

COVID-19 in Okayama Prefecture: Looking back and looking forward

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Abstract: In Japan, clinical and experimental studies addressing COVID-19 have been increasing in number since early February 2020, with many case reports being published. Concurrently, many notifications and guidelines have been issued from the government and academic societies. Taking optimal measures at the prefectural level as well as the national level is necessary to prevent the spread of COVID-19. Surveying and analyzing details of the incidences of infected persons in each prefecture is extremely important. This report describes the epidemiological characteristics of COVID-19 observed in Okayama Prefecture, followed by discussion of the direction of public health actions to be taken in the future. We reiterate the crucial importance of reinforcing and maintaining current public health measures, including rapid and detailed compilation of information related to infected persons and their surroundings, appropriate blocking of viral transmission, and early containment of infected persons, to minimize the spread of infection especially during the overlapping epidemic period of influenza in Okayama Prefecture.

Keywords: coronavirus disease 2019 (COVID-19), epidemic period of influenza, epidemiological survey, novel coronavirus pneumonia, Okayama University Hospital, public health actions

Introduction

COVID-19 is transmitted mainly through droplet infection, which occurs without coughs or sneezes in a poorly ventilated environment. Contact infection might also occur through nasal discharge or saliva. Although symptomatic patients comprise most infection sources, a non-negligible risk of infection is posed by asymptomatic carriers. The latent period is 1-14 days. Symptoms usually appear around 5 days after exposure (*I*).

Although infected people younger than 50 years of age (including children) are usually asymptomatic or only mildly symptomatic, the disease is more threatening and not infrequently fatal to people who are 60 years old or older. Patients might develop more severe symptoms when they have underlying diseases such as chronic respiratory disease, cardiovascular disease, hypertension, diabetes, severe obesity, hematologic tumor, and immunodeficiency.

The period during which infection can be transmitted to another person is regarded as being from 2 days before onset to 7-10 days after onset of symptoms. Not a small number of infected people have already infected other people by the time of onset. The viral level in the respiratory tract, along with high infectiousness, is also high in asymptomatic persons with infection. Viral excretion is presumed to peak from 1 day before onset

to the day of onset. It is likely that an infected person will spread infection with no knowledge of doing so. This characteristic differs from influenza (2).

Looking back on COVID-19 in Japan

In December 2019, an outbreak of novel coronavirus (severe acute respiratory syndrome coronavirus 2: SARS-CoV-2) pneumonia was reported in Wuhan, Hubei Province, China. Later, as the infection spread worldwide, the World Health Organization (WHO) declared a public health emergency on 30 January 2020. The first infected person in Japan was reported on 16 January 2020. COVID-19 was defined as a designated infectious disease by government ordinance on 1 February. The WHO declared COVID-19 a pandemic on 11 March 2020.

What actions were taken by the Government of Japan and the Ministry of Health, Labour and Welfare at this early stage of the pandemic? Under those circumstances, the Government of Japan declared a state of emergency from 16 April through 25 May for all prefectures. The government recommended that the nation adopt a lifestyle that includes reduction of contact with people by approximately 80%. It appears that a remarkable "lockdown"-like effect was achieved through the active participation of people. Apparently, Japan has

successfully controlled the numbers of infected persons and reduced the deaths to low levels in this way without legal restrictions (3).

New incidences of SARS-CoV-2 infection in Japan were markedly suppressed for approximately two months from late April through late June. However, the number of persons with infection increased rapidly thereafter. According to Japan's Ministry of Health, Labour and Welfare, a cumulative total of 78,847 persons with infection and 1,511 deaths had been confirmed in Japan as of 22 September 2020.

Looking back on COVID-19 in Okayama Prefecture and Okayama University Hospital

Japan experienced two waves of imported COVID-19 cases, after which local transmission occurred and the epidemic grew. In Okayama Prefecture, the first infected person was reported on 22 March 2020 in Okayama City. By 11 May 2020, the total number of COVID-19 cases reached 25 (forming the "first wave"). After a period with no new infection for 44 days, another infected person was identified on 24 June 2020 followed by an increasing number of persons with infection (forming the "second wave"). The Governor of Okayama Prefecture issued a strong message to people inside and outside the prefecture, asking them to "please refrain from moving across prefectural borders" before the long holiday from April to May at the early stage of the pandemic. The majority of the local people seemed to continue practices of universal masking and social distancing following the message, thereby contributing to the low number of infected persons in Okayama Prefecture.

