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Saliva Pcr Testing as a Covid-19 Screening Strategy for Passengers Traveling Remote Islands

Moto Kimura[1*], Junko Terada-Hirashima[4], Wataru Sugiura[2], Yosuke Shimizu[3], Yurika Tanaka[1], Yukari Uemura[3], Masahiro Ishikane[5], Yukumasa Kazuyama[6], Masato Ikeda[6], Kazuhiko Wakabayashi[7], Norio Ohmagari[5]

[1]Department of Clinical Science, National Center for Global Health and Medicine, Tokyo, Japan*

[2]Department of Clinical Science, National Center for Global Health and Medicine, Tokyo, Japan.

[3]Department of Data Science , National Center for Global Health and Medicine, Tokyo, Japan.

[4]Department of Clinical Research Promotion, National Center for Global Health and Medicine, Tokyo, Japan.

[5]Department of Disease Control and Prevention Center, Hospital of the National Center for Global Health and Medicine, Tokyo, Japan.

[6]Department of Clinical Research, SB Coronavirus Inspection Center Corporation, Chiba, Japan

[7]Department of Clinical Research, Tokyo Metropolitan Government Bureau of General Affairs, Tokyo, Japan

Correspondence to: Kimura M, Department of Clinical Science, National Center for Global Health and Medicine, Tokyo, Japan,Ph: 81332027181; E-mail: mkimura@hosp.ncgm.go.jp

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Abstract

Quarantine of coronavirus disease 2019 (COVID-19) in remote islands with weak medical systems is an important issue. We evaluated the usefulness of ship pre-boarding saliva polymerase chain reaction as a quarantine tool to prevent the spread of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) to Chichijima island by people headed to the island, which is far from the Japanese mainland. The infection rate on the island during the study period was 0.015% (2/13,448). Of the 8,910 individuals tested before boarding the ship during this study, 7 people tested positive by saliva PCR and one of them also tested positive by nasopharyngeal swab test. The quarantine strategy implemented in this study can be used as a reference for quarantine strategies in other remote islands with medical depopulation, where outbreaks must never occur.

Keywords: Saliva; Pcr Testing; Covid-19

Introduction

Since the beginning of the coronavirus disease 2019 (COVID-19) pandemic in March 2020, the high transmission rate of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) has been of great concern as one infected person can easily and quickly transmit the virus to others and form clusters. As experienced in 2020, spending a long time with an infected individual in a closed space like a passenger ship increases the risk of infection significantly [1]. Japanese government has declared a state of emergency for the nation's capital areas as Covid-19 cases surge to the highest levels since the start to the pandemic. Under a new state of emergency for 8th Jan 2021 to 21th Mar 2021, the government required restaurants, bars, and karaoke parlours serving alcohol to close, and big sporting events to be held without spectators.

Chichijima, a small island, which is a part of the Ogasawara Islands, is inhabited by approximately 2,152 residents [2]. It is located 1,000 km south of central Tokyo, and the only way to access this island is by ship, which takes about 24 h from mainland Tokyo to reach Chichijima. The island has only one clinic, which is not fully equipped to manage cases of severe COVID-19. If any individual on the island has symptoms of suspected SARS-CoV-2 infection, such as fever and cough, they will be tested for lateral flow-based rapid antigen test that does not require any special equipment using nasopharyngeal swabs. , Subsequently, transported to the specified hospital in Tokyo, if found positive. Even for negative results, if there is a strong suspicion of SARS-CoV-2 infection, the specimen will be transported to the mainland for PCR testing. A suspected case or cases that test positive for antigens would have to be transported to the mainland by Self Defense Force helicopter to prevent the spread of the infection. To lower the risk of an outbreak and keep the island safe from the pandemic, it is necessary to screen passengers before they travel from the mainland to Chichijima Island by pre-boarding polymerase chain reaction (PCR) testing.

Location of Chichijima, route from Tokyo to Chichijima. “Electronic Topographic Map 25000 (Geospatial Information Authority of Japan)” was processed and created. The enlarged map is provided by OgasawaraKaiun Co., Ltd.

Following this concept, the Tokyo Metropolitan Government conducted a saliva SARS-CoV-2 PCR test for all passengers planning to board a regular ship to Chichijima between September 1, 2020, and March 31, 2021. Here, we report the importance of extensive PCR testing in screening people who might be infected with SARS-CoV-2 but are asymptomatic, thereby facilitating quarantine measures.

Materials and Methods

Saliva collection kits were distributed free of charge to those wishing to travel to the island from the mainland one week before embarkation. Saliva collection is a non-invasive and simple method that can be performed by the passengers themselves, with little risk of exposure to the person collecting the sample [3]. Self-collected saliva at least 24 h prior to boarding was used as the sample for the screening test. All specimens were sent to a diagnostic company by post at room temperature, SB Coronavirus Inspection Center Corp., and "SARS-CoV-2 Direct Detection RT-qPCR Kit" (Takara Bio Inc.) was used for testing as per the manufacturer's instructions [4]. During the seven-month study period, 34 round trips were operated, and of the 11,372 inspection subjects attempting to board the ship, 8,910 agreed to take the PCR test before boarding (a testing rate of 78.4%). There were no vaccinations available in Japan during this period.

