



Special Commission of Inquiry into the Ruby Princess

EXHIBIT 99

Expert Report of Professors Anthony Kelleher and Andrew Grulich dated 17 June 2020

Expert report on the COVID-19 outbreak on board the Ruby Princess and related matters to the Special Commission of Inquiry into the Ruby Princess

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This report sets out our specific expert comments in response to questions asked by the Commission in the letter of engagement dated 27 May 2020. We have highlighted these questions in bold italics below, and our responses appear in plain type. We confirm that we have read the Uniform Civil Procedure Rules 2005, Sch 7: Expert Witness Code of Conduct, and we agree to be bound by it.

1. Your views, from the perspective of public health, on the appropriateness of classifying cruise ships as "low risk", "medium risk" and "high risk" in the circumstances presenting in February and March 2020. Your views are also sought as to the criteria used to make a determination of "low", "medium", or "high" risk.

In public health, as in clinical medicine, it is common to devise graded risk scales, especially in situations where a definition of "zero risk" is difficult. A graded scale of increasing risk allows calibrated levels of response.

With respect to the evolving COVID-19 pandemic in February and March 2020, it would have been difficult or impossible to define a zero-risk cruise, except by not allowing a cruise to occur. In our opinion, it was appropriate to develop a graded-risk scale to guide the public health response to cruise ships seeking to disembark passengers in Australia.

At the time of the Ruby Princess cruise commencing March 8, we understand that the procedure for classification of COVID-19 risk level was based on the document "Cruise ship COVID-19 assessment procedure for ports of first entry into Australia" draft of 11am 19 February 2020 (Tab 2 appendix 3). The stated purpose of this document was to "improve the detection and timely management of potential cases or outbreaks of COVID-19 on cruise ships." Further, on the first page of the document under the heading, "Enhanced measures", the two key criteria for risk assessment are "whether

- any passengers or crew have been in high risk areas in the 14 days prior or contact with a confirmed case of COVID-19
- there is undiagnosed respiratory illness among passengers or crew that is clinically compatible with COVID-19."

In this version of the assessment procedures form, it was noted that "as of 14 February 2020, these forms have been updated to include data on whether the vessel has been in mainland China, or whether any person on the vessel has been in mainland China less than 14 days ago, and whether any person on the vessel has been in contact with a proven case of novel coronavirus infection within the last 14 days".

The interpretation of "high risk areas" at the time of this cruise was complicated by the rapid evolution of epidemiological understandings of COVID-19. On 8th March 2020, when the Ruby Princess embarked, the Communicable Diseases Network of Australia (CDNA) case definition of a

suspect case of COVID-19 included reference to travel in the last 14 days to countries in two categories of increased risk. This categorisation was first introduced in the CDNA case definition of March 3 (Tab 23, versions of CDNA guidelines, version 1.15). The first of these categories was termed “higher risk” and included Mainland China, Iran, Italy and South Korea. The second was “moderate risk” countries and included Cambodia, Hong Kong, Indonesia, Japan, Singapore, and Thailand. On March 10th, while the Ruby Princess was at sea, the travel criteria required for a suspect case were changed again, to include any “International travel in the 14 days before illness onset.” (Tab 23, versions of CDNA guidelines, version 1.18). By March 14, of COVID-19 cases in Australia, the most common countries of recent travel were the USA (22% of all Australian cases who had recently travelled overseas), Italy (11%), Iran (9%), the UK (8%) and China (8%, Tab 25, CDI, COVID-19, Australia: Epidemiology Report 7). This multiplicity of changes regarding country of travel was not incorporated in new versions of the assessment form.

The assessment procedures document outlined situations of high-, medium- and low-risk as follows.

High-risk. A ship was judged as high-risk if there was a respiratory outbreak (affecting at least 1% of those on board) that was not explained by positive influenza tests, and affected passengers or crew who had visited mainland China in the 14 days before embarkation OR had contact with a confirmed COVID-19 case in the 14 days before embarkation. It is not clear whether the 1% threshold refers only to influenza-like illness, or also includes other acute respiratory diseases. The words “respiratory outbreak” are critical and are not precisely defined.

The evolution of risk criteria described in the CDNA case definitions above, means that by the date of disembarkation of the Ruby Princess (19th March), the travel-country based criterion for high-risk, of travel to mainland China, used in the Cruise Ship COVID-19 assessment procedure (Tab 2, appendix 3) was out of date and was inconsistent with current Australian epidemiological data and the then current CDNA case definition.

