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From: Antonio Neri, M.D., EIS Officer, Environmental Health Services Branch (EHSB), Division of Emergency and Environmental Health Services (DEEHS), National Center for Environmental Health (NCEH)

To: David Forney, Chief, Vessel Sanitation Program, DEEHS, NCEH

Subject: Trip Report: Outbreak of Gastrointestinal Illness Aboard Cruise Ship *MS Explorer of the Seas*, Miami, Florida

Through: Marilyn Radke, M.D., M.P.H., Acting Director DEEHS, NCEH
Hugh Mainzer, MS, DVM, DACVPM Supervisory Preventive Medicine Officer

Introduction

CDC's Vessel Sanitation Program (VSP) conducts surveillance for gastrointestinal (GI) illness aboard passenger cruise ships calling on U.S. ports. All passenger ships with a foreign itinerary that call on U.S. ports are required by law to notify the VSP at least 24 hours before arriving in this country of the percentage of passengers and crew reporting GI illness during the previous 15 days. Ships reporting that more than 3% of either passengers or crew have gastrointestinal illness are investigated by VSP.

Background

On March 1, 2006, Royal Caribbean International Cruise Line (RCI) notified VSP that 68 cases (2%) of GI illness had been reported to the infirmary among passengers and 3 cases (0.25%) among crew members aboard their ship, the *MS Explorer of the Seas*. On February 26, 2006, the ship sailed from Miami, Florida, with 3,245 passengers and 1,184 crew members (Appendix A). The GI illness log faxed from the ship to VSP showed that the first GI illness case was reported on February 26, 2006. Between February 26, 2006, and March 1, 2006, 129 cases (4%) were reported among the passengers and 7 cases (0.6%) were reported among the crew, with a single peak of 68 persons reporting to the infirmary on February 28, 2006 (Appendix B). An epidemic curve diagramming the number of cases by onset date was constructed showing that symptoms actually began on February 27, 2006 (Appendix C).

At the request of the VSP epidemiologist, the Epidemic Intelligence Service (EIS) officer from CDC's National Center for Environmental Health assisted in the investigation to determine the characteristics and extent of GI illness aboard the MS Explorer of the Seas, the causal pathogen, the potential modes of illness transmission, and enact public health intervention and control.

Objectives

The primary objectives of this investigation were to:

- determine the etiology of the outbreak,
- determine the method of transmission among passengers and crew,
- develop recommendations to stop the current spread of the illness and prevent future occurrences of illness.

Methods

Focused environmental inspection A team of VSP inspectors conducted a focused environmental inspection of the entire ship the morning she docked in Miami to disembark passengers. These inspections concentrated on critical control areas of the ship where a breakdown in system function could introduce pathogens into the ship's food or water supply. All company outbreak response protocols and general operational procedures were reviewed with each department manager and selected staff to determine compliance. Inspections were conducted throughout the time the team was aboard the ship.

Laboratory specimens collected Once notified of the outbreak VSP requested that the ship's infirmary collect stool specimens from crew and passengers reporting GI illness. These specimens were sent to University of Arizona (UA) laboratories for analysis.

Spatial analysis A map was made of the cabins of passenger cases reported to the infirmary to determine if a correlation existed in space and time between cases.

Identification of cases The investigators generated several hypotheses on the basis of interviews with RCI administration, ship staff, and a review of the ship's GI illness log. Given the shape of the epidemic curve and symptom profile from the GI illness log, it was initially thought that a common-source (i.e. food-borne) outbreak was occurring among passengers (Appendix B). Interviews with the ship's staff indicated that the illness was characterized by a rapid onset, short duration, and was self-limited. Despite interviews with all ill crew members and the directors of each department, the type and source of the disease remained unclear. While the epidemic curve appeared to indicate spread of disease primarily through passengers it also demonstrated an increasing incidence of illness amongst crew approximately 1 to 2 days after the initial passenger cases reported onset of symptoms. The later occurrence of illness among the crew indicated either that a contaminated food item was consumed by both groups or a person-to-person spread of disease. Given the predominance of viral gastroenteric illness on cruise ships at that time, the possibility of a viral etiology could not be excluded.

Two surveys were developed with these hypotheses in mind. Investigators developed a passenger survey asking about a guest's choice of ship dining locations, behavioral characteristics, and environmental exposures. Investigators decided that a case-control study was appropriate in the interest of expediency and efficacy. Thirty ill passengers were selected from the GI illness log according to their time of symptom onset. Controls were selected by assigning numbers to passengers who did not report any GI illness to the ship's infirmary. A non-replacement random number generator from Microsoft (MS) Excel was used to generate 60 numbers from the passenger list. The passenger survey was distributed to the first 30 ill passengers and to the 60 randomly selected passengers on March 4, 2006 (Appendix D). One extra survey was given to the cabin mate of a previously selected control, resulting in the distribution of 91 surveys.

Passengers were asked to provide demographic information, symptom profiles, history of exposure to sick people, illness reporting methods, and exposure to dining locations. Passengers were asked to return the survey to the reception desk on the ship. Investigators also designed, distributed, and collected a crew survey (Appendix E). A list of crew members who reported to the infirmary during that cruise was obtained along with a list of the entire staff of the ship, listed by department. Sick persons were removed from the staff list and every person in each department was assigned a number. Three crew members were selected from the same department as an ill crew member. The numbers were generated using the non-replacement random number generator in MS Excel.

The crew survey asked similar questions to those in the passenger survey, but also asked about jobs performed while on the ship. This survey was distributed to all crew members who reported to the ship's infirmary during that cruise at the time of distribution (17 persons) as well as the selected non-reporting crew members (51 persons) on March 4, 2006. A draft of the crew survey was mistakenly sent to the ship prior to finalization and was filled out by all ill crew members. Fortunately the final crew survey only differed in one question when compared to the draft crew survey and this question was excluded from analysis. Sick passengers or crew were asked to have a well person return the survey for them to avoid breaking isolation. Determination of a case was made after reviewing these surveys.

Case definition For this investigation, a case was defined as a person aboard the *MS Explorer of the Seas* who reported at least one of the following between the dates of February 26, 2006, and March 5, 2006:

- three or more loose stools in a 24-hour period
- three or more vomiting episodes in a 24-hour period
- at least one episode each of loose stools and vomiting

Those who reported illness during the cruise but whose symptoms did not meet the case definition and those who reported illness onset prior to embarkation were excluded from further analysis. Well persons (controls) were defined as passengers and crew members who did not report any signs or symptoms of illness. Surveys were entered into a MS Access 2003 database and analyzed using Epi-Info version 3.3.2.

Results

Interviews Initial interviews with RCI's public health assurance manager, ship hotel director, and the ship's physician provided no information that would have indicated the specific means of spread or etiologic agent of the illness. The hotel manager stated that the ship encountered rough seas on the first day of the voyage. Staff stated that a sign was posted at the embarkation terminal asking passengers to report if they had experienced GI illness recently. Staff also stated that no medical personnel were present at the terminal to screen passengers for GI illness during embarkation or disembarkation.

Affected persons appeared to have had a rapid onset of either vomiting or diarrhea, short duration of symptoms, and a self-limited illness. In total, 250 passengers and 20 crew reported to the infirmary. Out of all 270 cases, 4 (1.5% of total) fevers (a temperature >100.3°F) and 1 (0.4% of total) bloody stool were reported. Initial cases were primarily passengers, with an increasing number of crew members becoming ill with time. The peak in crew cases occurred approximately 48 hours after the peak in passenger cases. The number of crew member cases increased as the number of passenger cases decreased.

Fourteen of the 20 crew members that reported to the infirmary were present on the ship at the time of interview; the others had disembarked earlier that morning. Four dining room servers or food managers, each of whom worked in a separate dining room from the others were interviewed. Onset dates ranged from February 28 through March 3, 2006. Those with the earliest onset denied having contact with sick passengers, cabin mates, or workmates. Some of these crew members worked temporarily as room service attendants but recalled the exact cabin numbers of rooms they visited, none of which were listed on the ship's GI illness log. These crew members sometimes ate meals in the staff mess, but often ate while on break at their respective dining rooms.

Six interviewed crew members had high passenger contact positions, but none of them worked in the same department or location. All six of these people had onset dates between March 1 and March 3, 2006. Most of these crew members also had contact with crew members as well as passengers that had been sick before or were presently sick. None of these six crew members shared a common dining location or had sick cabin mates. Two of these crew members reported feeling mildly nauseated one to two days earlier than their stated onset date. These crew members felt this nausea to be mild and transient and did not report to the infirmary until later.