Coronavirus disease 2019 (COVID-19) occurring in Tokyo (orange line), number of passengers to Chichijima island (green line), and inspection subject rate of saliva PCR inspection before abroad (blue line), September 1, 2020, to March 31, 2021. The red squares indicate COVID-19 cases that occurred within Chichijima. Orange circles indicate patients who tested positive for saliva PCR prior to boarding. The period of emergency declaration is indicated by the orange area [5].

Of the seven individuals who tested positive based on the screening test, one was confirmed by a subsequent confirmatory PCR test at a COVID-19 designated hospital in Tokyo. The other six had negative results in confirmation PCR tests performed 2–3 days later. To understand the discrepancies between the screening and confirmation tests, we checked the Ct values of the screening test and found that all values were around the boundary of the detection limit (Ct <40.0), which suggests that there were false positives or viral copies were below the detection limits at the time of the second test. All seven individuals did not board the ship [6].

Ethical approvalAll saliva samples prior to testing have been processed in such a way that they cannot be used to identify a specific individual and that no personal data can be recovered. Testing is carried out on people aged 6 years and over. As it was anticipated that approximately 400 subjects would participate per boarding, it was deemed difficult to obtain individual written consent. Although written consent was not obtained for this study, information about the study was made available on the National Center for Global Health and Medicine website. Patients can therefore decline to participate in the study. Opt-out consent was approved for this study by the Institutional Review Board of National Center for Global Health and Medicine. The ethical review approval number for this study is No. NCGM-G-003678-00 [7].

Results and Discussion

Till March 2021, only two confirmed COVID-19 cases had been reported at Chichijima. The first case was a passenger who had a negative PCR test at the time of boarding. As there was a 7-day interval between the pre-boarding screening and the diagnosis, the case must have been in the "window period" at the time of screening. The second case, a resident of the island, was in close contact with the first case who was infected on the island. During this period, Ogasawara Village required all visitors to take their temperature and wear a mask, and restricted large groups of visitors. In addition, the number of people on board the ships was reduced by 30% to 50%, and the ships were regularly ventilation and sterilization.

So far, considering the number of residents and visitors to the island, the incidence of COVID-19 was 0.015% (2/13,448). Although it took 24 h to reach Chichijima and there was a high risk of infection on board, the percentage of infected people was relatively low compared to other islands in Tokyo (Table 1). Furthermore, the cumulative number of infected persons and the ratio of infected persons to population in Tokyo during the study period were 64067 and 0.45%, respectively, and the infection rate in Chichijima is much lower than in Tokyo. Of the 8,910 individuals tested before boarding the ship during this study, 7 were found positive on saliva PCR and 1 on nasopharyngeal swab tests. Thus the rate of infection appears to be low, and one might think that the low number of SARS-CoV-2 positive people in Japan might have led to this result. However, another remote island with direct flights from Tokyo had no special quarantine system with daily reports of several cases of COVID-19 (5). On an island as far away as Chichijima, which takes 24 h to reach from central Japan, preventing an outbreak of COVID-19 is imperative. In this regards, the pre-boarding PCR test to Chichijima was a crucial screening measure in preventing the COVID-19 outbreak on the island.

Island information		Chichijima	Hachijojima	Izu Oshima	Niijima	Kozushima	Miyakejima
Population*		2,152	7,224	7,411	2,121	1,887	2,383
Distance from central Tokyo (km)		1,000	287	120	150	178	180
Travel time (h)	Large ship	24.0	10.3	6.0–8.0	10.6	12.0	6.5
	Small ship	-	-	1.75	2.9	3.75	-
	Airplane	-	0.9	0.4	0.6	0.75	0.8
Passenger	Airplane	-	32,454	16,125	5,931	4,424	4,779
	Ship	11,296	5,252	50,436	6,324	6,327	9,951
Short term and long term Residents		13,448	44,930	73,972	14,376	12,638	17,113
COVID-19 positive		2	10	21	0	1	5
COVID-19 positive ratio† (%)		0.015	0.022	0.028	0	0.008	0.029

Inspection before boarding	Yes	No	No	No	No	No
Clinics	1	2	2	2	1	1

Table 1: Travel time, population, passengers, COVID-19 positive ratio, and medical clinic information on each island in Tokyo.

* Jan-1-2021

† COVID-19 positive ratio is calculated as Ratio = Number of COVID-19 positive / (Passenger + Population) × 100.

To understand the general profile of the passengers, several questions were asked to the participants undergoing PCR, as indicated in Table 2. Interestingly, even during the pandemic, the major reason for boarding was tourism (48.2%), followed by business (33.1%), residence (11.4%), and homecoming (5.4%). There were more men (n = 5,836) than women (n = 3,021), and the average age was 43.3 ± 16.7 years. The average body temperature at the time of examination was 36.2 ± 0.4℃. There were 81 (0.91%) participants who reported some symptoms on the day before boarding, but all tested negative for COVID-19.

