Conference Report

Managing Infectious Disease on Cross-Border Cruise Ships in the Post-COVID-19 Era: Application of Digital Technology

APEC Health Working Group

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Asia-Pacific
Economic Cooperation

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1. Introduction

This conference report is an output of an APEC- ASF Digital Innovation Sub-Fund project of Health Working Group (HWG) from Session 2 of 2022, “HWG 07 2022A - Digital Tools for Addressing Infectious Disease in the Asia-Pacific Region: Managing Infectious Disease on Cross-Border Cruise Ships in the Post-COVID-19 Era: Application of Digital Technology”. It is co-sponsored by Peru; Thailand and Viet Nam.

The cruise industry generates significant economic value for the global economy. However, in the early stage of the COVID-19 pandemic, there were large-scale clusters of cases among passengers and crews on cruise ships, resulting in a tremendous impact on the cruise tourism industry, especially in the Asia-Pacific region where the cruise output value was ever-growing.

In the post-COVID-19 era, resumption of healthy and safe cross-border cruise travel aimed to revive economic activity in each economy in this region is of great concern. Chinese Taipei proposes a project to provide APEC economies with a platform to share and exchange experience in epidemic prevention practices on cruise ships and to host a conference in August 2023. Conference activities include (1) interactive sessions and (2) a site visit to the Cruise Port of Keelung.

This project convenes a conference for cruise epidemic prevention policy makers and officials, public health officials, border health officers, experts and private sectors (e.g., cruise lines).

This physical conference was held on 24-25 August, 2023. Apart from the keynote speech, the one and half-day conference consisted of 4 main sessions: “Cruise Cooperation Dialogue Platform: Cruise Sanitation Inspections and Management”, “Cruise Cooperation Dialogue Platform: Experiences of Responding to Public Health Events on Cruise Ships”, “Strengthening Prevention and Control on Cruise Ships: Application of Digital Technology”, and “Site Visit to the Port of Keelung”.

There were a total of 97 participants from 11 member economies and 2 non-member economies. These member economies are Australia; Japan; Republic of Korea; Malaysia; Peru; The Republic of the Philippines; Singapore; Chinese Taipei; Thailand; United States; Viet Nam and the 2 non-APEC member economies are Greece and the United Kingdom.

2. Topic-Based Summaries of Presentations

2.1 Keynote Speech – Post-COVID-19 era: Global and regional cooperation on cruise ship preparedness and management of infectious diseases

This keynote speech was delivered by Dr. Christos Hadjichristodoulou, President of the EU Shipsan Association, Coordinator of the Horizon Europe project Healthy Sailing, and Professor of Hygiene and Epidemiology, Medical Faculty, University of Thessaly, Greece.

Professor Hadjichristodoulou began his speech by highlighting the exemplary practices of Chinese Taipei in managing points of entry during the COVID-19 pandemic. As an example of another economy's management at a point of entry, he cited the Diamond Princess incident at the Port of Yokohama in Japan on 3 February 2020. The Joint Action EU Healthy Gateways issued advice on COVID-19 prevention on the same day. Regrettably, the Japanese authorities didn't notice the advice. The COVID-19 outbreak on Diamond Princess resulted in 712 infections and 9 deaths, and the Rt ranged from 3-15 among different populations. In detailing the lessons learned from the outbreak on the Diamond Princess cruise ship, Professor Hadjichristodoulou underscored that young individuals aged 19-29 seemed to be the driving force of the infection, while older individuals experienced more symptoms, and the infection rate among food service workers was higher than that among people in other occupations. Additionally, He pointed out the crucial shift in understanding the transmission of COVID-19, particularly the characteristic of airborne transmission. The World Health Organization's evolving guidance on this matter was later recognized.

Another outbreak on a cruise ship in early 2020 showcased a different response. There were 383 crew members on board another cruise ship with no passengers. By testing all crew members, isolating positive cases on board, and moving negative cases onshore, the incident resulted in no death and no more infections from the negative cases. This incident demonstrated the importance of adapting response strategies to the facilities and conditions available at the port. The continuous evolution of relevant guidance and information was necessary to reflect the changing landscape of the pandemic. Essential prerequisites included the interoperability of ships, contingency plans, and collaboration between at least two ports (one home port and contingency port).

Professor Hadjichristodoulou proceeded with some findings from tested cases in Europe. In 2021 and 2022, the incidence rates stood at 0.17 per 1,000 person-days among both passengers and crew members and 0.11 for passengers alone, which was quite low. The testing measures implemented across Europe, including testing of crew members every seven days, symptom-based testing, and testing of passengers during the voyage, were successful. Thus, an early resumption of cruise operations in August 2020 was possible.

Further research was conducted on the effectiveness of wearing masks and practicing social distancing. Comparing the infection rate among passengers on ships with mask and social distancing requirements (Group 1) and those on ships without these requirements (Group 2), Group 1 was found to have a significantly lower number of cases—only 0.02 cases per 1000 person-days, while Group 2 had 0.44 cases. The combined use of face masks with physical distancing reduced the infection risk by 95.4%. Notably, ships without a mask mandate for passengers had incidence rates similar to those of communities in Europe, indicating that cruise ships were relatively safe even without mask mandates.

Professor Hadjichristodoulou continued to stress that effective public health measures, including pre-embarkation screening, crew quarantine, mask mandate, isolation and contact tracing, and ventilation improvements, have proven successful in preventing COVID-19 infection and outbreaks onboard. He then spoke about assessing response strategies at points of entry, particularly centering on cruise ports. Five in-action reviews were conducted – one at the EU level and four at Greece's own economy level. The findings demonstrated the need to streamline communication between ports. A core recommendation was the establishment of standardized protocols shared by both EU and non-EU member states.

The current focus of the cruise ship industry is to gather evidence to shape COVID-19 protocols for routine cruise operations, in order to adapt to various epidemiological scenarios. Some challenges have been identified, such as the lack of evidence for guidelines and policies, the prevalence of asymptomatic infections hindering outbreak detection, unreportable infections, low awareness among crew members and passengers, and the high costs associated with effective protocols. The proposed solutions entail a common, universal preparedness protocol for managing extraordinary events on cruise ships across economies. Collaboration is vital, particularly on a regional level, as ships travel across borders. To facilitate cooperation, a comprehensive database for information exchange between ports and authorities is necessary.

Furthermore, surveillance strategies, inspections of cruise ships, and relevant training and exercises should be in place as well.

Regarding some options that all economies can take advantage of, various surveillance options for early warnings include syndromic surveillance among symptomatic cases, random antigen testing of passengers, regular crew antigen testing, and monitoring of parameters such medicine requests. Sewage surveillance, emphasized by the European Commission, is new and important for both ships and communities. A risk-based approach to decision making, evidence-based thresholds with epidemiological indicators and vaccination status, ships designed for different scenarios, and validated protocols are also on the table. The overall goal is to build cooperation to safeguard community health and economic growth and ensure global coordination in pandemic responses. Since large pandemics are expected in the future, it is a priority to invest in public health preparedness and response through intra- and inter-governmental and multi-sectoral cooperation.

Before concluding his speech, Professor Hadjichristodoulou introduced a new EU project, Healthy Sailing (2022-2025), which aims to improve prevention, mitigation and management of infectious diseases on passenger ships through scientific research, guidelines, and technology integration.

2.2 Session I –Cruise Cooperation Dialogue Platform: Cruise Sanitation Inspections and Management

CDC Vessel Sanitation Program, FY23 Update, Luis O. Rodriguez, the United States

This presentation was delivered by Dr. Luis O. Rodriguez, Acting Chief of the Vessel Sanitation Program, Centers for Disease Control and Prevention.

Acting Chief Rodriguez leads the Vessel Sanitation Program (VSP) managed by the US CDC. He offered insights into its core objectives, historical development, program components, and ongoing activities. The VSP's central mission is to collaborate with cruise lines to mitigate the introduction, transmission, and escalation of acute gastroenteritis (AGE) on passenger ships. The cruise industry, a thriving luxury sector with over 400 vessels worldwide, is regarded as a unique domain of focus because of its extensive reach and potential for public health risks. The cruise ships falling under VSP's jurisdiction

are those carrying 13 or more passengers and featuring international itineraries with US ports of call. The presentation underlined the symbiotic relationship between VSP and the cruise ship industry, with their common goal of upholding good public health practices on cruise ships.

Established in 1975 as a cooperative effort, VSP underwent periods of suspension and resumption in response to industry demands and legislative directives. The program's restructuring in 1987 marked a significant phase, leading to its continued refinement, and the introduction of user fees in 1988 to cover associated costs. During the COVID-19 pandemic, VSP was actively involved in controlling viral transmission on cruise ships. Acting Chief Rodriguez cited an incident off the coast of California as an example. The incident took place in March 2020, he was part of the effort to implement rigorous medical triage and safety measures to control the spread.

The four core services of VSP provided for the cruise industry resumed in 2022. They are construction, training and consultation, operational inspections, and surveillance and AGE outbreak investigations. Firstly, construction reviews and inspections ensure compliance with construction plans and guidelines. VSP collaborates with shipyards and reviews drawings to uphold the global construction standards for passenger ships. The second service is training and consultation to support education, knowledge dissemination, and capacity-building efforts. The program offers training sessions intended for supervisors as well as construction workshops. These training sessions were temporarily halted due to the pandemic but are set to resume in 2024.

