptoms and asymptomatic carriers could be accommodated in the private hotels. As of July 2020, the number of cases had not reached the worst scenario, and the bed shortage that was once feared had not yet occurred. However, in the middle of July, the number of cases increased rapidly nationwide, and the bed shortage became a concern again.

[3] 'Critical' means patients who need to be cared for in the ICU by a mechanical ventilator due to critical pneumonia, etc. Moderate symptoms indicate conditions ranging from the stage of pneumonia or shortness of breath to the stage that requires oxygen administration due to respiration failure. These patients need to be hospitalized. Mild symptoms mean conditions that involve only respiratory symptoms and coughing without shortness of breath. Many of them are cured and recovered naturally, however, it is considered that patients with a risk factor need hospitalization. (Ministry of Health, Labour and Welfare, "Clinical Management of Patients with COVID-19, A guide for front-line healthcare workers Version 2.1")

The research team, including the author, estimated the future demand for social infrastructure including medical facilities in 45 emerging Asian countries using both macro- and micro-approaches.[4] The result of this research shows that the demand for medical infrastructure funds will be 6.5 to 6.7 trillion US$ (or 0.43 to 0.45 trillion US$ on annual average), which is equivalent to 1.1% against GDP for the period from 2016 to 2030. These figures are the demand for funds to achieve the minimum number of hospital beds per population (3.5 beds per 1,000 people), the standard set by the WHO.[5] Many developing countries need to raise the current level of expenditure at an ambitious growth rate in order to achieve this standard.[6] Moreover, beds to prepare for COVID-19 were not taken into consideration in this estimate. How should developing countries prepare policies to prevent bed shortage caused by global infectious diseases, the occurence of which is uncertain? With regard to infectious diseases with a high ratio of infected persons with mild symptoms and asymptomatic carriers such as COVID-19, what should the policy considerations be for the recuperation of those infected persons? These questions were considered from the viewpoint of "resilience," which is one of the pillars of "Quality Growth." As is common in discussions on resilience, the difficulty is that if we intend to prepare well in advance for external shocks, we will end up with an excess of facilities during normal times. In this case, investments are made in facilities which are idle in normal times, leading to lower rates of productivity and growth across the whole nation. This is a trade-off relationship. While it has slightly different implications from the relationship depicted in Figure-1, the question of how to solve this trade-off is a key issue. In the following sections, first we explain the concept of resilience in Section 2, and above all, "redundancy," which is applied to infrastructure in general. Then we consider medical facilities and the issue of redundancy in Section 3 and summarize the measures taken by Japan from this viewpoint in Section 4. We discuss approaches to ensure the redundancy of facilities based on the case of Japan in Section 5, and finally summarize what kinds of policies should be examined by developing countries in the future.

2. Resilience

Generally speaking, resilience means withstanding to and recovering form external shocks (WEF 2013 and others). Briguglio and Kisanga eds. (2004) describes the determination of the level of risks that affect a country by external shocks, depending on how much the country can mitigate the impact of these shocks through its response abilities (resilience) such as policies and governance to the country-specific vulnerability (see Figure-2). While this is a discussion on economic resilience, it seems to be applied in general. If we apply this idea to infectious diseases, a country's vulnerability is the level of exposure to external shocks, which is impacted by hygiene standards, the medical care system, and characteristics of the society (culture and custom, the way of business, transportation, etc.) of the country; resilience is the ability or extent to which the country can respond to infectious diseases

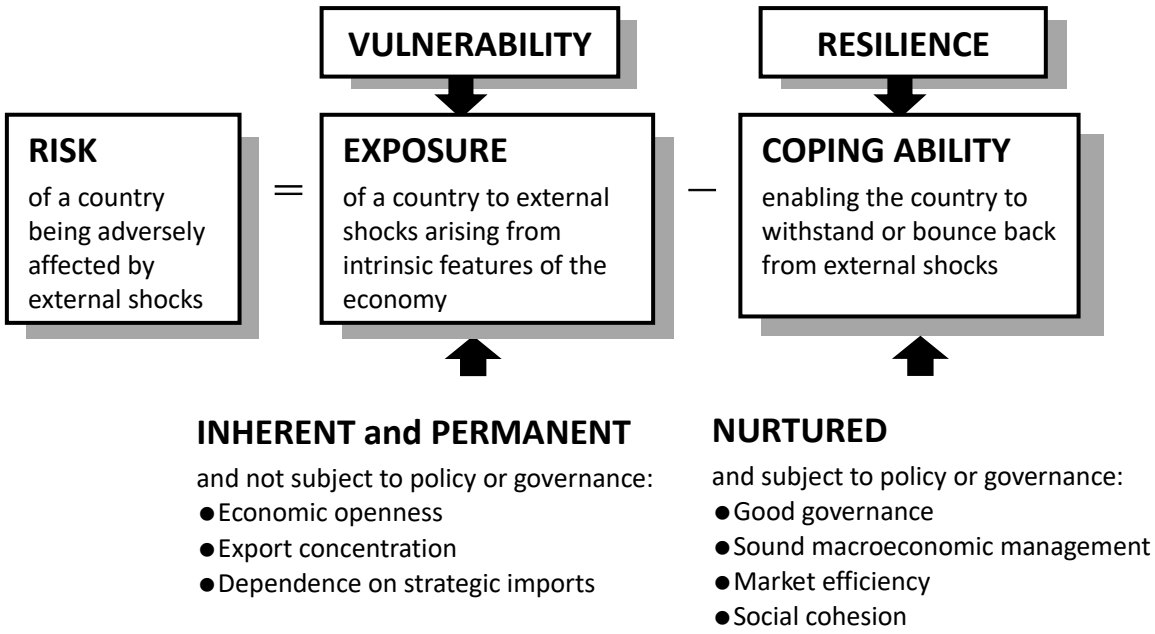
[4] Refer to "Research on Demand Estimate on Infrastructure in Asia" (JICA Ogata Sadako Research Institute for Peace and Development, https://www.jica.go.jp/jica-ri/ja/research/growth/20160901-20180331.html). For estimated figures, see LPEM FEB UI and JICA (2020).

[5] For countries in which number of beds per 1,000 people exceeded 3.5 at the time of estimation, we calculated the funds required to increase the number of beds to 7, which is equivalent to the figure of developed countries. For comparison, the figure in Japan exceeds 13.

[6] In the provisional estimate made by the author, the expenditure for medical facilities other than medical equipment in 2016 is only about 0.19% against GDP in the whole of Asia.

once they happen.[7] In the case of Japan, it is said that a relatively high-level public health awareness (for example, the habit of wearing a face mask) and law-abiding spirit of the people reduce vulnerability. On the other hand, from the comparison with Taiwan or Germany, it seems that we cannot say Japan had fully prepared policies to deal with this situation well in advance.

Figure-2: Vulnerability and resilience



(Source) Briguglio (2004)

There are various kinds of external shocks including disasters, climate changes and economic crises, global infectious diseases, and international terrorism. Resilience is most often discussed within individual sectors. However, WEF (2013) is one of a few examples that discuss an overall framework of social and economic resilience against external shocks as a whole, irrespective of different sectors.