Participants to be inspected *, No.		11,372
Tested participant, No.		8,910
Inspection rate, %		78.4
Passenger†, No.		11,296
Age, average ± SD‡		43.3 ± 16.7
Sex, No. (%)		
	Male	5,836 (65.5)
	Female	3,021 (33.9)
	Not available	53 (0.6)
Time after meal to inspection, h		7.4 ± 3.9
Symptoms, No. (%)		
	body temperature (℃)	36.2 ± 0.4
	Cough and phlegm	66 (0.7)
	feeling of fatigue	11 (0.1)
	olfactory impairment	2 (0.02)
	Dysgeusia	2 (0.02)
	No Symptoms	8,702 (97.7)
Reasons for visiting the island, No. (%)		
	Residence	1,012 (11.4)
	Retreat	477 (5.4)
	Business	2,946 (33.1)
	Sightseeing	4,299 (48.2)
	Others	286 (3.2)

Table 2: Profiles of pre-boarding PCR participants.

*All prospective passengers, except those aged <6 years, are considered for inspection.

†Actual number of passengers on board, including those aged <6 years

‡SD, standard deviation

Conclusion

Although the pre-boarding PCR has been successful until now, with few COVID-19 cases being reported on the island, the following limitations of this pre-boarding testing should be considered. First, as the pre-boarding test was voluntary, only 78.4% of the passengers agreed to take the test. The reasons for not taking the test were not clear but may include fear of being identified as infected and not being

allowed to board the ship. It is interesting to note that during the period of the emergency (January 8, 2021, to March 21, 2021), the percentage of pre-boarding PCR testing significantly increased from 72.4% to 92.2% (Student's t-test, $p < 0.001$). The emergency declaration might have led to behavioral changes in people. Second, the sensitivity and specificity of saliva tests have been reported to be 86.4% (95% confidence interval [CI] 82.8%–89.4%) and 97.0% (95% CI 95.0%–98.3%), respectively [6]. Further, the specimens were self-collected, i.e., there was a risk of improper collections. These would increase the ratio of false-negative PCR results. Third, individuals in early stages of COVID-19 may be in the "window period" [7], wherein the tests may be negative. Finally, it is possible that the medical system has failed to identify all cases of COVID-19. However, as mentioned earlier, adequate antigen testing could be performed in Chichijima, and when necessary, specimens were sent to hospitals in central Japan for PCR testing even if the antigen was negative. It is believed that this approach was effective in identifying all cases of COVID-19 on the island. While there are no simple actions to address the above limitations, it is crucial to educate people that false-negative PCR test results are possible, and highlight the need to continue observing standard precautions during the cruise.

In conclusion, we succeeded in preventing an outbreak of COVID-19 in Chichijima by screening visitors traveling to the remote island via pre-boarding PCR testing. For an island where it takes a long time to reach appropriate medical care facilities, preventing an outbreak is crucial. The quarantine strategy implemented in this study may be adopted for quarantine strategies for similar remote islands in other regions.

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Dr. Terada-Hirashima is a respiratory medicine specialist at Center Hospital of the National Center for Global Health and Medicine, Tokyo, Japan. Her primary research interests are clinical research and allergy.

References

1. Baraniuk C. (2020) What the Diamond Princess taught the world about covid-19. BMJ. 369:1632.
2. Ogasawara Village Office [Internet]. Tokyo: Ogasawara Village; c2021 [cited 2021 May 14].
3. Norizuki M, Hachiya M, Motohashi A, Moriya A, Mezaki K,et al.(2021) Effective screening strategies for detection of asymptomatic COVID-19 travelers at airport quarantine stations: Exploratory findings in Japan. Glob Health Med. 3:107-111.
4. Nagura-Ikeda M, Imai K, Tabata S, Miyoshi K, Murahara N, et al.(2020) Clinical Evaluation of Self-Collected Saliva by Quantitative Reverse Transcription-PCR (RT-qPCR), Direct RT-qPCR, Reverse Transcription-Loop-Mediated Isothermal Amplification, and a Rapid Antigen Test To Diagnose COVID-19. J Clin Microbiol. 58:e01438-20.
5. Ishigaki City Office [Internet].Okinawa: Ishigaki City; [cited 2021 June 7].
6. Zhu J, Guo J, Xu Y, Chen X. (2020) Viral dynamics of SARS-CoV-2 in saliva from infected patients. J Infect. 81:e48-e50.
7. Kucirka LM, Lauer SA, Laeyendecker O, Boon D, Lessler J, et al.(2020) Variation in False-Negative Rate of Reverse Transcriptase Polymerase Chain Reaction-Based SARS-CoV-2 Tests by Time Since Exposure. Ann Intern Med.173:262-267.