Thirdly, operational inspections represent the largest component of the program's workload. These inspections, involving one to five inspectors depending on the size of the vessel, cover from a broad range of aspects including food safety, portable water, recreational water, HVAC systems, childcare services, pest management, housekeeping, and medical facilities. The inspections adhere to the VSP Operations Manual and are based on international best practices to promote public health and safety. The 2018 VSP Operations Manual is a cornerstone of the program's practices and is used globally. It draws upon a selection of references and standards, including the WHO Guide to Ship Sanitation and the FDA Model Food Code. VSP completed 148 inspections of ships in 23 US ports, amounting to approximately 4,500 inspection hours, from October 2022 to July 2023. The inspection scores of these ships, ranging from 67 to 100, indicated good compliance with applicable inspection regulations and practices. Last but not least, Acting Chief Rodriguez spoke about the importance of VSP's surveillance and outbreak investigation efforts. There are 13 AGE outbreaks in 2023, and all of them are linked to

norovirus. Therefore, a proper reporting and monitoring mechanism of acute gastroenteritis cases to the VSP prior to arrival at US ports is urgently needed.

Acting Chief Rodriguez also briefly explained the VSP's utilization of digital tools to enhance the effectiveness of its efforts. Geographic Information System (GIS) mapping is used as a potential tool to visualize case locations and outbreak progression. This aligns with VSP's endeavor to predict outbreaks more effectively and gleaned lessons from the data.

Experience from SHIPSAN and EU Healthy Gateways, Barbara Mouchtouri, Greece

This presentation was delivered by Dr. Barbara Mouchtouri, Manager of the EU Projects (SHIPSAN, SHIPSAN TRAINET, SHIPSAN ACT) and EU HEALTHY GATEWAYS Joint Action and Associate Professor of Hygiene and Epidemiology at the Faculty of Medicine, University of Thessaly.

Dr. Mouchtouri first shared the historical evolution of the SHIPSAN and EU Healthy Gateways Joint Action. The European Union (EU) supports the development of common standards for ship sanitation and the prevention and control of communicable diseases. The first EU-launched SHIPSAN in 2006 marked the beginning of a series of funded projects under the same banner. The subsequent initiative, Healthy Gateways, was expanded to cover not only maritime but also air and ground transportation affairs.

These SHIPSAN projects were instrumental in setting the stage for research, guideline development, training, and practices. The establishment of an EU ship sanitation database proved significant, with five components: a database to record passenger ship inspections, ship sanitation certificates, a communication platform for real-time exchange of information among port health authorities, a database to store Maritime Declarations of Health, and records of focused inspections for COVID-19. Within this context, the EU POENET (web-based network for points of entry) was announced, a web-based network facilitating communication on health threats across various sectors, including maritime, air, and ground transportation.

Dr. Mouchtouri further added that the European Manual, divided into hygiene standards and guidelines for communicable disease surveillance on passenger ships, has been adopted by 20 EU member states and two non-member states. What's more, the integration of a grading system adds a new dimension to the

evaluation of inspections. One of the lessons learned during the pandemic, also seen as the main reason for the suspension of cruise travel, was a lack of a proper basis for cooperation and interoperability of plans. In light of this, some tools have been devised for port contingency planning, including a template for public health emergency plans to develop appropriate strategies for COVID-19 and potential future events. The guidelines also feature a cruise operation resumption plan, emphasizing high-level decision-making to basic-level port actions. Dr. Mouchtouri then moved from COVID-19 to all kinds of public health issues, stating that they could be addressed efficiently through inter-economy communication, SOPs for vector surveillance and control, and phased protocols. To better implement these mechanisms, training is important. A diverse pool of trainers for European and training sessions has given vital guidance for tabletop and simulation exercises to support these efforts.

Dr. Mouchtouri moved on to talk about the Healthy Gateways' active and swift transition into emergency mode, as required by their contract with the European Commission. This initiative, which began prior to the pandemic, involves a group of experts tasked to tackle new challenges. Over the course of the pandemic, they responded to numerous requests from the European Commission and offered more than 40 consultations across various sectors. In alignment with these requests, the Healthy Gateways has developed 17 evidenced-based guidance documents, a substantial portion of which focus on the maritime industry.

To enhance response capabilities, the Healthy Gateways has developed an EU digital passenger locator form that applies to air, cruise, and ferry travel. Dr. Mouchtouri asserted that this system, even if only utilized by a single economy, would remain accessible for future use. Additionally, the initiative employs the World Health Organization's in-action review methodology to assess response performance. The endeavor has also yielded a checklist to streamline inspections for COVID-19 in health facilities at ports and aboard ships. Besides that, the Healthy Gateways has held a blend of webinars and multi-sectoral tabletop exercises in which different authorities and shipping companies can participate to strengthen public health incident management. The Healthy Gateways also engages in research activities, including scientific publications, pilot testing of research protocols, and PoE interview studies. Dr. Mouchtouri summed up his presentation by noting that the experiences, lessons learned and infrastructure developed during COVID-19 have formed the foundation for best practices and should be applied to improve preparedness and response capacities at PoEs for future public health events.

Additionally, Dr. Mouchtouri drew audience's attention to the Healthy Sailing project that built an integrated electronic health surveillance IT system with AI, focused on the threats of air-borne diseases and environmental health. This AI-driven system produces voyage profiles based on various risk factors, serving as a proactive tool for threat assessment and response formulation. The initiative's impact has extended beyond the technical aspect as it has established a network of academic professionals and universities. This network has led to the development of a master's program in public health and maritime transport in the hopes of fostering expertise and collaboration.

Cruise Sanitation Inspections and Management, Paul K. Armstrong, Australia

This presentation was delivered by Mr. Paul K. Armstrong, Director of the Communicable Disease Control Directorate, WA Department of Health.

Director Armstrong centered his speech on public health management of infectious diseases on cruise ships, but he also briefly explained the ship sanitation inspections at the beginning. The idea of ship inspections could be dissected from various aspects: international health regulations' requirements for valid ship sanitation certificates, public health officials' visits during outbreak investigations, and jurisdiction-specific schemes in different economies. He pointed out that states and territories of Australia, in particular, have their own periodic ship inspection programs. Director Armstrong then touched on the status of the cruise industry in Australia. 54% of the population participated in cruise travel in 2018, which was very high by international standards. The cruise market contributed USD3.4 billion to the Australian economy. However, cruise ships are high-risk environments for infectious diseases due to high passenger density, frequent social interaction, communal eating, length of cruise journey, and suboptimal ventilation systems. Hence, cruise ships pose a high risk for severe outcomes due to a high percentage of elderly passengers and limited medical facilities on cruise ships.

Director Armstrong proceeded with Australia's experience of shaping its response to COVID-19 based on the timeline of its cruise industry. Key events included the repatriation of passengers from Japan's Diamond Princess and Australia's declaration of a biosecurity emergency that banned international cruise ships from entering Australian ports. In March 2020, outbreaks on the Ruby Princess and Artania cruise ships resulted in many cases and deaths. Before entering a port of Australia, an international cruise ship must send a pre-arrival report 12-96 hours before arrival via the Maritime and Aircraft Reporting

System (MARS) for a health risk assessment. Before the ban on international cruise ships was lifted in April 2022, Australia had formulated two documents on post-pandemic cruise management, “Eastern Seaboard and West Australian Cruise Protocols” and “COVID-19 CDNA National Guidelines for Cruising”, to outline the government’s expectations for the cruise industry and to maintain economy baseline standards for public health management.

Director Armstrong further described the Eastern Seaboard and Western Australian Cruise protocols, currently under review. Tier 1 baseline will be activated when positive COVID-19 cases are under 3%, which requires communication of outbreak risks to passengers and mandatory vaccinations for those over 12, symptom screening, and mask rules. Mask requirements apply during embarkation and disembarkation, and limiting indoor capacity should be considered. Other measures include pre-embarkation testing of passengers, weekly testing of crew members, and critical care support. Positive cases are isolated until they are asymptomatic. Tier 2 will be activated when there are 3-10% active cases. Crew members must wear masks outdoors if social distancing is not possible, and testing frequency should be doubled. Over 10% cases is the threshold for the highest level, Tier 3. Under Tier 3, even stricter measures, including mask mandates for passengers, regular testing of passengers, and testing before embarkation, will be adopted.

Under the protocols, cruise lines must report COVID-19 cases to the appropriate health authority 12 to 24 hours before arrival at a port. An Excel template is available for download to assist ship health staff in reporting voyage details, respiratory/gastrointestinal illnesses, and symptoms experienced by COVID-19 or influenza cases. Western Australia (WA), with a population of 2.6 million, managed outbreaks within its waters and achieved high vaccination rates. After the ban on international cruise ships was lifted in April 2022, cruise ships gradually began to dock in WA again, mostly in the remote Kimberley region. The region is home to a vibrant Aboriginal culture. During COVID-19, the health vulnerability of Aboriginal people, who are susceptible to severe COVID-19 illness, influenced cruise policies because of limited healthcare capacity. There were 67 voyages over nine months, mostly operated by domestic cruise ships. Despite the initial outbreaks on both small and large vessels, the risk decreased over time, with no Tier 2 or 3 outbreaks in the final three months before cruise operations resumed.

At the end of his presentation, Director Armstrong presented a case study to illustrate how the protocols were implemented. A cruise ship with 2,000 passengers and 900 crew members screened all the passengers and crew members before arriving at Fremantle Port in October 2022. When 130 cases,

predominantly asymptomatic, were detected, the outbreak level was elevated from Tier 2 to Tier 3. Effective collaboration between public health officials and ship personnel resulted in successful outbreak management. The experience emphasized the importance of addressing infectious disease risks on cruise ships while striking a balance between public health priorities and societal expectations.

The Cruise Industry's Current State and Future, Sally Riu, Chinese Taipei

This presentation was delivered by Ms. Sally Riu, Secretary General of the Association for Cruises Development.

Ms. Liu started her speech by describing the current landscape of the cruise industry. In 2023, amidst a near-complete standstill in various industries due to the pandemic, the cruise industry emerges as a standout sector, outpacing the revival of the travel sector in Asia. Surprisingly, a substantial 67% of non-cruise travelers are willing to consider cruise travel, a higher level of openness compared to the pre-pandemic era. This newfound interest in cruise travel has not only reinvigorated the industry but also created over a million new job opportunities worldwide.

