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## Floating countries and corona pandemic: Impact of COVID-19 on stranded Cruise ships

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### ABSTRACT

Cruise ships transport a significant number of people in confined spaces over an extended period than other modes of transportation, thereby presenting a unique environment to elevate human-to-human transmitted infections. The overcrowded public rooms, congested accommodations, standard food supplies, and shared sanitary facilities encourage the transmission of infectious diseases by affected persons and through contaminated food, water and surfaces. A novel coronavirus (COVID-19) originating from Wuhan, China in November 2019 spread globally. Unfortunately, Diamond Princess is the first cruise ship on board to have an outbreak of COVID-19 with 3711 passengers and crew members. It began from Yokohama on January 20, 2020, and was supposed to return to Yokohama on February 3 2020. An 80-year-old male passenger, who debarked in Hong Kong on January 25 2020, tested positive for COVID-19 on February 1. Diamond Princess was immediately ordered to stay in the ocean and follow quarantine measures near Yokohama from February 3 onwards. Several other cruise ships such as the Grand Princess, MS Westerdam, Zaandam, etc. had COVID-19 outbreaks onboard. The failure to isolate the crew at the very beginning of quarantine resulted in further transmission of the virus to the passengers and crew. In conclusion, the compact conditions in the cruise ships with high population density amplified the transmission of COVID-19, mainly driven by contact rate and mixing effects.



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### INTRODUCTION

It is a general observation of Cruise ships - they are isolated communities having a large density of population with overcrowded public rooms, congested accommodations, standard supplies of food

and beverages, and shared sanitary facilities. This condition may encourage the transmission of infectious diseases by affected persons and through contaminated food, water and surfaces (Dahl, 2020). Besides, it is challenging to manage outbreaks in ships, particularly during the quarantine of a large number of travellers and crew members on board. Cruise ships transport a significant number of people in confined spaces over a prolonged period than other modes of transportation, thereby presenting a unique environment to elevate human-to-human transmitted infections (Rocklöv *et al.*, 2020). A study of the epidemiology of illnesses among the travellers and crew members on cruise ships demonstrated that the predominant infectious conditions requiring medical attention were respiratory tract infections (Kak, 2015).

A novel coronavirus disease 2019 (COVID-19) origi-

nating from Wuhan, China during early December of 2019 spread globally into a pandemic accompanied with panic and chaos (Zhang *et al.*, 2020). As per the World Health Organization (WHO), it must be looked upon as “Public Enemy Number 1” as it “poses a very grave threat for the rest of the world” (Dahl, 2020). The long incubation period of 2-14 days makes COVID-19 particularly challenging for the cruise ships, thus, subjecting them to a lengthy quarantine period (Dahl, 2020). The evidence collected from various sources indicates that COVID-19 extensively spreads in confined settings like hospitals, prisons, cruise ships and religious places (Mizumoto and Chowell, 2020). Pandemic outbreaks in restricted settings require investigation of the changes in the active reproduction number occurring as a consequence of interventional strategies such as quarantine and self-isolation of the travellers and crew members on board (Mizumoto *et al.*, 2020). The susceptibility of cruise ships to the outbreaks of infectious diseases is also due to close contact of passengers from different countries and crew transfers among ships. Diamond Princess is the first cruise ship to be quarantined onboard due to COVID-19 outbreak, following which several other cruise ships have been identified (Moriarty *et al.*, 2020). Initially, it was presumed that the infection would not spread from the ship aboard, and those who were either asymptomatic or COVID-19 negative were to be immediately disembarked. However, insufficient medical resources can lead to emergency medical resource allocation issues (Nakazawa *et al.*, 2020). In Tokyo, Japan, a party inside Yakatabune, a traditional wooden ship, was linked to most of the reported infections (Mizumoto and Chowell, 2020).

Often the typical cruise passenger is an elderly individual and may have chronic illnesses, which can predispose him or her to several types of infection and its complications (Kak, 2015). The individuals onboard above the age of 70 years or presenting with co-morbidities were the most susceptible to COVID-19 (Dahl, 2020; Moriarty *et al.*, 2020; Rocklöv *et al.*, 2020). Besides, a couple of ship’s medical staff also experienced mental and medical health strain of their own (Russell *et al.*, 2020). The passengers usually have distinct health status inside the cruise ship owing to their different culture and home countries, health requirements while boarding a vessel for multi-week, or variations associated with socioeconomic status or co-morbidities (Russell *et al.*, 2020). Another crucial epidemiological parameter to combat COVID-19, which describes the intensity and range of social distancing strategies is the asymptomatic proportion of patients (Russell *et al.*, 2020). There is evidence that reveals a

substantial fraction of COVID-19 infected individuals are asymptomatic (Mizumoto *et al.*, 2020).