The four remaining crew members were all in the housekeeping or maintenance department. Two of the four were members of the ship's team that cleaned cabins where passengers were sick with GI illness. All crew members in this group had onset after the main contingent of passengers became ill (March 1st and subsequently).

Several crew members stated that they were forced to report to work despite their listed isolated status on the GI illness log. Those who objected were reprimanded or told that this was normal practice. Neither the ship's physician nor the hotel director was aware of this practice. All crew members reported to the ship's infirmary immediately upon feeling strongly nauseated, vomiting, or having experienced an episode of diarrhea.

Focused environmental inspection findings

- The cabins on the vomit response list did not always match the cabins on the sick cabin list.
- When interviewing the cabin attendants, the verbal list of sick cabins did not match the list of ill cabins from the executive housekeeper. In addition, it was not clear that the cabin attendants understood the company policy of identifying sick cabins as such until the conclusion of the cruise.
- Refills of Mikrobac did not always come from a centralized disinfectant distribution station, although this was stated to be company policy.
- A spray bottle in SLKR 9739 was labeled "1000 ppm Chlorine," but contained a cleanser instead.
- Several of the sinks intended as hand washing sinks for cabin attendants in the housekeeping lockers were used to store items or access to them was partially blocked by items stored around them.
- A crew member was seen carrying a red bag with used rags to the centralized disinfectant distribution station on deck 0. This bag was supposed to go to the garbage room for incineration.
- A large sprayer labeled 50 ppm was used for a 1000 ppm chlorine solution. The sprayer was a shoulder harness type container used for disinfecting potable water tanks.
- Yellow cloth bags were transported to the main laundry area under red cloth bags on the same trolley. The red cloth bags are used routinely on this vessel for dirty linens. The yellow bags were used during this outbreak to transport linens from sick cabins.
- The standardized gastrointestinal illness log and the vessel's isolation log did not always indicate crew positions.
- The length of isolation in the crew members' patient records did not always match the length of isolation on the vessel's isolation log. According to the ship's doctor, in cases of discrepancy, the patient's medical record was considered the correct record. Given this, isolation periods were noted to be correct.
- During the day of the outbreak, a food service employee returned for evaluation. This individual had experienced his last symptom the day before. A review of the patient's record revealed that this crew member was deemed fit for duty. This was less than the 48 hours required for isolation of a food employee. An interview with the doctor showed he had erroneously released this individual from isolation.
- Hand washing stations in the garbage rooms and laundry were not adequately stocked. These stations did not have signs advising frequent hand washing.

- The service in the Windjammer dining area was no longer self-service at the time of this investigation. It was noted that some condiments and individually packaged crackers were available for self-service. Bowls and plates at the dessert station were available for self-service.
- Roast beef and chicken were prepared for service to the guests. This food was properly prepared in different galleys. When it was determined that the food would not be served to guests, it was properly stored in a central facility. This same food was later served to the crew. It was not clear in which galley the food had been prepared before service.
- Around 3:00 PM on the day of the investigation large stock pots with white sauce and gravies were noted to be covered with plastic wrap and stored on a shelf under a preparation table in the sauce area. These pots contained potentially hazardous foods that had been removed from cooking around 12:30 PM. According to the crew members in this area, these items were to be used for the evening meal service around 6:30 PM. The white sauce was tested at 120°F. The other sauces were above 140°F. In addition, the top of the preparation counter had a large amount of pooled water. According to the crew members in this area, the table was being cleaned. In addition to the stock pots of food, clean equipment was stored on the shelf under the preparation table. A stock pot of gravy was noted to have a small puddle of water on top of the plastic film covering the pot.
- Roasted pepper sauce in a tilt pan in the sauce area was tested at 124°F. The tilt pan was not on at the time the sauce was tested.
- Crew members normally assigned as wait staff were plating food for service to passengers while wearing watches during this outbreak.

Laboratory specimens collected

Twelve stool specimens were collected from passengers. All testing was performed at UA laboratories, a contract lab for RCI. Three of the eight stool specimens tested positive for norovirus. According to UA reports, “Two different samplings for enteric pathogens were negative.”

Analysis of the survey

- 91 Passenger surveys distributed;
- 91 Passenger surveys collected (response rate = 100%);
- 8 Passenger surveys were incomplete
 - incomplete surveys were defined as those lacking sufficient information to determine whether the respondent was a case, control, or had been ill before boarding the ship;
- 5 Passenger surveys indicated the respondent was ill before boarding;
- 5 Passenger surveys indicated indeterminate illness
 - these respondents noted some symptoms but did not meet the case definition.
- 46 Passenger surveys met the case definition
- 71 Crew surveys distributed
- 71 Crew surveys collected (response rate = 100%)
- 1 Crew survey was incomplete
- 6 Crew surveys indicated indeterminate illness
- 16 Crew surveys met the case definition

The final GI illness log shows that the overall attack rate was 7.8% (252/3245) among the passengers and 1.7% (20/1183) among the crew.

Passenger Survey.

Appendix F provides a detailed analysis of each variable. Only the pertinent results are described here. Forty-six cases were compared with 73 controls. Five persons indicating that they were ill prior to embarkation and were excluded from the case-control study, a comparison to passenger cases is shown in Appendix G. The median age for cases was 45 (range, 7–80); the median age for controls was 43 (range, 17–68). There were no statistically significant differences between cases and controls with regard to age, sex, or number of cabin mates. The symptom profile is shown in Table 1.

Fifteen cases (37.5%) reported having a sick cabin mate while no controls did. Seventeen (42.5%) cases reported a sick social contact while only four (12.9%) controls did (OR 5.0; 95% CI, 1.5–16.9). On February 28, 10 cases (40%) reported ordering room service for breakfast while only 3 (21%) controls did so (OR 5.56; 95% CI, 1.32–23.46). No other significant differences were seen between cases and controls with respect to dining location. In addition, no significant differences were found between the two groups with respect to the use of the casino, bar, unbottled water, bottled water, or consumption of drinks containing ice.

Cases differed significantly vs. controls in their knowledge of hand sanitizer presence before the outbreak, even when accounting for the non-normal distribution (Students t statistic 3.64, $P < 0.001$; Mann-Whitney/Wilcoxon 1-tailed $\chi^2 = 9.2424$, $P = 0.002$). There were no significant differences between the two groups in knowledge about sanitizer presence after the outbreak, hand sanitizer use before or after the outbreak, nor belief in hand sanitizer efficacy against viruses or bacteria that can cause vomiting or diarrhea.

Table 1. Responses from the Passenger Survey.

Symptom profile (percentage of people answering yes vs. all responders)	
Diarrhea	36 (95%)
Vomiting	32 (84%)
Nausea	33 (80%)
Stomach cramps	24 (60%)
Headache	21 (52%)
Muscle ache	20 (50%)
Fever	17 (42%)
Blood in stool	1 (3%)
Median vomiting episodes	
Median	4
Range	1–10
Median diarrhea episodes	
Median	6.5
Range	1–10
Symptom onset	
2/26	4 (10%)
2/27	19 (49%)
2/28	10 (26%)
3/1	4 (10%)
3/2	1 (3%)
3/3	1 (3%)
Illness duration	
1 day	9 (22%)
2 days	15 (37%)
3 days	11 (27%)
4+ days	4 (10%)
Still ill	2 (5%)

Crew Survey.

A detailed analysis of each variable is available in Appendix H, only the relevant results are described here. Sixteen cases were compared to 48 controls. The median age for cases was 32 (range, 22–43), for controls it was 30 (range, 20–62). There were no statistically significant differences between cases and controls in regards to age or sex. The symptom profile is shown in Table 2.

Table 2. Responses from the Crew Survey.

