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## SPECIAL ISSUE ON GLOBAL RESPONSES TO COVID-19 PANDEMIC: CHALLENGES AND OPPORTUNITIES

## RESEARCH ARTICLES

# Global health governance for travel health: lessons learned from the coronavirus disease 2019 (COVID-19) outbreaks in large cruise ships

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## ABSTRACT

**Background:** The outbreak and global pandemic of coronavirus disease 2019 (COVID-19) attracts a great deal of attentions to the problem of travel health. Cruise tourism is increasingly popular, with an estimated 30 million passengers transported on cruise ships worldwide each year. Safeguarding the health of cruise travelers during the entire travel is of ultimate importance for both the industry and global public health.

**Objective:** This study aimed to explore the challenges and opportunities in travel health from the perspective of global health governance.

**Methods:** The global governance framework including problems, values, tools or regulations, and actors related to travel health were used to analyze the issues involved.

**Results:** Up to April 2020, nearly thirty cruise ship voyages reported COVID-19 cases. The Diamond Princess, Grand Princess and Ruby Princess cruise ship had over 1,400 total reported COVID-19 cases, and more than 30 deaths. A community with a common future in travel health is the core value of global health governance for travel health. The travel-related international regulations, including the *International Health Regulation* (IHR [2005]), *United Nations Convention on the Law of the Sea* (UNCLOS) and the International Maritime Organization (IMO) conventions should be further updated to deal with the travel health problems. The roles and responsibilities and the cooperation mechanisms of different actors are not clear in relation to the public health emergencies during the travel.

**Conclusion:** Travel health transcends national borders and involves multilevel actors, thus needs global cooperation and governance. Regulations and legislation at global and country level are required to prevent large-scale humanitarian crisis on travel health. Multilateral coordination, cooperation and collaboration mechanisms between governments, intergovernmental organizations, non-governmental organizations and industry are needed to build a better community of common destiny for travel health.

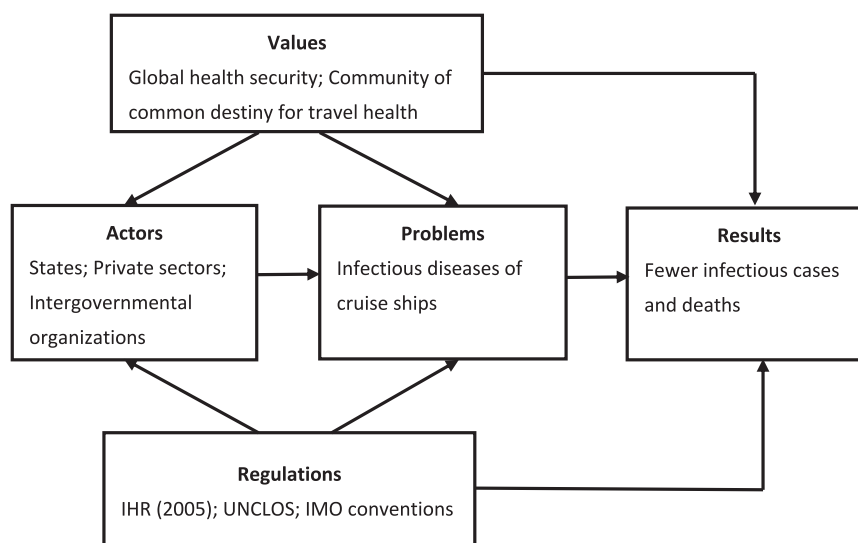
## 1. Background

Travel health is one of the most important global health issues. With the development of modern transportation, the international movement of people has increased significantly.<sup>1–2</sup> In addition to the frequent entry and exit of large numbers of international travelers, the likelihood of the transmission and spread of various emerging and re-emerging infectious diseases increase greatly.<sup>3–4</sup> In general, travel health measures range from the prevention and control of infectious diseases to all health hazards as well as other public health emergencies.<sup>5</sup> Air travel and cruise travel are two common means of transport for international travelers, especially in the leisure industry. The average length of a cruise is about seven days—enough time for travelers' health to be impacted in many ways.<sup>5–6</sup> Thus, this study focused mainly on cruise ships, and explored

global health governance mechanisms for public health emergencies, such as the outbreak of infectious diseases.

Growth in the cruise ship industry has continued in the twenty-first century.<sup>6</sup> An estimated 21.7 million passengers traveled on cruise ships in 2014, and the number increased to nearly 30 million in 2019.<sup>7–8</sup> To meet the increasing demand for cruises, the industry increased the size and capacity of cruise ships, with large ships carrying as many as 5,000 passengers. Previous studies have indicated that maritime transport, especially passenger ships, plays a major role in the transmission of infectious diseases.<sup>9</sup> There are several possible reasons for this phenomenon. First, leisure cruises are relatively long, with the large number of people living in close proximity providing ample opportunity for personal interaction and participation in common activities, and thus the direct and indirect transmission of infectious diseases.<sup>6,10</sup> Second, compared

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**Fig. 1.** The analytic framework of this study.