If a vessel was judged as high-risk, the ship was not to be allowed to disembark passengers or crew until given clearance by the Chief Human Biosecurity Office and clearance to disembark could only be granted following results of COVID-19 testing.

Medium-risk. A ship was judged as medium risk if there was a respiratory outbreak (affecting at least 1% of those on board) reported, and either passengers or crew had “visited a country included in Australian COVID-19 testing criteria in the 14 days before embarkation”, or there were other features of concern such as one or more cases with severe respiratory illness, or the outbreak was not explained by positive influenza tests.

As described above, on the 10th March, the CDNA case definition of a suspect case of COVID-19 was widened to include a suspect case with “International travel in the 14 days before illness onset”. While the Ruby Princess cruise of March 8 only visited New Zealand ports, it could be argued that the Ruby Princess passengers met the criterion of “international travel” by the fact that they had visited New Zealand. On the other hand, New Zealand has been lightly impacted by COVID-19, at about the same population rate as Australia. While the assessment procedure (Tab 2 appendix 3) only recorded data on countries visited “before embarkation”, it is our opinion that countries visited during a cruise are potentially equally important in COVID-19 risk. The only difference between the medium-risk category and the high-risk category in the assessment procedure above is that in the medium-risk category it was required that there were no passengers or crew who had recently visited China, but this differentiation was no longer highlighted in the CDNA case definition by the time of disembarkation.

If judged as “medium risk”, the ship would be met by a medical assessment team and swabs taken for COVID-19 where clinically appropriate. Well passengers and crew would have been allowed to disembark to “isolation” (in fact the correct term for a well person is “quarantine”). According to the assessment procedure, any samples taken on board for influenza testing must be forwarded to the laboratory for COVID-19 testing on arrival into the port. Thus, in this setting, COVID-19 results from unwell patients must be available before those passengers disembark, but passengers who are well are allowed to disembark.

Low-risk. This setting required that no respiratory outbreak be documented or that if there was a respiratory outbreak, it was explained by positive influenza test results AND required that “no one on board has visited a country included in Australian COVID-19 testing criteria in the 14 days before embarkation, or had contact with a confirmed case in the 14 days before embarkation”.

If judged as low risk, passengers were permitted to disembark with no specific COVID19-related assessments.

Interpretation of risk level: Risk level is interpreted by the NSW Ministry of Health, based on information in a pre-arrival risk assessment form called the “Cruise ship screening procedure for ports of first entry into Australia”. For the Ruby Princesses arrival on 19 March 2020, this was completed by Laura-Jayne Quinn (tab 2, appendix 7). The form contained two questions relating to recent travel. The first one recorded “the number of passengers and crew who have been in mainland China, Iran, South Korea or Italy within 14 days of embarking” in a single answer. There was no separate space on the form to record passengers from China specifically, despite the high-risk level requiring travel to China. The second question on recent travel recorded the “number of ill passengers and crew who had been in countries included in the Australian COVID-19 testing criteria in the 14 days before embarkation”. The recorded response to each question was zero. In our opinion it does not appear this question was answered correctly in the context of the CDNA case definition of 13th March.

The acute respiratory disease log of 18 March (Tab 11B) noted several patients who were judged to have acute respiratory illness who were residents of non-Australian countries, including the United Kingdom, United States, Ukraine, Italy, and New Zealand. There was one resident from the US (cabin L202) who was judged to have an influenza-like illness but who tested negative for influenza. There was no information on travel in the last 14 days in this log, but it seems likely that at least some of these non- Australian residents travelled to Sydney from overseas for the purpose of the cruise. In our opinion, the absence of data on travel in the 14 days prior to embarkation in these logs is concerning, especially as it relates to these non-Australian residents.

It is important to note that the CDNA COVID-19 case definition changed multiple times during February and March, sometimes on several occasions a week. It would have been extremely challenging for cruise ship doctors, who are not COVID-19 specialists, and even for public health specialists with multiple responsibilities, to keep up with these changing definitions. For a correct interpretation of risk, it would have been critical for both ship’s medical staff and NSW Health staff conducting the assessment and the forms and logs used for assessment to be up to date with these changes.