The revival of the cruise industry was evident despite COVID-19. The Cruise360 forum event in Miami, which took place after the initial wave of the pandemic, demonstrated strong sales and acted as a morale booster for the industry. With increasing travel demand, the cruise travel sector was positioned for a positive trajectory. However, the subsequent developments in the pandemic inflicted significant damage on the cruise industry. As the sole industry brought to a complete halt during the crisis, a report from CLIA highlighted the industry's total losses, which surpassed a staggering USD77 billion in 2020 alone. The prominent cruise line, Royal Caribbean International, suffered a USD5.7 billion loss, impacting not just the company but also relevant ports, supply chains, crew members and their families. The revival of the cruise sector thus garnered global attention.

The initial blow to traveler confidence was severe, triggered by the incident of Diamond Princess, where more than 700 passengers tested positive on the cruise ship early in the pandemic. Asian economies then prohibited cruise ships from entering their ports, and there came widespread suspensions of cruise operations. The pace of reopening borders varied from economy to economy. However, the most common request was for enhanced health and safety measures, which ultimately increased operational costs. To address these

challenges, Norwegian Cruise Line Holdings invested USD150 million to bolster its sanitation and disinfection facilities on its ships. New operational paradigms and regulations were promulgated, including limiting passenger capacity and enforcing social distancing and other measures. Reduced capacity led to diminished revenue and added expenses. The pandemic pushed some cruise lines to the brink of bankruptcy, such as Genting's Star Cruises.

To mitigate the negative impacts, cruise lines aim to enhance passenger safety. The average per-passenger expense of USD750 during a 7-day journey in port cities has helped sustain revenues. Companies have adopted stringent infection control measures, while recognizing the need to cooperate with health authorities in different economies. New ship designs have incorporated ample space for passengers and additional hand sanitization stations and sinks in dining areas to serve as hygiene reminders. Contactless technology has become pivotal in ensuring safe and smooth journeys. Bookings made through mobile apps, contactless boarding, and RFID-enabled interaction, cabin assistance apps, and voice recognition systems have gained popularity among cruise ships. Norwegian Cruise Line has even introduced an app that helps pre-cruise arrangements and online check-ins to reduce wait times in ports and avoid long lines.

Looking to the future, Ms. Liu expressed the increasing importance of sustainability on a global level for the industry. Sustainability initiatives include the use of liquefied natural gas to reduce carbon emissions and the elimination of bottled water distribution, with a goal of zero fuel consumption by 2050. The pandemic has prompted cruise lines to reconsider their operational efficiency. Collaborating with local health agencies is essential as relying solely on corporate strategies has proven inadequate for seamless operations. International collaboration between cruise lines, ports, and associations which act as intermediaries has facilitated the exchange of health experiences across regions. Moreover, four cruise lines, MSC, NCL, Costa, and RWC, have chosen Chinese Taipei as their homeport, indicating strong potential for growth in Chinese Taipei's market. This achievement is based on expert insights that emphasize leveraging health and safety as a starting point to communicate the safety of cruise travel to a broader audience.

Ms. Liu concluded his presentation by mentioning the importance of cooperation between cruise lines and home port's health authorities for safe cruise operations. Regional cooperation between economies will promote the exchange of health response experiences, which can start from the cruise industry or cruise associations.

Panel Discussion

Q1: VSP revealed that there were 13 Norovirus outbreaks in 2023, indicating that this issue remains significant. Based on VSP's experience, how do you assist the cruise operators in reducing this kind of risk?

A1 – Luis O. Rodriguez: All cruise lines have their outbreak prevention and response plans and they are based on requirements that we have in the VSP Operations Manual. Besides that, they always go above and beyond our minimum requirements. Overall, they're doing what we are expecting. One more thing is that when we are requiring these things, in our case, acute gastroenteritis prevention and control, these measures are helpful for any communicable disease. So that's kind of the way we are helping them and the surveillance and follow-up that we do with them during outbreaks. When we went to their ships for the outbreak investigations, they all generated lessons learned. And those are a few ways that we are helping them prevent that kind of risk.

Q2: The size of international cruise ships is increasing. The COVID-19 pandemic has revealed limitations in the ability of cruise ship personnel to respond to infectious diseases, and local ports have relevant constraints on sudden emergencies. Will the future design scale be modified? Will the air conditioning systems on cruise ships be reevaluated in terms of the operational methods and designs in response to the pandemic?

A2 – Ms. Sally Liu: I visited two new vessels recently. The cruise lines have strict pandemic prevention measures and drills in place. After the pandemic, a strong emphasis has been placed on health and safety. Observations of Norwegian Viva and Silver Nova showed that more space has been allocated to passengers than in the past and that capacity has been controlled. They cannot guarantee that passengers will manage their hygiene; thus, they remind passengers through numerous subtle arrangements. For instance, there are handwashing stations before heading to dining areas, encouraging passengers to wash and sanitize their hands. Currently, few people wear masks, and social distancing isn't practiced. However, the cruise lines still ask passengers if they have tested positive or developed COVID-19 symptoms in the past week and recommend frequent handwashing and sanitization.

A2 – Acting Chief Rodriguez: We help a lot with ship construction design. We have our ship construction guidelines, and those are the standards for healthy construction. We have minimum standards for ventilation as well. During the pandemic, there was a noticeable inclination to improve ventilation systems, which subsequently became essential for cruise ship operations. However,

these are only recommendations, not requirements. I know that some cruise lines are undoing a little bit of what they did during the pandemic as it costs a lot of money. Until they see healthy results, this will be their way they operate. I mentioned several times the installation of handwashing stations in front of passengers. This is a standard that we also have in our construction guidelines. Many years ago, those standards were requirements for crew members, but what we saw all the time was that outbreaks among were way more frequent than crew members getting sick. Therefore, in 2011, we revised the guidelines and included passengers in the guidelines. That is why you are seeing it more and more on newer ships. Cruise lines also have to do their part, such as reminding their passengers to kindly wash their hands before boarding. Though passengers do not always follow, I think that everybody is doing their part.

A2 – Dr. Barbara Mouchtouri: For ventilation systems, I would like to share a summary of the experiment that we are going to conduct as part of the EU Healthy Sailing project. We have engaged the experts from University of Greenwich and the University of Surrey in the UK to conduct experiments in real operational cruises in different areas. They start with the dispersion of aerosols in different modes of ventilation operations and also simulate the presence of people and the source of infected droplets. In these simulations, they incorporate air purifiers. We are going to have the results of these experiments in the following months. And we're going to combine these results with the results of our modeling of how the spread of COVID-19 can take place in different areas. We expect to have the results in 2024 and 2025. These results will inform decisions about ventilation systems and operation.

2.3 Session II –Cruise Cooperation Dialogue Platform: Experiences of Responding to Public Health Events on Cruise Ships

Singapore's Cruise Experience During COVID, Pream Raj S/O Sinnasamy, Singapore

This presentation was delivered by Mr. Pream Raj S/O Sinnasamy, Senior Assistant Director of the Communicable Diseases Division, Ministry of Health.

Mr. Pream Raj shared Singapore's cruise experience during the COVID-19 crisis. The cruise sector served as a vital source of employment for millions globally. Worldwide, the pandemic resulted in the loss of USD100 billion in revenue and half a million jobs between March and September 2020. Singapore was no exception. The outbreak onboard Diamond Princess in Japan revealed the vulnerabilities of cruise ships, whose confined spaces are susceptible to the

rapid spread of diseases. Infections among crew members surged post-quarantine, which was attributed to various factors including the presence of asymptomatic cases (estimated percentage was approximately 18%), crew continuing to work despite being identified as close contacts of cases, and the lack of public health and social measures (PHSMs).

Singapore responded to the pandemic by temporarily halting cruise operations in March 2020. Subsequently, through meticulous collaboration between the government and industry, a comprehensive set of strategies was developed to ensure the safe resumption of cruise operations. Pilot cruise operations commenced in November 2020 as testing grounds for various protocols, including the use of Bluetooth-based technology meant to aid contact tracing and the evaluation of adherence to PHSMs. The Bluetooth-based technology was adapted from Singapore's existing TraceTogether technology and calibrated for the cruise setting. Tests showed that the Bluetooth-based app and token were interoperable onboard cruise ships as well. The Bluetooth-based technology yielded promising results, demonstrating an impressive 99% precision and 91% recall. In essence, this meant that out of the close contacts identified by the Bluetooth-based technology, 99% were genuine, and out of all genuine close contacts, 91% were identified correctly.

In December 2020, “cruises to nowhere” began, which were limited to Singapore residents at a reduced cruise passenger capacity of 50% with no foreign port calls. Other measures taken included vaccination requirements, physical distancing, mask requirements, pre-boarding and post-disembarkation swabs, and the introduction of mandatory “CruiseSafe” certification, an independent endorsement and mark of quality for increased assurance that cruise ships have rigorous on-board safety and hygiene measures in place. It was also mandatory for all crew and passengers to carry Bluetooth-based devices while onboard. Data analysis from initial sailings showed strong adherence to PHSMs onboard, with 95% of contact groups of 6 or more (group sizes were limited to 5 at that point) occurring for less than 10 minutes and majority of passenger-to-passenger interactions being transient. These findings were validated by reports from independent cruise inspectors as well.

On 8 December 2020, a COVID case was detected onboard a “cruise to nowhere” which was subsequently determined to be false positive. Regardless, all control measures were implemented at the onset including immediate cessation of all activities and contract tracing. Using the Bluetooth-based technology alone, 31 out of 42 close contacts were successfully identified. The remaining 11 close contacts were identified through manual contact tracing. The Bluetooth-based technology was found to be very useful as it reduced the

time taken for contact tracing by more than half, was able to identify close contacts in areas with large congregation of individuals who do not know each other and was not subject to recall bias. Despite its effectiveness, the technology had four main limitations, namely, its inability to detect persons exposed to contaminated environments, missing short repeated interactions, lacking information about the nature of encounters, and its ineffectiveness when persons forget to carry their Bluetooth devices.