IHR: International Health Regulations; UNCLOS: United Nations Convention on the Law of the Sea; IMO: International Maritime Organization.

with entertainment facilities provided by cruise ships, sanitation facilities on cruise ships are often relatively poor, and medical care facilities inadequate.<sup>11</sup> Third, passengers and crew members are often from different countries with different immunization and health policies, all living in a semi-closed and crowded environment. In addition, cruise ships often visit different countries, and while sailing from one port to another in their long voyage, passengers and crew members have ample opportunity to introduce infectious disease to different places. Fourth, the majority of passengers on cruise ships are often over 65 years old and may have one or more chronic diseases, making them more susceptible to infection.<sup>3,8</sup>

The cruise ships are potentially at risk of many infectious pathogens and diseases, such as gastrointestinal infections, respiratory infections, and skin infections. The World Health Organization (WHO) has documented more than 100 disease outbreaks since the 1970s, which caused huge threats to passenger health as well as economic losses to the tourism industry.<sup>5</sup> The cruise industry consists of a large number of interlinked players, including shipping companies, logistic companies, flag states, operating ports, and passengers from different countries.<sup>12</sup> A broad range of actors are needed to prevent and control the transmission and spread of infectious diseases by cruise ships across state boundaries, as well as multi-level and multi-sectoral cooperation.

Previous studies focused on the micro level, taking a single port as the research object, and paying more attention to relative countermeasure research on infectious diseases occurring on cruise ships.<sup>3,4,13</sup> Strengthening the core capacity of preparedness and developing cooperation mechanisms among multi-level actors based on standard international norms is required to prevent and control outbreaks of infectious diseases on cruise ships. This study aimed to explore the challenges and opportunities in travel health from the perspective of global health governance.

We used the basic elements of global health governance, including problems, values, tools, regulations, and actors in global health governance related to travel health for the analysis. This study could serve as an important reference for preparedness and response mechanisms related to infectious disease outbreaks in the travel industry.

## 2. Method

Global health governance is defined as “the use of formal and informal institutions, rules, and processes by states, intergovernmental organizations, and nonstate actors to deal with challenges to health that require cross-border collective action to address effectively”.<sup>14</sup> There

are five elements of global health governance: (1) Problems: global health governance needs to grasp the issues accurately; (2) Values: global health governance often occupies the moral high ground in global health development, equity and security; (3) Regulations: the tools used for global health governance; (4) Actors: global health governance includes a wide range of actors, such as states, intergovernmental organizations, nongovernmental organizations, and private actors; and (5) Results: the timely evaluation of the effectiveness of global health.<sup>15</sup> The problems that need to be solved are the core elements of global health governance, and the actors are the organizations and institutions that take responsibility for those problems. Values are the guiding principles that the actors should follow when dealing with problems. Regulations are institutional systems that provide the tools for negotiation when handling global health issues. Results are the effects of global health governance that measure whether the goals of governance have been achieved. To summarize, the inner logic of the framework is that actors use regulations to solve global health problems guided by values in order to achieve desired results (Fig. 1).

Based on the definition and the inner relationships between the five elements of global health governance, we developed an analytic framework for this study. Different actors of global health governance were involved in solving the problem of infectious diseases spread by tourists, and actions should be enforced for the sake of global health security and a community with a common future in travel health. Meanwhile, all actions should follow international regulations, such as the *International Health Regulations* (IHR[2005]), the *United Nations Convention on the Law of the Sea* (UNCLOS), and the International Maritime Organization (IMO) conventions. The indicators for infectious cases and deaths were used to evaluate the effectiveness of global health governance.

## 3. Results

### 3.1. Public health emergencies caused by coronavirus disease 2019 (COVID-19) on cruise ships

Confirmed cases of COVID-19 on cruise ships were reported worldwide. According to data released by the United States Centers for Disease Control and Prevention (U.S. CDC), between February and April 2020, more than 30 cruise ships had confirmed cases of COVID-19. The three cruise ships with the most confirmed cases were the Diamond Princess, the Ruby Princess, and the Grand Princess. The COVID-19 outbreaks on these three cruise ships amounted to over 1,400 confirmed cases among passengers and crew members, and 30 deaths.<sup>8</sup>