2. *Your views on the relevance, utility or appropriateness of distinguishing between passengers and crew on a cruise ship entering a NSW Port in February-March 2020 who have presented to the ship's clinic with acute respiratory disease", and those who "have influenza like illness"[sic]: see the "pre-arrival risk assessment forms" for the Ruby Princess (Tabs 5 and 12).*

Acute respiratory diseases (ARDs, sometimes also called acute respiratory illnesses, ARI) are extremely common and may be caused by a wide range of infectious and other causes. Cruise ships are a well-documented high-risk setting for outbreaks of infectious respiratory illnesses (1). The Infectious Diseases Society of America (IDSA) defines "acute respiratory illness" as infection of either the upper or lower respiratory tract with respiratory symptoms, with or without fever. "Influenza-like illness" (ILI) is a sub-set of acute respiratory illness with fever and either cough or sore throat(1). "Fever" is not defined in the IDSA guidelines, but in United States Centers for Disease and Control and Prevention (CDC) guidance is defined as greater than 37.8 C° (100 F°)(2). The World Health Organisation defines ILI as acute respiratory infection with measured fever of ≥ 38 C° and cough(3).

Thus influenza-like illness is a well-established and recognised term which comprises a subset of patients with the usually much more common range of other acute respiratory illnesses. It requires the presence of fever. However, by early February it was well-established that COVID-19 was not always accompanied by fever. As early as February 2nd the CDNA definition of a suspect COVID-19 case was broadened to include people with a relevant travel history and acute respiratory infection with or without fever (tab 23, version 1.2). The lack of a fever requirement was consistent in all later CDNA case definitions.

Thus, by early February, CDNA had emphasised the importance of cases with ARD without fever by including this in the case definition of suspected COVID-19. While the majority of cases of COVID-19 do have fever, only considering ILI (ie respiratory illness with fever) would lead to an under-estimate of the potential numbers of COVID-19 cases

3. *Your views on the relevance, utility or appropriateness of using a percentage of a ships' passengers and crew (seemingly 1 %) who have either "presented to the ship's clinic with acute respiratory disease" or "have influenza-like illness", as a means of assessing risk to NSW public health.*

The magnitude of ILI epidemics on cruise ships varies. A recent review reported that they may affect 2-37% of cruise ship passengers and up to 13% of crew members (4, 5). It is difficult to define what constitutes an outbreak, as opposed to the occurrence of a few unconnected sporadic influenza cases. Formal reporting and public health review of every cruise which reports a single case of ILI would be impractical. The United States CDC requests that cruise lines immediately report outbreaks of influenza or ILI exceeding 1.380 cases per 1,000 traveller days among passengers or crew members (2). This recognises the fact that longer trips may be associated with increased ILI incidence(5). For a ship of 5000 passengers and crew, travelling for 5 days, the reporting threshold would be 45 cases, or 0.9% of those on board.

However, the fact that not all cases of COVID-19 have fever means that the proportion of passengers and crew with ILI would under-estimate COVID-19 risk. On the other hand, basing assessments on the proportion with acute respiratory disease would greatly over-estimate risk of COVID-19, because in most circumstances the large majority of people with acute respiratory disease do not have COVID-19.

4. *Your views on the relevance, utility or appropriateness of making distinctions between passengers and crew who had been assessed as having different levels of temperature*

Fever is one of the most common symptoms of COVID-19, being present in close to 90% of adult cases, however most published data are dominated by patients requiring hospitalisation and so this high prevalence of fever may have been biased by the relative severity of the infection (6). The threshold temperature above which defines fever is mostly taken as 38.0 Celsius in countries using the centigrade scale. It is often defined as 100 Fahrenheit (37.8 Celsius) in countries using the Imperial system.

Requiring fever in addition to having an acute respiratory illness for the definition of ILI is a practical requirement because acute respiratory illness is extraordinarily common. One Australian study estimated that 20% of all people had an ARI in the previous 4 weeks(7). Screening for ARI without requiring fever would likely result in several hundred passengers and crew being identified on every voyage of every large cruise ship. The small difference between screening using the commonly used thresholds for fever of 38.0 or 37.8 Celsius is unlikely to be meaningful. There clearly needs to be a balance between screening hundreds of people unnecessarily versus more targeted screening. This is particularly the case when resources such as personnel, personal protective equipment and test kits are limited.