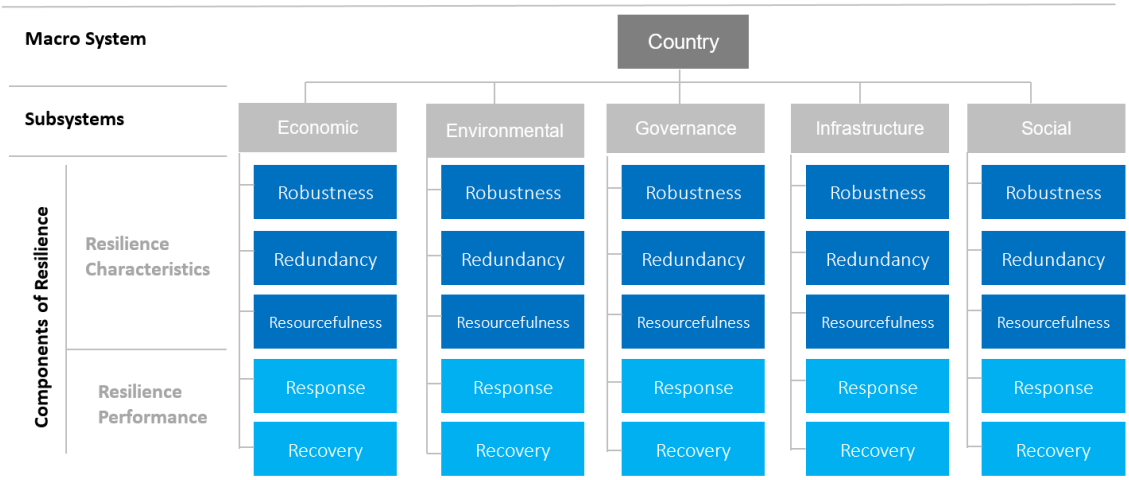
WEF (2013) listed five components to determine the level of resilience. Those include three characteristics to indicate the state of resilience— robustness, redundancy, and resourcefulness to solve problems—and two performance indicators to express the ability of a system to function in the event of a crisis, namely, response and recovery. Robustness is the ability to absorb and withstand a crisis, such as safety valves and firewalls incorporated into the national network to prevent the effects of schocks from spreading, and a decision-making system to respond in the event of a crisis.

[7] Briguglio (2004) states that vulnerability does not rely on policies, however, if policy intervention is continued on a long-term basis, there are fields that can impact vulnerability. For example, openness of the economy or economic structure can be changed by long-term policy intervention in the economic field. Through such intervention, the economy will move toward sustainable growth. Social structure, for example, structural inequality, which is one type of vulnerability, can be changed by long-term policy intervention as well. This is a policy area relating to inclusiveness. In the context of this paper, building an inclusive medical care system such as the universal health care to cover the whole nation will reduce vulnerability. This paper does not discuss vulnerability in detail, nor policies relating to inclusiveness and sustainability that would reduce the vulnerability over the long-term. Therefore, the contents herein are mainly focused on resilience.

Redundancy refers to the reserved capacity or backup that can sustain a situation against hazardous events. Taking electricity as an example, a certain amount of power generating capacity is always reserved according to the level of current demand, otherwise, the entire system may be put at risk in the event of an external shock, such as a disaster or accident. Resourcefulness means, for example, the size of a social or human capital, and the ability to change a negative impact to a positive one, where possible. System flexibility is a key factor, and how much this can lead to innovation is considered important. Response refers to the ability to take immediate action when facing a crisis, such as information gathering and inclusive response involving the private sector. Recovery refers to the ability to return to the normal state, which indicates the government's capacity to provide information and make policy decisions. We apply this framework for the following consideration in this study.

WEF (2013) analyzes each country's resilience by dividing it into five subsystems. It is because threats and risks differ according to each subsystem and may affect each other. The five subsystems, illustrated below (Figure-3) are economy, environment, governance, infrastructure, and society.

Figure-3: Factors of resilience



(Source) WEF (2013)

For COVID-19, each factor of resilience can be examined for each of those five subsystems. This paper particularly intends to look at a redundancy, and medical infrastructure falls under the category of fourth subsystem.

Much reaearch has already been published since the outbreak of COVID-19, and the media continues to report on the pandemic every day. Despite the fact that Japan is close to China, which was an epicenter, and many people travel between the two countries, we have succeeded in keeping the number of infections and deaths low thus far, compared with rates around the world. Western media have offered several views regarding the factors contributing to this.[8] The general tone of articles is that the reason is not clear, while many of them cite the hygiene standards in the country as a whole and the high level of public health awareness among individuals. That is, we seem to be perceived to

[8] For example, Rich, Motoko and Hisako Ueno. 2020. "Japan's Virus Success Has Puzzled the World. Is Its Luck Running Out?" *The New York Times*, May 26, 2020; Galloway, Linsey. 2020. "The healthiest countries to live in!" *BBC*, April 20, 2020; Sposato, William. 2020. "Japan's Halfhearted Coronavirus Measures Are Working Anyway." *Foreign Policy*, May 14, 2020; Harding, Robin. 2020. "'Japan model' has beaten coronavirus, Shinzo Abe declares." *Financial Times*, May 25, 2020.

have an advantage in terms of a country-specific vulnerability. Meanwhile, the Expert Meeting of the Government of Japan places emphasis on effective measures against clusters that have been taken.[9] It is expected to be become clearer later whether the relatively small spread of infection in Japan depends on its country-inherent vulnerability or policy response related to the resilience. The five analytic factors above will be useful as viewpoints for a discussion on the country's policy and governance responses, namely resilience.

This paper considers medical infrastructure, mainly from the viewpoint of resilience, and especially redundancy. It is beyond the scope of this paper to discuss health policies and governance from all the five viewpoints. However, as an example, the state of emergency was invoked on April 5 in Japan under the Act on Special Measures for Pandemic Influenza and New Infectious Diseases Preparedness and Response (hereinafter "Act on Special Measures"). Based on this declaration, prefectural governors were able to take measures for the designated areas within the designated period. During this crisis, measures taken by local governments seem to have left strong impressions among the people. Unlike in previous crises, heads of not only metropolitan governments such as Tokyo or Osaka, but also smaller governments such as Hokkaido, where the state of emergency in the region was declared in advance without being based on the Act of Special Measures, took initiatives. Further, the people might have generally understood that local governments that shared a mindset with general public implemented policies more swiftly than the national government. Local leaders' high approval ratings support this.[10] Although the provisions of the Act on Special Measures have been criticized as insufficient, we can conclude that they have helped to absorb the crisis and prevent infection from spreading to a certain extent, based on the fact that there has been a system through which decisions on countermeasures have been entrusted to local governments. Moreover, the fact that they could promptly respond without getting caught in a medical crisis can be highly appreciated in terms of response.

By using the five viewpoints as criteria, it becomes easier to discuss the level of resilience for issues other than infrastructure. For example, constraints on the inspection test system became a major issue. While it seems that Japan is a little behind Europe, the U.S., and China in the development of new drugs and vaccines, this may be related to problem-solving abilities based on the resourcefulness. Another major issue was the delay in implementation of economic measures, which was caused by prolonged passage of the national budget. This is likely to lower the resilience from the response aspect. We leave it to another occasion to examine Japan's overall resilience to infectious diseases from all five viewpoints.

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[9] Expert Meeting on Novel Coronavirus Disease Control "Analysis of the Response to the Novel Coronavirus Disease (COVID-19) and Recommendations" (2020, May 29) (https://www.mhlw.go.jp/content/10900000/000635389.pdf) accessed on July 9, 2020.

[10] According to opinion surveys conducted by Mainichi Shimbun, the most highly evaluated politician for the response to COVID-19 is Governor Yoshimura of Osaka Prefecture, followed by Governor Koike of Tokyo, the Prime Minister Abe, and Governor Suzuki of Hokkaido (2020, May 8). Mainichi Shimbun, https://mainichi.jp/articles/20200508/ddm/012/010/099000c). According to opinion surveys conducted by Hokkaido Shimbun from April 3 to 5, the Governor Suzuki's approval rating has reached 88% (https://bunshun.jp/articles/-/37204).

3. Redundancy of Medical Infrastructure and COVID-19

As described above, in the case of economic infrastructure such as electricity, we usually see redundancy in the capacity of facilities. In any economic sector including transportation, communication, water and swear services, facility capacity is designed in anticipation of increased demand in advance of the construction of new facilities. Given the long lead time of several years from planning to construction of economic infrastructure, it is not possible to cope with shortages quickly even if we try to add facilities. Therefore, when constructing new facilities, consideration should be given to meeting future increased demand for a period of time in order to avoid a bottleneck in economic activities. Meanwhile, in the case of social infrastructure such as medical care and education, we do not generally prioritize the redundancy of facilities, as a result ofdifferences in their character compared with economic infrastructure.