Symptom profile (percentage of people answering yes vs. all respondents)

Diarrhea	13 (100%)
Stomach cramps	11 (69%)
Vomiting	7 (64%)
Nausea	7 (47%)
Muscle ache	6 (43%)
Headache	4 (29%)
Fever	4 (27%)
Blood in stool	0

Median vomiting episodes

Median	4
Range	1–10

Median diarrhea episodes

Median	6.5
Range	1–10

Symptom onset

2/26	4 (10%)
2/27	19 (49%)
2/28	10 (26%)
3/1	4 (10%)
3/2	1 (3%)
3/3	1 (3%)

Illness duration

1 day	9 (56%)
2 days	3 (19%)
3 days	1 (6%)
Still ill	3 (19%)

No differences were seen between cases and controls with respect to having a sick cabin mate, working with a sick crew member, or being exposed to another person's body fluids. Cases were more likely to have been in contact with a sick passenger or crew member versus controls (OR 5.0; 95% CI, 1.5 – 16.9). Three (50% of respondents) crew cases ate breakfast in the Windjammer on February 28 vs. 2 (7% of respondents) (OR 14.0; 95% CI, 1.6–120.0). Three cases (60% of respondents) ate breakfast in the Windjammer on March 1 compared with 1 (3% of respondents) control. (OR 46.5; 95% CI, 3.2–676.2; Fischer exact test, $P < 0.005$). No other significant differences in dining location were noted for crew cases or controls. No statistically significant differences existed between the two groups regarding consumption of unbottled water, bottled water, or drinks containing ice. In addition, no differences were seen in casino or bar use.

Spatial analysis:

No specific clustering of cases over time was noted.

Discussion

This investigation describes the characteristics of an outbreak of gastroenteritis aboard the *MS Explorer of the Seas* sailing round-trip from Miami, Florida to multiple Mexican and Caribbean ports between February 26 and March 5, 2006. The causative agent of this outbreak appears to be norovirus, demonstrated through laboratory analysis and epidemiologic characteristics. Findings of the investigation are discussed regarding outbreak characteristics, analysis of the surveys, and validity of the data.

Initial reports to VSP indicated an outbreak pattern consistent with either a food-borne toxin/microbe or pre-existing illness that spread quickly. Both guests and crew were exposed to some of the same food items, but the lack of common dining locations among ill crew members argues against a common food item being the culprit. Guest cases used room service for breakfast on February 28 significantly more than controls. This finding is likely due to a number of them being confined in their rooms versus implicating any food item. Beyond the difference seen on February 28, the passenger survey analysis does not indicate any specific difference in dining locations between cases and controls. It is likely that people who were ill before boarding propagated the disease through person-to-person contact. Having a sick cabin mate or social contact was far more common among cases than controls for both guests and crew, which is characteristic of norovirus outbreaks. The 48 hour incubation period between passenger and crew illness peaks is also indicative of norovirus.

The data sheet from the manufacturer of the hand sanitizer used by RCI indicates it is 99.8% effective against bacteria and 90.5% effective against gastroenteritis-causing virus particles after 1 minute of contact. Passengers said they believed that this sanitizer was 60%–70% effective against bacteria and 50%–70% effective against virus particles. There was no difference between cases and controls regarding their knowledge about efficacy.

The operational policy of RCI states that four hand sanitizer stations were present in both public and crew areas during normal operations. Any indication of an abnormal increase in the number of gastroenteritis cases calls for deployment of four additional stations. When compared to controls, cases did not believe that hand sanitizer was present prior to the outbreak. This indicates that education regarding sanitizer location could help prevent future outbreaks.

Neither the passenger nor crew survey demonstrated any difference in demographic profiles when comparing cases with controls, adding validity to the findings. The passenger survey appears to be sufficiently large to detect differences between cases and controls; this is demonstrated by the relatively small confidence intervals. The sample size of the crew survey was often too small to accurately detect differences between cases and controls, as reflected in the large confidence intervals. Because of this, many of the positive crew results were likely false positives. A larger study would be needed to determine if this were the case.

Recommendations

- Ensure that all staff understand the necessity of adhering to isolation procedures for sick crew members.
- Make a concerted effort to screen passengers for GI illness before they board the ship. The current placement of a sign advising passengers to report illness while waiting to board the ship is a passive system with variable efficacy.
- Trained personnel should be present at the dock to screen passengers. In addition positive alternatives should be offered to those reporting, these alternatives should include members of their traveling party. It may be possible to enhance passenger and crew adherence to isolation procedures through the use of discounted room service and other incentives.
- Try demonstrating hand sanitization station locations to passengers through videos, tours, and ship announcements during embarkation day. Distribution of individual units of hand sanitizer may also facilitate use and decrease passenger contact with the hand-sanitizer station dispensers
- Encourage both passengers and crew with diarrhea to immediately report to the infirmary. Obtain, label, and immediately refrigerate stool samples from all passengers and crew presenting with diarrhea.

- Ensure that the medical staff evaluate the occupants of all cabins where a vomit response occurs to determine whether the vomiting episode is due to gastrointestinal illness. Any person considered a case should be placed in the GI illness log and the cabin should be added to the sick cabin list.
- Ensure that cabin attendants are given a written list of sick cabins on a daily basis. This list should include all of the sick cabins and not just the additional sick cabins.
- Ensure that cabin attendants are aware of the company policy on outbreak control and management, including how to treat sick cabins.
- Ensure that refill stations other than the centralized disinfectant distribution station are deactivated during outbreaks, as per company policy
- Ensure that working containers are properly labeled as to contents. Improperly labeled containers can contain potentially hazardous chemicals and which can result in injury if mixed with other chemicals or used inappropriately.
- Ensure that hand washing sinks are fully accessible at all times for hand washing. These sinks should be adequately stocked with paper towels and hand cleansers. Signs requiring frequent hand washing would also be beneficial.
- Ensure that red bags carrying potentially infectious waste are carried directly to the garbage room for incineration.
- If the shoulder harness type container for disinfecting potable water tanks is used during outbreaks, containing a different chlorine concentration than would normally be expected, it should be permanently labeled for use only during outbreaks. Ensure that the strength of the chlorine solution marked on the outside of the sprayer matches the contents.
- Transport yellow cloth laundry bags from sick cabins on separate trolleys.
- Ensure that the crew position is noted in both the GI illness log and the vessel isolation log.
- Ensure that the isolation log notes the correct length of isolation.
- Ensure that the correct isolation periods are enforced.
- Ensure that hand washing stations are adequately stocked with soap and paper towels. Signs advising frequent hand washing should be posted at each station.
- Ensure that self-service is discontinued for all foods during an outbreak, including those that are individually packaged.
- Ensure that self-service of plates, bowls, and utensils is discontinued during an outbreak.
- Potentially hazardous hot foods prepared in advance to a meal service should be kept at or above 140°F or should be properly cooled in shallow pans. If these are items are cooled, ensure that the cooling process is logged and monitored.
- Ensure that shelves under counters that are undergoing cleaning are emptied if the cleaning could result in contamination of the items on the shelves.
- Ensure that staff enlisted as food handlers during outbreaks do not wear watches or other jewelry on their wrists or hands. These items are difficult to properly clean and could transmit disease. A plain wedding band is allowed.

The following people worked many long hours under duress to investigate this outbreak. Their work is much appreciated.

Elaine Cramer, MD, MPH
CAPT George Vaughan
Ms. Lisa Beaumier
CDR Julia Chervoni
CDR Laura Rabb

LTJG Derek Sakris
Mr. Manuel Rivas
Mr. Richard Pruitt
MS Explorer of the Seas staff

Respectfully,

LT Antonio Neri, M.D.
EIS Officer
Environmental Health Services Branch
Division of Emergency and Environmental Health Services
National Center for Environmental Health