5. *Your views on whether any part of the risk assessment for COVID-19 on cruise ships from a public health perspective should include risks associated with:*

(a) asymptomatic transmission (that is, the risk of infection posed by a passenger who was asymptomatic when disembarking);

By March, the presence of asymptomatic disease and transmission had been confirmed in peer-reviewed literature(8, 9), but the magnitude of the contribution of asymptomatic transmission to epidemic propagation was controversial and remains somewhat uncertain(10). The possibility that patients may have been asymptomatic on disembarkation and may have been able to transmit to others was somewhat managed by the requirement for patients to quarantine at home for 14 days. However, with this voluntary process, there was a potential for asymptomatic or symptomatic transmission during transport home (eg in taxis, public transport, and flights to home interstate and overseas). In our opinion, the risk of asymptomatic transmission could have been more effectively reduced by secure transfer to local hotel quarantine for 14 days.

(b) passengers choosing not to report symptoms to the ship's medical clinic;

It is very likely that some passengers with respiratory symptoms will choose not to report to the ship's medical clinic, and this is probably more common in people with mild disease (5). NSW Health recommends that medical consultations relating to on-board disease outbreaks are free of charge (11) and records whether consultations are free, because cost is also likely to dissuade passengers to present to medical clinics. If choosing not to report happens widely, then the extent of an on-board epidemic will likely be under-estimated.

(c) passengers who have disembarked being "non-compliant" with any requests to self-isolate once off the ship.

Passengers who disembarked the Ruby Princess on March 19 were asked to arrange their own transport home and to isolate (if already sick) or quarantine (for those without symptoms) for 14 days. Australia has since moved to a system of organised secure transport to monitored hotel quarantine. A similar transition from voluntary home quarantine to a more closely monitored form of quarantine has occurred in other countries, largely because of concern that arrived passengers would not completely adhere to self-isolation/self-quarantine. Organised transport to hotel quarantine protects contacts during transport, and enables close surveillance of compliance with quarantine. In our opinion, monitored hotel quarantine is very likely to be a more effective means of quarantine than voluntary home quarantine.

6. Your views on the explanations provided in the anonymously authored "NSW Health Report on the Ruby Princess Cruise of 8 to 19 March 2020" (Tab 2).

We wish to comment on selected findings of this report which we view as being of importance.

Page 1, Key points. The authors state "International experience shows COVID-19 can rapidly spread among passengers if left on board, so self-isolation at home is a much safer option than leaving passengers on board." Evidence strongly supports this statement, at least from the point of view of the patients on the ship. In February 2020, there was an epidemic of more than 700 cases of COVID-19 in passengers and crew who were isolated/quarantined on board the Diamond Princess cruise ship moored in Japan. Evidence suggests that earlier disembarkation would have greatly reduced case numbers (12). This result emphasises the need for early disembarkation of unwell and potentially exposed passengers.

Page 1, Key points. Only 24 of 48 cases of ILI tested positive for influenza. Point-of-care influenza tests, as used on cruise ships, do not have perfect sensitivity in the diagnosis of influenza (13, 14). It is possible that a proportion of the 24 cases which tested negative actually did have influenza but this proportion would depend on the actual test used, as there is considerable variability in the sensitivity of the available tests (13, 14). The fact that 50% of the ILI cases were confirmed to be due to influenza demonstrates that there was influenza being transmitted on board the Ruby Princess, adding to the complexity of the assessment, and would have likely led the assessing public health physicians to conclude that influenza was the likely cause of most or all of the ILI on board.

Page 1, Key points. "At the time of embarkation, the reported risk of transmission of infection in New Zealand was very low, as was the number of cases reported from the United States". In our opinion, the report is correct to note that the number of cases in New Zealand was very low. The situation with respect to the United States was changing very rapidly. It is correct to state that the number of cases who had travelled recently to or from the US was very low at the time of embarkation. The weekly Australian COVID-19 report for the week ending 7 March mentioned China, Italy, Iran and South Korea and made no mention of the United States (15). However, the next weekly report, for the week ending 14 March, noted that people who had recently travelled from the USA constituted 22% (36 people) of all of those with COVID-19 who had a recent travel history (Tab 25).

Page 1, Key points. "The 337 passengers who developed COVID-19 acquired it while on board the ship. It is likely that many more cases were averted by their early disembarkation into self-isolation

at home.” It is our opinion that the findings of investigations into the prior Diamond Princess case (12) support this assertion.