This difference seems to be a starting point to consider the redundancy of medical infrastructure. In our view that differences between medical (hospitals and clinics) and economic infrastructures can be summarized in five points. The first is the scale of facilities. Economic infrastructure is generally large in scale and based on the network, while medical facilities are built to meet local demand in a limited area, and each facility unit is small. Accordingly, apart from a constraint on medical workers, it is possible to respond rather quickly to a demand increase in a certain area, because facilities themselves can be constructed in a short period of time. During this crisis, there is an example of such a case in Wuhan, China, where they constructed a hospital over a short period of time. Generally, the capacity of medical facilities would not be planned to include redundancy in order to prepare for external shocks, unlike economic infrastructure. Therefore, the shortage of facilities is likely to occur in the event of a pandemic.

The second is an issue of human resources. Those who are engaged in both economic and social infrastructure facilities play roles in keeping them ready to use. In the case of economic infrastructure, services can be provided to users once facilities are completed (for example, if a road is constructed, people can use it for travel). However, in the case of medical infrastructure, facilities are containers, and actual services are not provided until medical workers carry out medical activities (people cannot receive a medical service through the completion of hospital building).[11] For example, in the event of

[11] In sectors that have revenue from tariffs and are closer to commercial activities (for example, electricity and communication) in the economic infrastructure, activities by human resources are essential in order to manage facilities and provide a service (i.e., it is impossible to provide electricity only by maintaining a building of a power station). It is easy to understand this concept if we divide it into three classifications of maintenance and management of facilities, operation of facilities, and provision of public services.

	Economic infrastructure (road and embankment)	Economic infrastructure (electricity and communication)	Social infrastructure
Maintenance and management of facilities	A certain number of human resources are required.	A certain number of human resources are required.	A certain number of human resources are required.
Operation of facilities	Human resources are not required or limited.	Many human resources including procurement of raw materials	Human resources are not required or limited.
Provision of public services	Human resources are not required or limited.	Human resources are not required or limited.	Providers are medical workers (many).

ICU shortage, adding physical facilities alone cannot solve the problem, and the number of medical workers must be also increased accordingly. On the other hand, constructing facilities and training medical workers to the scale that is sufficient to cope with a pandemic could result in a considerable surplus number in normal times.

The third point is medical equipment. In the case of economic infrastructure, roads and electricity can be used once facilities are built. However, in the case of medical infrastructure, medical services cannot be provided by the building alone. For example, in the case of Japanese hospitals, investments in buildings account for just under 40% of total for medical facilities, while the ratio of investments in medical equipment reaches nearly 60%.[12] Adding beds means concurrently making a large investment in equipment for hospitals. Asymptomatic carriers and infected persons with mild symptoms of COVID-19 do not require as much medical equipment, as the purpose of their care is only observation (therefore, they are allowed to recuperate at home or hotels). On the other hand, if hospitals intend to increase the number of beds permanently, they need to consider the investments in equipment in anticipation of usage in normal times as a matter of course. Eventually, it becomes difficult for hospitals to increase the number of beds because of such a large investment in medical equipment.

The fourth point is management. Management bodies of hospitals and clinics vary considerably depending on a country's medical system. In Japan, approximately 80% of hospitals are run by the private sector, while most of hospitals are publicly owned in U.K. China is a mixture of public and private ownership (with slightly more publicly owned hospitals). Issues related to the relationship between the management body and the redundancy of beds are basically the same regardless of whether ownership is public or private. In both cases, the bed occupancy rate decreases as the number of beds increases, and therefore, hospitals are unlikely to prepare more than a certain number of beds in normal times from a viewpoint of economic efficiency. In the case of private ownership, medical corporations would not want to have the redundancy of beds exceeding a certain number, because this causes a management problem. In these cases it falls to the government to compensate medical corporations if redundancy of beds as part of medical infrastructure is a component of the health policy. On the other hand, in the case of public ownership, it may be possible to add beds via a country's policy decisions more easily, however, their maintenance creates an additional fiscal burden. Currently, for many developing countries in which number of hospital beds per population has not reached the WHO standard in the first place, there are many barriers to meeting the additional fiscal burden in order to generate the redundancy, and therefore, it is not likely a realistic option.

The fifth point is the importance of the role of facilities in the system. In the case of economic infrastructure, facilities are the center of the system or policy. For example, in the example of a road, development planning, structural standards, and financial resources are all centered on the road facilities. On the other hand, in the case of medical infrastructure, facilities are only one element within a larger system. When the medical system or policy is discussed, medical facilities themselves are less important than roads are to transportation systems or policies. This is also true of the redundancy of medical infrastructure. The issue of facilities needs to be discussed concurrently with various other aspects, including a medical insurance system and medical workers. To summarize the above, characteristics of medical infrastructure by comparison with economic infrastructure are shown in

[12] According to the *Report on survey results for capital investment by medical institutions, etc.* (Central Social Insurance Medical Council, 2013), the breakdown of investment by hospitals is 36% in buildings, 1.6% in structures, 57.6% in machinery and equipment, 0.1% in vehicles, 3.3% in software, and 1.3% in others.

Table-1. Based on this difference, the issues with redundancy of medical infrastructure are discussed below.

Table-1 Diffidence between medical and economic infrastructures

	Medical infrastructure	Economic infrastructure
Facility scale	Each facility is small.	Network, large scale
Roles of human resources	Services are provided by medical workers.	Roles of human resources are maintenance/management and operation of facilities.
Incidental equipment	The share of medical equipment is large.	Integral part of facilities.
Management	Mainly the private sector (in the case of Japan)	Mainly the public sector
System	Infrastructure is one element in the medical system.	Infrastructure facilities are the center of the system.

(Source) Author

Basic health policy responses against COVID-19 are firstly, to limit the spread of infection through containment, in particular to ensure the number of infected patients does not exceed the current bed capacity to deal with severe symptoms, and secondly, to prevent the infection from spreading by quaranting infected persons with mild symptoms and asymptomatic carriers immediately after they are infected. Such measures have been taken in Japan as well as other countries. In considering medical facilities for COVID-19, the problems are broadly divided into medical treatment for those with severe symptoms, and treatment for infected patients with mild symptoms and asymptomatic carriers. Since COVID-19 is a respiratory infection, firstly, the capacity of hospitals that have intensive care rooms such as ICUs and isolation beds for the relevant clinical department becomes an issue. As far as infected persons are within the institutional capacity of those hospitals, all of them can be treated,since COVID-19 is a designated infectious disease in Japan, the medical treatment of infected persons can be provided only by designated medical institutions for infectious diseases. However, while the number of persons infected with COVID-19 are increasing at an exponential pace, the number of ICUs is limited and cannot be increased immediately.[13] Accordingly, the priority is given to containment even in Japan so that the number of patients requiring treatment does not exceed the capacity of corresponding hospitals. With regard to the number of ICUs per population, we should consider what kind of target should be set on a medium-term basis, including the number of medical workers and management burdens, as mentioned in Table-1.

For the second point, it is a characteristic of COVID-19 that many infected persons either experience mild symptoms or are asymptomatic carriers. It has been estimated that approximately 80%

[13] According to the Japan Medical Association Research Institute, the number of intensive care rooms such as ICUs in Japan is 12,092, and the number of beds for infectious diseases for severe symptoms (including tuberculosis) is 5,373 (https://www.jmari.med.or.jp/). According to the international statistics, the number of ICUs per 100,000 population in Japan is the least among major OECD countries. Meanwhile, the Ministry of Health, Labour and Welfare expresses that such number increases from 4.3 per 100,000 people to 13.5 if high care units, which are equivalent to ICUs, are included (U.S.: 34.7, Germany: 29.2, Italy: 12.5, France: 11.6, Spain: 9.7, U.K.: 6.6; https://www.mhlw.go.jp/content/10900000/000627782.pdf). The Japanese Society of Intensive Care Medicine represented that they considered this number reasonable.