In conclusion, technology, exemplified by a Bluetooth-based system in this instance, is an invaluable asset in bolstering public health endeavors such as contact tracing. Nevertheless, awareness of its limitations is imperative, and jurisdictions should maintain the capability to adopt additional manual interventions where necessary. Mr. Pream Raj said that he hopes that such technology can pave the way for a safer cruise industry.

Alternative Yacht Quarantine (AYQ) during COVID-19 pandemic in Thailand 2020-2022, Rome Buathong, Thailand

This presentation was delivered by Mr. Rome Buathong, Director of the Division of the International Communicable Disease Control Port and Quarantine, Department of Disease Control, Ministry of Public Health.

Director Buathong shared insights gained from Thailand's response to the COVID-19 pandemic, including its quarantine measures and innovative alternative yacht quarantine (AYQ) strategy. In Thailand, the first confirmed case of COVID-19 was reported at Suvarnabhumi Airport on 8 January 2020. Travelers from designated economies with COVID-19 infections were required to make a health declaration and were subject to home quarantine. However, as cases surged, Thailand declared a state of emergency and closed its borders in late March 2020. In July 2020, Thailand began allowing the entry of foreign travelers with specific qualifications, such as work permits or residency. These eligible travelers had to meet strict conditions, including obtaining a "certificate of entry" (COE) from the Ministry of Foreign Affairs, staying at a quarantine facility, getting health insurance (USD100,000 coverage), presenting a negative COVID-19 RT-PCR test taken within 72 hours before departure, and a fit-to-fly certificate from a medical doctor. Upon arrival, these passengers had to undergo health screening at point of entry before proceeding to the quarantine facility. The designated lab center was responsible for collecting and testing samples for COVID-19.

Director Buathong explained Thailand's comprehensive approach to quarantine facilities, which were categorized based on management (state/private) and purpose (embassy, factory, university). An interesting addition was the AYQ program, launched in November 2020 in Phuket. This initiative set specific criteria for participants and procedures to be followed. For instance, these criteria included legal registration of yachts with 2-4 passengers and super yachts with less than 20 passengers, adherence to safety standards, 24/7 tracking, provisions during quarantine, and compliance with health protocols.

Director Buathong elaborated on the AYQ protocol saying that it sent agency notifications to quarantine authorities, requested document verification, and granted access if valid. Hospitals took part in by monitoring yachts during quarantine. Medical teams collected PCR samples and tested them two or three times depending on the length of quarantine, such as three times over 14 days. Positive cases were moved to onshore hospitals, while negative cases continued quarantine on the yacht before entering Thailand. Results showed that the infection rate of COVID-19 among people under AYQ was acceptable (<5%). The program's practicality and feasibility were underscored by its contribution to the local economy, but it may be hard to execute on cruise ships with a lot of passengers that require extensive manpower.

Despite challenges like unpredictable weather and signal interference, the AYQ program maintained an acceptable infection rate among participants, showcasing its viability. The success was underpinned by well-defined protocols, private sector engagement, and strong support from the local community. This approach serves as a model for addressing travel-related concerns in dynamic situations.

Managing Infectious Diseases and its Challenges on Cross Border Cruise Ships in the Post-COVID Era: The Philippines experience, Edgar O. Maala, The Philippines

This presentation was delivered by Dr. Edgar O. Maala, Quarantine Medical Officer and Officer-in-Charge (OIC), Quarantine Service Division, Bureau of Quarantine.

Dr. Maala from the Philippines discussed his economy's COVID and post-COVID experiences, particularly in collaboration between tourism and the cruise industry. He began by depicting the Philippines as an affordable, diverse, and friendly travel destination. He then clarified the role of the Bureau of Quarantine in implementing post-COVID border measures and shared the

evolution of legislation from Republic Act 123 to Republic Act 9271. The legislative framework enables the Bureau to prevent infectious diseases while aligning its standards with the International Health Regulations (IHR) of 2005. Dr. Maala stated that the goal of quarantine under the IHR standards is to limit the spread of health risks to neighboring economies and prevent unwarranted travel and trade restrictions.

Dr. Maala analyzed the Philippines' responses during the pandemic and post-pandemic period. During the pandemic, economies closed borders and cruise ships struggled to gain access to ports. In a pioneering move, the Philippines set up a green lane for seafarers in September 2020 to facilitate crew disembarkation. Manila Bay received 54 cruise ships in 2020 and 25 in 2021, accommodating 120,000 and 44,000 crew members, respectively, for repatriation and crew changes. As COVID restrictions eased in 2022, the number of arrivals decreased since other Asian economies launched their own green lanes. By 2023, cruise tourism resumed in the Philippines, signaling the beginning of the post-pandemic era.

In early 2023, the Bureau of Quarantine was tasked with developing guidelines to ensure COVID-19 control and prepare for the resumption of the cruise industry. Interim guidelines have been established and are subject to change, given the ongoing public health emergency. These guidelines require pre-arrival consultations, medical documents recorded by the ship's physicians, including health status, vaccination records, and medical logs for passengers and crew members. In addition, cruise agents are required to identify a referral hospital for medical evacuation. As for passengers and crew, they should register via a travel app and undergo thermal imaging temperature screenings.

Upon entry into the Philippines territory, its border health control measures apply at both airports and seaports. A quarantine officer comes on board to discuss how to carry out health screenings with the ship's officers. Then, passengers and crew go through an infrared thermal camera and present a green QR code for immigration clearance. A red code means further evaluation. When influenza-like symptoms develop, a risk assessment should be done, followed by a rapid antigen test if required. To illustrate his points, Dr. Maala showed the Philippines' e-travel homepage that generates QR codes through a digital system.

Digital technology has played a critical role in managing infectious diseases on cruise ships in the Philippines. The WHO International Certificate of Vaccination (ICV) incorporates a QR code for vaccination status and detailed description.

Thermal imaging cameras and online test results have aided in detection. On top of that, Dr. Maala stressed that they have put together reports of data on arrival notifications for surveillance in a timely manner. That being said, there were still some challenges during the pandemic, such as erroneous declarations, delayed reporting of health threats, ill-equipped medical facilities on board, and so on.

Additionally, Dr. Maala recognizes the limitations of technology. In the Philippines, these limitations include asymptomatic transmission, costly infrastructure development, personnel training, and education for passengers. Connectivity issues and data privacy concerns then follow. In spite of these difficulties, measures like contact tracing apps should be well instituted to solve these problems and, in turn, support cruise ship safety. Dr. Maala looks forward to improving his systems with AI and machine learning for data collection and quarantine tracking purposes. The cruise industry could lead in applying digital tech to disease control and enhancing regional cooperation. Digital applications and shared successes can further global health efforts.

Responding to COVID-19 Public Health Events on Cruise Ships—Experience from Chinese Taipei, Yung-Ching Lin, Chinese Taipei

This presentation was delivered by Dr. Yung-Ching Lin, Chief Medical Officer of the Office of Preventive Medicine, Centers for Disease Control, Ministry of Health and Welfare.

Dr. Lin gave the audience an idea about Chinese Taipei's response to COVID-19 on cruise ships. He introduced its border controls and quarantine system and stressed the importance of timely reporting of potential cases by cruise ship captains. The six regional centers of the Centers for Disease Control, Ministry of Health and Welfare, oversee border quarantine at international airports and seaports for risk assessment and inspections when necessary. The pandemic significantly impacted cruise ship ports of call, with a berthing ban on international cruise ships. Three outbreaks on cruise ships before the pandemic, including norovirus and chickenpox, informed Chinese Taipei's approaches. The Central Epidemic Command Center (CECC) was established to coordinate interdepartmental efforts and implement preventive measures. Despite some challenges, the legislative body enacted a special law in February 2020 to enforce control measures and mitigate the disease's impact on the economy and society.

Dr. Lin presented a full timeline of COVID-19 risk management for cruise ships in three stages, containment, preparedness, and recovery. The CECC swiftly responded to the outbreak on Diamond Princess by imposing a ban on all international cruise ships in the early stage. Dr. Lin also shared a unique contact tracing incident associated with passengers on Diamond Princess. Leveraging mobile phone positioning data, they estimated passengers' routes and identified potential contacts who visited the same spots. Another example was the use of thermal imaging cameras, PCR testing, and health assessments to evaluate passengers and crew members on the cruise ship SuperStar Aquarius after the docking ban on all international cruise ships. All specimens from the passengers were tested negative before disembarkation. The passengers were subsequently required to practice self-health management for 14 days.

Moving on to stage two, as the pandemic situation improved and cases were mostly imported, domestic cruise operations resumed in July 2020. Ninety-one voyages were made, and no single COVID-19 case was reported. In terms of the requirements for crew members and passengers on cruise ships, the most important ones were vaccination and negative PCR results before boarding. In the third stage, vaccine coverage increased, leading to more relaxed preventive measures aimed at striking a balance between disease control and economic revival.

Dr. Lin expressed his gratitude for international guidelines from the EU; Australia; and the United States. Through reference to these international guidelines and multisectoral partnerships, two cruise ship guidelines were published by the CECC to safely lift the ban on international cruises. These guidelines stressed the significance of quarantine facilities, testing, vaccination requirements, and management plans for confirmed cases and close contacts. Dr. Lin concluded his presentation by demonstrating Chinese Taipei's adaptive and well-coordinated approach to managing COVID-19 on cruise ships. The combination of timely bans, meticulous evaluation procedures, contact tracing innovations, and the development of responsive guidelines have ensured effective control and adaptation to evolving pandemic conditions.

Cruise Quarantine Changes in the Republic of Korea due to COVID-19 - Focusing on Sustainability, Jinuk Park, Korea

This presentation was delivered by Mr. Jinuk Park, Deputy Director of the Division of Quarantine Policy, Korea Disease Control and Prevention Agency.