Page 6: “The national case defining (SIC) (appendix 8) included international travel as part of the criteria for suspected case of COVID-19. It is acknowledged that some overseas passengers presented with acute respiratory illness during the cruise that in retrospect elevates the risk profile.” We agree with this assertion, although the absence of information on recent overseas travel in the acute respiratory disease log makes it difficult to be entirely certain of the movements of the passengers prior to embarkation. However, the presence of a number of patients who were non-Australian residents who had a respiratory illness likely means the CDNA definition of a suspect case of COVID-19 was likely met.

7. Assuming:

- (a) the Ruby Princess had reported the matters on the Pre-Arrival Risk Assessment form completed on 18 March 2020 (copy enclosed);**
- (b) 13 swabs were taken onboard and were available for COVID-19 testing;**
- (c) the result of those tests would be known within six to nine hours of laboratory receipt;**
- (d) passengers were required to isolate at home for 14 days upon their return to Australia; and**
- (e) passengers, once disembarked, would be free to make their own way home including on public transport (buses, taxi, Uber etc) and planes;**

and assuming further that there were certain options available to NSW Health officials including:

- (i) immediately disembarking all passengers to make their way home to self-isolate;**
- (ii) immediately disembarking all asymptomatic (including uninfected and pre-symptomatic) passengers whilst keeping symptomatic passengers on board until test results were known;**
- (iii) keeping all passengers on board the Ruby Princess pending swab testing results; and**
- (iv) arranging for secure transport of passengers (either all, or symptomatic, passengers) to a quarantine facility (either pending test results, or following a positive test result),**

then balancing the risks posed to:

- (a) the people on board; and**
- (b) the broader community;**

what is the most appropriate and proportionate public health response?

In framing the answer to this question, risk is considered to refer to the risk of infection with SARS-CoV-2.

Option 1: immediately disembarking all passengers to make their way home to self-isolate

This was what occurred when the Ruby Princess docked in Sydney on 19 March 2020.

- a) *Risk to people on board:* This option would likely have led to transmission of SARS-CoV-2 from symptomatic and asymptomatic passengers to other passengers and crew while disembarking. This would have been especially the case if disembarkation of all passengers was accompanied by crowding and prolonged exposure. If it was possible for disembarkation to be staged and gradual, to allow social distancing, this may have reduced transmission between passengers and between passengers and crew. However, the degree to which passengers would have complied with a staged and gradual procedure is uncertain. This option has the likely advantage of reducing the amount of time that passengers were exposed to each other on board the ship.
- b) *Risk to the broader community:* Immediate disembarkation of all passengers would have been associated with a risk of SARS-CoV-2 transmission during onwards local, interstate and international travel after disembarkation. Self-isolation/quarantine can be monitored only to a limited degree and would likely have been associated with a higher rate of breaking quarantine/isolation and potential onwards transmission. Recently, most countries, including Australia, have moved from self-quarantine/isolation to supervised quarantine/isolation in centralised locations such as hotels to simplify monitoring and minimise breaches of quarantine/isolation.

Option 2: immediately disembarking all asymptomatic (including uninfected and pre-symptomatic) passengers whilst keeping symptomatic passengers on board until test results were known;

- a) *Risk to those on board:* This option requires passengers to be sorted into two categories of symptomatic or asymptomatic. While some will have been identified as symptomatic by the on board medical staff, others would have to self-identify. The degree to which they would do this accurately is difficult to know, especially if the passengers knew that declaring symptoms would lead to them having to remain on the ship. If the symptomatic passengers were kept on board and confined to their own cabins for the 6-9 hours required for specimen results, then the risk of further transmission on board outside of those cabins would have been low. A risk of transmission from these passengers to crew would remain as well as a risk of transmission from infected crew to symptomatic passengers who were not SARS-CoV-2 infected. This risk could have been reduced by confining the passengers to their cabins, and providing food service only by drop off at the cabin door. The risk of transmission between on-board crew would have continued. This and other potential transmissions could have been reduced by mask wearing and social distancing among the crew and passengers. For the asymptomatic passengers immediately disembarked, who would represent the large majority of passengers on board, it is possible that a somewhat lower risk of transmission than in scenario 1 would likely apply. This is because there would have been less mixing with symptomatic people. However, they would still mix with pre-symptomatic people who were likely infectious at this point of time, so some transmission during disembarkation would still occur. In addition, it is likely that some people with minor symptoms would disembark, despite instructions not to do so, exposing others to the potential of SARS-CoV-2 infection.
- b) *Risk to broader community:* If symptomatic SARS-CoV-2 infected cases were isolated on board while waiting for results, this may have led to less transmission to other passengers during disembarkation and to the general community. However, the disembarkation of all asymptomatic passengers would mean that a substantial number of pre-symptomatic or asymptomatic people with SARS-CoV-2 infection would have disembarked and returned into the community. The risks associated with travel and voluntary quarantine/isolation noted in option 1 above also apply in this option.

