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LETTER

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Perspectives on countermeasures against COVID-19 in the remote islands of Yaeyama region, Okinawa, Japan

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Abstract: Numerous difficulties unique to remote island regions exist in the fight against coronavirus disease 2019 (COVID-19). For example, in the Yaeyama Medical Region (Okinawa, Japan), there are only clinics without beds on constituent islands. As medical resources are limited on remote islands, a single outbreak can put the entire medical system at risk. In addition, local governments need to maintain economic support while taking measures to contain outbreaks. For future COVID-19 countermeasures, it is essential to establish a response team in the regional hospital to conduct on-site epidemiological surveys as early as possible in a pandemic. In addition, distributing effective oral antivirals to remote islands may reduce the spread of infection and the number of severe cases requiring off-region transfer.

***Keywords*:** epidemiological surveys, off-region transfer, infection control, oral antivirals

Okinawa Prefecture is located in southwestern Japan and comprises 160 islands (*1*). The most southwestern part of Okinawa is the Yaeyama Medical Region, with a population of approximately 50,000. The regional hospital (Okinawa Prefectural Yaeyama Hospital) located on Ishigaki Island, the main island, plays a pivotal role in the medical system of the region. It is surrounded by small- and medium-sized outlying islands (Iriomote, Kohama, Hateruma, Taketomi, Yonaguni, and Kuroshima), where clinics without beds are the only medical facilities, and barely inhabited remote islands (Hatoma and Aragusuku) without clinics. For simplicity, small- and medium-sized outlying islands without inpatient beds are referred to as "remote islands". Each clinic in the Yaeyama region is staffed by only one doctor and nurse, with no inpatient facilities. Patients who require advanced medical care are transferred to the regional hospital in Ishigaki Island or the larger hospitals in mainland Okinawa only when the weather and the situation permit. The Japan Coast Guard and Ground Self-Defense Force are primarily responsible for transfers. However, clinics provide adequate non-critical health care because the staff are familiar with inhabitants' health status and social backgrounds.

The Yaeyama Medical Region has experienced numerous outbreaks since its first coronavirus disease 2019 (COVID-19) case in April 2020. By January 2022, three large outbreaks that required external assistance occurred in the Yaeyama region. One of them occurred in a nursing home on the remote Yonaguni Island (*2*), and the others occurred on Ishigaki Island. Assistance received included medical resources and staff from the Okinawa Prefectural Headquarters for COVID-19 (the Headquarters), the Disaster Medical Assistant Team (DMAT; a Japanese governmental medical aid team dispatched in disasters) (*3*), and Japan Heart (a nonprofit organization) (*4*). The head of the chain of command for COVID-19 measures is the prefectural governor, under whom the Headquarters has been established. COVID-19 countermeasures on remote islands involve a variety of region-specific difficulties:

i) Limited medical resources because of geographical factors When a COVID-19 outbreak occurs on remote islands, interventions such as epidemiological surveys and treatment of patients with severe disease can be conducted with support from the regional hospital. When large outbreaks occur, especially in nursing facilities on remote islands, assistance from outside the region is often required. In such situations, only minimal on-site treatment such as oxygen supply from temporary oxygen tanks, oral dexamethasone, and intravenous neutralizing antibodies can be provided.

Moreover, although the regional hospital has an intensive care unit with several beds, it does not have advanced medical equipment such as extracorporeal membrane oxygenation. In a large outbreak in a nursing facility in Yonaguni Island, more than 30 facilities