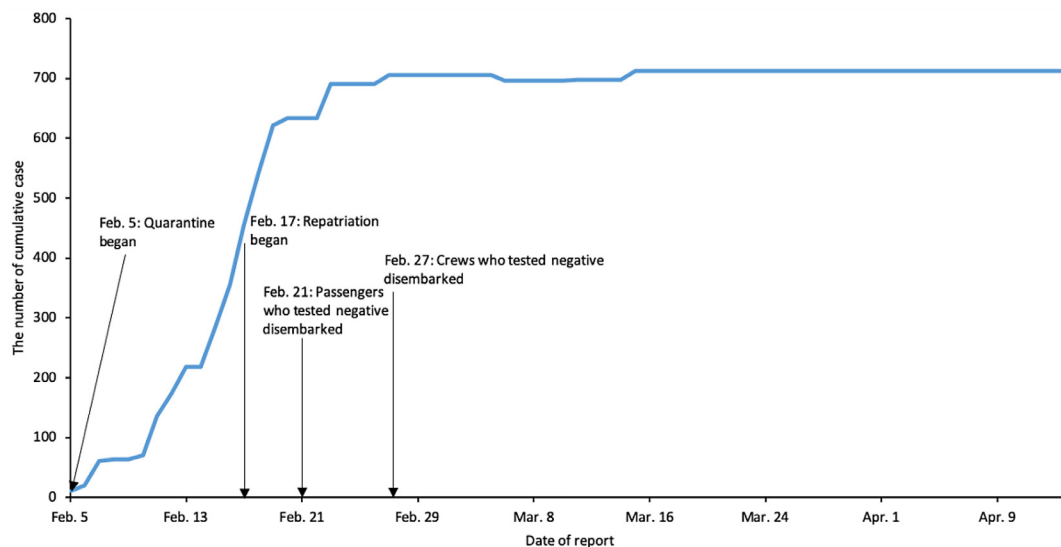


Fig. 2. The cumulative COVID confirmed cases in Diamond Princess cruise ship\*.

\*The information source changed the calculation method and corrected the overlapping figures on March 6.

The Diamond Princess had a total of 3,711 individuals on board—2,666 passengers and 1,045 crew members. On January 20, 2020, the Diamond Princess departed from Yokohama, Japan. A passenger who disembarked on January 25, 2020 in Hong Kong was tested positive for COVID-19 on February 1, 2020. Two days later, the Diamond Princess returned to Yokohama, and on February 5, all passengers were quarantined in their cabins and tested. Passengers with lab-confirmed COVID-19 were disembarked and transferred to isolation wards at healthcare facilities and passengers with negative tests remained on board for a 14-day quarantine. Eventually, just under 1,000 persons were repatriated by air to their home countries, and 712 (19.2%) passengers and crew members returned positive tests for SARS-CoV-2 (Fig. 2).<sup>16–17</sup>

There were 3,533 individuals on the Grand Princess—2,422 passengers and 1,111 crew members from 54 countries. The ship departed from San Francisco on February 21, 2020 (Voyage B). Between February 11 and March 7, 2020, the Grand Princess completed two voyages (Voyage A and Voyage B). On March 4, during Voyage A, one of the passengers disembarked and was tested positive for COVID-19. However, most of Voyage A's 1,111 crew members and 68 passengers remained on board for Voyage B. The next day, a response team collected 45 specimens for testing, and 21 tested positive. On March 8, passengers and crew members were transferred to onshore sites for a 14-day quarantine. On March 21, of the 469 persons tested, 78 (16.6%) had positive results (Fig. 3).<sup>8</sup>

On March 19, 2020, when the Ruby Princess docked in Sydney Harbor, nearly 2,700 tourists disembarked without being quarantined. Subsequently, more than 600 people were infected with COVID-19 and 21 died. On April 22, 2020, another 115 crew members were allowed to disembark, 21 of who tested positive for the new coronavirus. Of the 2,700 passengers who were allowed to disembark before the test results came out, almost 1700 were Australians, which further exacerbated the outbreak of COVID-19 in Australia, as well as in other countries (Fig. 3).<sup>18</sup>

During the outbreak of COVID-19, many states prohibited cruise ships from entering their ports. Crew members and passengers were not allowed to disembark, this left the cruise ships at sea and exacerbated the spread of the COVID-19 on the ships. Taking the Diamond Princess as an example, in the process of isolating passengers on board the ship, the Japanese government found themselves ill-equipped with insufficient resources. The United States of America, a country where many cruise companies are located, was slow to act, and did not respond to Japan's urgent requests for consultation. The flag country, the United Kingdom (U.K.), was also non-responsive and took no action at all.<sup>12</sup>

The COVID-19 pandemic exposed several global health governance issues in travel health. First, there are no clear international cooperation mechanisms among nations to respond to public health emergencies. Second, core capacities to respond to public health emergencies are insufficient, including medical supply stockpiles and medical staffing. Third, existing regulations relevant to the governance of travel health in the case of a public health emergencies are not sufficiently binding to the state actors, and lack unified implementation standards, and clearly defined roles and responsibilities for the state and nongovernmental actors.

