EVALUATING THE EFFECTIVENESS OF ONBOARD ISOLATION PROTOCOLS IN PREVENTING DISEASE SPREAD

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Abstract

The management of an epidemic of an unusual viral respiratory illness aboard a ship, characterized by transmission from person to person, is an issue of public safety due to the close association of occupants in an intimate and air-conditioned atmosphere. It possesses the potential for explosive outbreaks, characterized by a high Secondary Attack Rate (SAR), resulting in considerable morbidity and mortality. This paper evaluates the control methods implemented on two ships experiencing analogous outbreaks and advocates for a consistent, evidence-based approach to such incidents. This descriptive investigation presents a comparative examination of the control methods implemented on two vessels: a cruise ship during a COVID-19 outbreak and a battleship during an H1N1 influenza epidemic, occurring at various time intervals. Data regarding the date of commencement, clinical specifics, test outcomes, travel time, interactions with positive specimens, and initiated prevention efforts were gathered, analyzed, and contrasted. Among the two vessels analyzed, one was a cruise ship reporting 710 COVID-19 instances, an Attack Rate (AR) of 18.4%, and 14 fatalities, while the other was a battleship with 15 cases of H1N1 influenza and an AR of 4.75%. The epidemic trajectory for each epidemic was constructed to analyze temporal dispersion. Active monitoring, prompt self-reporting, and fast disembarkation of participants, coupled with stringent adherence to hand sanitation, coughing protocol, and enhanced disinfection, will facilitate the early abatement of the epidemic. Health instruction should be conducted to disseminate evidence-based information and mitigate fear of the unfamiliar. Vaccination is absent, but if accessible, it should only be delivered following a rigorous study of risk-benefit, cost-benefit, and efficacy.

Keywords – Isolation, Disease, Spread, Cruise

1. INTRODUCTION

In January 2020, Severe Acute Respiratory Syndrome Coronavirus 2 (SARS-CoV-2) [1] was discovered as the primary cause of a viral pneumonia epidemic in Wuhan, China, where the sickness was initially diagnosed in December 2019 [16]. This recently identified virus, responsible for extreme acute respiratory illness, is associated with the extreme acute respiratory syndrome coronavirus or the Middle East Respiratory Syndrome (MERS) coronavirus [2]. However, it remains unique from both. Studies of outbreaks have indicated that SARS-CoV-2 disease can be transmitted between individuals [19].

Ten years prior, the worldwide pandemic was instigated by the influenza A (H1N1) strain, initially identified in North America [15]. The World Health Organization (WHO) designated Coronavirus Disease (COVID-19) as a Public Health Emergency of International Concern (PHEIC) due to the limited scientific understanding of its progression, time frame, dimension, and control measures across diverse environments [3][4][5][12].

Novel viral respiratory illnesses, such COVID-19 and H1N1 influenza, can transform ships into incubators for infections due to person-to-person delivery, intricate population movement, constrained air-conditioned environments, and inadequate medical facilities aboard. An epidemic in such an environment, where the secondary Attack Rate (AR) can reach 43%, is exceedingly challenging to manage and, in addition to delaying the scheduled operation of ships, can result in substantial mortality and morbidity on board [18]. Only two known research studies exist about H1N1 control on board, with none addressing the COVID-19 outbreak [14][8]. This descriptive investigation compares the control methods implemented on two vessels: a cruise ship during the COVID-19 pandemic and a warship during the H1N1 influenza outbreak, aimed at containing a novel respiratory illness characterized by confirmed human-to-human transmissions. This article proposes a standardized response

protocol for epidemics of viral respiratory diseases in restricted and air-conditioned environments, such as ships or submarines [11][17].

2. MATERIAL AND METHODS

2.1 Definition of a COVID-19 case

A possible instance of COVID-19 is characterized as an individual exhibiting severe acute lung infection (fever, cough, and necessitating hospital acceptance) without an alternative etiology that adequately accounts for the clinical signs and symptoms, and who has a history of go to or where they live in China within the 15 days preceding symptom onset. Alternatively, it refer to an individual with any acute respiration disease who, during the 15 days before the onset of symptoms, has had (a) interaction with a verified or probable COVID-19 case or (b) has worked in or visited a medical center where those who had verified or probable COVID-19 acute lung disease underwent medical treatment [13]. A likely case is characterized as an individual for whom screening yields equivocal results or tests positive via a pan-coronavirus test, without laboratory confirmation of other infectious agents. A verified case refers to an individual with a laboratory diagnosis of COVID-19 infection, regardless of clinical manifestations.