Deputy Director Park showed the changes in cruise quarantine in the Republic of Korea to address the COVID-19 pandemic, with a particular focus on sustainability. The past three years have seen the pandemic's far-reaching impacts on movement, the economy, and culture. Quarantine policies aimed to create a health safety line for the economy. For this objective, Korea inspected five health hazards: biological, chemical, electrical, physical, and environmental hazards. While traditional quarantine efforts centered on biological hazards like viruses, the experience of COVID-19 put people at risk of other hazards. Therefore, the Korea Disease Control and Prevention Agency (KDCA) identified that immigrants from outbreak areas and vehicles as well as cargo were two main targets for quarantine to minimize health risks.

The cruise industry in Korea suffered a stark drop due to COVID-19, from 156 cruise arrivals in 2019 to only 12 in 2020. In response to the situation, KDCA's quarantine approach was changed to apply to both travelers and cargo, and plans were made to tackle infectious diseases. The plans included the requirements for health declarations, temperature checks, and communicable disease assessments. Deputy Director Park stressed his economy's expansion of ship sanitation inspections to include biological hazards to ensure a holistic approach to health and safety.

Deputy Director Park continued to share Korea's transformation upon the COVID-19 outbreak. In February 2020, Korea identified its first case. Cruise ships faced prolonged outbreaks lasting over two years. Initially, Korea imposed entry restrictions that brought a halt to tourism and disembarkation from cruise ships. The ban was lifted in October 2022, allowing for tourism and embarkation to resume. During the five months between the lifting of the ban and the eventual reopening, both quarantine authorities and cruise lines worked hard to better prepare themselves. The strategies that they proposed included facility readiness, streamlined processes for suspected cases, and plans for handling symptomatic passengers. As the fatality rate decreased and the epidemic situation improved, the requirement for the economy's designated areas to be inspected for COVID-19 quarantine was lifted in July 2023, which had been effective for almost three years. The experience emphasized the importance of proactive pandemic readiness for the next pandemic.

Deputy Director Park also pointed out the shift from traveler-centered to cruise-centered quarantine to strengthen sustainable cruise operations. Through sanitation management and protocols and self-reporting mechanisms, the cruise industry could treat passengers with symptoms and detect potential outbreaks of disease X. This shift is vital as Korea prepares for future

pandemics in the hopes of safeguarding public health while maintaining a resilient cruise industry.

Quarantine Experience of DIAMOND PRINCESS in Japan, 2020, Kyoko Umeda, Japan

This presentation was delivered by Dr. Kyoko Umeda, Manager of the Quarantine and Sanitation Control Division, Yokohama Quarantine Station, Ministry of Health, Labour and Welfare.

Manager Umeda first provided a brief overview about the quarantine system in Japan. Two acts were enacted on the basis of the International Health Regulations (2005). The Act on the Prevention of Infectious Diseases and Medical Care for Patients with Infectious Diseases addressed domestic public health risks at the community level, while the Quarantine Act focused on preventing foreign pathogens from entering Japan through vessels or aircraft. There were 110 quarantine stations across Japan. COVID-19 had initially been listed as item 2 among infectious diseases but is no longer categorized as such as of May 2023.

Manager Umeda went on with the process of quarantine inspections for vessels and cruise ships. Vessel captains must report vessel information to its relevant quarantine station to understand the port restrictions in advance. If a vessel is not from a WHO-identified affected area, does not have infectious diseases on board, hold a valid ship sanitation control exemption certificate, and utilizes a radio pratique system, a protection certificate will be issued before the vessel enters a Japanese port. Manager Umeda stressed that quarantine procedures for cruise ships are similar except for avian flu and Middle East respiratory syndromes (MERS). Quarantine inspections for the two diseases must be done onboard. Quarantine officers use thermograms and a self-reporting mechanism to detect potential infections.

Manager Umeda demonstrated the trends of travel by cruise ships in Japan from 2013 to 2022. For three consecutive years from 2017, over 2 million cruise passengers visited Japan. In addition, the number of cruise ships calling at ports in Japan increased to 2,866 in 2019. However, due to the influence of COVID-19, only domestic cruises could operate and the number of port calls had decreased significantly since 2020. To prepare for outbreaks of quarantinable infectious diseases on vessels, each quarantine station conducted training every year. Annual training and drills were conducted at the

Port of Yokohama, the third-largest port in Japan, but the response to the COVID-19 outbreak required more effort than expected.

Next, Manager Umeda explained in detail the timeline of the Diamond Princess incident. Diamond Princess departed from Yokohama on 20 January 2020 to start her 16-day voyage. However, on 2 February, the Hong Kong, China government reported to the Japanese government that a passenger who had disembarked in Hong Kong, China on 25 January had tested positive for COVID-19. Following this, the Japanese government imposed quarantine on all the 2,666 passengers and 1,045 crew members again. Around 30 quarantine officers, including Manager Umeda, from the Yokohama quarantine station boarded the ship on 3 February. They conducted health assessments and collected samples from passengers who had experienced fever or respiratory symptoms since 25 January. They found the process challenging due to the ship's location and communication issues between the onboard quarantine team and the land-based station.

Diamond Princess finally docked at the port on 6 February after the situation worsened, particularly among elderly passengers with health problems. The Self-Defense Force and disaster medical assistance teams were deployed to provide additional support. On 15 February, the Japanese government announced the criteria for passengers to complete their quarantine, including a 14-day period on board, a negative PCR result, and a pre-disembarkation health check by physicians. Disembarkation began on 19 February and was not completed until 1 March. The quarantine lasted about two months and officially ended on 25 March after disinfection. Unfortunately, 712 confirmed COVID-19 cases and 13 deaths had been reported on Diamond Princess by that date.

The early COVID-19 outbreak on the Diamond Princess cruise ship presented unique challenges in Japan. No prior guidelines were available, and quarantining nearly 4,000 people on board was necessary due to limited facilities on shore. Medical needs, communication challenges due to language barriers among passengers from 57 economies, sewage problems, and mental health concerns also hindered the work. Nevertheless, the mission was accomplished with the authority granted by the Quarantine Act.

To manage the quarantine on Diamond Princess, over 170 organizations and entities were involved, highlighting the need for cross-sectoral collaboration in the event of a communicable disease cluster on a cruise ship. Japan introduced an initiative involving cruise operators to formulate infection prevention guidelines, enforced by the Class NK certification, and allowed Japanese cruise

ships to resume operations in December 2022 and foreign ships in March 2023. However, to ensure safety after COVID-19, more comprehensive measures are required, such as improved outbreak detection systems and stricter international infection prevention standards. Strengthening the authority of quarantine stations and cooperation with local governments are also crucial.

Panel Discussion

Q1 – Professor Christos Hadjichristodoulou: I have a question for the Singaporean presenter. You presented your contact tracing tool. I would like to know the acceptability of the tool. We developed similar tools in Europe, not for cruise ships especially, but for contact tracing on land-based premises. And I don't think that they were very successful. Not many people were using them. They said there was latency. What's your experience in Singapore with the acceptance of this tool?

A1 – Mr. Pream Raj: While there were some concerns from the public on TraceTogether, the Bluetooth-based technology for contact tracing which was rolled out in Singapore, the government made it a priority to explain the technology and its safeguards. TraceTogether collected only proximity-based data. The government did not have access to the information unless the case uploaded the data after receiving a code. It did not track the users' GPS coordinates. This gave the public some assurance. The adoption rate in Singapore was fairly high as it was also mandatory to use TraceTogether to enter malls, markets, etc which are essential for daily life. Another contributing factor was likely that the Singaporean public generally has a high level of trust in its government and is more willing to accept such technologies.

Q2 – Professor Christos Hadjichristodoulou: Because ships are moving from economy to economy, is it reasonable to have a harmonized approach to responding to events? Ships cannot change their plan when they're visiting Thailand or Chinese Taipei. Can you consider any means of how to encourage collaboration as a network because there is a need for that? We face a similar problem in Europe. We have 28 different economies and the ships could have a different approach in each port and receive different responses even in routine measures or inspection. If they ask for different things, it is going to be a nightmare for cruise ships. So how do you consider enhancing your collaboration at the regional level at least?

A2 –Dr. Yung-Ching Lin: I mentioned this in my talk about future challenges. Since we are developing guidelines for cruise ships, we also refer to documents from other organizations or economies, but we haven't found more as they really economy-specific. Some economies want to pay more attention or have

a higher standard, while others can tolerate more risks, especially because the burden or the pandemic situation in every economy is different. For example, in the early stage, Chinese Taipei pursued the zero Covid policy. We couldn't tolerate any case, so we had really strict regulations regarding cruise ships. But I think you're right because it is really difficult to follow different kinds of standards when cruise ships are visiting different economies. It is an issue that we need to solve. We can take this opportunity to create a platform like this conference. Most of the participants are from the same region. It's a really good chance for us to have a platform to communicate, share, and make some common strategies and standards. Though some of them could be economy-specific, we could know what other economies are doing. We can have more discussions on that.

A2 – Deputy Director Park: We could find a solution from the WTO cases. Before enacting the WTO trade agreement, economies had different regulation and standards. But after the agreement took effect, every economy tried to align their regulations with the agreement. This may be the way that we can consider to solve the problem.

Q3 – Participant from Malaysia: What do you mean by close contact for positive COVID-19 from crew members and passengers on cruise ships?

A1 – Mr. Pream Raj: Generally, a close contact is defined as someone who had exposure for 30 minutes or longer within two meters. Crew working, staying or eating together are likely to be assessed as close contacts. Similarly, passengers staying, eating or participating in activities together are likely to be assessed as close contacts.

A2 – Professor Christos Hadjichristodoulou: We have the 15-minute definition in Europe. Close contacts include those working together, eating together, mostly going or shopping together, doing activities together for a short period, on the same path, within one and a half meter of each other. Again, we have a different definition. So harmonizing is good because cruise lines should know the definition and how to do contact tracing. It's another issue that you have to communicate with each other and identify areas of collaboration. You say 30 minutes, for example, while we say 15 minutes, and the CDC says 15 minutes. It is a difference, but you have to collaborate and harmonize things.

