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To: Douglas Hamilton, MD, PhD, Director, Epidemic Intelligence Service, Office of Workforce and Career Development (OWCD)

Subject: Final Epi-Aid Trip Report: Outbreak of Gastrointestinal Illness Aboard Cruise Ship *MS Zuiderdam*, Fort Lauderdale, Florida, and Nassau, Bahamas, 2005 (Epi-2006-28)

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Attachments: Emergency Epidemic Investigations Form

INTRODUCTION

The Centers for Disease Control and Prevention's (CDC) Vessel Sanitation Program (VSP) conducts surveillance for gastrointestinal (GI) illness aboard passenger cruise ships calling on U.S. ports. At least 24 hours before arriving in the United States, all passenger ships with a foreign itinerary that call on U.S. ports are required by law to notify the VSP of the percentage of passengers and crew reporting GI illness during the previous 15 days. A reportable case is defined as a person who reports to the ship's physician or their designee after 3 or more episodes of loose stools in a 24-hour period or after vomiting and having any one of the following: 1 or more loose stools in a 24-hour period, abdominal cramps, headache, muscle aches, or temperature of $\geq 38^{\circ}\text{C}$ (100.4°F). Ships that report more than 3% of either passengers or crew having GI illness are investigated by the VSP.

BACKGROUND

On December 30, 2005, the *MS Zuiderdam* sailed from Fort Lauderdale, Florida, with 1,888 passengers and 814 crew members (Appendix A) aboard. On January 1, 2006, Holland America Line notified the VSP that 53 cases (2.81%) of GI illness had been reported among passengers and 15 cases (1.84%) had been reported among crew members aboard the *MS Zuiderdam*.

The GI illness log faxed to the VSP from the ship showed that the first GI illness case was reported on December 30, 2005. Between December 30, 2005, and January 2, 2006, a total of 60 cases (3.18%) were reported among passengers and 27 cases (3.31%) were reported among crew, with a single peak of 59 persons reporting onset of GI illness on January 1, 2006 (Appendix B).

At the request of the VSP environmental health officer, EIS officers Antonio Neri, MD, from CDC's National Center for Environmental Health and Ciara O'Reilly, PhD, from the National Center for Infectious Diseases, Foodborne and Diarrheal Diseases Branch assisted in the investigation to determine the characteristics and extent of GI illness aboard the *MS Zuiderdam*, the causal pathogen, and the potential modes of illness transmission, as well as to enact public health intervention and control.

OBJECTIVES

The primary objectives for this investigation were as follows:

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

METHODS

Focused environmental inspections:

The VSP environmental health officer conducted focused environmental inspections of the entire ship, concentrating on the critical areas where breakdowns in the ship's systems could introduce pathogens into the food or water supply.

All outbreak response protocols and general operational procedures of the cruise ship company were reviewed with each department manager and with selected staff to determine their compliance. Inspections were conducted for the 2 days the VSP team was onboard. One inspection occurred at 0400 hours to ensure that the night-shift staff also understood and followed all health procedures during this sailing.

Laboratory specimens collected:

When notified of the outbreak, the VSP requested that the ship's infirmary collect stool specimens and rectal swabs from crew and passengers who reported GI illness. These specimens were collected by the VSP EPI-AID (epidemiologic investigation) team and transported to CDC for analysis.

Survey development:

Investigators generated several hypotheses following interviews with the ship's staff and review of the ship's GI illness log. Because of the shape of the epidemic curve and the information in the GI illness log, the investigators initially thought that a point-source outbreak was occurring. Interviews with the ship's staff indicated that the illness was generally of short duration and was self-limited. No instances of fevers were noted in the GI illness log, and only one episode of bloody stool was recorded among the approximately 100 cases reported to the infirmary by the time of the interviews. The absence of fevers and bloody diarrhea indicated that the causative agent was less likely to be bacterial.

Interviews with the ship's medical personnel indicated that a peak in passenger cases had occurred on the previous sailing approximately 48 hours prior to the peak in passenger cases during the current sailing. The prior cases were not recorded in the GI illness log of the previous sailing because the illness peak occurred just as the passengers were leaving the ship, and the ill passengers did not report to the ship's infirmary. It was also reported that approximately 35 cabins were contaminated by vomitus or diarrhea on the day of disembarkation. Three of these cabins had housed sick persons on an earlier cruise (December 4–12, 2005). No record was kept that identified which cabins were contaminated and subsequently disinfected prior to the December 30 embarkation. In addition, at least one public vomiting episode (on the gangway) occurred during the December 30 disembarkation. No records reviewed by investigators included this vomiting episode.

The infirmary also received reports from passengers that other people in their traveling group may have been ill prior to their embarkation. On the basis of information available, the investigators hypothesized that the illness was most likely viral (based on the absence of bloody stools and no fevers) and was associated with person-to-person transmission rather than with point-source transmission.