The Okayama University Hospital is the designated medical institution for class I infectious diseases. It has been led under the strong leadership of its Director, who has vowed a policy of "Do not let patients die in Okayama Prefecture." The hospital has been holding morning meetings, attended by the medical counselor of the Okayama Prefectural Government, every week since 5 March 2020 and making immediate decisions on policy. The Director and eight assistant directors, including the corresponding author of this paper, have been discussing and sharing information about the medical care system in remote meetings with directors of major general hospitals, including three designated medical institutions for class II infectious diseases, in the prefecture every week since 8 April 2020. The chief of the health promotion section of the Okayama Prefectural Government and the director of the Okayama Healthcare Center also attended the meetings (4).

Various manuals have been prepared, and revised as appropriate, mainly by the Infection Control Team of the hospital. Medical doctors in the Infection Control Team have been on call 24 hours a day since the middle of March 2020. Those doctors joined the

cluster management team of the Okayama Prefectural Government and the contact tracing team of the Okayama Healthcare Center. As a result, our hospital has been in close cooperation with the Okayama Prefectural Government and the Okayama Healthcare Center.

Our hospital is the "last defense" against severe diseases in the Chugoku and Shikoku regions. For COVID-19 we conduct systemic management of patients in critical or severe conditions who will need advanced facilities, including extracorporeal life support. The other general hospitals provide medical care to patients mainly in moderate or mild conditions (4).

Epidemiological survey on COVID-19 in Okayama Prefecture

Actions suitable for the healthcare system of each prefecture are necessary to prevent the spread of COVID-19. For that purpose, surveying and analyzing details of the incidences of persons with infection in each prefecture is extremely important. However, reports have been insufficient to date. Recently, our group conducted a detailed survey of incidents of persons with SARS-CoV-2 infection in Okayama Prefecture and analyzed the current situation in Okayama, forming the basis for discussions on the direction of public health actions to be taken in the future (5).

The survey was performed using records from the Okayama Prefecture website and data from Sanyo Shimbun (digital version). We defined the period of the "first wave" as extending from 22 March through 11 May 2020, the "second wave" as extending from 24 June through 22 September 2020 and divided subjects into these two groups because no infections were reported (for 44 days) from 12 May through 23 June 2020. The last day of the survey has been extended from 24 August 2020 in Higashionna's paper (5) to 22 September 2020 in the present paper. The essential points of the results are summarized below:

i) The first wave and second wave included 25 patients and 123 patients, respectively. They included 15 males (15/23, 65%) among 23 cases in the first wave, and 67 males (67/117, 57%) among 117 cases in the second wave, excluding unknown cases (2 in the first wave, 6 in the second wave).

ii) Excluding unknown cases (1 in the first wave, 7 in the second wave), infected persons in their 50s accounted for 29% of the first wave and comprised the largest age group. Persons aged 50 years and older accounted for 54% of the total. In the second wave, infected persons in their 20s accounted for 41% which was the largest, followed by 30s for 13% and 40s for 16%. Persons aged 20-49 accounted for 70% of the total.

iii) Regarding the residence of persons infected with SARS-CoV-2, the locations with greater numbers were