### 3.2. Values of global governance for travel-related health

Travel and trade have become the main factors leading to the spread of infectious diseases worldwide.<sup>10</sup> For cruise ships, travelers often come from different countries or regions. Once an outbreak of an infectious disease occurs, travelers may cause the disease to spread to many countries around the world in a short time. Therefore, on one hand, the governance of infectious diseases in travel health is to maintain global health security and to reduce the impact of the disease on the health of global residents. On the other hand, as an outbreak of infectious diseases has a significant and negative impact on politics, economy, tourism, trade, and even the whole social development, global governance on these issues could minimize the side effects. Only through international cooperation mechanisms, can we build a community with a common future in travel health and guarantee global health security.

During the COVID-19 outbreak, many countries banned cruise ships from entering their ports. This posed an important moral dilemma: on the one hand, a country has a moral responsibility to safeguard its citizens and, on the other hand, individuals on cruise ships also have rights to be saved and protected. Furthermore, when the COVID-19 cases occurred on the cruise ships, the flag states, the cruise operating countries, and the countries where the home ports were located blamed each other, which violates the concept of unity and mutual assistance among the relevant actors. The aforementioned practices are not conducive to the construction of a community with a common future in travel health.

### 3.3. Travel-related international regulations and global governance

The IHR were adopted by the World Health Assembly in 1969, and were reviewed and revised by all member states in 2005.<sup>19</sup> The purpose and scope of the IHR (2005) are “to prevent, protect against, control and

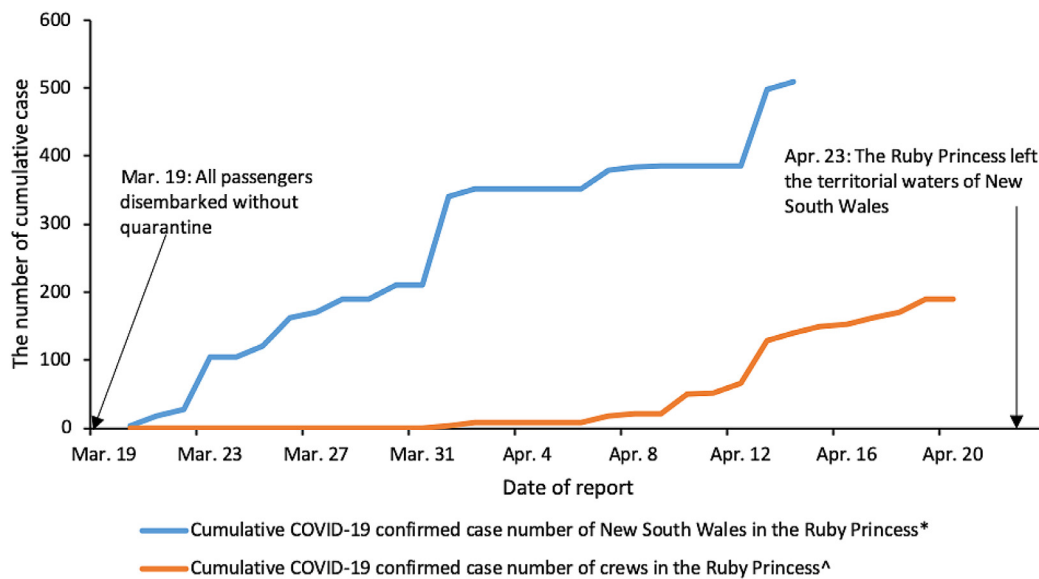


Fig. 3. The COVID confirmed cases in Ruby Princess cruise ship.

\*The number of cases only counted the total number of confirmed cases of passengers and crews from the Ruby Princess. The data of March 31, April 3 to April 6, April 10 to April 12 was missing, the vacancies with missing data between two points were directly connected with lines. The number of cases only counted the number of confirmed cases of crews from the Ruby Princess. The data of March 21 to March 31, April 3 to April 6 was missing, the vacancies with missing data between two points are directly connected with lines.