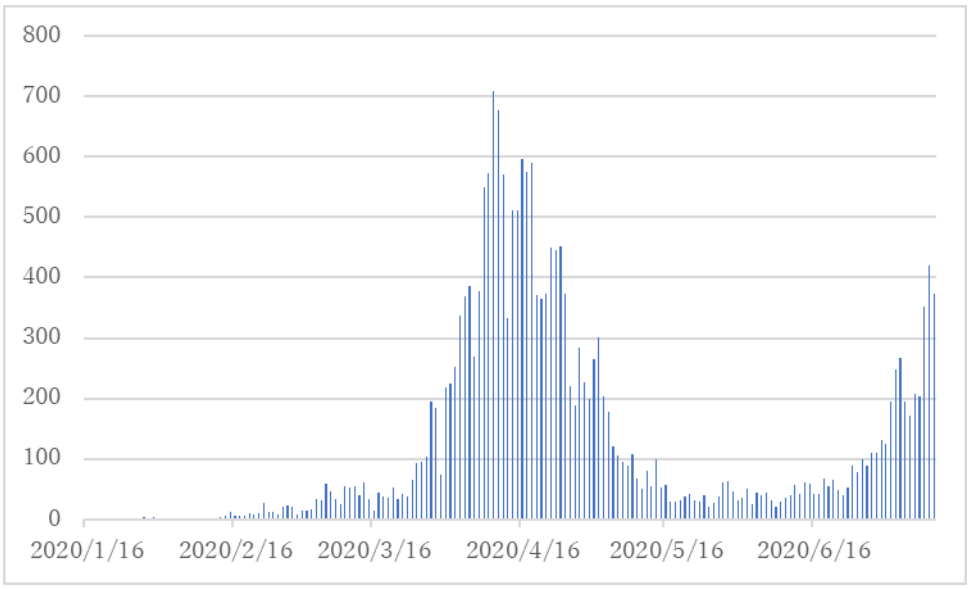
of infected persons are either mildly infected or asymptomatic carriers, while those with severely ill account for 14%, and critically ill patients are 6% (Anderson et al. 2020). Early isolation of infected persons is essential the limit the spread of infection. The incubation period is 1 to 14 days, and the onset often occurs within around five days after exposure to pathogen. However, it is possible to infect others as early as two days before the onset of symptoms. The degree of infectability of asymptomatic carriers seems not to have been identified yet. Given these circumstances, it is recommended that all people who test positive for polymerase chain reaction (PCR) need quarantine. It is important to prepare methods of quarantine systematically in advance, preparing for cases where the number of infected persons becomes numerous in a short time, like COVID-19, in order to strengthen a society's resilience.

The characteristics of this preparation to be considered are as follows: firstly, it should be effective to prevent the spread of infection; secondly, it should secure enough number of places for quarantine; thirdly, it should respond flexibly to increase or decrease in the number of quarantined patients; fourthly, the burden of costs for quarantine should be small; and fifthly, it should be a low burden to maintain during normal times. The examples from Japan presented in the next section can be described using the above characteristics. Options may include (i) increase of designated medical institutions for infectious diseases; (ii) utilization of (unoccupied) beds in general hospitals: (iii) construction of temporary hospitals; (iv) recuperation at home; (v) utilization of hotels (private and public) : and (vi) use of public facilities. After reviewing measures taken by Japan up to now in the following section, we will discuss pros and cons and the costs of those options in Section 5, as well as consider how the redundancy of medical infrastructure should be.

4. Measures Taken by Japan related to Medical Infrastructure

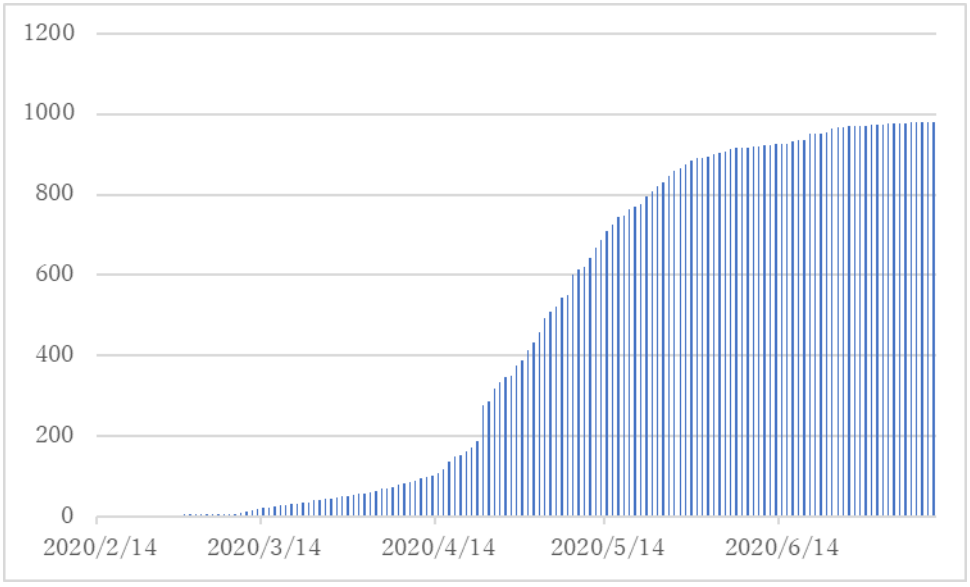
Trends of the incidence of COVID-19 infection and the number of fatalities in Japan are as shown in Figure-4 and -5. While newly infected persons did not rapidly increase in Japan until the latter half of March 2020, the large scale quarantine first became an issue as a result of two cases. The first case was a returnee on a chartered flight from Wuhan in China, which was the epicenter of COVID-19. Among Japanese nationals living in Wuhan who returned on several government-chartered flights, those infected were transferred to designated medical institutions for treatment of infectious diseases. Most of the remaining Japanese were all tested and further stayed in accommodation facilities for two weeks regardless of the test result. They stayed at government facilities such as the National Institute of Public Health, the National Tax College and the private Hotel Mikazuki located in Katsuura City. Some who stayed in such places later tested positive. The target of quarantine in this case was basically non-infected persons.

Figure-4: Trend of number of confirmed cases of COVID-19 in Japan (occurrence basis)



(Source) Made from the Ministry of Health, Labour and Welfare website "Novel Coronavirus (COVID-19): Current situation in Japan" (https://www.mhlw.go.jp/stf/COVID-19/kokunainohasseijoukyou.html#h2_1).

Figure-5: Trend of number of deaths from COVID-19 in Japan (cumulative basis)



(Source) Same as Figure-4.

The second case is a cruise ship, the Diamond Princess, which called at the Port of Yokohama. The number of passengers on board was 2,666. After the ship called at the Port of Yokohama on February 3, the passengers who had previously disembarked from Hong Kong on January 25 were found to have been infected with COVID-19. After a medical examination, the passengers with symptoms and their close contacts were tested, which resulted in confirmation of 10 positive cases. Those passengers left the ship on February 5 and were treated at designated medical institutions for infectious diseases. The rest of the passengers and crew were kept in the ship. When disembarkation

started on February 23, the number of people who had a positive PCR test totaled 691.[14] It seems that there were both positive and non-infected persons aboard the ship. This response was later criticized for causing the spread of infection on board. A ship is a more closed space than a hotel, but they are similar in character. This case demonstrates the difficulty for infected and non-infected persons to remain in a closed area.

In March, the number of infected persons in Japan started increasing. Since COVID-19 was specified as a designated infectious disease, doctors can force patients to be hospitalized if their PCR test is positive. Hospitalization costs are not borne by patients but by the public. Only designated medical institutions for infectious diseases can provide treatment. In principle, patients with designated infectious diseases must be admitted to a designated medical institution for infectious diseases. Therefore, if the number of patients increases more than the capacity of designated medical institutions for infectious diseases, as in the case of COVID-19, it becomes difficult to respond to the situation with the number of beds in such medical institutions. Since such a circumstance is expected, Article 19 of the relevant law stipulates that in case of emergency or other unavoidable circumstance, patients are allowed to be hospitalized in medical institutions other than those designated for infectious diseases. The Ministry of Health, Labour and Welfare gave a reminder of this interpretation of the law in a notification dated February 10.