Option 3: keeping all passengers on board the Ruby Princess pending swab testing results;

For this option, we have presumed that the swab test results refer to the 13 swabs from symptomatic patients referred to above, and not swabs on everyone who was symptomatic.

- a) *Risk to those on board:* If the people who had been swabbed were confined to their own cabins with their close contacts (family/travelling companions), there would be an increased risk of transmission to these contacts in these close quarters. The increased risk could have been ameliorated to some degree by giving masks to people in these cabins and by disinfecting surfaces in the cabins. Further transmission from infected crew members could be reduced by having food service to the cabin door only and by eliminating other interactions with crew during this time. The extended period of time on board with those with pre-symptomatic/asymptomatic infection may have led to additional transmission. This would have been a challenging option involving much larger numbers of people left on the vessel. The issue of transmission during eventual disembarkation noted in option 1 and 2 still applies. There is an additional possibility of increased transmission that would have occurred if passengers were unable or unwilling to be confined to their cabins during this 6-9 hr period. This risk is difficult to accurately quantify.
- b) *Risk to broader community:* The identification of SARS-CoV-2 infected symptomatic passengers, coupled with their isolation, would have reduced transmission to others while disembarking, and therefore reducing possible spread to the community. The issues of pre-symptomatic or asymptomatic patients being released into general community, and issues of self-isolation/quarantine noted above in options 1 and 2 still apply. If all passengers were informed prior to disembarkation of positive SARS-CoV-2 testing of some passengers, this may have led to behaviour change that would have reduced transmission.

Option 4; arranging for secure transport of passengers (either all, or symptomatic, passengers) to a quarantine facility (either pending test results, or following a positive test result)

We assume option 4 applies after the moment of disembarkation, and thus applies to each of options 1, 2 and 3. As noted in in section 5c of this report, since the dates of the relevant Ruby Princess cruise, Australia and many other countries have moved to a system of organised secure transfer of international arrivals to monitored hotel quarantine/isolation. This enables the protection of transport operators during transfer to the hotels, and the close surveillance of compliance with quarantine/isolation. If this had been arranged, it would likely have led to decreased transmission to transport operators. However, as it requires travel together to the quarantine facility it is possible that it would have led to extra transmission to fellow passengers while on buses used to transfer them to the facilities. For a few family groups or groups of friends, it may have led to increased transmission among people sharing a hotel quarantine room. However, on balance, overall it is likely to have decreased onwards transmission to the community.

Summary: the most appropriate and proportionate public health response

There are uncertainties which make it difficult to be specific about which of these options is most appropriate from the point of view of reducing infections in those on board and onwards to the community. It is important to consider issues of both symptomatic and pre-symptomatic transmission, and transmission from those with symptoms who may not declare their symptoms. It

would be important to know whether disembarkation which allowed for social distancing was possible. This requires input from those with expertise in controlling the movements of large numbers of people in the confined spaces of a large cruise ship. In retrospect, we know that the Ruby Princess was in the early stages of a SARS-CoV-2 outbreak at the time of disembarkation. As it was early in the outbreak, it is likely that a large proportion of those with SARS-CoV-2 during disembarkation were pre-symptomatic.

The provision within option 4 for secure transport of passengers to a quarantine facility, is likely to have reduced transmission of SARS-CoV-2 to the community. This process has now been adopted for arriving international flights at Australian airports. Although not stated within the named options, a staged, more organized disembarkation which facilitated social distancing may also have reduced transmission. However, as this would have involved thousands of passengers behaving in a highly organized and highly compliant fashion. The passengers had not received prior training for this style of disembarkation, so it is not certain as to how effective this would have been in reality.