provide a public health response to the international spread of disease in ways that are commensurate with and restricted to public health risks, and which avoid unnecessary interference with international traffic and trade.” The first paragraph of Article 28 of the IHR (2005) stipulates that “subject to Article 43 or as provided in applicable international agreements, a ship or an aircraft shall not be prevented for public health reasons from calling at any point of entry. However, if the point of entry is not equipped for applying health measures under these Regulations, the ship or aircraft may be ordered to proceed at its own risk to the nearest suitable point of entry available to it, unless the ship or aircraft has an operational problem which would make this diversion unsafe.” Meanwhile the second paragraph of Article 28 of the IHR (2005) stipulates that “subject to Article 43 or as provided in applicable international agreements, ships or aircraft shall not be refused free pratique by States Parties for public health reasons; in particular they shall not be prevented from embarking or disembarking, discharging or loading cargo or stores, or taking on fuel, water, food and supplies.” In addition, the third paragraph of the Article 43 of the IHR (2005) stipulates that “a State Party implements additional health measures which significantly interfere with international traffic, for example refusal of entry or departure of international travelers, baggage, cargo, containers, conveyances, goods, and the like, or their delay, for more than 24 h, shall provide to WHO the public health rationale and relevant scientific information for it.” During the COVID-19 pandemic, many countries adopted some form of cross-border measures that did not fall under the remit of the IHR (2005).<sup>20</sup> However, the Secretariat of the WHO has no right of enforcement to compel member states to comply with the contents of the IHR (2005), the core principle of which is protecting public health while minimizing unnecessary interference with travel and trade.

UNCLOS defines the rights of countries to apply their national sanitary laws while a ship is at port and within 24 nautical miles of land.<sup>21</sup> The first paragraph of the Article 94 of the UNCLOS states that each country should effectively exercise jurisdiction, control over administrative, technical, and social matters on ships flying its flag. Therefore, when a cruise ship is at sea, the flag state is obliged to exercise jurisdiction over its own ships. Once the cruise ship docks, the ship is jointly governed by the flag state and the port state. Yet, the problem is that there is no uniform implementation standard for these

principled provisions, leading to unclear responsibilities of the relevant states in response to public health emergencies on cruise ships.

The IMO is a specialized agency of the United Nations for the purpose of ensuring safety and security at sea as well as the prevention of marine pollution.<sup>10,22</sup> All voyages must comply with all the relevant IMO conventions, including the *International Convention on Safety of Life at Sea* (SOLAS), which defines the requirements for safety relating to fire safety measures, and life-saving appliances and arrangements. However, how to address the problem of preventing the spread of infectious diseases on ships through technical improvements is hardly the routine work of the IMO. When the COVID-19 pandemic occurred, there was no cooperative mechanism between the IMO and public health actors, which contributed to the increase in the number of infections.

### 3.4. Actors for travel health-related global governance

The COVID-19 pandemic has exposed many problems related to the roles and responsibilities of the different actors. First of all, during the epidemic, the travel health system did not provide appropriate risk warnings and alerts about traveling on cruise ships, which contributed to increasing the number of infections on cruise ships. Second, the core capacity of the points of entry (PoE) was insufficient to deal with the public health emergency. Third, some countries were neither prepared nor were their responses remotely adequate, for example, the government actions of the U.K. and the U.S. only focused on quarantining “arrivals from high risk regions” until early March,<sup>23</sup> causing a lack of cooperative actions between the relevant actors. Fourth, for private actors, especially cruise companies, how to better control and prevent infectious disease outbreaks from spreading further is an urgent problem that needs to be solved. The resolution of all these problems depends on the relevant actors making timely changes.

#### 3.4.1. State parties

Sovereign states are the main actors that take responsibility when it comes to the governance of infectious diseases during a cruise.<sup>24</sup> For state actors, it is necessary to prepare for peacetime and wartime responses to public health emergencies.



**3.4.1.1. The system of travel medicine.** To solve problems caused by infectious diseases in the process of traveling between destinations, good preparation in travel medicine is the best way to move the gate forward. Travel medicine refers to arming the traveler with information, vaccinations, medical supplies, and resources to keep diseases at bay.<sup>25–26</sup> First, before departure, health care providers must assess the current health status of travelers to confirm any underlying illnesses. Second, doctors should review the itineraries of travelers to advise on local disease patterns and current outbreaks in destination countries. Third, according to the health status and disease patterns of destinations, required, routine, and recommended immunizations should be given to travelers. Fourth, doctors should give sufficient advice to travelers on how to stay healthy and how to self-medicate or to seek medical care if ill. After the trip, doctors should assess travelers who are ill with regard to symptoms as well as geography and epidemiology.<sup>27</sup> However, the development of travel medicine faces many challenges which hinder the effectiveness of travel medicine in travel health. In most low- and middle- income countries, the field of travel medicine is short of specialists, and knowledge of travel medicine is insufficient among both public health professionals and the general public.<sup>28</sup> Therefore, the state should pay attention to the development of travel medicine to maintain the health and safety of travelers while in transit. During the COVID-19 pandemic, perhaps the most useful measure to contain the spread of the disease would have been to delay all cruise travel worldwide. Health care providers in travel medicine should have given this advice and recommendations to all travelers.