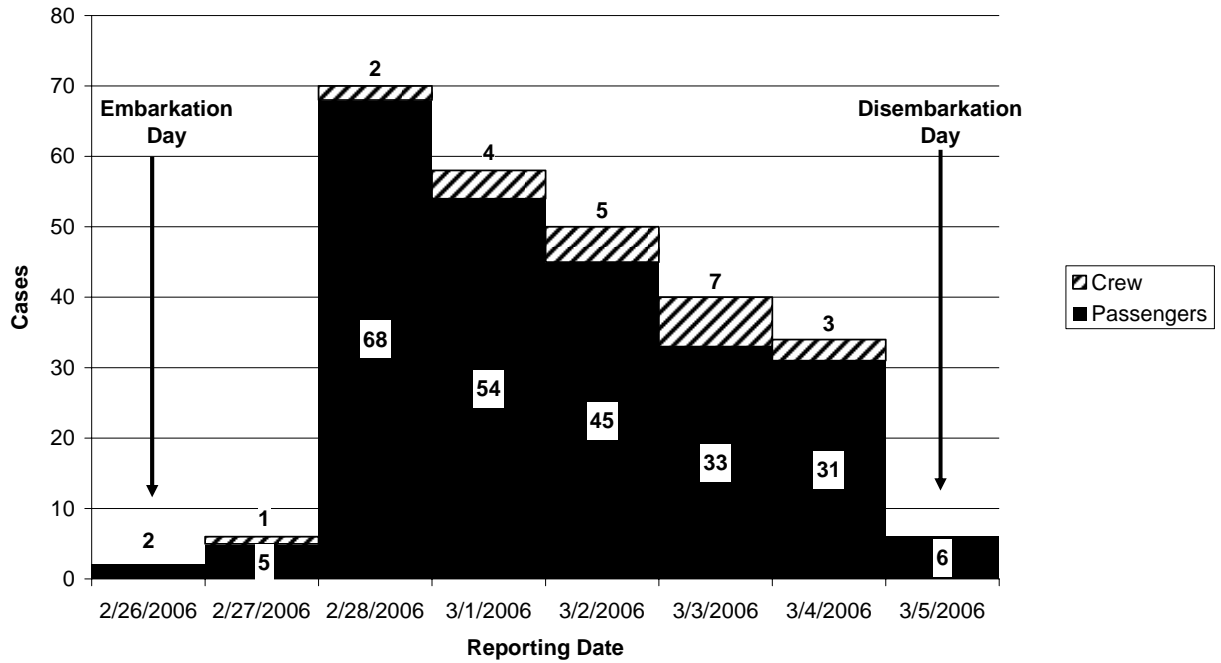
Appendix A

Itinerary for ms Explorer of the Seas — February 26 through March 5, 2006

26 February 2006	Miami, Florida (Embarkation day)
27 February 2006	At sea
28 February 2006	Belize City, Belize
1 March 2006	Costa Maya, Mexico
2 March 2006	Cozumel, Mexico
3 March 2006	Grand Cayman, Bahamas
4 March 2006	At sea
5 March 2006	Miami, Florida (Disembarkation day)

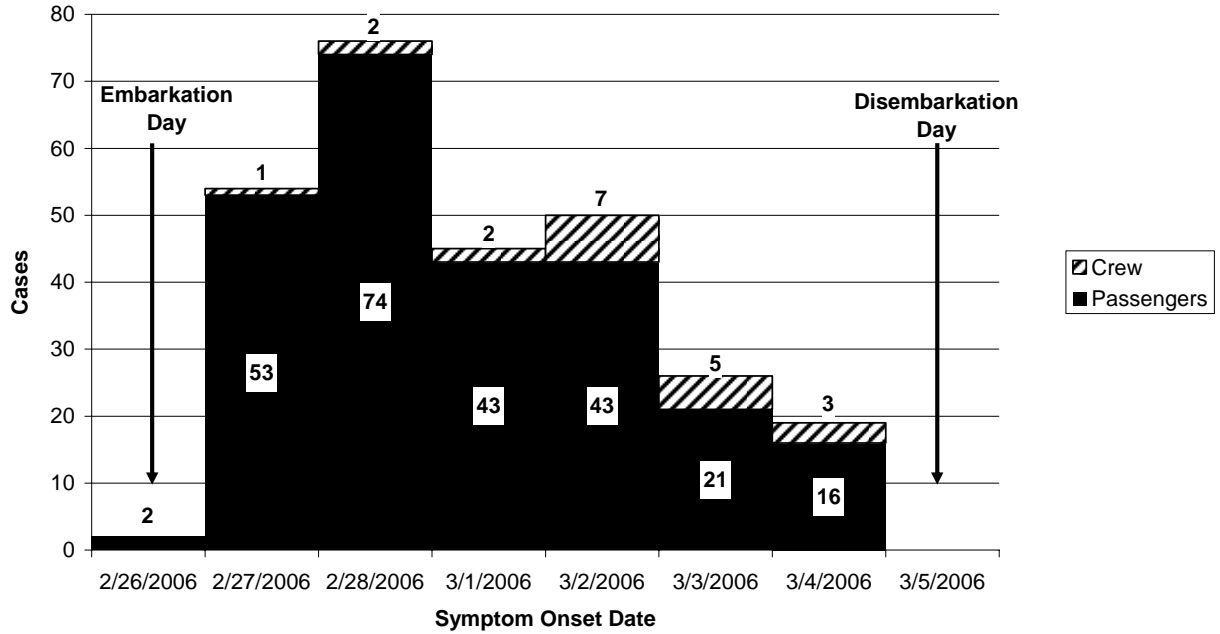
Appendix B

MS Explorer of the Seas Acute Gastroenteritis Outbreak
Epicurve by Reporting Date
n = 272



Appendix C

**MS Explorer of the Seas Acute Gastroenteritis Outbreak
Epidemic Curve by Symptom Onset Date
n = 272**



Appendix D

CDC ID Number: _____
(CDC use only)



Guest Questionnaire

Explorer of the Seas 26 February to 5 March 2006

Dear Guest:

As you have been advised by the staff of the Explorer of the Seas, there has been more than the expected amount of vomiting and diarrhea on this cruise. The staff of the Vessel Sanitation Program, Centers for Disease Control and Prevention (CDC), in collaboration with Royal Caribbean International, has been investigating the illness in an effort to characterize the nature and extent of the illness aboard the ship, to identify the mode(s) of transmission of disease, and to identify other potential risks associated with illness.

In order to assist with our investigation we ask that **select guests** complete the attached questionnaire. Please return your completed questionnaire to the **Guest Relations Desk, Deck 5** as soon as it is completed. If you are still ill, please have someone return the questionnaire for you.

Please use this itinerary to assist you with the completion of this questionnaire.

Day of week	Date	Port/Location
Sunday	26 February 2006	Miami, FL
Monday	27 February 2006	At Sea
Tuesday	28 February 2006	Belize City, Belize
Wednesday	01 March 2006	Costa Maya, Mexico
Thursday	02 March 2006	Cozumel, Mexico
Friday	03 March 2006	Grand Cayman, Bahamas
Saturday	04 March 2006	At Sea
Sunday	05 March 2006	Miami, FL

An investigation summary will be posted to the CDC Vessel Sanitation Program website at: <http://www.cdc.gov/nceh/vsp> once available.

We appreciate your participation.

Sincerely,

CDC Vessel Sanitation Program and Royal Caribbean International

*PROTECTION OF PRIVACY INFORMATION

Public Law 93-579 entitled the Privacy Act of 1974 requires that individuals asked to furnish information such as that requested in this form be informed of the purpose for collecting such information and what the information will generally be used for. The following information is accordingly provided:

Authority: The Centers for Disease Control and Prevention, and agency of the Department of Health and Human Services, is authorized to solicit the information requested in this form under the authority of the Public Health Service Act, Section 301,361 (42 U.S.C. 241,264).

Purpose and Uses: The information requested will be used to implement appropriate control measures if any health problems are identified, and may be shared with federal, state and local health authorities. An accounting of such disclosures will be made available to you upon request.

Effects of Non-Disclosures: Your disclosure of the requested information is voluntary, and no penalty will be imposed if you choose not to respond. However, if you do not fill out the questionnaire, it will be more difficult for us to determine the health status of the persons on this cruise.

DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTERS FOR DISEASE CONTROL AND PREVENTION
ATLANTA, GEORGIA 30333

Public reporting burden of this collection of information is estimated to average 3 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to PHS Reports Clearance Officer: ATTN:PRA; Hubert H. Humphrey Bldg., Room. 721-B; 200 Independence Ave., SW; Washington, DC 20201, and to the Office of Management and Budget; Paperwork Reduction Project (0920-0008); Washington, DC 20503.