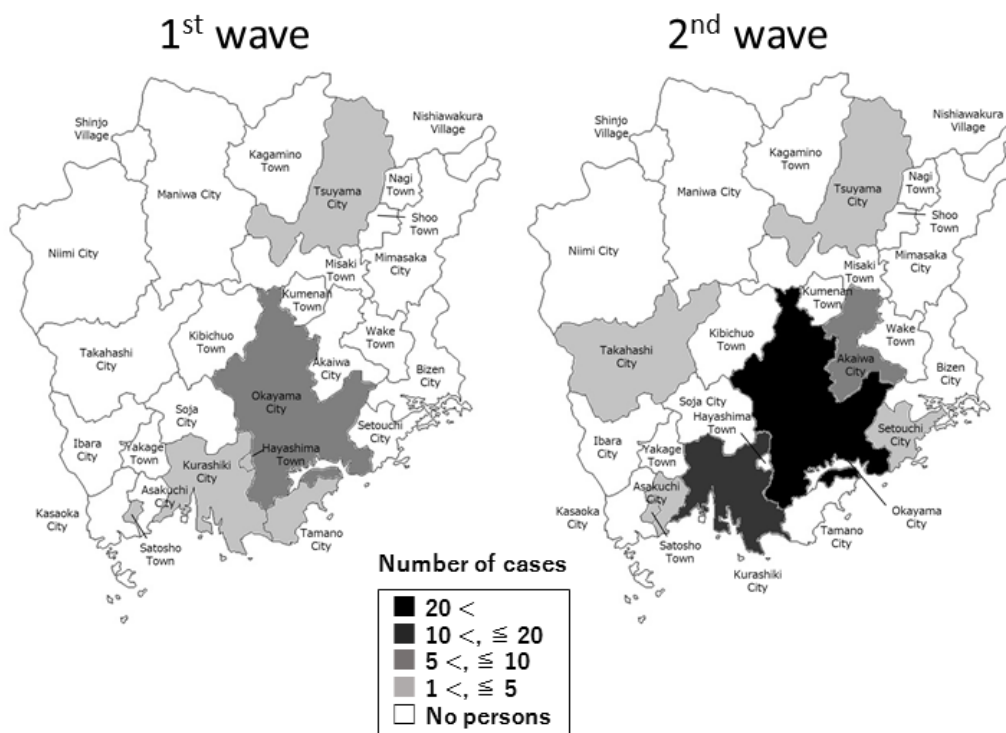


Figure 1. Geographic distribution of cases of SARS-CoV-2 infection (COVID-19) during the first and second waves in Okayama Prefecture.

Okayama, Hayashima, and Tsuyama in the first wave, and Okayama, Kurashiki, and Akaiwa in the second wave, in descending order. Okayama City residents accounted for 65% and 72% of the total in the first wave and second wave, respectively (Figure 1).

iv) Investigation excluding cases with unknown epidemiological link (6 persons in the first wave, 73 persons in the second wave) showed that infection between persons both aged at least 20 years occurred in 4 persons in the first wave, and in 47 persons in the second wave. One person in the first wave and 4 persons in the second wave were aged below 20 years and were infected from persons aged at least 20 years. All of these 5 persons were between 10 and 20 years of age. There were no cases of anyone under 20 years of age infecting anyone else.

v) No cluster was found in the first wave, although three clusters were identified in the second wave. All clusters occurred in Okayama City. The numbers of infected persons in the clusters were 5, 8, and 6, making 19 in all.

vi) For cases in which a person in close contact was positive, excluding cases with an unknown epidemiological link (sporadic cases, or the first case when infection spread in a specific group, or cases with unknown details), the time from the date on which the first case was confirmed positive by PCR to the date when a person in contact was confirmed positive by PCR (designated as "time to positive PCR") was surveyed. The mean time to positive PCR ± SD / median

(minimum - maximum) was 0.8 ± 0.8 days / 1 (0-2) days in the first wave (6 persons in total), and 2.0 ± 1.4 days / 2 (0-9) days in the second wave (73 persons in total).

Looking forward on COVID-19 in Okayama Prefecture

Japan comprises 47 administrative districts (prefectures), covering an area of 377,900 km² and supporting a population of 125.7 million (population density: 333 persons/km²). Okayama Prefecture, located in the southern part of the Chugoku region, faces the Seto Inland Sea, covers an area of 7,114 km², and has a population of 1.88 million (population density: 264 persons/km²).

The cumulative number of persons infected with SARS-CoV-2 as of 22 September 2020 was 148 including 1 person who tested positive again. The cumulative number was the second highest in the Chugoku and Shikoku regions following Hiroshima. However, the number of infected persons per 100,000 people was 7.8, which was the second lowest in the Chugoku and Shikoku regions, next to 6.5 in Tottori. Although cities and towns in the Chugoku and Shikoku regions are connected to urban areas such as Tokyo, Nagoya, and Osaka via the Okayama City traffic hub (JR Okayama station on the Sanyo Shinkansen line), the number of infected persons per population was remarkably smaller at the prefectural than the national level (62.4 per 100,000 people) (<https://web.sapmed>.

ac.jp/canmol/coronavirus/japan).