**3.4.1.2. Core capacity building of PoE.** State parties should develop, strengthen, and maintain public health core capacities related to public health emergencies at designated points of entry under the requirements of the IHR (2005). At all times, the PoEs should have the capacity to provide an appropriate medical service and adequate staff, equipment and premises, provide access to equipment and personnel for the transport of ill travelers, provide trained personnel for the inspection of conveyances, ensure a safe environment for travelers, and control the vectors and reservoirs in and near points of entry. When responding to the events that may constitute a public health emergency of international concern, the PoEs should have the essential capacity to detect an event, initiate standard preliminary responses in the port, assess the event risk at port level and on board the ship, and take timely response measures to the event. It is necessary for the PoE authorities to establish public health assessment interview places, in order to provide adequate space to assess ill travelers or those suspected of being ill.<sup>24</sup> In the case of the Ruby Princess, passengers disembarked in Sydney without being quarantined, which suggests inadequate core capacity and insufficient supervision of the PoEs in Australia.

**3.4.1.3. Cooperation mechanisms under public health emergencies.** When infectious diseases break out on cruise ships, typically at sea, the flag states should take responsibility for their ships. However, frequently shipping companies fly the flag of a particular country for reasons of tax savings or convenient procedures, and the flag states may have no ability to deal with the public health emergencies.<sup>29</sup> In such cases, a cooperation mechanism among different countries should be formed. The country of the ship operating company, the country of the ship's main business, and the countries of passengers, should work together to solve the problem. To repatriate the passengers or crew members to their own countries, the response requires coordination between different sectors of the individual countries, including ministries of foreign affairs and health, hospitals, and local public health departments. Efforts are needed to contain transmission on board and to prevent further transmission on disembarkation and repatriation.

#### 3.4.2. Intergovernmental organizations

As the core agency of global health governance, the WHO plays a leading role in the response to public health emergencies. In the

COVID-19 pandemic, many countries refused to call cruise ships into ports. The adoption of these measures exceeded the scope of the WHO's temporary recommendations. According to the IHR (2005), all state parties are obliged to comply with the WHO public health measures within 48 h. However, in practice, many countries could not fully comply with the IHR regulations and could not implement them within the prescribed timeframe.<sup>30</sup> This left cruise ships at sea, further aggravating the spread of the virus on the cruise ships. On the other hand, the IHR (2005) set specific requirements for port capacity building in various countries, but the capacity building of many ports did not meet the required standards. This problem was particularly evident in the events surrounding the Diamond Princess and the Ruby Princess.

As a specialized UN agency for maintaining maritime safety, the main tasks of the IMO currently focuses on international maritime trade, maritime safety, and the prevention of marine pollution. How to respond to incidents that threaten public health safety caused by infectious diseases has not been clearly defined in the scope of the IMO's responsibilities. However, responding to public health emergencies requires close cooperation between the IMO and public health departments, such as the WHO and national disease control authorities. The current status is that this cooperation provision is ambiguous or has not been invoked.

#### 3.4.3. Private sectors

The continued progression of the COVID-19 epidemic has gradually increased its impact on the cruise industry. At the same time, the epidemic has emphasized the need for higher requirements in terms of safety, health, and emergency responses on cruise ships. On one hand, cruise companies need to increase technological innovation to meet the challenges posed by public health events and strength core capacities to respond to the public health emergencies; on the other hand, they need to cooperate with other nongovernmental organizations or insurance institutions to set up corresponding liability funds to mitigate the pressure of public health events on cruise companies and coastal countries, and to motivate the countries more willing to accept cruise ships during an epidemic.<sup>31</sup>

## 4. Discussion

This study explored travel health issues, mainly the spread of infectious diseases on cruise ships, from the perspective of global health. To our knowledge, it is the first study that examines problems related to the five critical elements of global health governance. With the increasing popularity of cruises, how to prevent and control outbreaks of infectious diseases is of great importance for global health security as well as economic growth. Global health governance actors should clarify the values of a community with a common future in travel health, build a sound regulation system step by step, and form more durable, equitable, and better funded forms of cross-border cooperation mechanisms to solve the issues effectively. We believe our study could shed light on the issues of travel health.

International regulations for global health governance can serve as critical and authoritative tools when cross-border health issues need to be handled. When it comes to the IHR (2005), the WHO has limited legislative and law enforcement powers, and relevant regulations serve more as a guiding norm.<sup>32</sup> Establishing a disciplinary mechanism for the IHR (2005) that all WHO member states are required to abide by, and strengthening the binding force of the IHR (2005) on states are key measures to consolidate the WHO's position at the center of global health governance. In addition, when revising international conventions, more specific provisions on "jurisdiction" should be included based not only on experience gained during the COVID-19 pandemic, but also on the principle of giving priority to saving lives, so that state actors can more effectively provide with assistance within their ability. Meanwhile, the IMO's convention system needs to be supplemented and improved for epidemic management. To be specific, mandating the prevention and control of infectious diseases as part of the roles and responsibilities

of the IMO and enhancing collaboration between the IMO and public health sectors, and the WHO, are urgently needed for global governance of infectious diseases on cruise ships.