### DIAMOND PRINCESS

The Diamond Princess can be called an infection model of a community (Xu *et al.*, 2020). It is the first cruise ship on board, which experienced an outbreak of Covid-19 with 3711 passengers and crew members. It voyaged from Yokohama on January 20, 2020, with stops in Kagoshima, Hong Kong, Vietnam, Taiwan and Okinawa to its destination at Yokohama on February 3 Dahl (2020) (Dahl, n.d.). A traveller, who debarked in Hong Kong on January 25, tested COVID-19 positive on February 1. On February 3, Diamond Princess was requested to stay in the ocean near Yokohama, with no passengers or crew disembarking and the ship was quarantined for 14 days until February 17 (Dahl, 2020). The testing was conducted by PCR, prioritising the symptomatic or high-risk groups (Mizumoto *et al.*, 2020). Shortly after the quarantining the Diamond Princess, some passengers tested COVID-19 positive and were hospitalised ashore, whereas, the rest were quarantined on board (Dahl, 2020).

As per the collected evidence, the peak time of infection occurred from 2 to February 4, and the incidence abruptly declined afterwards (Nishiura, 2020). During the quarantine, the number of positive subjects increased steadily. Since its incubation time is 2–14 days or more, quarantine of the ship for 14 days was mandatory for all the exposed individuals (Dahl, 2020; Xu *et al.*, 2020). On February 27, all guests were disembarked (Dahl, 2020). During the early stages of the pandemic, it had the largest outbreak outside the mainland of China (Dahl, 2020; Moriarty *et al.*, 2020). Since one quarantine officer, one administrative officer and one nurse developed COVID-19 onboard, the infection risk was persistent in the ship (Mizumoto and Chowell, 2020). Interviews with the nine COVID-19 positive crew members implied that the infection was widespread among persons whose cabins were on the same deck (deck 3) and who worked in the foodservice, probably through droplet or contact spread (Kakimoto *et al.*, 2020). After quarantine began, crew members carried on their regular duties, delivered meals individually to cabins, and stayed in their cabins when they were not working, while the symptomatic crew members remained in quarantine in their cabins (Kakimoto *et al.*, 2020).

### GRAND PRINCESS

Between February 11, 2020, and February 21 2020, the Grand Princess travelled roundtrip from San

San Francisco, California with four stops in Mexico (first voyage). Majority of the 1,111 crew and 68 passengers from the first voyage stayed on board for a second trip, which left San Francisco on February 21 (second voyage) to return on March 7 (Moriarty *et al.*, 2020). During the second voyage, several crew members and travellers developed "flu-like symptoms", and on March 5, a response team was sent to gather specimens from 45 passengers and crew members, out of which 21, including 19 crew members and two passengers, had positive test results for COVID-19. They were then quarantined in their cabins, and room service was provided to them individually until debarkation. On March 8, after docking in Oakland, California, the travellers and crew members were transferred ashore for a full quarantine period of 14 days (Moriarty *et al.*, 2020).

As of March 21, 78 passengers and crew members tested positive. After the disinfection of the vessel according to guidance from the Centers of Disease Control and Prevention's (CDC) Vessel Sanitation Program, the remaining foreign nationals were requested to undergo full quarantine onboard (Moriarty *et al.*, 2020). The Grand Princess is an example of continuous transmission of the virus from the crew members across several successive voyages and the prospective infection to the crew and travellers on other ships (Moriarty *et al.*, 2020).

### ADDITIONAL SHIPS

The Cruise ship MS Westerdam sailed from Hong Kong on February 1, 2020, travelling through Kaohsiung on February 5 to Ishigaki Port in Japan (Nakazawa *et al.*, 2020). Japanese government prohibited it from docking at Naha port due to suspected COVID-19 infection, but on February 12, Cambodia allowed MS Westerdam to dock and disembarked passengers (Nakazawa *et al.*, 2020). Another Cruise ship, Zaandam sailed from Argentina, on March 7, 2020, to San Antonio, Chile with 586 crew and 1,243 passengers (Berhe *et al.*, 2020; Vashist, 2020). On April 1, 8 out of 190 suspected travellers and crew members tested positive for COVID-19 (Berhe *et al.*, 2020; Vashist, 2020). Since February, several international cruises reported COVID-19 cases (Moriarty *et al.*, 2020).