I. Personal Data

1. Cabin number: _____ 2. Total number of people in your cabin (including yourself): _____
3. Age (in years) _____ 4. Sex (Circle one) Male Female

II. Medical Information

5. Were you ill with vomiting or diarrhea in the 7 days prior to the start of the cruise? Yes No

Please circle Yes or No for EACH of the following symptoms you may have experienced during this cruise:

If Yes for Vomiting or Diarrhea circle the maximum # of episodes you had in a 24 hour period:

6. Vomiting Yes No If yes maximum # of episodes in 24 hours 1 2 3 4 5 6 7 8 9 10+

7. Diarrhea Yes No If yes maximum # of episodes in 24 hours 1 2 3 4 5 6 7 8 9 10+

If you were ill with diarrhea are you still currently ill with diarrhea? Yes No N/A

8. Fever Yes No

9. Stomach cramps Yes No

10. Blood in your stool Yes No

11. Headache Yes No

12. Nausea Yes No

13. Muscle aches Yes No

14. If you were ill with vomiting or diarrhea what day and time did it start? _____

15. If ill how many days were you ill (Circle one)?

1 2 3 4+

I am still ill

I was not ill between 2/26 and now

16. Were any of your cabin-mates ill? Yes No If yes date of onset _____

17. Were you exposed to another person's vomit or diarrhea? Yes No

If Yes where/When _____

18. Were any of the people with whom you were social during the cruise sick? Yes No

If yes what were their cabin numbers? _____

19. List the cabin numbers of all people you traveled with _____

III Food Information

26 February 2006 (Sunday) Lunch

20. Did you eat lunch in the Windjammer on Embarkation day? Yes No Don't know

26 February 2006 (Sunday) Dinner

21. Did you eat dinner in the Columbus dining room? Yes No Don't know

22. Did you eat dinner in the Magellan dining room? Yes No Don't know

23. Did you eat dinner in the Da Gama dining room? Yes No Don't know

24. Did you eat dinner in the Windjammer? Yes No Don't know

25. Did you eat dinner in the Chops Grill? Yes No Don't know

26. Did you eat dinner in the Portofino Grill? Yes No Don't know

27. Did you order room service for dinner? Yes No Don't know

27 February 2006 (Monday) Breakfast

28. Did you eat breakfast in the Main dining room? Yes No Don't know

29. Did you eat breakfast in the Windjammer? Yes No Don't know

30. Did you order room service for breakfast? Yes No Don't know

27 February 2006 (Monday) Lunch

31. Did you eat lunch in the Main dining room? Yes No Don't know

32. Did you eat lunch in the Windjammer? Yes No Don't know

27 February 2006 (Monday) Dinner

33. Did you eat dinner in the Columbus dining room? Yes No Don't know

34. Did you eat dinner in the Magellan dining room? Yes No Don't know

35. Did you eat dinner in the Da Gama dining room? Yes No Don't know

36. Did you eat dinner in the Windjammer? Yes No Don't know

37. Did you eat dinner in the Chops Grill? Yes No Don't know

38. Did you eat dinner in the Portofino Grill? Yes No Don't know

39. Did you order room service for dinner? Yes No Don't know

28 February 2006 (Tuesday) Breakfast

- 40. Did you eat breakfast in the Main dining room? Yes No Don't know
- 41. Did you eat breakfast in the Windjammer? Yes No Don't know
- 42. Did you order room service for breakfast? Yes No Don't know

28 February 2006 (Tuesday) Lunch

- 43. Did you eat lunch in the Main dining room? Yes No Don't know
- 44. Did you eat lunch in the Windjammer? Yes No Don't know

28 February 2006 (Tuesday) Dinner

- 45. Did you eat dinner in the Columbus dining room? Yes No Don't know
- 46. Did you eat dinner in the Magellan dining room? Yes No Don't know
- 47. Did you eat dinner in the Da Gama dining room? Yes No Don't know
- 48. Did you eat dinner in the Windjammer? Yes No Don't know
- 49. Did you eat dinner in the Chops Grill? Yes No Don't know
- 50. Did you eat dinner in the Portofino Grill? Yes No Don't know
- 51. Did you order room service for dinner? Yes No Don't know

52. Circle the average number of glasses of **UNBOTTLED** ship's water you drank per day:

0 1 2 3 4 5 6 7 8 9 10+

53. Circle the average number of bottles of **BOTTLED** water you drank per day:

0 1 2 3 4 5 6 7 8 9 10+

54. Circle the number of beverages **CONTAINING ICE** from the ship per day:

0 1 2 3 4 5 6 7 8 9 10+

55. Did you visit the casino during this cruise? Yes No
If yes circle ALL dates 2/26 2/27 2/28 3/1 and later

56. Did you visit any bars during this cruise? Yes No
If yes what bars did you visit on 2/26 (Sunday) _____
If yes what bars did you visit on 2/27 (Monday) _____
If yes what bars did you visit on 2/28 (Tuesday) _____

57. How often was hand sanitizer available on the ship BEFORE you knew that others were sick?

Never available Always Available
0 1 2 3 4 5 6 7 8 9 10

58. How often was hand sanitizer available on the ship AFTER you knew that others were sick?

Never available Always Available
0 1 2 3 4 5 6 7 8 9 10

59. How often did you use hand sanitizer when it was available BEFORE you knew that others were sick?

Never Always
0 1 2 3 4 5 6 7 8 9 10

60. How often did you use hand sanitizer when it was available AFTER you knew that others were sick?

Never Always
0 1 2 3 4 5 6 7 8 9 10

61. How effective do you believe hand sanitizer is against bacteria that can cause vomiting or diarrhea?

% Bacteria killed (Circle one)
0 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

62. How effective do you believe hand sanitizer is against viruses that can cause vomiting or diarrhea?

% Virus killed (Circle one)
0 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

63. Additional comments that may help us investigate this outbreak:



Crew Questionnaire

Explorer of the Seas 26 February to 5 March 2006

Dear Crew Member:

As you have been advised by the staff of the Explorer of the Seas, there has been more than the expected amount of vomiting and diarrhea on this cruise. The staff of the Vessel Sanitation Program, Centers for Disease Control and Prevention (CDC), in collaboration with Royal Caribbean International, has been investigating the illness in an effort to describe the nature and extent of the illness aboard the ship, to identify how the disease is transmitted, and to identify other potential risks associated with illness.

In order to assist with our investigation we ask that **select crew members** complete the attached questionnaire. Please return your completed questionnaire to the **Guest Relations Desk, Deck 5** as soon as it is completed. **Please have someone help to interpret this survey if you do not understand the questions.**

Please use this itinerary to assist you with the completion of this questionnaire.

Day of week	Date	Port/Location
Sunday	26 February 2006	Miami, FL
Monday	27 February 2006	At Sea
Tuesday	28 February 2006	Belize City, Belize
Wednesday	01 March 2006	Costa Maya, Mexico
Thursday	02 March 2006	Cozumel, Mexico
Friday	03 March 2006	Grand Cayman, Bahamas
Saturday	04 March 2006	At Sea
Sunday	05 March 2006	Miami, FL

An investigation update will be posted to the CDC Vessel Sanitation Program website at: <http://www.cdc.gov/nceh/vsp> once available. We appreciate your participation.

Sincerely,

CDC Vessel Sanitation Program and Royal Caribbean International

*PROTECTION OF PRIVACY INFORMATION

Public Law 93-579 entitled the Privacy Act of 1974 requires that individuals asked to furnish information such as that requested in this form be informed of the purpose for collecting such information and what the information will generally be used for.

The following information is accordingly provided:

Authority: The Centers for Disease Control and Prevention, and agency of the Department of Health and Human Services, is authorized to solicit the information requested in this form under the authority of the Public Health Service Act, Section 301,361 (42 U.S.C. 241,264).

Purpose and Uses: The information requested will be used to implement appropriate control measures if any health problems are identified, and may be shared with federal, state and local health authorities. An accounting of such disclosures will be made available to you upon request.

Effects of Non-Disclosures: Your disclosure of the requested information is voluntary, and no penalty will be imposed if you choose not to respond. However, if you do not fill out the questionnaire, it will be more difficult for us to determine the health status of the persons on this cruise.

DEPARTMENT OF HEALTH AND HUMAN SERVICES
PUBLIC HEALTH SERVICE
CENTERS FOR DISEASE CONTROL AND PREVENTION
ATLANTA, GEORGIA 30333

Public reporting burden of this collection of information is estimated to average 3 minutes per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to PHS Reports Clearance Officer: ATTN:PRA; Hubert H. Humphrey Bldg., Room. 721-B; 200 Independence Ave., SW; Washington, DC 20201, and to the Office of Management and Budget; Paperwork Reduction Project (0920-0008); Washington, DC 20503.