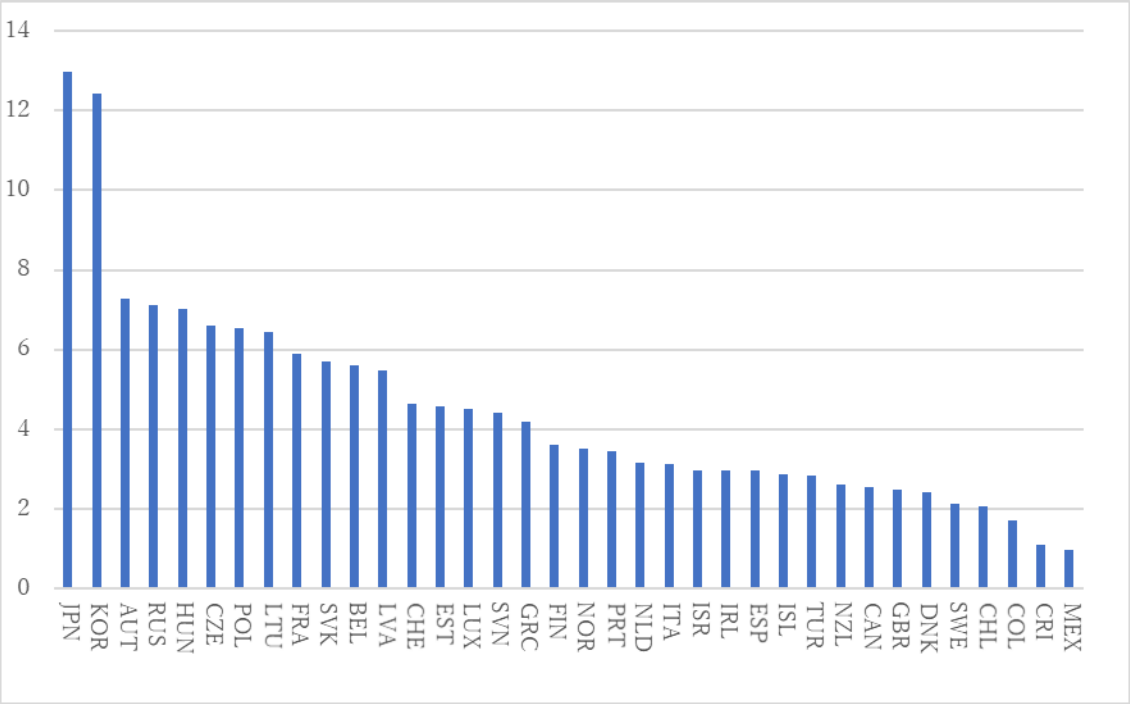
Japan is generally deemed as one of the OECD countries with the highest number of hospital beds per population in spite of low rate of ICUs per population as explained (see Figure-6). Although these statistics do not necessarily reflect the accurate situation of each country as the definition somehow affects it, it is generally considered that the number of hospital beds in Japan is large from an international standards, and, therefore, the government has taken measures to reduce the number of beds. The number of beds for general diseases in the whole nation is about 1.2 million (excluding beds for psychiatric patients), and if we assume that the bed occupancy rate is around 80%, simple calculation would suggest that 240,000 beds are available nationwide.[15] In fact, when the state of emergency was actually declared, local governments began to utilize general hospitals for treatment of COVID-19.[16]

[14] The above sequence of events is based on the summary made by Nakazawa, Ino and Akayabashi (2020). According to the announcement by the Ministry of Health, Labour and Welfare, the number of people who have a positive PCR test result was 696 as of March 10, while the number of asymptomatic carriers was 327 (https://www.mhlw.go.jp/stf/newpage-10130.html).

[15] The statistics of the Ministry of Health, Labour and Welfare are available for the bed occupancy rate (https://www.mhlw.go.jp/toukei/saikin/hw/byouin/m18/01.html).

[16] There are two ways to use a general hospital to treat patients with COVID-19: one is to make the entire hospital a specialized hospital for COVID-19 and the other is to allocate a portion of the hospital beds. For example, a private hospital located in Osaka, “Hanwa Daini Hospital” was converted to a hospital dedicated to COVID-19 patients in cooperation with the Osaka Prefectural Government. According to the hospital’s website, it became the second hospital specializing in COVID-19 after Osaka City Juso Hospital and would accept mainly elderly patients with mild symptoms (https://kinshukai.or.jp/kinshukai/hanwa2/).

Figure-6: International comparison of numbers of hospital beds (2018)



(Source) Prepared from OECD Data (https://data.oecd.org/healtheqt/hospital-beds.htm).

The Ministry of Health, Labour and Welfare released guidance for a gradual shift of the hospitalization system on March 1.[17] According to this guidance, while infected persons are admitted to general medical institutions depending on the situation, infected persons with no or mild symptoms, in principle, should recuperate at home. In fact, such infected persons were requested to recuperate at home. It was explained that this was because there were constraints on medical workers treating critical cases. The constraints on medical institutions seemed also to be in the background. Later, however, the policy on home recuperation for infected persons with mild symptoms and asymptomatic carriers was changed due to increased infections within homes, and the need to respond to sudden change of the condition of people infected. On April 23, the Ministry of Health, Labour and Welfare notified local governments that those persons should recuperate in accommodation facilities. This system has remained in effect since that time, such that while infected persons with mild symptoms are quarantined in hospitals or accommodation facilities such as hotels or at home, infected persons who are asymptomatic carriers are quarantined in accommodation facilities or at home. Those hotels are not only private but also public accommodation facilities.[18]

[17] "Transition of each measures (surveillance, prevention of the spread of infection, medical care provision system) in the event of increase of COVID-19 patients in the region (in Japanese)" (Ministry of Health, Labour and Welfare, March 1)

[18] For example, the Akita Prefectural Government rented "Le Port Mizuho," which is a public facility of the Mutual Aid Association of Prefectural Government Personnel (16 rooms for 29 people) to be used as a facility for the recuperation of persons with mild symptoms and asymptomatic carriers (refer to Akita consultation meeting between prefectural government and assembly and "Akita shows a facility for persons with mild symptoms to the public (in Japanese)" (2020, May 1). Nihon Keizai Shimbun. The Kanagawa Prefectural Government has utilized its training facility with accommodations, "Shonan Village Center" (about 100 rooms), as a recuperation facility for persons with mild or no symptoms

In July, the number of newly infected persons rapidly increased. Although we cannot simply make a comparison because numbers of tests conducted differ, 981 cases were confirmed on July 23, breaking a record high for two consecutive days. As the number of patients increased, exceeding the capacity of accommodation facilities contracted by local governments, there were growing concerns again about the shortage of accommodations for infected persons with mild symptoms and asymptomatic carriers.[19] Taking Tokyo as an example, it was reported that 21 people were admitted to ICUs (critical symptoms), 943 people were hospitalized (moderate symptoms/infected person with mild symptoms), 168 people recuperated in accommodation facilities, 392 people recuperated at home, and 717 people were in the process of coordination for hospitalization, recuperation, etc. (excluding those who were discharged from the hospital and died among those who tested positive). We find that places for recuperation of infected persons with mild symptoms and asymptomatic carriers are divided into three (as of July 23, 2020).[20]

5. Consideration

Based on the sequence of events in Japan mentioned in the preceding section, we consider how developing countries should address the issue of redundancy of medical infrastructure. Since medical infrastructure, unlike economic infrastructure, is inherently limited in terms of having redundancy, one area to consider is the multiple use of facilities. Examples include the treatment of infectious disease patients by general hospitals, and the use of public facilities, which were originally constructed for multiple purposes, as a place for recuperation of infected persons with mild symptoms and asymptomatic carriers.

As summarized in Section 3, there are six possible recuperation options for infected persons with mild symptoms and asymptomatic carriers. Table-2 summarizes this from the viewpoint of effectiveness of prevention of infection, such as scale, flexibility of response, costs for quarantine, and burden to maintain during normal times. The higher the effectiveness for infection inhibition is, the more favorable. Meanwhile, a large financial burden for maintenance during normal times puts pressure on hospital management. It is desirable to prepare a system that can respond to the spread of infection, by comprehensively considering the overall balance. In order to compare the extent of costs in the discussion, we set the number of infected persons as a benchmark. What we should consider is facilities that can accommodate infected persons with mild symptoms and asymptomatic carriers at the peak of infection. Specifically, such a benchmark number is obtained by deducting the number of inpatients with severe symptoms from the total number of infected persons. According to the estimate released by the Ministry of Health, Labour and Welfare, its scale exceeds 60,000 people in a scenario in which the outbreak is severe.[21] Although it is unlikely that policy intervention is not undertaken at

(https://www.pref.kanagawa.jp/docs/y2w/cnt/f5962/mura_top.html). However, most rented facilities are private hotels in Japan as a whole (http://www.hoteresonline.com/articles/8594).