Two surveys were developed using these hypotheses. On January 6, 2006, a passenger survey that included questions about ship menus, shore excursions, and environmental exposures was placed in the box beside the doors of all passenger cabins (Appendix C). Passengers were asked to provide demographic information, symptom profiles, history of exposure to sick people, illness reporting methods, and information on meals and dining locations. Passengers were asked to return the surveys to the ship's reception desk. Investigators also designed, distributed, and collected a crew survey (Appendix D). The crew survey included questions similar to those on the passenger survey but also included questions about jobs performed while on the ship. The crew survey was distributed on January 7, 2006, after the ship had set sail on its next voyage. Sick passengers and crew were asked to have a well person return the survey and to remain isolated in their cabins. Determination of a case of GI illness was made after reviewing these surveys.

Case definition:

For this investigation, a case was defined as a person on the *MS Zuiderdam* who reported at least one of the following conditions between December 29, 2005, and January 7, 2006:

- Three or more episodes of 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 Microsoft Access database and were analyzed using Epi-Info 2002 (Version 3.3.1) as well as SAS version 9.1.

Two studies, a case-control study and a cohort study, were conducted using the passenger survey responses. The case-control study primarily focused on evaluating the consumption of water and the choice of dining locations on the ship. The cohort study was conducted to further evaluate any abnormal findings related to dining locations and to evaluate the relation between environmental exposures and disease status. A cohort study for the crew was conducted using the passenger survey format to look at similar outcomes following similar exposures. To better evaluate the risk associated with a food item or a dining location, passenger cases were divided into groups according to the date of their illness onset. Because the incubation period of norovirus is 48–72 hours, passenger cases were divided into two groups: those who reported illness onset prior to January 3, 2006, and those who reported illness onset on or after January 3, 2006.

RESULTS

Interviews:

Nine of the initial crew members to report to the infirmary were interviewed. Seven of these crew members were entertainers who worked and socialized together. Only two of the entertainers went ashore on December 29, 2005. None of the entertainers reported eating any unusual foods or having any exposures to sick people. The other two crew members had a high degree of passenger contact on embarkation and did not eat when ashore in Nassau. All nine crew members stated that they reported immediately to the infirmary upon feeling ill.

Five food handlers from the crew reported to the infirmary between December 30, 2005, and January 3, 2006; four were interviewed. All food handlers interviewed reported knowing about and having followed proper food-handling procedures the entire time they were at work on the ship. The information on crew members reporting illness is as follows:

- One with onset of illness December 31, 2005; fired for breaking isolation on January 1, 2006,

and was not available to be interviewed. Although he reportedly worked in the galley, his responsibilities were unclear.

- One with onset of illness January 3, 2006; his cabin mate was sick with GI illness two days prior to the onset of his own symptoms. This person was responsible for preparing raw fish for any food item on any menu. He felt mild nausea on January 1, 2006, but this quickly resolved, and he reported to the infirmary January 3, 2006, immediately upon feeling ill.
- One with onset of illness January 1, 2006; this person served in the dining room, felt ill after work on December 31, 2005, and on the following morning reported to the infirmary; this person had frequent passenger contact the previous night.
- One with onset of illness on January 1, 2006; this person managed one of the main galleys but was not responsible for preparing any specific food item; this person claimed to have reported immediately to the infirmary upon feeling ill.
- One with onset of illness December 31, 2005; this person served appetizers in a bar and helped passengers down a gangway during a shore excursion on January 1, 2006. The crewmember felt mild nausea on December 31, 2005, but did not think it significant. The crewmember felt worse after returning to the ship from the shore excursion on January 1, 2006, and claimed to have reported immediately to the infirmary.

Focused environmental inspection:

The major defects noted in the ship's operation and management were as follows:

- Housekeeping management was unaware of the 35 cabins contaminated by vomitus or diarrhea the staff had reported on an earlier cruise. There was clearly a breakdown in communication between management and staff in this department.
- Security personnel on the dock reported having seen many sick passengers during the disembarkation from the previous cruise, but this information was not relayed to the staff on the ship.
- The ship's medical staff did not screen passengers for GI illness at the dockside check-in prior to embarkation or during the earlier disembarkation.
- Some equipment in the kitchen needed repair and had not been used for many months. One dishwasher was unable to maintain the appropriate duration of hot water rinse treatment and was shut down during the inspection pending repairs.
- Some of the public restrooms offered no way to exit without touching the door handles with bare hands. A requirement in the Vessel Sanitation Program Operations Manual, August 2005, is to allow exit from public restrooms without having to touch the door handles with bare hands.
- Approximately half of the ice pantries in passenger areas were found to be unlocked; housekeeping staff stated that the pantries are required to be locked during an outbreak situation.
- Approximately 100 passengers reported to the infirmary but only one stool sample was obtained from passengers.
- No gross abnormalities were found with the ship's food or water storage systems.

Laboratory specimens collected:

Two stool specimens and five rectal swabs were collected; six specimens were from crew members and one was from a passenger. Both stool specimens tested positive for norovirus (GII/4 Bristol). This strain is very prevalent and was isolated earlier (January 2005) on two other ships operated by this cruise line. Those two ships also sailed in the Caribbean. There were no abnormal isolates from the rectal swabs.