I. Personal Data

1. Name _____ 2. Cabin Number _____
3. Age (years) _____ 4. Sex (Circle one) Male Female

II. Medical Information

5. Have you been ill with vomiting or diarrhea during this cruise? Yes No Don't Know
If yes when did your illness start? _____
If yes are you still ill? Yes No Don't Know

Please **circle Yes or No** for **EACH** of the following symptoms you may have had during this cruise:

If yes for Vomiting or Diarrhea circle the maximum # of episodes you had in a 24 hour period:

6. Vomiting Yes No If yes circle the maximum # of episodes in 24 hours 1 2 3 4 5 6 7 8 9 10+
7. Diarrhea Yes No If yes circle the maximum # of episodes in 24 hours 1 2 3 4 5 6 7 8 9 10+
If you were ill with diarrhea are you still ill with diarrhea? Yes No N/A

8. Fever Yes No

9. Stomach cramps Yes No

10. Blood in your stool Yes No

11. Headache Yes No

12. Nausea Yes No

13. Muscle aches Yes No

14. If you were ill how many days were you ill? _____ I was not ill between 2/26 and now

15. Were any of your cabin mates ill?

(Circle one) Yes No Don't know If yes who _____

16. Did you come into contact with any passengers or crew who were sick with vomiting or diarrhea in the last 10 days? (Circle one) Yes No If yes when and where _____

17. Were any of the people you work with sick with vomiting or diarrhea during this cruise? Yes No

If yes when did the first person get sick? _____

If yes what was their name? _____ What was their job? _____

18. Please list the cabin numbers of your closest friends _____

III Food Information

25 February 2006 (Saturday) Breakfast

19. Did you eat breakfast in the Staff mess? Yes No Don't know

20. Did you eat breakfast in the Officer's mess? Yes No Don't know

21. Did you eat breakfast in the Windjammer? Yes No Don't know

22. Did you eat breakfast in your room? Yes No Don't know

25 February 2006 (Saturday) Lunch

23. Did you eat lunch in the Staff mess? Yes No Don't know

24. Did you eat lunch in the Officer's mess? Yes No Don't know

25. Did you eat lunch in the Windjammer? Yes No Don't know

26. Did you eat lunch in your room? Yes No Don't know

25 February 2006 (Saturday) Dinner

27. Did you eat dinner in the Staff mess? Yes No Don't know

28. Did you eat dinner in the Officer's mess? Yes No Don't know

29. Did you eat dinner in the Windjammer? Yes No Don't know

30. Did you eat dinner in your room? Yes No Don't know

26 February 2006 (Sunday) Breakfast

31. Did you eat breakfast in the Staff mess? Yes No Don't know

32. Did you eat breakfast in the Officer's mess? Yes No Don't know

33. Did you eat breakfast in the Windjammer? Yes No Don't know

34. Did you eat breakfast in your room? Yes No Don't know

26 February 2006 (Sunday) Lunch

- | | | | |
|--|-----|----|------------|
| 35. Did you eat lunch in the Staff mess? | Yes | No | Don't know |
| 36. Did you eat lunch in the Officer's mess? | Yes | No | Don't know |
| 37. Did you eat lunch in the Windjammer? | Yes | No | Don't know |
| 38. Did you eat lunch in your room? | Yes | No | Don't know |

26 February 2006 (Sunday) Dinner

- | | | | |
|---|-----|----|------------|
| 39. Did you eat dinner in the Staff mess? | Yes | No | Don't know |
| 40. Did you eat dinner in the Officer's mess? | Yes | No | Don't know |
| 41. Did you eat dinner in the Windjammer? | Yes | No | Don't know |
| 42. Did you eat dinner in your room? | Yes | No | Don't know |

27 February 2006 (Monday) Breakfast

- | | | | |
|--|-----|----|------------|
| 43. Did you eat breakfast in the Staff mess? | Yes | No | Don't know |
| 44. Did you eat breakfast in the Officer's mess? | Yes | No | Don't know |
| 45. Did you eat breakfast in the Windjammer? | Yes | No | Don't know |
| 46. Did you eat breakfast in your room? | Yes | No | Don't know |

27 February 2006 (Monday) Lunch

- | | | | |
|--|-----|----|------------|
| 47. Did you eat lunch in the Staff mess? | Yes | No | Don't know |
| 48. Did you eat lunch in the Officer's mess? | Yes | No | Don't know |
| 49. Did you eat lunch in the Windjammer? | Yes | No | Don't know |
| 50. Did you eat lunch in your room? | Yes | No | Don't know |

27 February 2006 (Monday) Dinner

- | | | | |
|---|-----|----|------------|
| 51. Did you eat dinner in the Staff mess? | Yes | No | Don't know |
| 52. Did you eat dinner in the Officer's mess? | Yes | No | Don't know |
| 53. Did you eat dinner in the Windjammer? | Yes | No | Don't know |
| 54. Did you eat dinner in your room? | Yes | No | Don't know |

28 February 2006 (Tuesday) Breakfast

- | | | | |
|--|-----|----|------------|
| 55. Did you eat breakfast in the Staff mess? | Yes | No | Don't know |
| 56. Did you eat breakfast in the Officer's mess? | Yes | No | Don't know |
| 57. Did you eat breakfast in the Windjammer? | Yes | No | Don't know |
| 58. Did you eat breakfast in your room? | Yes | No | Don't know |

28 February 2006 (Tuesday) Lunch

- | | | | |
|--|-----|----|------------|
| 59. Did you eat lunch in the Staff mess? | Yes | No | Don't know |
| 60. Did you eat lunch in the Officer's mess? | Yes | No | Don't know |
| 61. Did you eat lunch in the Windjammer? | Yes | No | Don't know |
| 62. Did you eat lunch in your room? | Yes | No | Don't know |

28 February 2006 (Tuesday) Dinner

- | | | | |
|---|-----|----|------------|
| 63. Did you eat dinner in the Staff mess? | Yes | No | Don't know |
| 64. Did you eat dinner in the Officer's mess? | Yes | No | Don't know |
| 65. Did you eat dinner in the Windjammer? | Yes | No | Don't know |
| 66. Did you eat dinner in your room? | Yes | No | Don't know |

1 March 2006 (Wednesday) Breakfast

- | | | | |
|--|-----|----|------------|
| 67. Did you eat breakfast in the Staff mess? | Yes | No | Don't know |
| 68. Did you eat breakfast in the Officer's mess? | Yes | No | Don't know |
| 69. Did you eat breakfast in the Windjammer? | Yes | No | Don't know |
| 70. Did you eat breakfast in your room? | Yes | No | Don't know |

1 March 2006 (Wednesday) Lunch

- | | | | |
|--|-----|----|------------|
| 71. Did you eat lunch in the Staff mess? | Yes | No | Don't know |
| 72. Did you eat lunch in the Officer's mess? | Yes | No | Don't know |
| 73. Did you eat lunch in the Windjammer? | Yes | No | Don't know |
| 74. Did you eat lunch in your room? | Yes | No | Don't know |

1 March 2006 (Wednesday) Dinner

75. Did you eat dinner in the Staff mess? Yes No Don't know
76. Did you eat dinner in the Officer's mess? Yes No Don't know
77. Did you eat dinner in the Windjammer? Yes No Don't know
78. Did you eat dinner in your room? Yes No Don't know

79. Circle the average number of glasses of **UNBOTTLED** ship's water you drank per day:
0 1 2 3 4 5 6 7 8 9 10+

80. Circle the average number of bottles of **BOTTLED** water you drank per day:
0 1 2 3 4 5 6 7 8 9 10+

81. Circle the number of beverages **CONTAINING ICE** from the ship per day:
0 1 2 3 4 5 6 7 8 9 10+

82. Did you **visit or work** in the casino in the last 10 days? Yes No
If yes circle ALL dates 2/23 2/24 2/25 2/26 2/27 2/28 3/1

83. Did you **visit or work** in any bars on the ship in the last 10 days? Yes No
If yes what bars did you visit or work at on 2/23 (Thursday) _____
If yes what bars did you visit or work at on 2/24 (Friday) _____
If yes what bars did you visit or work at on 2/25 (Saturday) _____
If yes what bars did you visit or work at on 2/26 (Sunday) _____
If yes what bars did you visit or work at on 2/27 (Monday) _____
If yes what bars did you visit or work at on 2/28 (Tuesday) _____
If yes what bars did you visit or work at on 3/1 (Wednesday) _____

84. Do you use the hand sanitizer on the ship? Yes No
If yes how often? (Circle one)
< 1 per week 2 – 3 x per week Once per day Many times during the day