2.2 Description of H1N1 influenza infection

A possible case of H1N1 influenza is characterized as an individual exhibiting acute febrile breathing disease (fever >102.0 °F) with beginning (a) within 8 days following close contact with a verified event of H1N1 virus disease, (b) within 8 days of move to regions with one or more confirmed infections, or (c) residing in an area with one or more verified infections of H1N1 [6].

2.3 Data acquisition

The COVID-19 epidemic data aboard the cruise liner was additional information obtained from official reports by the Government of Healthcare, Labor, and Welfare, and the ship's owning business. Information about the H1N1 influenza epidemic was obtained from medical facilities where patients were sent for re-evaluation and inquiry. Any deficiencies were addressed using the health returns submitted to the relevant offices by the vessel and the medical center.

Information on the onset, clinical particulars, testing outcomes, travel history, previous contact with confirmed cases, and measures implemented by the various vessels for outbreak management of the two new viral respiratory infections was gathered and analyzed.

2.4 Laboratory examination

Oropharyngeal samples were obtained and analyzed using Reverse Transcription Polymerase Chain Reactions (RT-PCR) for approval, by the testing standards established by the Centers for Disease Control and Prevention (CDCP) and the WHO for both illnesses [7].

2.5 Data analysis

Instances were categorized based on the case description, and the proportions of probable and laboratory-confirmed instances and the AR and Case Fatality Rates (CFR) of the illnesses were determined . The epidemic curve was constructed to analyze the temporal distribution of cases. The vessel experiencing the COVID-19 epidemic departed as scheduled in December 2019 and arrived in China in January 2020. Following the positive COVID-19 test of a symptomatic traveler who left in January, the ship was placed under quarantine off the port of Tokyo in February 2020 for 15 days, concluding in February 2020 [9]. Continuous monitoring persisted for 15 days following the discovery of the final case aboard the vessel during the H1N1 influenza epidemic to evaluate the efficacy of the implemented control measures on its reduction [10].

2.5 Practical Dimensions of the Outbreak Reaction

- Cleaning and Decontamination of Vessels

Before the commencement of quarantine, a crew of 35 commercial cleaners performed hospital-grade ambient cleaning. Decks 4-9 communal spaces were initially prioritized. The objective was to provide sterilized access zones for external healthcare, food service, and security workers. Common spaces' frequently contacted objects and flooring were sanitized daily. The cabins designated for the confinement had been disinfected the following night, after which the workplaces were sanitized. The workplaces were sanitized to meet ecological requirements; yet, they were deemed polluted due to the persistent traffic from possibly contaminated End Consumers (EC) during the quarantine period. The washing apparatus was sanitized daily.

- Segregation of Workers

The EC was housed in individual cabins and permitted to access their assigned work locations (bridge and engine room) to address maritime problems. All ECs were housed separately in a designated vessel section, utilizing unoccupied or cleaned staterooms previously abandoned by discharged customers. They adhered to a stringent quarantine for 15 days. Under guidance, EC and nEC could get off if they tested negative for SARS-CoV-2, for other medical causes, or due to a vessel crisis. All occupied cabin windows were designated to indicate personnel and food drop points, and for rescue reasons.

- Infection Areas

The wharf next to the ship and the nearby terminal buildings were clear of SARS-CoV-2 pollution (green area). The entry gangway, hallways, and hallways leading to staterooms were deemed minimal danger for pollution (yellow area) and served as buffer areas. Polluted (red area) zones included EC work sites and all inhabited apartments.

- Standards for personal safety gear

Access to the green area did not necessitate Personal Protection Equipment (PPE). However, surgical helmets and gloves were mandatory for admission to the yellow area. In the red zone, several levels of personal protective equipment were required. All outside vendors received protocol training and supervised adherence at access and exit locations.

- Health and Wellness

Interpreter facilities were accessible; as English was the primary tongue on board, all crew members possessed a competent proficiency in English. All individuals could interact using cell phones (top-up credit coupons were supplied) and fixed-line phones in cabins. It obtained, responded to, and evaluated health-related inquiries from the crew. Initial communication occurred by telephone and progressed to a cabin visit or hiring onshore Western Australia health emergency assets, if necessary. The onboard healthcare services were not utilized.

Initiatives to reduce psychological anxiety and a sense of isolation, while enhancing compliance, encompassed promoting communication through individual two-way and mass messaging structures, utilizing daily health checks as possibilities for meaningful interaction, and employing public speaking and Closed-Circuit Television (CCTV) structures to ensure the crew remained well-informed. Additional variables encompassed the recognition of significant occasions (holidays and religious observances), everyday cognitive challenges, and unwanted neighborhood assistance (handwritten greetings from elementary school pupils).