[19] Based on the standard estimation model of the government, when compared with the number of persons with mild symptoms and asymptomatic carriers estimated for the second wave, the number of rooms currently secured would cause about 4,000 room shortage in a total of 23 prefectures (“Facility shortage for persons with mild symptoms in 23 prefectures: Estimate for Corona second wave (in Japanese),” (2020, July 21). Nihon Keizai Shimbun.

[20] https://stopCOVID-19.metro.tokyo.lg.jp/

[21] To what extent infection could spread is estimated by using a statistical model focused on how many people are infected by one infected person on average (effective reproduction number: R). In Japan, the epidemic

all in the event of the external shock such as COVID-19, it is essential to consider the worst scenario when we prepare for a shock, and therefore, we advance discussions setting the scale of infected persons with mild symptoms and asymptomatic carriers as 60,000 people below.

Table-2: Pros and cons of options for capacity redundancy for COVID-19 patients with mild symptoms and asymptomatic carriers

	Effectiveness of prevention of infection	Securing of sufficient number	Flexibility to increase or decrease	Costs for quarantine	Costs in normal times
Increase of hospitals for infectious diseases	◎	×	×	◎	×
Utilization of unoccupied beds for general diseases	○(however, there is a risk of in-house infection)	○	○ (prompt response is possible to some extend)	△ (cost for diversion, impact to management)	◎
Temporary establishment of hospitals	◎	△	△	△ (construction)	○
Recuperation at home	△	◎	◎	◎	◎
Utilization of hotels	◎	◎	○	△ (rent)	◎
Use of public facilities	◎	○	◎	○	◎

Note: Symbols in the table express the degree of effectiveness.
(Source) Author.

Firstly, we consider the option to increase the number of hospitals specializing in infectious diseases or patient wards in advance in preparation for crises. This is the first policy response in

scenario presented by the Ministry of Health, Labour and Welfare in March became a big topic. It estimated that if no measures were taken, the peak number of infected persons would exceed 426,000, of whom 225,000 would be hospitalized, and 7,500 would be critical. Therefore, it was estimated that the number of other patients who require treatment (= mild symptoms, no symptoms) would reach to 194,000 (as of February 28, from the website of Japan Medical Association Research Institute (https://www.jmari.med.or.jp/research/research/wr_697.html)). After that, the Ministry of Health, Labour and Welfare released the estimate which reflected the results in Japan and added a factor of policy intervention (refer to "Improvement of medical care provision system for COVID-19 with a view to the future (in Japanese)" by Novel Coronavirus Response Headquarters, the Ministry of Health, Labour and Welfare (administration circular dated on June 19, 2020)). The estimate was made for each prefecture based on two models of the spread of infection in metropolitan areas and in other areas with many elderly people. Assumptions include options such as 1.7±0.3 for the effective reproduction number, 1 to 7 days range with regard to how many days should have passed after the reference date (newly infected persons per 100,000 people are 2.5 people/week) to request the society for cooperation (= timing of policy intervention) , and 14 days required to be discharge from hospital evenly. According to this estimate, the total number of infected persons is 37,800, of which 18,900 are inpatients, 2,700 are critically, and the number of persons with mild or no symptoms who require recuperation is 16,241, when the estimated figures for prefectures are totaled under the scenario with moderate level severity (R = 1.7; the society is requested for cooperation (= policy intervention) 3 days later; a model of the spread of infection from metropolitan areas). Furthermore, in the case of the worst scenario for metropolitan areas (R = 1.7; the society is requested for cooperation (=policy intervention) 7 days later; a model of the spread of infection from metropolitan areas), it shows that the total number of infected persons is 145,600, of which inpatients are 72,300, those with severe symptoms are 10,500, and the number of those with mild or no symptoms requiring recuperation is 62,844.

developing countries where the number of hospital beds per population is still insufficient. In China, a specialized hospital was constructed in the short time when the first pandemic occurred in Wuhan. They took their permanent infection control measures a step forward, with the outbreak of COVID-19. In many developing countries where beds for general diseases are in short supply, hospitals specializing in infectious diseases are also insufficient. Accordingly, their active construction is desired. However, the implication of such construction is not for the redundancy of the capacity, but for the response to patients with severe symptoms. In Japan, the number of beds in designated medical institutions for infectious diseases is 1,871. It's not realistic to increase this number to 60,000 in preparation for the maximum risk of infected persons with mild symptoms and asymptomatic carriers, if we consider a constraint on medical workers. According to the simple estimation, an increase of 60,000 beds in Japan would require at least 1.4 trillion yen for the medical building construction and at least 3.8 trillion yen for medical equipment, with at least 300 billion yen annually for maintenance and replacement of the buildings and equipment.[22] This is an extraordinary figure, considering that the annual construction scale of hospitals and clinics in recent years has been 680 billion yen.

Secondly, we consider the possibility that beds in general hospitals generate redundancy as recuperation places for infected persons with mild symptoms and asymptomatic carriers. In the simple calculation, as the bed occupancy rate in 2017 is 73.22% against 1,277,000 hospital beds in Japan,[23] theoretically there would be 342,000 vacancies. In fact, in Japan, the government proposed the approach to use more beds in general hospitals for infected persons, according to the phases of the spread of COVID-19.[24] There are two ways to accept patients infected with COVID-19 in general hospitals: one is to divert the whole hospital to a specialized hospital and the other is to accept infected patients on certain floors of the hospital. In the case of the latter, several problems have been reported. For example, most of general hospitals are not equipped with a depressurized room to prevent sickroom air from leaking out of the building. It is also necessary to separate passageways and toilets from those for general patients. Furthermore, there is a negative effect of hospital management due to the damage of groundless rumors.[25] Transferring general beds to those for infected patients requires a considerable amount of cost as well. Therefore, the national and local governments grant subsidies.[26]

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[22] This was estimated by first calculating the building floor area of a general hospital in the case of 60,000 beds based on 71.29 m^2, the average floor area per bed (actual), and then multiplied by the planned construction cost per m^2 for 2019. For medical equipment, a ratio introduced in Note 12 was used. For maintenance/management and replacement, assuming that 1% of initial cost is incurred for both respectively, we calculated the rehabilitation and placement costs considering different depreciation periods for building and equipment (since an interval between replacement of equipment is short, its rehabilitation was not considered). This figure should be considered rather underestimated, because it is presumed that floor area per bed is larger in hospitals for infectious diseases than general wards, or there are many cases where expensive medical equipment is required (calculated using the statistics from Japan Hospital Federation (2018), Statistics on Building Construction Started 2019).

[23] Japan Hospital Federation, etc. (from 2018)

[24] The Ministry of Health, Labour and Welfare, "Improvement of medical care provision system for COVID-19 with a view to the future (administration circular dated on June 19, 2020, in Japanese)." For example, it specifies 1,000 beds in Level 1, 3,000 beds in Level 2, and 4,000 beds in Level 3 for Tokyo as an example ("Flexible operation of beds according to the number of cases (in Japanese)" (2020, June 10). Nihon Keizai Shimbun.

[25] The above problems are cited from "Desperate situation at a medical field (in Japanese)"(2020, May 29 issue). Weekly Toyo Keizai.