Analysis of the survey:

Accuracy of reporting: The breakdown of the collected surveys is as follows:

- 1,888 Passenger surveys distributed
- 1,023 Passenger surveys collected (Response Rate = 54.2%)
- 3 Passenger surveys were incomplete
- 153 Passenger surveys met the case definition
- 31 Passenger surveys indicated indeterminate illness
- 764 Crew surveys distributed
- 707 Crew surveys collected (Response Rate = 92.5%)
- 17 Crew surveys were incomplete
- 50 Crew surveys met the case definition
- 69 Crew surveys indicated indeterminate illness

The attack rate among the passengers was 15.0% (153/1020) and among the crew was 7.2% (50/690). These denominator numbers exclude the count of partially completed surveys, and the numerator numbers exclude those responders with pre-existing or indeterminate illnesses. Thirteen passengers who indicated that they were ill prior to embarkation were excluded from the cohort and case-control analysis. Analysis of the passenger study and crew study will be reported sequentially below.

Passenger case-control study:

A full table of the passenger case-control analysis is presented in Appendix E, the pertinent results will be reported here. 153 cases were compared to 306 controls. Median case age was 63 (range 2 – 88), median control age was 61 (range 5 – 89). 53% of cases were female as compared to 57% of controls. There were no significant differences between cases and controls in relation to age or gender. Both passenger-cases and passenger-controls had a median of 2 persons in their cabin with a range of 1–4.

The symptom profile was as follows:

Symptom profile (Note: %s are % of people responding “yes” versus all responding)	Diarrhea	138 (90%)
	Vomiting	114 (74%)
	Stomach cramps	83 (54%)
	Nausea	75 (49%)
	Muscle ache	50 (33%)
	Headache	48 (31%)
	Fever	38 (25%)
	Blood in stool	1 (1%)
Median vomiting episodes	Median	3
	Range	1–10+
Median diarrheal episodes	Median	5
	Range	1–10+
Symptom onset	Date	Frequency Cum. %
	12/31/05	42 (28%) 28%
	1/1/06	42 (28%) 55%
	1/2/06	18 (12%) 67%
	1/3/06	19 (12%) 79%
	1/4/06	20 (13%) 92%
	1/5/06	10 (6%) 99%
	1/6/06	2 (1%)
Illness duration	1 day	47 (31%)
	2 days	58 (38%)
	3 days	15 (10%)
	4 days	6 (4%)
	5 days	6 (4%)
	6 days	2 (1%)
	7 days	1 (1%)

Fifty-six (37%) cases shared a cabin with ill persons as opposed to 23 (8%) controls (Odds ratio [OR] 6.30 [3.68–10.8]). ORs increased in proportion to the number of ill persons reported in a cabin; one ill person [OR 5.58 (3.00–10.3)]; two ill people [OR 48.8 (6.4–371)]. Sixty (40%) cases reported traveling to the ship with a group versus 67 (24%) controls (OR 2.14 (1.40–3.27)). No significant difference between groups was noted when comparing whether a member of the pre-embarkation group was sick. Fourteen (33%) cases were with a pre-embarkation commercial tour group compared with 18 (30%) of the controls, this difference was not significant. Passenger-cases reported a mean of 0.49 (range 0–28) people in their pre-embarkation group that were ill compared with a mean of 0.11 (range 0–10) among passenger-controls. This difference was significant in the Students *t*-test analysis as well as in the Mann-Whitney/Wilcoxon test (p-value 0.049). Fifty-one (54%) passenger-cases reported an ill person in their traveling party while aboard the ship versus 74 (28%) of passenger-controls [OR 3.02 (1.97–4.62)]. Five (3%) passenger-cases reported being exposed to another person’s vomit or diarrhea, but no controls reported such exposure.

The characteristics of passenger-cases concerning their reporting habits and their reasons for not reporting are as follows:

Infirmary use	Visited Notified but did not visit Chose not to visit	80 (53%) 15 (10%) 56 (37%)
Number advised to isolate due to illness (Note: % is percent of those responding to the question)	89 (93%)	
Reasons for not reporting	Self-treated Self-isolated / visited by medical staff Did not believe serious Other	8 (18%) 10 (23%) 19 (43%) 7 (16%)
Reporting status, self-isolation, and duration of isolation of those who did not report to the ship's clinic Note: These numbers include columns for which some data was missing	Elected to self-isolate Duration of self-isolation < 24 hrs. 24–48 hrs. > 48 hrs.	33 (59%) 10 (30%) 23 (70%) 0
Those who self-treated and did not report to the ship's clinic	Elected to self-isolate Duration of self-isolation < 24 hrs. 24–48 hrs. > 48 hrs.	3 (38%) 1 (12%) 2 (25%) 0
Those who self-isolated or were visited by a nurse from the ship's clinic	Reported self-isolate Duration of self-isolation < 24 hrs. 24–48 hrs. > 48 hrs.	7 (70%) 1 (10%) 8 (80%) 0
Those who did not report to the clinic because they did not believe their illness was serious	Elected to self-isolate Duration of self-isolation < 24 hrs. 24–48 hrs. > 48 hrs.	8 (50%) 5 (26%) 3 (16%) 0
Duration of isolation (all cases) (Note: % is percent of those responding to the question)	< 24 hrs. 24–48 hrs. > 48 hrs.	17 (11%) 107 (70%) 16 (10%)

One-hundred-thirty-two (92%) passenger-cases ate lunch at the Lido on December 30, 2005, compared with 239 (82%) controls (OR 2.35 [1.21–4.56]). This OR increased when accounting for cases with onset prior to January 3, 2006, with 91 (95%) cases versus 239 (82%) controls (OR 3.88 [1.50–10.0]). Passenger-cases with onset prior to January 3, 2006, were more likely to have consumed watermelon than were control subjects [OR 1.91 (1.06–3.44)], but survey results did not show any other food item to have such an association.