- Food Preparation, Provision, and Distribution

Before the commencement of quarantine, every cabin's refrigerator was provisioned with a multi-day supply of water in bottles and non-perishable foods and beverages. To mitigate potential fomite transmission, the cooking and catering services aboard were not utilized. An external catering firm comprising 15 personnel cooked and supplied food for all individuals on board, under the immediate control. No dietary restrictions were reported, and the meals comprised culturally suitable dishes similar to those typically offered on board.

Food distribution occurred by evening-only food reduces, comprising a cold morning meal and afternoon snack, along with a hot dinner. The meal was deposited in front of every room, and the pontoon notified the pertinent personnel via public address to unlock the entrance and get the food box following arrival.

- Waste Collection and Disposal

Dumpsters for waste were strategically placed in each room, retrieved from the front of every cabin, and thrown off by the nighttime cleaning crews. Prudent packaging for groceries led to negligible waste.

- Textiles & Fabrics

To reduce traffic, two sets of bed sheets were provided in each inhabited room; an emergency protocol for exceptional situations was accessible via an external subcontractor. Upon conclusion of the quarantine time frame, all clothes and linen were gathered in plastic containers and subjected to heat cleaning at 62°C utilizing the vessel's cleaning equipment.

A detailed brief outlining the isolation process, demands, and limitations was conveyed to the crew. Adherence was consistently overseen by an interim internal CCTV network of 15 cameras, augmented by five security personnel tasked with promptly reporting any violations of the quarantine rules.

3. RESULTS

3.1 Vessel experiencing the COVID-19 epidemic

In February 2020, the cruise ship went into quarantine with 2.7k passengers and 1.1k employees, totaling 3.8k individuals of many nationalities. Out of the entirety, 720 instances were confirmed positive based on screenings conducted by onboard medical personnel. The attack rate of COVID-19 during the epidemic was 18.1%. The pandemic curve depicted in Fig. 1 was constructed.
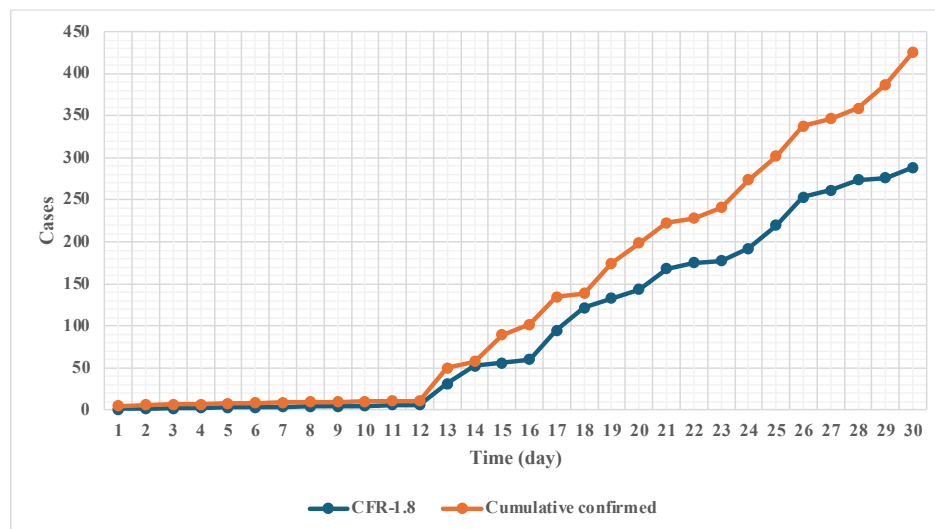
Fig. 1. Pandemic curve analysis

Of the positive cases, 54.2% exhibited symptoms, and 8.3% necessitated Intensive Care Unit (ICU) treatment. Thirteen fatalities occurred due to the sickness, and three members of the testing group aboard were later confirmed positive for the illness. The case fatality rate of the disease in the current epidemic was 1.4%.

3.2 Control procedures implemented

An observation system involving periodic screenings by the appointed personnel was implemented upon the ship's isolation. Symptomatic cases (fever > 101.2 °F, respiratory distress, cough, tightness in the chest, etc.) underwent RT-PCR testing for verification on board; upon approval, the patient was transferred to a land-based isolation hospital. Hand washing and the proper coughing method were underscored, and N95 masks were supplied to visitors and employees. Social distancing, defined as keeping a distance greater than 6 feet (1.8 meters), was recommended both within the cabin and outdoors; however, it was unfeasible for the crew operating in a somewhat more confined area. Guests in cabins without windows were permitted to access upper levels for oxygen in groups, for up to 60 minutes daily.