### HIGHLIGHTS

During quarantine in the cruise ship, crew members provided all forms of additional services individually to the passenger cabins. However, they were not trained to run the quarantined ship (Dahl, 2020). The passengers, as well as the crew members, sig-

nificantly felt helpless and anxious with varying extents of mental and physical enervation. Moreover, additional services such as increased security and safety measures, assigned daily housekeeping tasks, foodservice to individual cabins under the infectious state, etc. were undertaken by the crew members (Mizumoto *et al.*, 2020). Although on the second day of quarantine (February 5 2020), there was a shortage of medicines in quarantined Diamond Princess, to which MHLW responded quickly on the day seven by supplying medications to the patients with heart diseases and diabetes, there still was a shortage (Nakazawa *et al.*, 2020). There was a delay in the testing of the crew, and a testing inclination was observed towards testing more travellers than the crew members (Rocklöv *et al.*, 2020).

The prime goal of the quarantine of the cruise ships was to prevent the exposure of potentially infected travellers and crew members to the public ashore (Dahl, 2020). Travellers on board stayed in their rooms, wore masks, walked on the deck for a few minutes every day, and maintained social distancing (Xu *et al.*, 2020). Transmission of COVID-19 on the Diamond Princess primarily took place among travellers before the implementation of quarantine, while the transmission among crew members increased after quarantine. Transmission on the Grand Princess occurred mainly among the crew members on voyage A, whereas the transmission to passengers took place on voyage B (Moriarty *et al.*, 2020).

The testing began among elderly passengers, descending by age (Russell *et al.*, 2020). PCR tests were done prioritising the symptomatic or high-risk groups (Mizumoto and Chowell, 2020). They, along with crew members, were disembarked from the Diamond Princess ship and hospitalised. The remaining passengers and crew were quarantined on board (Rocklöv *et al.*, 2020).

### FUTURE CONSIDERATIONS

The failure to isolate the crew members of the Diamond Princess from the initiation of the quarantine significantly contributed to further spread of COVID-19 to the travellers and crew members during quarantine, resulting in second full quarantine period of the rest of the crew members ashore after debarking all travellers. Early detection and disembarkation would prevent further spread on board the ship and would help to limit the number of travellers requiring quarantine that would not be allowed to travel internationally (Mouchtouri *et al.*, 2020; Rocklöv *et al.*, 2020). Health measures to crew members who would be classified as having high-risk expo-

sure are particularly complex. Capacities for cleaning and disinfection of different types of surfaces are essential, including trained staff, personal protective equipment and materials. International Health Regulations (2005) requires that at least one port of each country can apply or supervise health measures to mitigate an emergency of international concern. If there is a lack of capacities at one port, then ships are to be diverted to another port according to the State Party.

An effective mitigation strategy for COVID-19 cases onboard cruise ships includes :

1. The availability of predefined standardised emergency plans at ports and on ships,
2. trained crew to implement these plans and,
3. coordinate efforts of ships and authorities at the local, central and international level to combat an emergency ([Mouchtouri et al., 2020](#))

During a pandemic outbreak in a cruise ship, the elimination of opacity and the disclosure of the information is a part of emergency public health activities ([Nakazawa et al., 2020](#)). Global justice and international coordination is a must to decrease the socioeconomic differences taking into account that a cruise ship represents a small international community ([Nakazawa et al., 2020](#)).

## CONCLUSION

The closed and crowded environment of the cruise ships is responsible for the outbreaks of infectious diseases. Besides, cruise ships are prone to infections of the respiratory and gastrointestinal systems. Several cruise ships faced the COVID-19 outbreak onboard. The essential epidemiological parameters to be considered to combat COVID-19 are elderly, individuals with chronic illness and asymptomatic COVID-19 positive patients. An effective mitigation strategy for COVID-19 cases onboard cruise ships includes the availability of predefined standardised emergency plans at ports and on ships, trained crew to implement these plans, and coordinated efforts of the ships and authorities at the local and global levels to combat an emergency.