As shown in Figure 1, the incidence of infected persons in Okayama Prefecture tended to spread concentrically, centered on Okayama City in both the first wave and the second wave. In the future, strict infection control in Okayama City is expected to decrease the incidence of infection throughout Okayama Prefecture.

The percentage of infected persons aged 20 through 40 was higher in the second wave compared to the first wave. This trend matched the overall trend in Japan (1). However, of national concern is that infection might spread more among elderly people than young people in the near future. Reportedly, mortality in infected elderly people is much (over 100 times) higher than in infected young people. For that reason, the incidence by age group continues to attract attention (<https://vdata.nikkei.com/newsgraphics/coronavirus-japan-chart>).

Five persons in all were younger than 20 years (but older than 10) and had been infected by people aged 20 years or older. There were no reports of any persons under 20 years of age infecting anyone else. In Okayama Prefecture, it is estimated that the percentage of people below age 20 involved in infection transmission is rather small. It is intriguing that children in general are less

susceptible to severe COVID-19 (6).

Three incidences of SARS-CoV-2 cluster infections were observed, with a total of 19 patients in the second wave only. These occurred in entertainment establishments that serve beverages or food in Okayama City. The spread of infection was limited to a small scale. Presumably, a subsequent rapid increase in the number of infected persons was prevented by the following factors: surveys of persons in close contact, led by public health centers, were conducted rapidly; establishments where clusters occurred actively participated in surveys of surrounding persons; and the prefectural governor of Okayama emphasized and promoted the importance of compliance to the "New Lifestyle".

From the viewpoint of the "time to positive PCR", we can infer that public health centers in Okayama Prefecture responded rapidly. To prevent the subsequent spread of infection, it is important to rapidly provide instructions for infection prevention and conduct PCR testing for close contacts of infected persons at the appropriate time. Thorough surveys of persons in contact, assisted by the recently intensified PCR test system have led to the prevention of infection spread during the second wave in Okayama Prefecture.