85. Additional comments that may help us investigate this illness:

Appendix F

Passenger survey analysis

Variable	Cases n = 46 (Excludes pre-existing illness)		Controls n = 73		Significance and CI
	Age	Mean	43.0	Mean	
	Median	45	Median	43	
	Range	7 – 80	Range	17–68	
Sex	Female	17 (42.5 %)	Female	15 (51.7 %)	1.28 (0.50–3.26)
	Male	23 (57.5 %)	Male	14 (48.3 %)	
Number of people in cabin	Median	2	Median	2	
	Range	1 – 3	Range	1 – 3	
Number ill prior to cruise	5				
Symptom profile (Note: %'s are % of people responding yes versus all responding)	Diarrhea	36 (95%)			
	Vomiting	32 (84%)			
	Nausea	33 (80%)			
	Stomach cramps	24 (60%)			
	Headache	21 (52%)			
	Muscle ache	20 (50%)			
	Fever	17 (42%)			
	Blood in stool	1 (3%)			
Median vomiting episodes	Median	4			
	Range	1 – 10			
Median diarrheal episodes	Median	6.5			
	Range	1 – 10			
Symptom onset	2/26	4 (10%)			
	2/27	19 (49%)			
	2/28	10 (26%)			
	3/1	4 (10%)			
	3/2	1 (3%)			
	3/3	1 (3%)			
Illness duration	1 day	9 (22%)			
	2 days	15 (37%)			
	3 days	11 (27%)			
	4+ days	4 (10%)			
	Still ill	2 (5%)			
Number sharing cabin with ill person	15 (37.5%)		0 (0%)		N/A

Number exposed to another persons vomit or diarrhea	2 (5.1%)		1 (3.3%)		NA
Number with a sick social contact	17 (42.5%)		4 (12.9%)		5.0 (1.5 – 16.9) †
% eating lunch on 2/26 in Windjammer	35 (85.4%)		25 (78.1%)		
Locations people ate on the following dates:					
2/26 Dinner	Windjammer	4 (10%)	Windjammer	9 (24%)	0.29
	Columbus	13 (33%)	Columbus	5 (13%)	2.70 (0.84–8.70)
	Magellan	15 (38%)	Magellan	17 (45%)	0.56
	Da Gama	7 (18%)	Da Gama	7 (18%)	0.77
	Chops grill	0	Chops grill	0	
	Portofino grill	0	Portofino grill	0	
	Room service	1 (3%)	Room service	0	
	Any Main	34	Any Main	28	0.91 (0.19–4.41)
2/27 Breakfast	Windjammer	30 (75%)	Windjammer	23 (77%)	0.72
	Main	5 (13%)	Main	2 (17%)	1.91 (0.34–10.65)
	Rm. Svc.	5 (13%)	Rm. Svc.	5 (7%)	0.68
2/27 Lunch	Windjammer	31 (82%)	Windjammer	17 (77%)	1.22 (0.30–4.91)
	Main	7 (18%)	Main	5 (23%)	0.75
	Rm. Svc.	0	Rm. Svc.	0	
2/27 Dinner	Windjammer	4 (11%)	Windjammer	4 (12%)	0.82
	Columbus	10 (26%)	Columbus	5 (15%)	2.70 (0.84–8.70)
	Magellan	14 (37%)	Magellan	16 (48%)	0.56
	Da Gama	6 (16%)	Da Gama	6 (18%)	0.77
	Chops grill	0	Chops grill	0	
	Portofino grill	1 (3%)	Portofino grill	0	
	Room service	3 (8%)	Room service	2 (6%)	1.28 (0.20–8.19)
	Any Main	30	Any Main	27	0.63
2/28 Breakfast	Windjammer	12 (48%)	Windjammer	19 (68%)	0.44
	Main	3 (12%)	Main	6 (11%)	0.50
	Rm. Svc.	10 (40%)	Rm. Svc.	3 (21%)	5.56 (1.32–23.46) †
2/28 Lunch	Windjammer	11 (92%)	Windjammer	18 (82%)	2.44 (0.24–24.78)
	Main	1 (8%)	Main	4 (18%)	0.41
	Rm. Svc.	0	Rm. Svc.	0	

2/28 Dinner	Windjammer	3 (13%)	Windjammer	3 (10%)	1.35 (0.25–7.40) 0.75 0.20 0.49 0.09
	Columbus	3 (13%)	Columbus	5 (17%)	
	Magellan	4 (17%)	Magellan	15 (50%)	
	Da Gama	3 (13%)	Da Gama	7 (23%)	
	Chops grill	0	Chops grill	0	
	Portofino grill	0	Portofino grill	0	
	Room service	11 (46%)	Room service	0	
	Any Main	10	Any Main	27	
Number of glasses of <u>unbottled</u> water consumed	Mean	2.6	Mean	3.4	Students t test T Stat = 1.60 P Value = 0.11
	Median	2.0	Median	3.0	
Number of glasses of <u>bottled</u> water consumed	Mean	1.3	Mean	1.4	Students t test T Stat = 0.25 P Value = 0.81
	Median	1.0	Median	1.0	
Number of drinks <u>containing ice</u> consumed	Mean	4.6	Mean	5.0	Students t test T Stat = 0.59 P Value = 0.56
	Median	4.0	Median	5.0	
Use of casino	22 (56% of respondents)		21 (66% of respondents)		0.68 (0.26–1.78)
Visit bars	15 (39% of respondents)		16 (53% of respondents)		0.54 (0.21–1.44)
How often person believed hand sanitizer was present <u>before</u> knowing others were sick	Mean	0.8	Mean	3.3	Students t test T Stat = 3.64 P Value < 0.001 † Mann-Whitney/Wilcoxon $\chi^2 = 9.2424$ P Value = 0.002 †
	Median	0	Median	2.0	
How often person believed hand sanitizer was present <u>after</u> knowing others were sick	Mean	7.8	Mean	8.4	Students t test T Stat = 0.8.0 P Value = 0.43
	Median	10.0	Median	10.0	
Use of hand sanitizer <u>before</u> knowing others were sick	Mean	4.4	Mean	4.8	Students t test T Stat = 0.35 P Value = 0.73
	Median	3.0	Median	4.5	
Use of hand sanitizer <u>after</u> knowing others were sick	Mean	8.9	Mean	8.4	Students t test T Stat = 0.80 P Value = 0.43
	Median	10.0	Median	10.0	

Efficacy of hand sanitizer against bacteria	Mean Median	63.9% 60.0%	Mean Median	68.3% 70.0%	Students t test T Stat = 0.69 P Value = 0.49
Efficacy of hand sanitizer against virus	Mean Median	60.8% 50.0%	Mean Median	64.8% 70.0%	Students t test T Stat = 0.64 P Value = 0.52

† Indicates significant difference at 95% confidence interval

Appendix G

Passengers with prior illness analysis

Variable	Illness prior to boarding		Illness after boarding	
Age	Mean	46.0	Mean	43.1
	Median	42	Median	45
	Range	34 – 62	Range	7 – 80
Sex	Female	2 (40.0 %)	Female	17 (42.5 %)
	Male	3 (60.0 %)	Male	23 (57.5 %)
Number of people in cabin	Median	2	Median	2
	Range	2 – 6	Range	1 – 3
Symptom profile	Diarrhea	4 (100%)	Diarrhea	36 (95%)
	Vomiting	5 (100%)	Vomiting	32 (84%)
	Nausea	1 (20%)	Nausea	33 (80%)
(Note: %'s are % of people responding yes versus all responding)	Stomach cramps	1 (20%)	Stomach cramps	24 (60%)
	Headache	1 (20%)	Headache	21 (52%)
	Muscle ache	0	Muscle ache	20 (50%)
	Fever	0	Fever	17 (42%)
	Blood in stool	0	Blood in stool	1 (3%)
Median vomiting episodes	Median	5	Median	4
	Range	1 – 10	Range	1 – 10
Median diarrheal episodes	Median	4	Median	6.5
	Range	2 – 10	Range	1 – 10
Symptom onset	2/24 @ 1420	1 (50%)	2/26	4 (10%)
	2/27 @ 0800	1 (50%)	2/27	19 (49%)
(Note: %'s are % of people responding yes versus all responding)			2/28	10 (26%)
			3/1	4 (10%)
			3/2	1 (3%)
			3/3	1 (3%)
Illness duration	1 day	2 (40%)	1 day	9 (22%)
	2 days	0	2 days	15 (37%)
	3 days	1 (20%)	3 days	11 (27%)
	4+ days	2 (40%)	4+ days	4 (10%)
	Still ill	0	Still ill	2 (5%)
Number sharing cabin with ill person	1 (20.0%)		15 (37.5%)	
Number exposed to another persons vomit or diarrhea	1 (20.0%)		2 (5.1%)	