A3 – Mr. Pream Raj: We had different tiers for identifying close contacts. For higher-risk exposures such as mask-off settings, more stringent criteria were applied. This included places where people dined or if they went to the gym. Apart from person-to-person exposure, there were other factors such as environmental contamination which needed to be taken into consideration. For example, in Singapore, we had a COVID outbreak linked to a rock climbing gym. The cases used the gym at different times and had no exposure to each other. It was uncovered that the only commonality was the rock climbing wall. Hence,

for that outbreak, we quarantined persons who had used the wall for X period after the case had used it. Our risk assessment needs to be made on a case-by-case basis at times. We can come up with broad parameters like timing and distance, for example, but there will be specific instances where other parameters need to be considered which may not be easily defined upfront.

Q4 – Moderator: When you said that we need a new IHR, I would say hopefully not. We should find a harmonized way to comply with the IHR and that we're all talking the same language. The others thought that that we are all asking cruise lines to comply with different things, but they have become pretty good at applying digital technology to businesses. In addition to trying to get together and compromise the way that we approach them, it will be helpful for them, instead of waiting to see what they're asked to do, to take a more proactive role.

A4 – Professor Christos Hadjichristodoulou: The member states are now in the fifth meeting and revising the IHR. They attended it with recommendations on which articles they would like to revise or changes they would like to see. One of them is related to points of entry and means of transport, and more. We are negotiating. This is a very high level, but it's going to change. Like I said before, we must involve the industry in what we decide. We're going now to update our manual. We're going to create working groups on food safety and potable water safety. We're going to invite representatives and experts to participate in the working groups. The manual is also owned by them. We're not going to prepare something, bring it to them and ask them to take it and use it. They're going to be part of the working group that is developing the updates to the manual. It is the way that even during the pandemic when we were creating guidance, we invited them and discussed it with them. We had hard talks with them because they didn't like what we were suggesting to them many times. But in the end, we survived both, and we reached an agreement.

2.4 Session III –Strengthening Prevention and Control on Cruise Ships: Application of Digital Technology

COVID-19 & Future Solutions, Ethan Tu, Chinese Taipei

This presentation was delivered by Mr. Ethan Tu, founder of AI Labs.tw

Mr. Tu founded his team's AI Lab in 2017, a pioneering open AI research institute in Asia. Its primary focus is on enhancing precision health and covering the entirety of a person's life. Mr. Tu is proud to say that Chinese Taipei excels in its unique approach to data collection. Rather than relying on big tech

companies or government sources, his Lab has adopted a federated approach. This means various entities, including medical centers, individuals, and government agencies, generate their own data. All of this data is fed into a common model which facilitates federated learning and validation while preserving privacy and avoiding bias.

Mr. Tu mentioned in his presentation that they had established a unique federated learning approach when many institutes retain their private data within the hospital. This model does not centralize data but enables the creation of an AI hospital network in Chinese Taipei. They also use genomic studies, real-world evidence, and paramedic decision support powered by AI. Federated learning has been promoted across healthcare centers, leading to the formation of the Healthcare Federated Learning Alliance. This alliance consists of three major arms: a clinical trial consortium (disease-based), a smart health care consortium (medical center-based), and the Kaohsiung Alliance (city-based). Over 80% of medical centers in Chinese Taipei participate, facilitating the operation of more than 120 federated learning programs.

More importantly, federated nodes have been set up in healthcare centers, and mobile devices. These nodes have expedited the creation of a system to detect disease outbreaks and support local model aggregation and parameter sharing to forecast future disease cases. This approach, in collaboration with the U.S. CDC and federal government agencies, avoids data collection debates by allowing each institute to gather data using a common protocol. It democratizes data analytics and promotes open data protocols and services for healthcare centers globally.

During the pandemic, the AI Lab collaborated with the Centers for Disease Control, Ministry of Health and Welfare, to develop the Social Distancing App. Individuals stored their own data on personal devices, which realized the idea of a federated and decentralized approach to understanding disease transmission. The initiative successfully curbed the spread of the disease. Additionally, the Health Reporting App simplified the symptom reporting process during quarantine through facial and speech recognition. Mr. Tu also recognized the disturbance brought by misinformation, so the Infodemic was created to identify and counter healthcare misinformation.

The AI Lab envisions that the post-pandemic solutions for the cruise industry will be found through collaboration with the Ministry of Transportation and Communications. These solutions can encompass a three-dimensional approach. Firstly, to protect human health, the social distancing app, an AI

symptom identification system, should be used before boarding, and AI-assisted health reporting should be recommended during the cruise. Secondly, information accuracy should be checked by verifying information with the Infodemic Cybersecurity Center to combat misinformation. Thirdly, disease control and management should be highly emphasized through a COVID-19 chest x-ray classifier, a drug discovery tool, virus sequencing technology, and access to medical papers via PubMedKB. These measures are expected to safeguard travelers and streamline disease management in the cruise industry.

Experience in Promoting Digital COVID-19 Certificate, I-Ming Parng, Chinese Taipei

This presentation was delivered by Dr. I-Ming Parng, Director General of the Department of Information Management, Ministry of Health and Welfare.

Director General Parng introduced the experience of using digital COVID-19 certification. After Europe announced its digital certificate in 2020, Chinese Taipei also developed a fast and efficient application process. Users could enter their ID number, health insurance card number, household number, passport number, and other details to obtain their certificate quickly. There was no need to download an app, as it could be accessed through a web interface. Moreover, the digital COVID-19 certificate issued by Chinese Taipei complied with GDPR standards to protect privacy.

Director General Parng added that, apart from applying the EU DCC standards to its own digital certificate, Chinese Taipei also rolled out the Smart Health Card, inspired by Japan. This offered convenience for travelers to Japan, as Japan did not accept the EU standards. The Smart Health Card could be easily saved on mobile devices for future use.

During the pandemic, there were claims filed related to medical certificates and health insurance, leading to what was called “insurance chaos.” To ease the burden on healthcare professionals and public offices, the government expanded the use of the digital COVID-19 certificate to various types of isolation notices and relief documents. The advantages of digital certificates included rapid verification, anti-counterfeiting measures, paperless operation, and easy to use. The performance of the system was also monitored closely, and its operation was mainly based on Google Cloud for better stability, efficiency, and effective management of costs. In terms of the environmental impact, the digital certificate system saved a significant amount of paper, equivalent to 824 million

sheets, and reduced the need for additional human resources, equivalent to 1,000 workers, for three years.

Director General Parng concluded that the experience has prompted the development of user-friendly systems on the existing infrastructure. The benefits of a digital application are evident as paperless operations and dashboards to assess the effectiveness of the processes have received praise. The support of government and commercial partners in this endeavor made all this possible.

Using Digital Technology to Promote the Prevention and Control of Infectious Diseases on Cruise Ships, Pierfrancesco Lepore, United Kingdom.

This presentation was delivered by Mr. Pierfrancesco Lepore, Vice President Medical Services of the Medical Department, MSC CRUISE MANAGEMENT (UK) Ltd.

Mr. Lepore provided his perspectives about the post-pandemic restart of MSC Cruises. It was marked by a comprehensive embrace of digital solutions and a proactive approach to health and safety concerns. In the early phase of the pandemic, the company's top management rapidly assessed more than 200 companies from 15 economies, including Chinese Taipei, to identify the most suitable digital technologies for their recovery efforts. These efforts were driven by a commitment to passenger and crew safety and aligned with evolving safety guidelines. Thus, they designed an electronic health questionnaire, revolutionizing the embarkation process by digitizing health assessments. QR codes replaced traditional paper menus to elevate safety level.

Furthermore, Mr. Lepore pointed out that they redefined safety drills and passenger briefings to be in line with safety guidelines and the SOLAS standard. Advanced digital tools, such as bracelets and the "MSC for Me" application, were utilized to carry out proximity and contact tracing. Throughout their voyages, cruise ships worked closely with local authorities with an aim to exemplify their commitment to safety and efficiency.

Mr. Lepore then introduced different robust, enhanced medical monitoring systems adopted during their post-pandemic restart. For example, daily temperature checks were done twice for guests and passengers. The results would be interfaced with COVID-19 testing machines with electronic health

records. For contact tracing, they followed the WHO-recommended guidelines, emphasizing a 15-minute interaction within a meter and a half. Initially, they used bracelets for contact tracing but found them data-intensive and less effective. They then transitioned to facial recognition through widely distributed onboard cameras for security purposes.

The company also implemented machine interfaces, including second-generation antigen tests (PIA) and immunofluorescence techniques. RT-PCR tests were conducted on board to confirm cases before disembarkation. To expedite this process, Mr. Lepore shared how they intended to secure agreements with private facilities and COVID-19 hotels in Europe to accommodate patients when public facilities were unavailable. They acknowledged the limitations of antigen tests, primarily suited for screening rather than diagnostic confirmation.

Their approach also included strict protocols for crew members, involving quarantine, pre-embarkation PCR tests, and ongoing antigen tests. This way, medical capabilities were strikingly improved, supported by additional medical staff and equipment like respirators in case of severe outbreaks. Concerned about airborne transmission, they maximized fresh air circulation in ventilation systems and added HEPA filters in hospital and isolation areas.

MSC Cruises' response to the potential airborne transmission of COVID-19 through HVAC systems began with their observation of a medical journal article. The article discussed the turbulent gas cloud generated by human activities and its potential implications for virus transmission at considerable distances. Recognizing the uncertainty surrounding aerosol transmission, MSC Cruises proactively explored HVAC system modifications as a precautionary measure. They considered regulatory and scientific guidance, such as the ASHRAE Epidemic Task Force's recommendations in 2021 for reducing airborne aerosol exposure. Consequently, ventilation, filtration, and air cleaning measures, including the use of high-performance filters like MERV 13 filters and HEPA systems, were commonly found in hospitals and other settings requiring stringent sanitation.