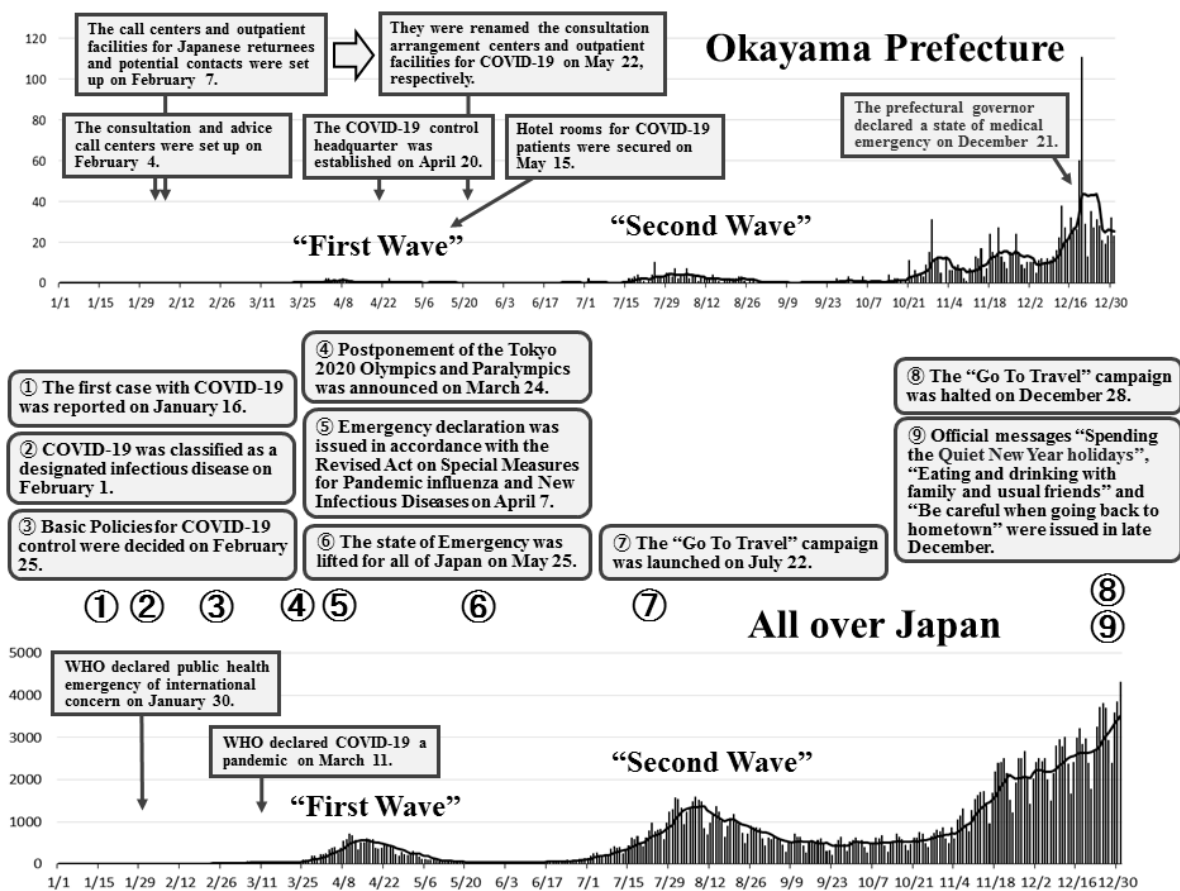


Figure 2. Confirmed cases of COVID-19. Daily numbers and 7-day averages of confirmed cases are plotted by reported date (January 16, 2020 to December 31, 2020) in Okayama Prefecture (top panel) and all over Japan (bottom panel). Major epidemic response actions taken by the Japanese Government (from ① to ⑨) are shown.

Future direction of public health action in Okayama Prefecture

Just before the submission of the first draft of our manuscript, we found that several prefectures in Japan were experiencing a resurgence of COVID-19 cases (7). Around late October, several clusters of COVID-19 cases occurred mostly in non-urban areas in Okayama Prefecture. Apparently, the virus resurged along with resumption of socioeconomic activities.

As of 31 December 2020, the number of confirmed cases in Japan reached 232,495, with 3,459 deaths (fatality rate: 1.5%) (https://www.mhlw.go.jp/stf/newpage_15831.html), whereas the number of confirmed cases in Okayama Prefecture reached 1,363, with 15 deaths (fatality rate: 1.1%) (<https://www.pref.okayama.jp/page/700024.html>, <https://www.pref.okayama.jp/page/667843.html#shibou>). Therefore, Okayama Prefecture can still be regarded as a region that is not severely affected by COVID-19 (Figure 2).

The Okayama University Hospital has treated 38 patients with COVID-19. Most of them were in critical or severe clinical condition, with two patients subsequently requiring extracorporeal life support. Their ages ranged from 26 to 90 years, with a median age of 60 years (mean \pm SD: 57 \pm 20); and 20 (53%) were male. No patient has died at our hospital. As additional information, we report that the Emergency Rescue Team of the hospital has developed the portable transparent vinyl chloride shield as a feasible tool to securely cover the face of the COVID-19-positive patient during emergency transport (8).

To prevent the spread of COVID-19, the National Institute of Infectious Diseases emphasizes the importance of taking action at the national and prefectural (not just local) levels. Considering the mode of transmission of SARS-CoV-2, high prevalence of COVID-19 is expected to prevail during and after November 2020, particularly because of its overlap with the epidemic period of influenza (2). It is critical to continue efforts in containment of SARS-CoV-2 transmission at an early phase, thereby simultaneously preventing infection spread and maintaining socioeconomic activities.

In conclusion, we infer the crucial importance of reinforcing and maintaining current public health measures including rapid and detailed comprehension of information related to infected persons and their surroundings, appropriate blocking of viral transmission, and early containment of infected persons. By doing so, it will be possible to minimize the infection spread

and overlapping of the epidemic period of influenza in Okayama Prefecture, where the numbers of cases and deaths are fewer than those of more densely populated prefectures such as Tokyo, Osaka, Kanagawa, Aichi, and Saitama.

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