[26] The costs arises in order to renovate beds for general diseases to those for infected diseases. For example, it was reported that it costed several tens of millions of yen in some hospital to install partitions to separate

Needless to say, thorough measures are taken to avoid nosocomial infection, and this seems to be especially important for developing countries to avoid that risk from the viewpoint of general hygiene situation. While general hospitals treat their own patients in the first place, it is unavoidable that such treatment to their patients is affected by the acceptance of persons infected with COVID-19. For example, surgeries may be delayed. Since there is a limit to the number of infected persons that can be accepted by designated medical institutions for infectious diseases, the first priority in Japan was to keep the number of infected persons within that limit (priority for critical patients) at the beginning. In the case of Japan, the number of tests conducted is significantly smaller than in Europe, U.S., and South Korea due to the constraint on the inspection system. Therefore, the Expert Meeting on COVID-19 called for enhancements of the test system, while stating that tests should be concentrated on those who are at a high risk of critical symptoms.[27] From the viewpoint of redundancy, it appears that utilization of vacancies in general hospitals should be focused on patients with moderate symptoms, and infected persons with mild symptoms and asymptomatic carriers should be quarantined by other means as much as possible, without depending on hospitals too much.

There are several cases in the world where hospitals have been temporarily constructed. Temporary hospitals have large spaces, such as convention halls and athletic fields, where there is no risk of infection. Some facilities are made with a tent or prefabrication. For example, the Kanagawa Prefectural Government set up a temporary medical facility with 180 beds in the athletic ground in Fujisawa City for the first time in Japan. This is a one-story prefabricated building to accept patients with moderate symptoms.[28] In London, ExCel London was turned into a temporary hospital with 4,000 beds. Looking at emerging countries, the exhibition center was used in Teheran, and the stadium became a temporary hospital with 200 beds in Sao Paulo.[29] In these cases, the medical system was overwhelmed so that it was necessary to construct temporary hospitals, so it is likely that many patients accommodated therein are those with moderate symptoms or worse, such as developing symptoms of pneumonia. However, these temporary facilities seem to be also effective for recuperation of mildly infected persons. The costs in normal times are not required, and only minimum medical equipment needs to be installed for the mild infected persons. If we can determine in advance a a plan for constructing temporary facilities in the event of a pandemic, it can be effective for securing the redundancy of medical infrastructure. Some initiatives are observed. The Nippon Foundation has installed 100 beds using a gymnasium of Nippon Foundation Para Arena, and is developing prefabricated houses with 150 beds with a plan to expand the scale further.[30] Also, the National Police

moving routes of patients (“COVID-19, Hospitals in Hokkaido in great difficulty: Revenue decline is some hundreds million yen due to suspension of beds for general diseases as well as patients refraining from seeing a doctor and rising prices of medical materials (in Japanese)” , (2020, July 22). Hokkaido Shimbun, https://www.hokkaido-np.co.jp/article/442494. Therefore, the national and local governments grant a subsidy to support acceptance of infected persons in beds for general diseases or to ensure the availability of beds. It is not identified how much it will cost for renovation as a whole. According to LPEM and JICA (2020), an example of Indonesia shows that interior decoration and equipment in a hospital account for about 48% of hospital construction costs. If this is simply applied to 60,000 beds, it will cost approximately 670 billion yen (48% of 1.4 trillion yen).

[27] From the Expert Meeting on Novel Coronavirus Disease Control “Analysis of the Response to the Novel Coronavirus Disease (COVID-19) and Recommendations (in Japanese)” (May 4, 2020)

[28] https://www.pref.kanagawa.jp/docs/ga4/prs/r3241191.html and https://www.nikkei.com/article/DGXMZO59041250T10C20A5L82000/

[29] These examples are based on “In pictures: Field hospitals treating patients around world”, BBC. March 31, 2020. https://www.bbc.com/japanese/features-and-analysis-52087717.

[30] https://www.nippon-foundation.or.jp/who/news/information/2020/20200708-46065.html

Agency has earmarked a budget to build prefabricated facilities to be originally planned as waiting rooms for police officers guarding the Tokyo Olympics and Paralympics, as facilities to accept infected persons with mild symptoms.[31] In overseas cases, the Korean Government took similar measures on a large scale. They renovated a training facility for teachers in Daegu City to accept mildly infected persons. They have built a system in which a doctor is stationed, and people staying in the facility are transferred to a hospital if their condition gets worse.[32]

Thirdly, we consider recuperation places other than hospital. Home recuperation is common in any country with infected persons with mild symptoms and asymptomatic carriers of COVID-19. In Japan, as described above, recuperation at home was considered basic for a certain period, and even after the policy of using hotels as a basis was adopted, there were still patients who recuperated at home. Every country where wards to treat infectious disease have filled up, has likely adopted measures to direct infected persons to quarantine in their houses, instead of hospitalization in a ward for general diseases in which there is a risk of transmission to other persons. The use of homes as redundancy locations for recuperating at home does not require additional costs during quarantine or normal times. However, it carries a large risk of transmission to family members. Moreover, there contains a possibility that a condition suddenly deteriorates in a short time and leads to death. As the Ministry of Health, Labour and Welfare prepared a guidebook which lists cautions, people who have an underlying disease and the elderly are requested to recuperate in a place other than home even if they have only a mild infection. In developing countries, particularly the poor, live in unsanitary dwelling environments, and many of them live in small houses with large families. Furthermore, nuclearization of family has not progressed, and in many cases, households include elderly people. Accordingly, we have to say that recuperating at home carries a much higher risk than it does in developed countries in Europe and U.S. From the viewpoint of inclusiveness, policy consideration should be given to the possibility that inequality in housing situations may increase the infection risk among the poor. Considering this, the use of home as a redundancy of medical infrastructure could be an option for developing countries, only when no other means are available.

Currently in Japan, infected persons with mild symptoms and asymptomatic carriers are frequently quarantined in hotels. It seems that hotels are being used in other cities such as New York,[33] however, renting hotel rooms for the purposes of recuperation does not seem to be globally common as of this moment. In Japan, since all costs for treatment of designated infectious diseases are borne by the public in the first place, local governments had the option of renting hotels. Renting the whole building of a hotel is recommended in order to reduce the risk of transmission to others. Also, even is a person's symptoms suddenly get worse, the problem is relatively small, because a supportive staff is usually stationed for monitoring. If infections increase, it can be responded by increasing the number of hotels to rent. The problem lies in the cost burden and the inefficiency that is inevitable for renting. For example, renting single rooms for three months to respond to 60,000 people would cost 28.6 billion yen.[34] In addition, since the whole building is rented, it is unavoidable that a considerable number of

[31] https://www.npa.go.jp/policies/budget/r2/r2hosei1.pdf

[32] Kenta Kawasaki (April 2, 2020). "Prevent medical collapse! The case of Korea that converted the public and private facility to a quarantine facility for persons with mild symptoms (in Japanese)", FNN Prime Online, https://www.fnn.jp/articles/-/27895

[33] Drew Jones (2020, May 7). "Hotels across Ney York City will offer rooms to people with mild COVID-19 cases", Washington Post, https://www.washingtonpost.com/travel/2020/05/07/hotels-across-new-york-city-will-offer-rooms-people-with-mild-covid-19-cases/

[34] Calculated based on 5,300 yen per night according to the supplementary budget of Osaka Prefecture.

rooms remain unused. Thus far, with a few exceptions such as Akita Prefecture, most of the rented hotels are private. Since there are various types of public accommodation facilities, we cannot discuss those all together. However, for example, it seems that facilities funded by a local government should be more actively utilized as a place for recuperation. The use of public funds for public accommodation facilities has made it possible to set lower rates than those at private facilities, and therefore, it is important to use those facilities for public purposes in the event of emergency, bearing in mind the principle to avoid competition with the private sector. In fact, those are used in that way following the occurrence of a natural disaster.[35] This is especially important in some developing countries, where the share of state-owned-companies in the economy is large. There are several countries in Asia where state-owned-companies operate hotels, such as Vietnam and Indonesia; we consider it to be appropriate to make use of those facilities for public purposes, in accordance with the objective of infrastructure. In addition, with regard to hotels that are constructed by a public-private partnership[36] or financed by a government-affiliated bank, it may be effective to strengthen the redundancy of medical infrastructure by contracting in advance for use of those as accommodation facilities in the event of an emergency.