## Authors' contribution

WMN suggested the design of the study. AS and WMN lead the creation and design of the study. WMN suggested the design of the study. AS wrote the manuscript of this article. AS and WMN read and approved the final manuscript for publication.

## Conflict of Interest

The authors declare that they have no competing interests.

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## REFERENCES

- Berhe, B., Legese, H., Degefa, H., Adhanom, G., Gebrewahd, A., Mardu, F., Tesfay, K., Welay, M., Negash, H. 2020. Global epidemiology, pathogenesis, immune response, diagnosis, treatment, economic and psychological impact, challenges, and future prevention of COVID-19: A scoping review. *MedRxiv*.
- Dahl, E. 2020. Coronavirus (Covid-19) outbreak on the cruise ship Diamond Princess. *Int Marit Health*, 71(1):5-8.
- Kak, V. 2015. Infections on Cruise Ships. *Microbiology Spectrum*, 3(4).
- Kakimoto, K., Kamiya, H., Yamagishi, T., Matsui, T., Suzuki, M., Wakita, T. 2020. Initial Investigation of Transmission of COVID-19 Among Crew Members During Quarantine of a Cruise Ship — Yokohama, Japan, February 2020. *MMWR. Morbidity and Mortality Weekly Report*, 69(11):312-313.
- Mizumoto, K., Chowell, G. 2020. Transmission potential of the novel coronavirus (COVID-19) onboard the diamond Princess Cruises Ship, 2020. *Infectious Disease Modelling*, 5:264-270.
- Mizumoto, K., Kagaya, K., Zarebski, A., Chowell, G. 2020. Estimating the asymptomatic proportion of coronavirus disease 2019 (COVID-19) cases on board the Diamond Princess cruise ship, Yokohama, Japan, 2020. *Eurosurveillance*, 25(10).
- Moriarty, L. F., Plucinski, M. M., Marston, B. J., Kurbatova, E. V., Knust, B., Murray, E. L., Pesik, N., Rose, D., Fitter, D., Kobayashi, M., Toda, M., Canty, P. T., Scheuer, T., Halsey, E. S., Cohen, N. J., Stockman, L. 2020. Public Health Responses to COVID-19 Outbreaks on Cruise Ships - Worldwide. *MMWR Morb. Mortal. Wkly. Rep*, 69(12):347-352.
- Mouchtouri, V. A., Dirksen-Fischer, M., Hadjichristodoulou, C. 2020. Health measures to travelers and cruise ships in response to COVID-19. *Journal of Travel Medicine*.
- Nakazawa, E., Ino, H., Akabayashi, A. 2020. Chronology of COVID-19 cases on the Diamond Princess cruise ship and ethical considerations: a report from Japan. . *Disaster med. public health prep*, pages 1-27.
- Nishiura, H. 2020. Backcalculating the Incidence of Infection with COVID-19 on the Diamond Princess. *Journal of Clinical Medicine*, 9(3):657-657.

- Rocklöv, J., Sjödin, H., Wilder-Smith, A. 2020. COVID-19 outbreak on the Diamond Princess cruise ship: estimating the epidemic potential and effectiveness of public health countermeasures. *Journal of Travel Medicine*, 030.
- Russell, T. W., Hellewell, J., Jarvis, C. I., van Zandvoort, K., Abbott, S., Ratnayake, R., Flasche, S., Eggo, R. M., Edmunds, W. J., Kucharski, A. J. 2020. Estimating the infection and case fatality ratio for coronavirus disease (COVID-19) using age-adjusted data from the outbreak on the Diamond Princess cruise ship, February 2020. *Eurosurveillance*, 25(12).
- Vashist, S. K. 2020. In Vitro Diagnostic Assays for COVID-19: Recent Advances and Emerging Trends. *Diagnostics*, 10(4):202.
- Xu, J. W., Wang, X. Y., Qin, Z., Song, H. L., Wang, H., Luo, H. Y., Ye, L., Feng, Z. H. 2020. Deep thought of COVID-19 based on Diamond Princess's quarantine and home quarantine. *European review for medical and pharmacological sciences*, 24(7):4027-4029.
- Zhang, S., Diao, M., Yu, W., Pei, L., Lin, Z., Chen, D. 2020. Estimation of the reproductive number of novel coronavirus (COVID-19) and the probable outbreak size on the Diamond Princess cruise ship: A data-driven analysis. *International Journal of Infectious Diseases*, 93:201-204.