When comparing those who ate in the other dining locations, no significant differences between cases and controls was seen. No difference was found in bar use or in New Year's Eve party attendance between the passengers who became ill and the passengers who did not on either December 30 or 31. Consumption of bottled water, unbottled water, or drinks containing ice did not differ between the two passenger groups. Ninety-six (70%) case and 168 (60%) controls consumed ice that was supplied to their rooms, a comparison that achieved significance when all cases were included (OR 1.55 [1.00–2.40]). Prior to January 3, 2006, cases' consumption of ice delivered to their rooms was not significantly different from that of controls [1.59 (0.96–2.64)].

Passenger cohort study:

Eight-hundred-twenty-nine surveys (comprising 44% of all passengers) were entered into the database, 153 passengers met the case definition for GI illness. A table showing all results can be found in Appendix F; only pertinent results will be reported here. The median age for ill persons was 63 (range 2–88); the median age for controls was 63 (range 5–89). Fifty-three percent of those ill were female as compared to 54% of controls. No significant differences existed between ill and well persons in regard to sex or age. Most of the case-control study findings were supported by the cohort analysis shown in the table below:

Question	OR (95% CI) for case-control	RR (95% CI) for cohort
Sharing cabin with an ill person	6.30 (3.68–10.8)	3.34 (2.57–4.33)
Number traveling with group prior to embarkation	2.14 (1.40–3.27)	1.66 (1.24–2.21)
Number reporting an ill person in their traveling party while aboard the ship	3.02 (1.97–4.62)	2.22 (1.66–2.96)

The findings of the cohort study contradicted the findings of the cohort study in the following way:

Question	OR (95% CI) for case-control	RR (95% CI) for cohort
Number of people in the pre-embarkation group that were sick	Mann-Whitney/Wilcoxon X ² = 3.88 P-Value = 0.049†	Mann-Whitney/Wilcoxon X ² = 0.2711 P-Value = 0.60

† Significant at 95% two-tailed confidence interval

The difference between ill and well persons who dined in the Lido for the embarkation lunch remained, even when accounting for symptom onset date in the cohort study.

Question	OR (95% CI) for case-control	RR (95% CI) for cohort
12/30 Lunch in the Lido (using all cases)	2.35 (1.21–4.56) †	2.02 (1.16–3.53) †
12/30 Lunch in the Lido (using only cases with onset prior to 1/3/06)	3.88 (1.50–10.0) †	3.34 (1.39–8.04) †
Food items for 12/30 using only cases with onset prior to 1/3/06		
Watermelon	1.91 (1.06–3.44) †	1.49 (0.97–2.28)
Cod fillet	1.98 (0.85–4.64)	1.79 (1.01–3.18) †
Cheddar Cheese	2.46 (0.74–8.18) (*0.12)	2.24 (1.12–4.46) (*0.046) †

* Fischer's 1-tailed p value due to a value ≤ 5

† Significant at 95% two-tailed confidence interval

Passengers reporting prior illness:

Appendix G compares passengers reporting illness prior to boarding versus those reporting illness after boarding. The two groups showed similar age distribution, gender ratios, symptom profile, illness duration, ratio of exposure to another ill person, and percent of people reporting a sick social contact.

Crew cohort study:

Six-hundred-twenty surveys were entered into the database; 50 of these met the case definition. A table showing all results can be found in Appendix H; only pertinent results will be reported here. The mean age of those ill was 30.2 while the mean age of those who remained well was 32.9, these values were significantly different (Students *t*-test, *p* value = 0.0205; Wilcoxon / Mann-Whitney $X^2 = 6.1458$, *p* value = 0.013). No differences in gender or in number of persons sharing a cabin were observed between those who were ill and those who were well. Six (12%) ill crew members reported sharing a cabin with an ill person. Sixteen (3%) crew members who remained well reported sharing a cabin with an ill person, this difference was significant [RR 3.4 (1.6–7.0)]. Ill crew members were significantly more likely to have worked with an ill crew member than were crew members who remained well [RR 2.2 (1.1–4.2)]. Crew members from the entertainment department were over-represented in the ill population compared with the well population [RR 6.70 (1.32–34.2)] Twenty-nine (67%) ill crew members reported to the infirmary but 12 (28%) did not. Seventy-five percent of crew members who met the case definition for GI illness but who did not report to the infirmary (6 crew members) stated that they were “not ill.” The illness profile was as follows:

Symptom profile (Note: %'s are % of people responding "yes" versus all responding)	Diarrhea	30 (60%)
	Headache	26 (52%)
	Vomiting	22 (44%)
	Muscle ache	17 (34%)
	Stomach cramps	16 (32%)
	Nausea	16 (32%)
	Fever	14 (28%)
	Blood in stool	1 (2%)
Median vomiting episodes	Median	2
	Range	1–10+
Median diarrheal episodes	Median	3
	Range	1–10+
Symptom onset	12/30	2 (9%)
	12/31	3 (13%)
	1/01	8 (35%)
	1/02	3 (13%)
	1/03	1 (4%)
	1/04	3 (13%)
	1/05	2 (9%)
	1/06	1 (4%)
Illness duration	< 24 hrs.	6 (17%)
	24–48 hrs.	12 (60%)
	> 48 hrs.	8 (23%)
Illness reporting habits	Visited Infirmary	29 (67%)
	Reported illness	2 (5%)
	Did not report	12 (28%)
Reasons for not reporting	"Because I am not sick"	6 (75%)
	"Not sure if I was ill"	1 (12%)

Except for the Lido buffet, no differences existed between ill crew members' reported dining locations and those of well crew members. Ill crew members consistently reported eating in the Lido more frequently than did well crew members for all meals included on the survey. Results are shown below:

RRs for crew members eating in the Lido

Date and Meal	Relative Risk
12/29 Breakfast	2.3 (1.0–5.4)
12/29 Lunch	2.0 (1.0–3.7)
12/29 Dinner	2.2 (1.2–4.1)
12/30 Breakfast	3.1 (1.4–6.7)
12/30 Lunch	2.3 (1.2–4.2)
12/30 Dinner	2.4 (1.3–4.5)
12/31 Breakfast	2.3 (1.2–4.6)

Because the crew survey only asked questions about foods served in the crew or petty officer messes, no analysis could be performed on the foods consumed by crew members in the Lido.

Ill crew members were more likely to report having worked in or visited any bar on December 30 or December 31 (RRs 1.8 [1.0–3.1], 2.2 [1.3–3.7] respectively). Analysis of individual bars did not show any differences between ill and well crew members. Furthermore, ill crew members were more likely to have worked in or visited multiple bars than were well crew members, as shown in the table below.

Bars visited 12/30 (% = % of all crew members visiting/working at these locations)	0 Bars	30 (60%)	0 Bars	425 (75%)	Referent 1.3 (0.6–2.9) 3.7 (1.9–7.2) $X^2 = 10.35$ P Value = 0.001
	1 Bar	11 (22%)	1 Bar	117 (20%)	
	≥ 2 Bars	9 (18%)	≥ 2 Bars	28 (4%)	
Bars visited 12/31 (% = % of all crew members visiting/working at these locations)	0 Bars	27 (54%)	0 Bars	418 (73%)	Referent 2.2 (1.2–4.1) 2.0 (1.0–4.3) $X^2 = 6.59$ P Value = 0.01
	1 Bar	15 (30%)	1 Bar	95 (17%)	
	≥ 2 Bars	8 (16%)	≥ 2 Bars	57 (10%)	

No significant differences were shown between ill and well crew members in attending the New Year’s Eve party, drinking bottled or unbottled water, or consuming drinks containing ice.

DISCUSSION

Passenger studies:

This investigation characterizes a typical norovirus outbreak. These outbreaks on ships are commonly transmitted person-to-person from either individuals who were ill prior to and during boarding or who were exposed to vomitus or feces after the ship’s crew improperly cleaned and disinfected contaminated cabins. Unfortunately there was no record of which cabins were contaminated and not disinfected prior to the embarkation of passengers for the next sailing, no comparison could be made. Thirteen passengers reported having been ill prior to embarkation. With only a 44% response rate for the surveys, the possibility exists that twice this number of passengers were ill prior to embarkation. The infectious dose of norovirus is between 10 and 100 particles, indicating a highly transmissible agent. Twenty-six people who were ill prior to embarkation could easily have spread disease throughout the ship on the first day of the cruise. The same hypothesis holds true for those who were exposed to improperly cleaned and disinfected cabins.

Because the incubation period of norovirus illness is typically 48 hours, either hypothesis can be supported by the fact that the illness peak was on day 3 of the cruise. High ORs and RRs in relation to sharing a cabin with an ill person, having an ill person in their on-board traveling party, and being exposed to another person’s vomit or diarrhea all support a person-to-person spread of disease.

Previous outbreak investigations have estimated that only 10% to 25% of ill passengers will report their symptoms. In this investigation 63% of all persons meeting the case definition reported their illness to the infirmary. In addition, 93% of those ill passengers who did contact medical staff stated that they received instructions to isolate. This large percentage is encouraging in the effort to detect outbreaks and initiate control measures at an early stage. Thirty-three (59%) of the remaining cases who did not report to the infirmary indicated that they self-isolated; of these, 23 (70%) reported the proper self-isolation duration of 24 to 48 hours. Many previous studies have demonstrated the effects of norovirus on isolated populations as well as on the cruise ship industry. Passenger education about the reasons for isolation may help reduce the spread of disease on ships. In addition, encouraging passengers to report illness by providing compensatory opportunities (i.e., free room service, refund on travel expenses) may facilitate early detection of outbreaks.