Multilevel actors are involved in travel health, and measures corresponding to each actor's role should be taken. For state parties, a well-built system of travel health is the foundation for the prevention and control of infectious diseases while traveling.<sup>27</sup> Also, fulfilling the IHR (2005) core capacity requirements of PoEs, strengthening human resource capacity building, and maintaining routine and emergency capacities are all necessary to protect global health security.<sup>33</sup> A good example would be China's rapid action in the case of the Costa Serena cruise ship that docked in Tianjin port, where the Chinese government was able to implement a timely and effective response to deal with the emergency within 24 h.<sup>34</sup> By comparison, the Diamond Princess and others cruises showed that some developed countries were poorly prepared for the public health emergency and strengthening core capacities is urgently needed. The concept of a community with a common future in travel health requires state parties to initiate bilateral and multilateral cooperation to form joint prevention and control mechanisms for the control of infectious diseases.<sup>32</sup> For intergovernmental organizations, clarifying the scope of their responsibilities, summarizing the shortcoming of existing regulations, and improving them are key in dealing with a public health emergency like the COVID-19 pandemic. Companies in the private sector, such as cruise companies, should assess the risks of a public health emergency, make efforts to solve structural defects of ventilation and isolation on cruise ships, and enhance the ability for public health emergency responses in case of an outbreak.

## 5. Conclusions

The outbreak of COVID-19 on cruise ships highlighted the importance of global health governance in travel health. In an era of globalization, resolving such crises requires strengthening cooperation between governments, intergovernmental organizations, and the private sector under the constraints of sound international regulations. At the same time, it is necessary for countries to build and improve their health service systems for travel health, strengthen core capacities of ports, and establish comprehensive emergency response mechanisms for public health emergencies. Global health security can only be improved by strengthening a community with a common future in travel health.

## Competing interests

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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## Author contributions

SZ, ZZ participated in conception of the research ideas, study design, interpretation of the findings. SZ wrote the first draft of the manuscript. LH, PL and ZZ made critical revisions on the manuscript and provided implications of the study findings. All the authors gave final approval of the version to be published.