While there was debate about aerosol transmission, evidence suggested COVID-19 could spread through droplets and aerosols. MSC Cruises implemented 100% fresh air circulation in public areas and total fresh air systems in cabins. They devised systems to prevent air mixing and used MERV 10 filters where high-efficiency filtration was not possible. UV and ozone technologies were considered for air purification, but UV-C tests in a closed

circuit yielded no significant improvements and raised safety concerns. Ultimately, they opted for fleet-wide air filtration. This experience has highlighted the importance of technology and human expertise. MSC Cruises focuses on the role of technology in enhancing communication, relationships, and equal opportunities in the post-COVID-19 period.

Using Digital Technology to Promote the Prevention and Control of Infectious

Diseases on Cruise Ships, Jenny Lim, Malaysia

This presentation was delivered by Ms. Jenny Lim, Regional Vice President of Fleet Hotel Operation, Norwegian Cruise Line.

As an overseer of hotel operations for NCL (Norwegian Cruise Line), Ms. Lim made a point of the company's commitment to guest safety and memorable experiences. NCL, a leading global cruise line with a rich history, operates 19 vessels worldwide, including one coming to Chinese Taipei in 2024. They put safe travel and sustainability at the top of their tourism agenda through collaborations with destinations and adherence to regulations. NCL is experienced in handling logistical challenges as they view their ships as floating cities. COVID-19 posed unique challenges, but NCL's focus on innovation, safety, and science-backed protocols motivates them to adapt and prioritize the well-being of guests, crew members, and destinations, even after the pandemic.

Ms. Lim proceeded with their categorization of health and safety efforts in prevention, control, and recovery. Prevention implies extensive guest education, including pre-sailing safety videos and handwashing reminders. They have upgraded HVAC systems with bipolar ionization technology, HEPA filters, and medical-grade filters to improve indoor air quality. Crew members receive thorough training, including outbreak prevention and response, PPE use, and biohazard management. They also dispatch a team of health specialists that travel from ship to ship to train crew members.

In the control phase of health and safety, NCL is prepared to cope with illnesses that may arise on board. They have built health centers for rapid testing that can administer up to 32 tests at once. Technologies like RFID in key cards and facial recognition surveillance help monitor potential contacts with infected individuals. Their well-trained team maintains constant communication to prevent further spread and secure necessary supplies. NCL's self-sufficiency extends to the production of environmentally friendly sanitizers on board using

hypochlorous acid generators, with at least 10 units on every ship. These measures can ensure a rapid and effective response to any health challenges on board.

With regards to recovery, NCL makes sure that each ship has dedicated medical facilities staffed with health experts, including intensive care units and isolation areas. Guests in need of additional medical care will be assisted, either on board or with shoreside partners like Cleveland Clinic. Ms. Lim stressed the importance of health and safety in the cruise industry and looks forward to delivering unforgettable experiences while offering useful concepts of what and how the world should do.

Panel Discussion

Q1 – Professor Hadjichristodoulou: First of all, Ethan, I was impressed by what you are doing with using artificial intelligence, machine learning, and big data management. I would like to ask you why in a flow chart you showed to us, you are using the X-ray for the diagnosis of COVID-19. Why not the test? Are you taking only severe cases?

A1 – Mr. Ethan Tu: Back in 2020, in the very early stage of COVID-19, there was no rapid test kit. Therefore, we actually used a chest X-ray from a university hospital medical center. We had very few COVID-19 cases, but all together we were using a federated learning technology. We were able to determine if this patient had pneumonia and if that was from COVID-19 or not. So that was at a very early stage from January to March 2020. This later became a very useful kit because a test kit was pretty specific. If you used it for COVID-19, maybe it could not be used for other diseases. But with a chest X-ray, you are able to see what is in your lungs inside. Besides, we had many portable X-ray devices. We also had a very affordable, portable chest X-ray solution for screening the crew before they went on board. But, of course, PCR testing was quick and there were also a lot of rapid test kits afterward. Later on, we didn't use chest X-rays anymore. But I would say this depends on the context of the disease. If there is an emerging disease in the future, before we have a test kit, we can use a chest X-ray.

Q2 – Professor Hadjichristodoulou: It is about the EU DCC and your vaccination certificate that you managed very well. But again in Europe, we can also have the EU DCC in five minutes. The complex thing in the EU is mutual recognition. For example, a certificate issued in Greece could be validated in Germany, so we had a central cloud. With a key, the certificate issued in Greece was verified and could be used throughout Europe. Some other non-EU economies were

also connected to the EU DCC. The main advantage is that the certificate for Chinese Taipei could be used in the EU area. Did you connect your system with the EU DCC?

A2 – Director General I-Ming Parng: Sure, we were part of the EU system. We got the permission from the EU Commission. Our people could take the certificate to Greece, England, Germany, the Netherlands, and France. There was no problem.

Q3 – Professor Hsiu-Hsi Chen: I just wanted to give feedback to Jenny. I used to be a friend for the Swedish cruise ship, though not from Norway. The cruise ships in the European system are well-circulated, but their culture is different from that of Asian economies. We'd love to know the guidelines because the guidelines for cruise ships have been requested. Another thing is that I'm very happy to hear Mr. Pierfrancesco's presentation. You talked about HVAC. When we compare Explorer to Diamond Princess, one thing that stands out is that Explorer has a positive pressure system. That's a very important factor. You are proposing to use this very important system in the future, and I'm happy to hear that. Today, we are talking about different transition models. We have to pay attention to different viruses with different transmission routes. Disinfection and different transmission modes require different measures. That's why we need AI applications. Dr. Tu and Singapore have already mentioned some very good AI applications, but how to apply them to cruise ships is important.

A3 – Mr. Pierfrancesco Lepore: I totally agree because the first presenter talked about the difference between some offshore facilities or buildings and cruise ships. Cruise ships are a very complex environment. Artificial intelligence can help us because a complex environment that can be approached only with a complex systemic approach. We have developed it now, as explained by Barbara and Christos. I don't want to be self-referring, but it is a situation that I know very well, and I'm learning from there because they approached the prevention of communicable diseases onboard the ship with a systemic approach. And now, they are studying artificial intelligence modeling, because only with this kind of approach, we can have great results in a brief time, but most of all in a complex environment. For instance, we used a pressure-positive environment. The solution is not always applicable everywhere around the ship. But also, we have a different segment of air conditioning, the HVAC system. For sure, we cannot apply it everywhere or to everything. We have to be careful because, otherwise, there can be discrepancies that can affect your results or your aim. If your aim is to prevent it, then probably you have to do some cross-contamination with the environment. It can be risky. I don't want to be a catastrophist, but it seems that the next pandemic will be a vector-borne or airborne disease. If it's true, we will be prepared.

Q4: For Vice President Lim, Norwegian Cruise Line has a large fleet, so crew health management is crucial. How can information systems be used for management, and what are the practical applications?

A4 – Ms. Jenny Lim: In Norwegian Cruise Line Holdings, we have a system that manages every aspect of our medical operations. We collect and compile all the data across our brands and all the fleets that we are managing. This allows us to improve management visibility, to have a more efficient process, and to control while mitigating very high-risk medical operations on board. The system includes, but not limited to, basically a global dashboard and centralized health data, public health management, case management, and, last but not least, the health and wellness program they manage on the ship.

2.5 Session IV –Site Visit to the Port of Keelung

The Cruise Market of Keelung Port in the post-Covid-19 Era, Huei-Hsuan Liu, Chinese Taipei

This presentation was delivered by Ms. Huei-Hsuan Liu, Manager of Stevedoring and Warehousing Business Division, Port of Keelung.

The presentation of Ms. Huei Hsuan Liu provides useful information about the location, advantages, and facilities of Keelung Port. The advantages of Keelung Port include its location in close proximity of major Taipei's attractions, the huge purchasing power of the local population of 6.8 million, and its pivotal location for the development of transit and homeport calls.

Keelung Port has invested significantly in enhancing its cruise infrastructure in recent years. The port boasts two cruise terminals, the East Passenger Terminal and the historic West Passenger Terminal, both of which were renovated and upgraded in 2021 and 2022. These terminals are now equipped with state-of-the-art facilities, including boarding bridges, passenger waiting areas, and service amenities.

Keelung Port is poised for exponential growth in the post-COVID-19 era. Projections indicate a substantial increase in passenger numbers, with ambitious plans to welcome new cruise ships in the coming years. These developments underscore Keelung Port's commitment to redefining itself as a prominent cruise destination and contributing to the ongoing success of Chinese Taipei's cruise industry.

Practical Experience in Cruise Quarantine and Inspection of Ships at the Port of Keelung, Pei-Chun Chuang, Chinese Taipei

This presentation was delivered by Dr. Pei-Chun Chuang, Section Chief of the Taipei Regional Center, Centers for Disease Control, Ministry of Health and Welfare.

Cruise ships, once known for their luxurious experiences and exotic destinations, became emblematic of disease outbreaks and uncertainty. The global cruise industry, like many others, has faced significant challenges due to the COVID-19 pandemic.

Dr. Pei-Chun Chuang began her talk with the disposal process for cruise ships in an outbreak. She highlighted the importance of preparedness, cross-functional communication, and response strategies. She also emphasized that effective coordination and communication are vital in containing outbreaks on cruise ships, which are confined environments for passengers and crew.

One of the most crucial topics was the COVID-19 cruise quarantine policy. The policy included several measures aimed at preventing the spread of the virus on cruise ships. These measures included requiring health declarations from passengers and temporarily banning international cruise ships from docking. The ban was lifted in October 2022, marking a significant step toward the industry's recovery.