Two discrepancies exist between the passenger case-control study and the passenger cohort analysis. In the case-control study there was a significant difference in the number of people in a pre-embarkation group reported to be sick. The cohort study failed to support this finding, likely because of the large skew present in the cases. Two passenger-cases reported 28 ill persons in their pre-embarkation group. Although this certainly is possible it is more likely that this was a misinterpretation of the question.

Ill persons were consistently more likely to have dined in the Lido during the embarkation lunch than were controls. Yet, food items indicating an increased OR in the case-control study did not do so in the cohort study. Commonly, single food items that cause illness have much larger odds and risk ratios than were demonstrated here. Given the high likelihood of person-to-person disease transmission, simply having an increased duration of exposure to common areas of the ship may have been a risk factor in contracting the disease.

Worth noting is that the crew cohort analysis also indicated increased risk ratios for dining in the Lido on all occasions. Future studies should focus on space-time analysis of disease spread, underlying risk factors for person-to-person spread of disease, and efficacy of pre-embarkation screening for ill persons.

Crew study:

The greatest limitation in the investigation was the inability to interview or to get further information about the crew member who was ill and fired for breaking isolation. This crew member had onset of symptoms on December 31, 2005, and broke isolation on the day when most passengers had onset of symptoms (January 1, 2006). The circumstances surrounding his dismissal and potential passenger contact were unclear. Analysis of all the dining-location responses, however, failed to consistently show one area or one food item to be the source of the illness. In addition, the incubation period between his illness onset and the majority of the passengers was approximately 12 hours. The average norovirus incubation period is between 12 and 48 hours. For onset within 12 hours, gross contamination of a food item would have had to have occurred, yet none was apparent. Evidence (contaminated cabins) of passengers being ill prior to disembarkation from the previous cruise indicates a much larger exposure risk within the appropriate time frame (48 hours prior to the peak of GI illness) than the risk from this one individual. In addition, 12 persons were reported to have been ill prior to embarkation on this cruise, which indicates a large potential index group.

For the most part, the outcomes of the crew analysis mirrored those of the passenger analysis. Ill crew members were more likely to have an ill cabin mate or to work with another sick crew member. Most departments consist of a limited number of nationalities. Given that there were more entertainers ill than were other crew members and that cases were younger than controls, it is not surprising to find that a higher proportion of crew members who were ill were from the United States. This disproportionate ratio likely accounts for the elevated risk ratios seen for those dining in the Lido during any meal. Only certain crew members are allowed to dine in the Lido (i.e., entertainers and executive staff). These crew members have more interaction with potentially ill passengers through their jobs and through their exposure to passengers in the Lido. In addition, those crew members who visited or worked in more than one bar were more likely to have been ill. Outbreak prevention plans and protocols that decrease staff presence in passenger dining areas during an outbreak may help prevent the spread of disease among the crew.

The degree of non-reporting among ill crew members (28% of those who met the case definition) likely reflects a number of limitations of the study; these limitations are discussed below. Thus, we cannot ascertain whether crew members who met the case definition were truly sick or whether their report of “Because I was not ill” merely reflected their lack of understanding about the symptom questions.

Limitations:

The results of this study have several limitations. In general, the passengers and crew members on this ship may not be representative of all cruise ship populations. The response rate for passengers was lower for this survey than for past surveys on other ships. As a result, some degree of sampling bias was likely. Although a majority of the questions were standard for cruise ship outbreak investigations, the way in which some questions were asked was open to interpretation. Specifically, asking whether a person traveled with a “pre-embarkation group” without defining “group” allowed for variability in the responses. Comparing those who indicated that they participated in a commercial tour and those who stated that they were with friends or family may not be a valid comparison. In this circumstance, allegations were made that specific tour groups brought ill passengers on board without notifying the ship staff. These allegations could not be supported nor rejected by our analysis. Another limitation of the study was that the crew survey was only available in English. English did not appear to be a native language for many of the crew members. Numerous studies have shown that interviews and surveys that are not conducted in the person’s native language inevitably introduce a reporting bias. Lack of understanding of the intent or the wording of some questions may have led to misclassifying a crew member as ill or well.

RECOMMENDATIONS

After the initial investigation, VSP made the following suggestions to Holland America Line:

General Outbreak Management

- Screen passengers and crew at the dockside check-in for GI illness prior to embarkation and during disembarkation. The cruise ship company should have non-punitive options for passengers who report illness and who voluntarily do not board the ship.
- Provide ways for users of the public restrooms to exit the restrooms without bare-hand contact with the door handles.
- Encourage hand washing among passengers by showing safe hand-washing videos, having the staff encourage passengers and other crew members to wash their hands frequently, and using public announcements to encourage safe hand washing, especially during outbreaks.
- Notify passengers scheduled for the subsequent cruise as soon as possible after confirmation of a GI outbreak so that the passengers’ decisions to board the ship are not influenced by their having traveled to the embarkation port or by their already awaiting boarding.
- Make periodic announcements during an outbreak to encourage passengers to complete the outbreak questionnaires, thus helping to ensure a high response rate.
- Follow up with ill passengers and crew to get diagnostic specimens.
- Ensure prompt reporting of GI case counts as soon as a GI illness is suspected.
- Complete all fields in the GI illness log, especially data items about crew members, such as the crew members’ jobs and cabin numbers.
- Do not assign food handlers to high passenger-contact tasks.
- Continue to isolate passengers and crew members if they show signs of GI illness and try to house well cabin mates in separate locations.
- Work with pre-embarkation tour operators to help detect illness prior to allowing people to board the ship.