## References

- Diedrich A. Cruise ship tourism in Belize: The implications of developing cruise ship tourism in an ecotourism destination. *Ocean & Coastal Management*. 2010;53(5):234-244.
- Zhang N, Miao R, Huang H, Chan EY. Contact infection of infectious disease onboard a cruise ship. *Scientific Reports*. 2016;6:38790.
- Marshall CA, Morris E, Unwin N. An epidemiological study of rates of illness in passengers and crew at a busy Caribbean cruise port. *BMC Public Health*. 2016;16:314.
- Schlauch CC, Oldenburg M, Lamshöft MM. Estimating the risk of communicable diseases aboard cargo ships. *Journal of Travel Medicine*. 2009;16(6):402-406.
- Chinese Preventive Medicine Association. *Blue Book on the Development of Preventive Medicine*. Beijing: Chinese Preventive Medicine Association; 2008. (in Chinese).
- Kak V. Infections on cruise ships. *Microbiology Spectrum*. 2015;3(4). doi:10.1128/microbiolspec.IOL5-0007-2015.
- Buckley R, Gretzel U, Scott D, Weaver D, Becken S. Tourism megatrends. *Tourism Recreation Research*. 2015;40(1):59-70.
- Moriarty LF, Plucinski MM, Marston BJ, et al. Public Health Responses to COVID-19 Outbreaks on Cruise Ships - Worldwide, February-March 2020. *MMWR Morbidity and Mortality Weekly Report*. 2020;69(12):347-352.
- Schlagenhauf P, Funk M, Mütsch M, Prasad L, Stürchler M. Focus on cruise ship travel. *Journal of Travel Medicine*. 2004;11(3):191-193.
- Infectious Diseases and Maritime Law. The United Nations website. [https://www.un.org/Depts/los/nippon/unnff\\_programme\\_home/fellows\\_pages/fellows\\_papers/iteraera\\_0910\\_kiribati.pdf](https://www.un.org/Depts/los/nippon/unnff_programme_home/fellows_pages/fellows_papers/iteraera_0910_kiribati.pdf). Accessed June 24, 2020.
- Carling PC, Bruno-Murtha LA, Griffiths JK. Cruise ship environmental hygiene and the risk of norovirus infection outbreaks: an objective assessment of 56 vessels over 3 years. *Clinical Infectious Diseases*. 2009;49(9):1312-1317.
- Looking at the Construction of Cruise Multilateral Cooperation Governance System from the Perspective of China's Plan under the Epidemic Crisis. The People website. <http://theory.people.com.cn/n1/2020/0312/c40531-31629263.html>. Accessed June 24, 2020. (in Chinese).
- Kornylko K, Henry R, Slaten D. Respiratory disease on cruise ships. *Clinical Infectious Diseases*. 2012;54(5):v-vi.
- The Challenges of Global Health Governance. The Council on Foreign Relations website. <https://www.cfr.org/report/challenges-global-health-governance>. Accessed June 24, 2020.
- Xu J, Liu PL, Guo Y. Global health governance mechanism: A review and its suggestion for China. *Chinese Journal of Health Policy*. 2013;6(11):1-7. (in Chinese).
- Mizumoto K, Kagaya K, Zarebski A, Chowell G. Estimating the asymptomatic proportion of coronavirus disease 2019 (COVID-19) cases on board the Diamond Princess cruise ship, Yokohama, Japan, 2020. *Euro Surveillance*. 2020;25(10).
- National Institute of Infectious Diseases. Field briefing: Diamond Princess COVID-19 Cases. <https://www.niid.go.jp/niid/en/2019-ncov-e/9417-covid-dp-fe-02.html>. Accessed June 24, 2020.
- Coronavirus: How did Australia's Ruby Princess cruise debacle happen?. The British Broadcasting Company website. <https://www.bbc.com/news/world-australia-51999845>. Accessed June 24, 2020.
- World Health Organization. *International Health Regulations (2005)*. 2nd ed. Geneva: World Health Organization; 2008. <https://www.who.int/ihr/publications/9789241596664/en/>. Accessed June 24, 2020.
- Lee K, Worsnop CZ, Grépin KA, Kamradt-Scott A. Global coordination on cross-border travel and trade measures crucial to COVID-19 response. *Lancet*. 2020;395(10237):1593-1595.
- Lallier LE, McMeel O, Greiber T, Vanagt T, Dobson AD, Jaspars M. Access to and use of marine genetic resources: understanding the legal framework. *Natural Product Reports*. 2014;31(5):612-616.
- Balkin R. The International Maritime Organization and maritime security. *Tulane Marit Law Journal*. 2006;30(1-2):1.
- Scally G, Jacobson B, Abbasi K. The UK's public health response to covid-19. *BMJ (Clinical Research Ed.)*. 2020;369:m1932.
- World Health Organization. Handbook for management of public health events on board ships. <https://www.who.int/ihr/publications/9789241549462/en/>. Accessed June 24, 2020.
- Spira AM. Preparing the traveller. *Lancet*. 2003;361(9366):1368-1381.
- Hill DR, Ericsson CD, Pearson RD, et al. The practice of travel medicine: guidelines by the Infectious Diseases Society of America. *Clinical Infectious Diseases*. 2006;43(12):1499-1539.
- Spira AM. Assessment of travellers who return home ill. *Lancet*. 2003;361(9367):1459-1469.
- Zhang JW, Robert Steffen. Development and characteristics of travel medicine in China. *Chinese Front Health Quarantine*. 2017; (5): 305-309. (in Chinese).
- Heavy legal experts answer: Who should be responsible for the nearly 17% infection rate of the "Diamond Princess"? The China Business Network website. <https://www.yicai.com/news/100516639.html>. Accessed June 24, 2020. (in Chinese)
- Rhymer W, Speare R. Countries' response to WHO's travel recommendations during the 2013-2016 Ebola outbreak. *Bulletin of the World Health Organization*. 2017;95(1):10-17.
- Peng XW, Wu YN. A preliminary research on the quarantine measures of cruise vessels in novel coronavirus outbreak—from the perspective of international health law. *Chinese Journal of Maritime Law*. 2020;31(1):20-27. (in Chinese).
- Liu XF, Zhang YQ. On the improvement of the emergency mechanism of cruise epidemic prevention—Taking prevention and control of COVID-19 pneumonia as a reference. *Chinese Journal of Maritime Law*. 2020;31(1):11-19. (in Chinese).
- Chiu HH, Hsieh JW, Wu YC, Chou JH, Chang FY. Building core capacities at the designated points of entry according to the International Health Regulations 2005: a review of the progress and prospects in Taiwan. *Global Health Action*. 2014;7:24516.
- Zhang ZW. Reflections on Emergency Response to Public Health Incidents on International Cruises. *Journal of Beijing City University*. 2020(02):17-19. (in Chinese).