Number with a sick social contact	3 (60.0%)	17 (42.5%)
--	-----------	------------

Appendix H

Crew survey analysis

Variable	Cases n = 16		Controls n = 48		Significance and CI
Age	Mean	32.1	Mean	32.5	Students t test T Stat = 0.21 P Value = 0.83
	Median	32	Median	30	
	Range	22 – 43	Range	20 – 62	
Sex	Female = 6 (37.5 %) Male = 10 (62.5 %)		Female Male	17 (62.2 %) 28 (37.8 %)	1.01 (0.31 – 3.29)
Symptom profile (Note: %'s are % of people responding yes versus all responding)	Diarrhea	13 (100%)			
	Stomach cramps	11 (69%)			
	Vomiting	7 (64%)			
	Nausea	7 (47%)			
	Muscle ache	6 (43%)			
	Headache	4 (29%)			
	Fever	4 (27%)			
	Blood in stool	0			
Median vomiting episodes	Median	4			
	Range	1 – 10			
Median diarrheal episodes	Median	6.5			
	Range	1 – 10			
Symptom onset	2/26	4 (10%)			
	2/27	19 (49%)			
	2/28	10 (26%)			
	3/1	4 (10%)			
	3/2	1 (3%)			
	3/3	1 (3%)			
Illness duration	1 day	9 (56%)			
	2 days	3 (19%)			
	3 days	1 (6%)			
	Still ill	3 (19%)			
Number sharing cabin with ill person	2 (14%)		2 (5%)		3.4 (0.4 – 26.9)

Number exposed to another persons vomit or diarrhea	2 (5.1%)		1 (3.3%)		NA
Number whom had contact with a sick passenger or crew member	4 (25%)		17 (39%)		5.0 (1.5 – 16.9) †
Number whom worked with a sick crew member	2 (13%)		13 (28%)		(*0.19)
Locations people ate on the following dates:					
2/25 Breakfast (Fisher Exact Test used on values < 5)	Staff mess Officers mess Windjammer Room	3 (50%) 1 (17%) 2 (33%) 0	Staff mess Officers mess Windjammer Room	23 (88%) 5 (19%) 1 (4%) 0	(* 0.063) (* 0.69) (* 0.083)
2/25 Lunch (Fisher Exact Test used on values < 5)	Staff mess Officers mess Windjammer Room	5 (50%) 2 (20%) 3 (30) 0	Staff mess Officers mess Windjammer Room	24 (67%) 13 (36%) 3 (8%) 0	(* 0.27) (* 0.29) (* 0.11)
2/25 Dinner (Fisher Exact Test used on values < 5)	Staff mess Officers mess Windjammer Room	6 (55%) 2 (18%) 3 (27%) 1 (9%)	Staff mess Officers mess Windjammer Room	26 (72%) 8 (22%) 2 (6%) 2 (6%)	(* 0.23) (* 0.57) (* 0.076) (* 0.56)
2/26 Breakfast (Fisher Exact Test used on values < 5)	Staff mess Officers mess Windjammer Room	3 (50%) 2 (33%) 1 (17%) 0	Staff mess Officers mess Windjammer Room	23 (79%) 5 (17%) 1 (3%) 1 (3%)	(* 0.16) (* 0.34) (* 0.32) (* 0.83)
2/26 Lunch (Fisher Exact Test used on values < 5)	Staff mess Officers mess Windjammer Room	3 (50%) 2 (33%) 1 (17%) 0	Staff mess Officers mess Windjammer Room	23 (72%) 9 (28%) 3 (9%) 0	(* 0.27) (* 0.57) (* 0.51)
2/26 Dinner (Fisher Exact Test used on values < 5)	Staff mess Officers mess Windjammer Room	8 (67%) 2 (88%) 2 (17%) 1 (8%)	Staff mess Officers mess Windjammer Room	28 (78%) 7 (19%) 2 (6%) 2 (6%)	(* 0.34) (* 0.35) (* 0.26) (* 0.59)

2/27 Breakfast (Fisher Exact Test used on values < 5)	Staff mess Officers mess Windjammer Room	4 (67%) 0 2 (33%) 0	Staff mess Officers mess Windjammer Room	22 (79%) 6 (21%) 2 (7%) 0	(* 0.44) (* 0.28) (* 0.13)
2/27 Lunch (Fisher Exact Test used on values < 5)	Staff mess Officers mess Windjammer Room	6 (55%) 1 (9%) 3 (27%) 1 (9%)	Staff mess Officers mess Windjammer Room	27 (71%) 11 (29%) 3 (8%) 0	(* 0.25) (* 0.17) (* 0.12) (* 0.22)
2/27 Dinner (Fisher Exact Test used on values < 5)	Staff mess Officers mess Windjammer Room	6 (67%) 1 (11%) 2 (22%) 0	Staff mess Officers mess Windjammer Room	26 (70%) 9 (24%) 4 (11%) 1 (3%)	(* 0.56) (* 0.36) (* 0.33) (* 0.80)
2/28 Breakfast (Fisher Exact Test used on values < 5)	Staff mess Officers mess Windjammer Room	2 (33%) 1 (17%) 3 (50%) 0	Staff mess Officers mess Windjammer Room	24 (80%) 6 (20%) 2 (7%) 0	0.12 (0.18–0.85) (* 0.038) (* 0.67) 14.0 (1.6–120.0) † (* 0.024)
2/28 Lunch (Fisher Exact Test used on values < 5)	Staff mess Officers mess Windjammer Room	5 (50%) 2 (20%) 3 (30%) 0	Staff mess Officers mess Windjammer Room	27 (75%) 10 (28%) 2 (6%) 0	(* 0.13) (* 0.48) (* 0.06)
2/28 Dinner (Fisher Exact Test used on values < 5)	Staff mess Officers mess Windjammer Room	4 (44%) 2 (22%) 2 (22%) 1 (11%)	Staff mess Officers mess Windjammer Room	28 (76%) 8 (22%) 3 (8%) 0	(* 0.08) (* 0.64) (* 0.25)
3/1 Breakfast (Fisher Exact Test used on values < 5)	Staff mess Officers mess Windjammer Room	2 (40%) 0 3 (60%) 0	Staff mess Officers mess Windjammer Room	25 (78%) 7 (22%) 1 (3%) 0	(* 0.11) (* 0.33) 46.5 (3.2–676.2) † (* 0.005)
3/1 Lunch (Fisher Exact Test used on values < 5)	Staff mess Officers mess Windjammer Room	3 (43%) 0 2 (29%) 2 (29%)	Staff mess Officers mess Windjammer Room	26 (79%) 9 (27%) 1 (3%) 0	(* 0.075) (* 0.14) (* 0.074)

3/1 Dinner (Fisher Exact Test used on values < 5)	Staff mess Officers mess Windjammer Room	4 (40%) 0 3 (30%) 3 (30%)	Staff mess Officers mess Windjammer Room	26 (74%) 10 (29%) 2 (6%) 0	0.23 (0.05 – 1.01) (* 0.052) (* 0.065)
Number of glasses of <u>unbottled</u> water consumed	Mean Median	3.9 3.5	Mean Median	2.6 2.0	Students t test T Stat = 1.57 P Value = 0.12
Number of glasses of <u>bottled</u> water consumed	Mean Median	1.5 1.0	Mean Median	1.7 1.0	Students t test T Stat = 0.30 P Value = 0.76
Number of drinks <u>containing ice</u> consumed	Mean Median	2.3 2.0	Mean Median	2.2 2.0	Students t test T Stat = 0.14 P Value = 0.89
Use of casino	0		1 (2% of respondents)		
Visit bars	6 (38% of respondents)		12 (25% of respondents)		(* 0.27)
Frequency of hand sanitizer use	Not analyzed due to wrong survey distributed to cases vs. controls				

† Indicates significant difference at 95% confidence interval

* Fischer's 1-tailed P value used instead of OR due to a value ≤ 5