Housekeeping Program Management

- Ensure that all contaminated and potentially contaminated cabins are thoroughly cleaned and disinfected between occupancies.
- Document in a log all body fluid contamination events, including those in public and private areas, and housekeeping's response to those events. Incorporate this documentation into the existing Outbreak Prevention and Response Plan for the ship.
- Ensure that all ice pantries are locked when not in use to prevent unauthorized passenger access during an outbreak.

Based on the results of the survey analyses, the following additional suggestions apply:

Further Recommendations

- Create a section in the ship's Outbreak Prevention and Response Plan that provides for decreasing, to the extent possible, crew members' contact with passengers during an outbreak. Specifically, crew members' dining with passengers and visiting passenger bars should be prohibited during an outbreak.
- Incorporate a section in the passenger orientation material that discusses the reasons for reporting illness and for isolation while ill. Understanding these reasons may enhance passengers' compliance should they become ill.

The following people worked during and after this outbreak and their help is appreciated:

Dr. Elaine Cramer
CAPT George Vaughan
Mrs. Stephanie Lawrence
Holland America Lines Staff

Sincerely,

Antonio Neri, MD
Epidemic Intelligence Service Officer
Environmental Health Services Branch
Division of Emergency and Environmental Health Services
National Center for Environmental Health
U.S. Centers for Disease Control and Prevention

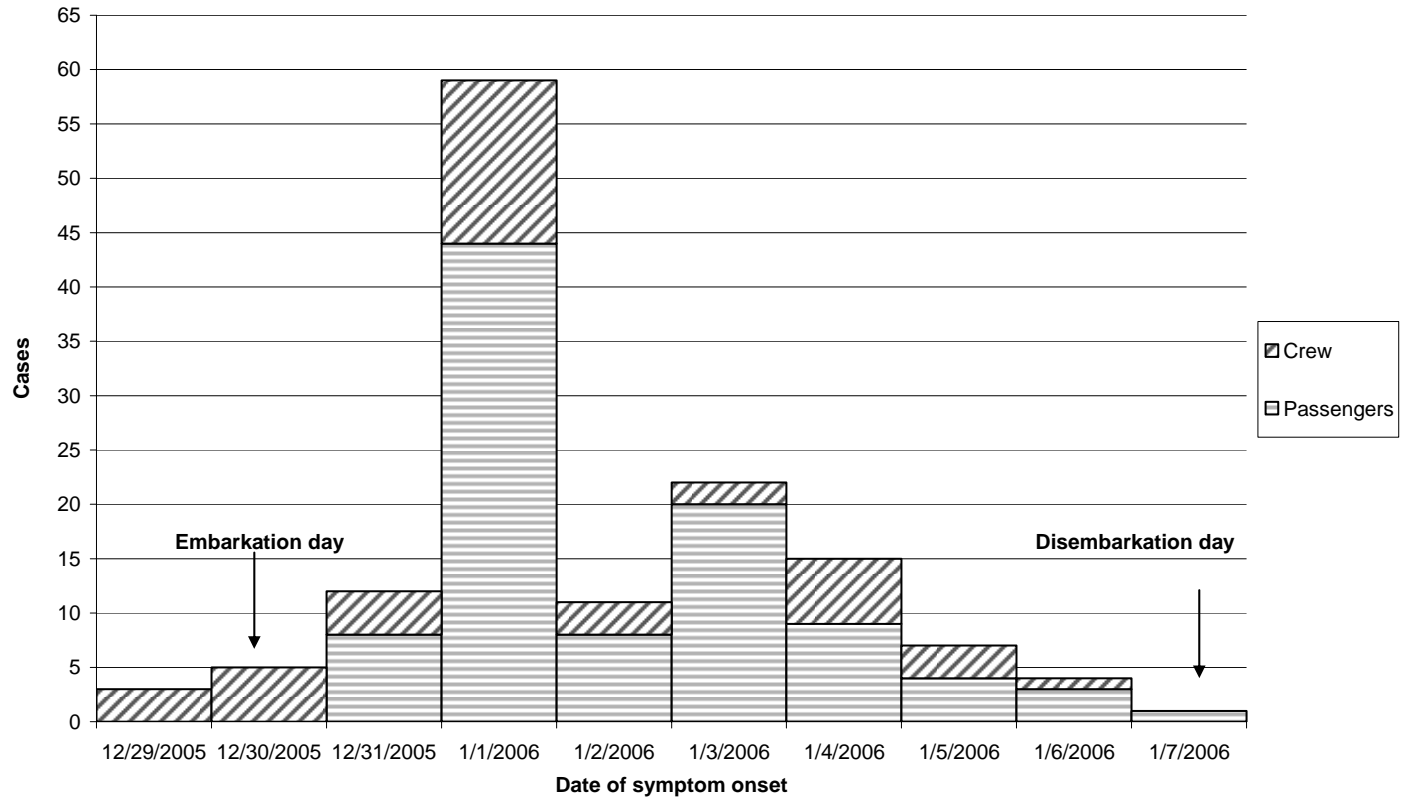
Appendix A

Itinerary for *MS Zuiderdam* – Sailing 166

30 December 2005	Fort Lauderdale, Florida (Embarkation day)
31 December 2005	Half Moon Cay, Bahamas
1 January 2006	At sea
2 January 2006	St. Thomas, U.S. Virgin Islands
3 January 2006	Philipsburg, St. Maarten
4 January 2006	Road Town, Tortola, British Virgin Islands
5 January 2006	At sea
6 January 2006	Nassau, Bahamas
7 January 2006	Fort Lauderdale, Florida (Disembarkation day)