8. *Your views as to any different set of procedures you consider the Commissioner should consider recommending, should a similar situation arise in the future as that faced by NSW Health in February and March 2020 concerning cruise ships entering NSW Ports.*

Preliminary remarks: In making comments on potential new procedures, it is first important to note that the public health response to COVID-19 in NSW, and more widely across Australia, has in general been exemplary. As of the 6th June 2020, NSW has almost eliminated local transmission of SARS-CoV-2. The public health emergency response has been well-coordinated, thorough and extremely successful. It stands in complete contrast with flawed public health responses seen in the majority of comparable high-income countries in Europe and North America. The high degree of control of SARS-CoV-2 is a tribute to our public health authorities. There are few countries which have controlled SARS-CoV-2 as well as NSW has done.

It is also important to note that each major outbreak of a new pathogen will lead to a new set of circumstances, so even similar future situations are very unlikely to be entirely the same as the situation we experienced in March 2020. While health authorities were well prepared for a response to pandemic influenza and had experience of doing so as recently as 2009, the circumstances presented by SARS-CoV-2 were different. An understanding of case fatality rates was still evolving at the time of the Ruby Princess cruise considered here, but it was clear that there was a higher mortality rate than seasonal influenza, and that mortality rates were higher still in the elderly population who comprise a large proportion of cruise ship passengers. Other characteristics of SARS-CoV-2, including precise mode of transmission incubation period and generation time, were different to influenza and to other coronaviruses including SARS(10).

Cruise ships are known to be a high-risk environment for the transmission of respiratory pathogens. In recommending any change to existing procedures for managing this risk, it is important to note that we support NSW Health's assertion that rapid disembarkation of cruise ship passengers with a respiratory pathogen is the best course of action with respect to the health of passengers on board. Leaving them on board risks the further rapid dissemination of the respiratory pathogen among passengers and crew, and evidence suggests this will likely lead to many more cases among passengers than early disembarkation.

An important question however, is the protection of the wider population of New South Wales, of Australia, and of other countries to which infected passengers are likely to travel to soon after disembarkation. In the case of the Ruby Princess, multiple secondary and tertiary transmissions resulted in New South Wales, and it is highly likely many more cases will have occurred elsewhere in Australia and around the world in returning travellers and their contacts. In our opinion the Commissioner should consider recommending the following changes to procedures in order to reduce such transmissions.

Potential changes prior to embarkation from Sydney: The Ruby Princess arrival on 19 March was one of the last large cruise ships arrivals in Australia before a national ban was implemented (16). Between 7 and 29 March 2020, at least 17 cruise ships docked in Australia and 9 of these had confirmed cases of COVID-19 (17). It is our opinion that the only way to ensure that a COVID-19 epidemic did not occur onboard a cruise leaving Australia in early March 2020 would have been to require cancellation of the cruise. On 18/3/2020 a national cruise ship ban was enacted. Enforcing this ban 10-14 days earlier would have prevented any cases of COVID-19 being related to the Ruby Princess cruise of March 8. Given the fact that World Health Organization had declared a Public Health Emergency of International Concern, and the well-documented high-risk nature of cruise ships with respect to respiratory transmission, we believe consideration should have been given to an earlier ban of cruises, and that this should be strongly considered in future pandemics caused by respiratory pathogens.

Potential changes to on-board procedures: in the setting of a respiratory pandemic, more attention to on-board passengers with acute respiratory infection is important. In this exceptional situation, this would include broader application of facilitated testing for influenza and COVID-19 such as the use of point of care tests on board or emergency transport of swabs to on shore testing laboratories, while the cruise is at sea. This would be applied to all patients with acute respiratory infection, not just those with influenza-like illness. The ARD logs that ships are required to keep should include travel history in the last 14 days, not just country of residence, because recent travel is a critical risk factor early in a pandemic.

There needs to be a more direct and systematic updating of ships doctors and state public health physicians when national case definitions change. These changes should be actively communicated to these critical components of the response rather than passively published for their information. Changes in national case definitions potentially require systematic changes in public health responses, including in the questions asked of ships in any future risk assessment. Consideration should be given to directly linking changes in important criteria, such as case definition, to critical reporting forms. Self-updating electronic forms and notifications may be one way to address this.

Potential changes in disembarkation: In situations where there is potential spread of a respiratory pathogen, specific phased and highly-organised disembarkation procedures which maintain spatial distancing and reduced crowding, during the process should be designed. Specific secure transport should be organised to monitored hotel quarantine.

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