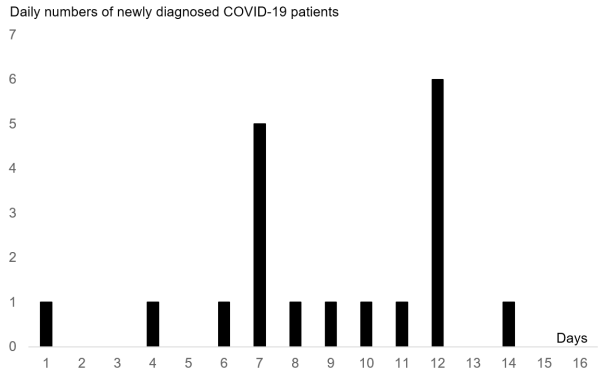

Figure 1. Residents who tested positive by nasal pharyngeal swab severe acute respiratory syndrome coronavirus 2 (SARS CoV 2) PCR test in the primary cluster in Iriomote Island, the largest remote island in the Yaeyama region, in July 2020. Eighteen residents were diagnosed with COVID-19, and none developed severe disease requiring oxygen supply. The vertical axis displays the number of patients with disease onset occurring each day. On the horizontal axis, "days" shows the number of days between "day 1" to the day of disease onset for each patient. "Day 1" is when the first COVID-19 patient was diagnosed on Iriomote Island.

residents were infected (*2*). Transferring these patients to the main island was almost unfeasible, and they were treated with steroids and neutralizing antibodies on site.

ii) Closer household ties Remote island residents generally have closer household ties than urban residents. This can be a drawback in preventing the spread of infection and protecting the privacy of those affected.

iii) Downside effect on the economy Almost all remote islands depend on tourism for financial support. However, measures to prevent infection, such as shortening operating hours or banning alcohol, often conflict with promoting economic activities.

The solutions currently in place include the following:

i) Early implementation of an epidemiological survey In the Yaeyama region, the first COVID-19 cluster was successfully suppressed in western Iriomote Island in July 2020, before COVID-19 vaccines were available. Medical staff from the regional hospital were dispatched twice to conduct real-time polymerase chain reaction (RT-PCR) testing of nasal pharyngeal swabs to detect Severe Acute Respiratory Syndrome Coronavirus 2. Among 69 residents who had contact with COVID-19 patients, 18 tested positive (Figure 1), but no severe cases were reported. This experience suggests that early implementation of on-site epidemiological surveys and quarantine may reduce the impact ("COVID-19 Countermeasures in Small Remote Islands - An On-Site Study on Cluster Response that Occurred in the Western District of Iriomote Island" from the first author's presentation at the Joint Conference on Global Health 2020, Tokyo, Japan).

ii) Active promotion of infection prevention and vaccination Hospitals, clinics, and local governments in the Yaeyama region have raised residents' awareness of COVID-19. Grassroots campaigns have been effective because of the small population. By March 2022, more than 95% of residents aged over 65 years in the Yaeyama region had received at least one dose of vaccine.Moreover, in Ishigaki City, 82.5% of residents aged > 65 years had received three doses by March 14, 2022. This coverage far exceeds the national (69.9% on March 14, 2022) and prefectural (approximately 60% on March 7, 2022) averages in the same week (*5*).

Vaccination is crucial to reduce the number of off-island patient transportation and reliance on outside assistance. In addition, minimizing the number of residents with COVID-19 is beneficial to the region's economy.

iii) Active promotion of antigen testing and oral antivirals Although the Yaeyama region has some experience in controlling COVID-19 outbreaks on remote islands, establishing a fixed emergency response team and scheme to dispatch medical staff from the main island is ongoing. In addition, we suggest lowering the antigen testing threshold (using PCR, if available) on remote islands. Without this, future larger outbreaks may be challenging to manage and cause substantial damage.

We also propose to expand treatment options at remote island clinics. For example, oral antivirals are more straightforward to administer than intravenous agents, as there is no space for infectious patients in small clinics. Furthermore, oral antivirals could reduce the risk of severe disease and the need for off-region transfer.

As of March 2022, no COVID-19-specific medications have been provided to remote islands in the Yaeyama region beyond Ishigaki Island. We suggest that government, local authorities, and pharmaceutical companies prioritize remote islands to distribute the latest drugs.

In conclusion, delivering quality and quantity of health care on remote islands poses many challenges. There is an urgent need to establish specific countermeasures, considering the region-specific background and the latest evidence.

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