In addition to hotels, many other public facilities have accommodation facilities. The above example in Kanagawa Prefecture where the prefectural training facility was used as a recuperation place is one such example. Because training is not usually conducted during a pandemic, the facility is mostly idle. In addition, there is a case where the National Tax College was used for a place to stay, as described above, though it was not for infected persons. Advantages of using public facilities are that accommodations are somehow prepared, and it is not necessary to rent all the rooms for a certain period and make payment, unlike in the case of hotels. The low occupancy rate of national training facilities was once a social problem as of around 2011. According to the documents at that time, it seemed that there were public facilities which could accommodate more than 10,000 people. Currently, according to the report by the Board of Audit of Japan (2019), among the existing government-owned training facilities, 90 are equipped with accommodation facilities.[37] Since some of these facilities, such as so-called ministry and agency college, house students in dormitories for a relatively long period while they participate in the program, it may not be possible to deem all of them as a redundancy, however, it would be better to consider more active utilization of these facilities. If they are available, additional costs to renovate the facilities, such as repairing utilities, might be minimal, apart from costs for lodging during a pandemic. In addition, it is also possible that public facilities of local governments and government agencies[38] can be considered for this purpose. In some developing

[35] In response to the heavy rainfall disaster in July 2020, the Ministry of Internal Affairs and Communications announced that accommodation facilities operated by the Mutual Aid Association for Local Public Officers were to be provided for the victims of the disaster free of charge or at low prices (the Ministry of Internal Affairs and Communications "Acceptance of affected people in accommodation facilities of the Mutual Aid Association for Local Public Officers - in relation to heavy rain in July 2020 -" (July 10, 2020). https://www.soumu.go.jp/menu_kyotsuu/important/kinkyu02_000429.html

[36] Although this is not a case of a hotel, for example, the National Women's Education Center located in Saitama Prefecture changed its operation and management to concession method of PFI in 2016. In this crisis, it was decided that all rooms in the Center's accommodation building are used to accept infected persons with mild or no symptoms.

[37] The Board of Audit of Japan "Implementation Situation of Training Programs for Personnel in Each government Ministry office" (January, 2017). https://report.jbaudit.go.jp/org/h28/ZUIJI5/2016-h28-Z5007-0.htm#5007_3_4)

[38] For example, JICA has 15 domestic offices, and each of those has an accommodation facility for training participants from overseas. According to the website of JICA Kansai, Hyogo Prefectural Government requested

countries, state-owned companies may own such facilities in addition to the national or local governments. Furthermore, private training facilities with accommodations can also be used as a place for recuperation of infected persons with mild symptoms and asymptomatic carriers. For example, the Hyogo Prefectural Government utilized 100 rooms of a training facility of the private company, NICHIIGAKKAN. Similar cases are also seen overseas. In South Korea, private company facilities such as Samsung are being utilized for quarantine. It would be possible to consult with private companies in advance about the availability of such facilities in the event of an emergency.

As above, we have discussed the possibility of strengthening the redundancy of medical infrastructure, focusing on several types of facilities where infected persons with mild symptoms and asymptomatic carriers can recuperate. Due to the difficulties establishing redundancy of medical infrastructure, unlike economic infrastructure, the basic considerations are how quickly facilities can be employed to respond to the spread of infection, and whether or not their costs (including both during normal times and during a crisis) are affordable for each country. From those viewpoints, the first option would be to utilize existing public facilities as locations for recuperation during the spread of infection. The capacity to use public facilities in multiple ways should be a requirement for the society from a budget standpoint. The cases of National Women's Education Center, Kanagawa Prefecture, and Hyogo Prefecture were introduced as examples. Even if the number of secured rooms is not enough to respond to the peak of infection, we can create time to prepare for the next phase as they are functioning as the first choice for recuperation. In developing countries, as the government or state-owned-companies still own a significant share of facilities in the society, a scenario for their use in the event of spread of infection should be considered in advance.[39] The second option is the use of hotels. Hotels are excellent in terms of comfort of stay. On the other hand, the financial burden is also large. Using hotels, like Japan did, may not be possible for many of developing countries. However, in countries that have state-owned hotels, it is feasible to discuss how to utilize them to serve the public sector. The third option is the construction of temporary recuperation facilities. We introduced examples of Kanagawa Prefecture and the Nippon Foundation. If there is any suitable place, it would be a viable option for developing countries to construct recuperation facilities with a tent or similar structure in a field. In this case, it would be cost-saving if common use of such temporary houses can be materialized in the event of natural disasters, particularly in countries that have experienced a lot of disasters. For example, there is a possibility that cardboard simple beds, toilets, tents, and prefabricated facilities can be used in both disaster and pandemic situations. This is another multipurpose use. It might be better to rely on recuperation at home as a last resort if there is still a shortage of facilities, based on considerations for individual family's situations.

There is a difficulty in diverting general hospitals, as described above, and it is necessary to pay enough attention to a risk of nosocomial infection, especially in developing countries. General hospitals should primarily deal with patients who require hospitalization, such as infected persons with moderate symptoms, and we should be careful to regard unoccupied beds as a redundancy of medical infrastructure for infected persons with mild symptoms and asymptomatic carriers.

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the acceptance of persons with mild symptoms, although the acceptance was not actually made during the state of emergency period. It can be said that they played a role as redundancy in times of crisis (https://www.jica.go.jp/kansai/index.html).

[39] The case of South Korea is a good example globally. They accepted infected persons with mild symptoms and asymptomatic carriers after conducting a large-scale PCR test at a "Community Treatment Center," which used to be a training center owned by a private company. It was reported that the number of beds prepared exceeded the peak number of recuperating people.

6. Conclusion

This paper examined COVID-19, specifically, how recuperation facilities for infected persons with mild symptoms and asymptomatic carriers should be established, from the viewpoint of "Quality Growth." In particular, we focused on the redundancy among several factors to strengthen resilience and discuss the preparation of medical infrastructure. At the same time, we considered how best to reduce negative impacts that would hinder the growth. After all, if there is no cost constraint, we can be well prepared in any way we want. However, in the real world, there are restrictions on funds and allocations. More reserve capacity means that funds are not utilized in normal times, which is negative for growth. Since medical infrastructure, unlike economic infrastructure, is not by its nature operated with a certain volume of redundancy, this paper proposes that facilities used for different purposes in normal times should be the first option for recuperation facilities for infected persons with mild symptoms and asymptomatic carriers during a pandemic. In fact, Japan has been making efforts for a long time to make multiple use of public facilities during times of disaster, which is a typical event of external shock. Schools built in developing countries with Japan's grant aid are disaster-resilient and serve as regional shelters in the case of a large disaster.

In conclusion, this paper makes a proposal about how infected persons with mild symptoms and asymptomatic carriers should be accommodated in phases in response to the spread of infection from the viewpoint of "Quality Growth." Since there are limitations to increasing the number of hospital beds, the basic perspective is the multiple uses of facilities. Specifically, the first is the multiple use of public facilities, the second is the use of accommodation facilities, particularly the utilization of government-run facilities, the third is the construction of temporary facilities, and the last is having patients remain at home. Using homes increases the risk of infection, particularly among the poor, making this a less inclusive option. As for temporary facilities, preparation of multiple uses against disasters is desired. Development of a system that makes those sustainably possible is required.

As mentioned, discussions on medical infrastructure are not limited to medical facilities alone. Rather, it depends on the constraint of medical workers. This paper focused on the recuperation of infected persons with mild symptoms and asymptomatic carriers, care for whom places a smaller constraint on human resources. Moreover, there is little mention of the important issues of how to deal with patients with critical or moderate infections. In particular, to respond to infected persons with moderate symptoms it is very important to strengthen the resilience in terms of medical facilities, which include what plan should be used to divert general hospitals to those for infectious diseases in the event of sudden spread of infection, and how the costs for such diversion should be appropriated. We need to consider this as a future issue. In addition, this paper was written from the viewpoint of building resilience based on the viewpoint of growth, thus inclusiveness and sustainability are mentioned only to the extent to which they are relevant to growth. However, an inclusive and sustainable health system is essential in the long run to overcome vulnerability to infectious diseases. We need to consider the system from a broader perspective in the future.

The situations of the spread of COVID-19 are largely different among countries. Even countries that are not yet currently in dire circumstances could experience the pandemic if the spread of infection continues globally. COVID-19 seems to change the way medical infrastructure is built in developing countries. We would be delighted if this paper is helpful for further studies in the future.

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