As the cruise industry looks beyond the pandemic, preparedness has taken the center stage. Key elements discussed for cruise ship preparedness include stockpiling of drugs and personal protective equipment (PPE), enhanced testing capabilities, environmental cleaning and disinfection procedures, and improved ventilation systems. These measures are considered critical in ensuring the safety of passengers and crew members and preventing future outbreaks.

The meeting acknowledged the profound impact of COVID-19 on the cruise industry. Cruise ships experienced outbreaks, leading to widespread cancellations and a decline in demand. To control the virus's spread, a number of measures were implemented, including inspections, temperature monitoring, and stockpiling of medical supplies.

She concluded by emphasizing the importance of further knowledge and enhanced management of health control measures on ships and at ports. She also suggested an array of measures, including vaccination requirements, incentives for respiratory hygiene and cough etiquette, improved ventilation and disinfection equipment, and improved infectious disease detection capabilities.

Site visit at the Port of Keelung, Yu-Ting Chang, Chinese Taipei

This presentation was delivered by Ms. Yu-Ting Chang, Manager of the Occupational Safety and Health Division, Port of Keelung.

Keelung Port's primary advantage lies in its location, in close proximity of major Taipei's attractions. This location provides cruise travelers with unparalleled access to renowned sites, including the Bangka Longshan Temple, the skyscraper "Taipei 101", the old gold mining town "Jiufen" and the Yehliu Geopark. Visitors can seamlessly explore these cultural gems for a rich and diverse experience.

The port's main attraction is not only its picturesque location, but also its immense purchasing power. With a local population of 6.8 million, Keelung Port represents a robust market for cruise lines, attracting travelers seeking high-quality experiences and shopping opportunities. This demographic strength makes it an ideal destination for cruise operators looking to tap into an economically vibrant market.

Beyond its location and market strength, Keelung Port offers compelling transit and homeport opportunities. It serves as a central hub for cruise itineraries, facilitating seamless connections to neighboring destinations. Travelers can opt for pre-cruise stays in Taipei to explore its myriad attractions before embarking on their cruise adventure from Keelung Port.

2.6 Summary of the Conference

This conference covered three main topics, which are (1) Cruise Sanitation Inspections and Management; (2) Experiences of Responding to Public Health Events on Cruise Ships; (3) Strengthening Prevention and Control on Cruise Ships: Application of Digital Technology and included a (4) site visit to the Port of Keelung. The summary of the conference is as follow.

Keynote speech

Professor Christos Hadjichristodoulou from Greece cited the Diamond Princess incident, emphasizing the importance of timely advice which should be updated regularly. It is also emphasized that evidence-based COVID-19 measures should be used in daily routine operations. Strengthened training and drills for port personnel to enhance port response capabilities are also crucial, with collaboration and surveillance as key strategies. Common protocols for port responses to extraordinary emergency events and using common standards for ship inspections are proposed. The overall goals are to enhance the resilience of the cruise industry, promote people's health, and ensure the sustainable development of the cruise industry.

(1) Cruise Sanitation Inspections and Management

Acting Chief Luis O. Rodriguez from the United States leads the Vessel Sanitation Program (VSP) to prevent acute gastroenteritis. In 2020, VSP joined the COVID-19 maritime unit to support COVID-19 epidemic prevention work and returned to its original mission in 2022. The four core services of VSP are construction inspections, training and consultation, operational inspections, and AGE surveillance, with operational inspections accounting for the largest component of the program. Surveillance and outbreak investigations are vital and focus on norovirus outbreaks in 2023. VSP also uses the GIS mapping to assist cruise ships in controlling and predicting AGE cases.

Dr. Barbara Mouchtouri from Greece discussed the Shipsan and Healthy Gateways projects, which supported the establishment of common health guidance in the EU for maritime, air, and ground transportation and to strength the EU’s capacity. The initiatives stressed the need for cooperation and interoperability in response planning. During the COVID-19 pandemic, the Healthy Gateways also provided a framework to conduct operational activities, training, and research activities for COVID-19 responses at ports and on cruise ships in the EU. What’s more, the Healthy Sailing project, which focuses on cruise ships, has introduced an AI-driven surveillance system and a master's program to promote expertise and collaboration.

Director. Paul K. Armstrong from Australia commented on the two main protocols enacted by Australia for post-pandemic cruise management to ensure economy minimum standards of public health management. Despite initial outbreaks, the risk decreased over time, with successful outbreak management through collaboration between health officials and ship staff.

Ms. Sally Liu presented that, due to the pandemic's impact, cruise lines invested heavily in sanitation and disinfection, limited passenger capacity, and implemented contactless technology. Sustainability has become a global focus and encouraged global efforts to reduce carbon emissions and eliminate plastic bottle use. Collaboration with local health agencies and international cooperation play a vital role in ensuring safe operations.

(2) Experiences of Responding to Public Health Events on Cruise Ships

Mr. Pream Raj S/O Sinnasamy from Singapore shared that Singapore temporarily halted cruise operations and collaborated with industry stakeholders for the safe resumption of cruises. They developed a comprehensive set of strategies, including innovative Bluetooth-based technology for contact tracing and monitoring of adherence to public health and social measures . Health protocols, reduced passenger capacity, and safe management measures were implemented to ensure safety.

Director Rome Buathong from Thailand touched on the implementation of an innovative Alternative Yacht Quarantine (AYQ) strategy for foreign travelers during the pandemic. It included regular PCR testing and medical monitoring, and infected individuals were transferred to onshore hospitals. The AYQ program maintained a low infection rate and contributed to the local economy.

Mr. Edgar O. Maala from the Philippines described a pioneering green lane for seafarers that facilitated crew changes. In 2022, to prepare for the post-pandemic era, the Bureau of Quarantine introduced guidelines that regulate pre-arrival consultations, health screenings, and digital tools for vaccination status and temperature checks.

Dr. Yung-Ching Lin from Chinese Taipei stated that the response to COVID-19 on cruise ships involved three stages of risk management. He shared a cost-effective example of the application of digital technology to contact tracing of passengers who disembarked and a practice of border quarantine of cruise ships at the home port in the early stage of the COVID-19 outbreak. During the pandemic, there were 91 domestic cruise voyages with no COVID-19 cases on board, which was the cornerstone of international cruises. Finally, through multisectoral partnerships and reference to international guidelines, two cruise ship guidelines were published to lift the ban on international cruises safely.

Deputy Director Jinuk Park expressed that the Republic of Korea shifted its quarantine approach to address various health hazards, extending its scope beyond biological threats to include other risks like chemical, electrical,

physical, and environmental hazards. They placed a special focus on both travelers and cargo, backed by measures such as health declarations, temperature checks, and comprehensive ship sanitation inspections.

Manager Kyoko Umeda from Japan said that Japan's quarantine system faced significant challenges during the COVID-19 outbreak on Diamond Princess. Despite a lack of prior guidelines and communication issues, Japan successfully employed quarantine measures, and the experience highlighted the need for improved outbreak detection systems, stricter infection prevention standards, and strengthened cooperation between quarantine stations and local governments.

(3) Strengthening Prevention and Control on Cruise Ships: Application of Digital Technology

Mr. Ethan Tu founded the AI Lab which applies digital technology through a federated approach to healthcare data in Chinese Taipei. This approach has extended to disease outbreak detection using decentralized nodes. They also developed apps for social distancing, symptom reporting, and combating misinformation. They proposed to use digital solutions, including AI symptom identification and disease control measures, for the cruise industry in the post-pandemic period.

Director General I-Ming Parng mentioned that his government launched a user-friendly digital COVID-19 certificate system. It complied with GDPR standards and was also expanded to include various isolation notices and relief documents. Leveraging Google Cloud, it improved efficiency and saved substantial paper use and manpower, promoting environmental sustainability.

Mr. Pierfrancesco Lepore from MSC Cruises embraced digital solutions and a proactive health and safety approach for its post-pandemic restart. They digitized health assessments, introduced QR codes for menus, and revamped safety drills. Advanced tools like "MSC for Me" app facilitated contact tracing. They also addressed potential airborne transmission through HVAC system modifications.

Ms. Jenny Lim from Norwegian Cruise Line prioritizes guest safety and sustainability through digital innovations. They have upgraded the HVAC system with advanced filters and used RFID and facial recognition for contact tracing. In addition, their well-equipped medical facilities, intensive care units, and isolation areas are staffed by dedicated health experts.

(4) Site Visit to the Port of Keelung

Keelung Port has consistently served as the economy's maritime gateway. During the challenging times of the pandemic, various units of Chinese Taipei's CIQS at Keelung Port remained steadfast in their posts to ensure the economy's security and provide quality services to cruise ship passengers. Their dedication is commendable. Over these years, Keelung Port has not slowed down its pace of development, even in the face of the pandemic. On the contrary, it has increased its investments in upgrading cruise network facilities and introducing smart customs clearance equipment to offer passengers a comfortable and convenient travel environment.

Overall, the cruise industry has undergone a transformative response to the challenges posed by the COVID-19 pandemic. Regional leaders in the industry, representatives from various economies, and experts have shared their insights on how the cruise industry has adapted and innovated its practices to ensure the safety and well-being of passengers and crew members.

Key themes that emerge from these diverse perspectives include the adoption of advanced digital technologies to enhance health and safety protocols, the importance of international collaboration and standardized guidelines, and the implementation of comprehensive measures at all stages of cruise operations, from prevention to control and recovery.

Digital solutions have played a crucial role, which is evident from the use of technologies by cruise lines, such as contact tracing through RFID and facial recognition, advanced HVAC systems, and AI-driven surveillance systems to monitor and manage health and safety on board. These innovations have not only improved passenger and crew safety but have also contributed to the industry's sustainability efforts.

The cruise industry's response has been characterized by its commitment to guest safety, innovative approaches to public health, and a focus on sustainability. While the pandemic has created significant challenges, the cruise industry's resilience and adaptability demonstrate its determination to provide safe and memorable experiences for passengers in the post-pandemic period.