3.3 Vessel experiencing the H1N1 influenza epidemic

In June 2018, 25 individuals sought care at the vessel's sick bay during a three-week interval. Out of the 22 clinically believed cases, swabs from 15 individuals tested positive for H1N1. Each of the two verified infections reported on June 8 had a history of interaction with the H1N1 virus. In this research, he was identified as a reference instance. During these 15 days, the attack rate for the illness was 5.6%. The curve for epidemics has been constructed and is presented in Fig. 2. The case fatality rate of the disease was zero.
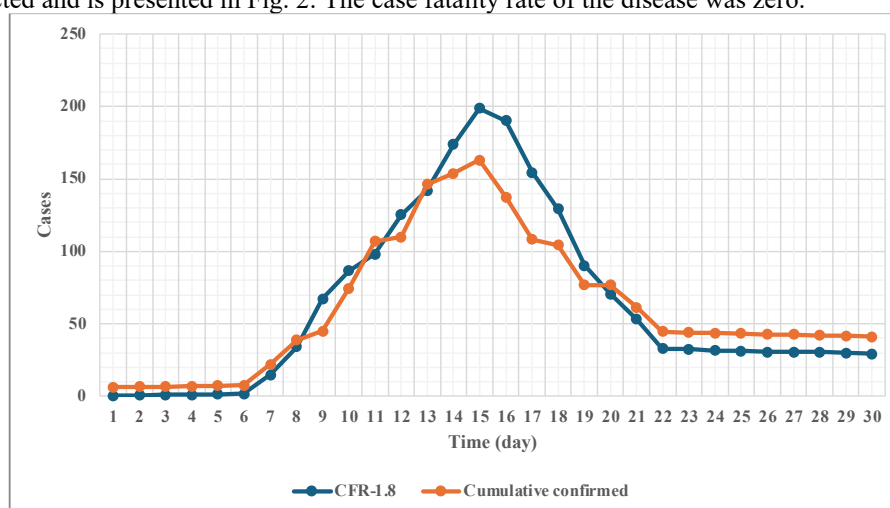

Fig. 2. Epidemic curve analysis

3.4 Control procedures implemented

All possible instances have been sent to a tertiary care facility for reconsideration and inquiry. It was highlighted that suitable methods for preventing infections and droplet precautions, specifically disinfecting with 5% cresol

every 12 hours, must be consistently adhered to. Health classes on washing hands frequently, using throwaway tissues, disinfecting all ladders, handles for doors, and railings throughout the ship with sanitizers made from alcohol were conducted. Cough behavior according to established rules was recommended. Health professionals conducted active case identification.

4. CONCLUSION

Based on the widespread control responses to two novel viral respiratory illnesses that occurred onboard, the following recommendations are made:

1. Proactive monitoring and departure

Active monitoring, prompt self-reporting, and timely disembarkation of suspected individuals are essential for preventing an outbreak in confined, Air-Conditioned (AC) environments. It will direct the pandemic to conform to an epidemiological tendency toward an isolated epidemic rather than a propagated one, facilitating an expedited resolution.

2. Refrain from quarantining the vessel

The ship ought not to be confined unless strictly warranted for administrative reasons, notwithstanding the presence of suspected cases. It is utterly unfeasible to isolate infected individuals from the non-infected in a space-restricted, AC environment during an epidemic with potential airborne, droplet, or fecal-oral transmission routes. All close contacts of proven positive individuals must be evacuated and confined in a suitable land-based hospital.

3. Sanitation and Cleanliness

The need for proper hygiene and sanitation procedures for the impacted vessel and everyone on board shouldn't be overstated. The frequency of cleaning operations should be augmented to at least every 12 hours, with all potentially contaminated objects disinfected using alcohol-based sanitizers containing 60-90% alcohol. Consistent hand hygiene, proper coughing protocol, and adherence to social distancing throughout conversations must be rigorously observed. Using facial masks is advisable; however, their inappropriate application and disposal pose more risks than the safeguards they provide.

4. Health Learning

It is essential to mitigate fear within the shipping company regarding any novel, unfamiliar illness and to disseminate accurate, evidence-based information concerning signs and preventative measures for individual and group protection, emphasizing the prompt self-reporting of suspected instances.

5. Vaccination

Vaccination is unavailable if an outbreak occurs onboard shortly after the emergence of the causal organisms. The vaccine, if accessible, should be provided solely to the vulnerable following a thorough evidence-based study of risk-benefit, cost-benefit, and efficacy. Due to regular engagement with vulnerable cases and heightened exposure risk, healthcare staff on board should be prioritized.

6. Health Information

Proactive awareness of health risks, especially prevalent infectious illnesses at the upcoming port of call, is essential to guarantee that the crew refrains from boarding at that location as part of the preventative approach. This serves as a definitive lesson derived from a cruise ship incident, wherein an individual reportedly contracted COVID-19 on an excursion to China, resulting in an epidemic aboard the vessel.

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