Appendix B

ms Zuiderdam Acute Gastroenteritis Outbreak Epidemic Curve
N=139



Onset dates for 12 passengers are not given

Appendix C



Passenger Questionnaire Zuiderdam, 30 Dec 2005 to 07 January 2006

Dear Passenger:

As you have been advised by the staff of the Zuiderdam, there has been a higher than expected incidence of vomiting and diarrhea on this cruise. The staff of the Vessel Sanitation Program, Centers for Disease Control and Prevention (CDC), in collaboration with Holland America Line, 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 **every** passenger complete the attached questionnaire. **Please complete this survey regardless of whether or not you have been ill during this voyage.** Please return your completed questionnaire to the **Front Office Desk on Deck 1** as soon as it is completed. If you are still ill, please have someone return the questionnaire for you.

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

Day of week	Date	Port/Location
Friday	30 December 2005	Ft Lauderdale, FL
Saturday	31 December 2005	Half Moon Cay, Bahamas
Sunday	01 January 2006	At sea
Monday	02 January 2006	St Thomas, USVI
Tuesday	03 January 2006	Phillipsburg, St Maarten
Wednesday	04 January 2006	Road Town, Tortola, BVI
Thursday	05 January 2006	At sea
Friday	06 January 2006	Nassau, Bahamas
Saturday	07 January 2006	Ft Lauderdale, 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 Holland America Line

***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. Last name

4. First Name

5. Age (in years)

6. Sex (Circle one)

Male

Female

7. City

8. State/Province

9. Country

10. Zip/postal code

II. Medical Information

11. Were you ill with vomiting or diarrhea during the cruise?

Yes No

12. If you were ill, which of the following symptoms did you experience? (check all that apply)

Vomiting Diarrhea Fever Stomach cramps

Blood in your stool Headache Nausea Muscle aches

13. If you had diarrhea, circle the maximum number of loose stools you had during any 24-hour period (circle only one)

1 2 3 4 5 6 7 8 9 10+

14. If you had vomiting, circle the maximum number of vomiting episodes you had during any 24-hour period (circle only one)

1 2 3 4 5 6 7 8 9 10+

15. Were you ill with any of the above symptoms during the 7 days prior to the beginning of the cruise?

Yes No

16. When did your symptoms begin? (Select only one date below)

- Before 30 December 2005 (Enter the date: _____)
- Friday, 30 December 2005 (Embarkation Day)
- Saturday, 31 December 2005 (New Year's Eve)
- Sunday, 01 January 2006 (New Year's Day)
- Monday, 02 January 2006
- Tuesday, 03 January 2006
- Wednesday, 04 January 2006
- Thursday, 05 January 2006
- Friday, 06 January 2006
- Saturday, 07 January 2006 (Disembarkation Day)

17. Are you still ill?

- Yes No Not sure

18. If your illness is over, how many days were you ill? _____

III. Other Medical Information

19. Did you share a cabin with someone who was ill with vomiting and/or diarrhea?

(check only one)

- Yes, if so how many became ill: _____ No, my cabin mates were not ill

20. Did you travel to the ship with a group?

- Yes, Group name _____ No

If yes did any of your group experience vomiting or diarrhea prior to embarkation?

- Yes, How many _____ No

21. Were there members in your traveling party (on the cruise and at ports of call) who were ill with vomiting and/or diarrhea? (check only one)

- Yes, if so when did the first member become ill (Date: _____)
- No, none in my traveling party were ill I am traveling alone

22. Prior to the start of your illness, did you have physical contact (including your clothes, shoes or skin) with vomit or diarrhea from another person for any reason? (check only one)

- Yes, while cleaning up vomit or diarrhea Yes, I touched vomit or diarrhea by mistake
- Yes, for other reasons: _____
- No, I did not contact vomit or diarrhea from another person

23. If you were ill with vomiting or diarrhea, did you go to the medical infirmary? (check only one)

- Yes, I visited the infirmary (Date of visit: _____)
- Yes, I reported my illness, but I did not visit the infirmary (Date of report: _____)
- No, if not why not? _____

24. If you reported to the medical infirmary for vomiting or diarrhea, were you advised to isolate yourself in your cabin? (check only one)

- Yes No Not applicable to me

25. If you were ill and did not report to the medical infirmary, did you isolate yourself in your cabin? (check only one)

- Yes No Not applicable to me

26. Regardless of reporting to the medical infirmary, if you were ill with vomiting and diarrhea, how long where you in isolation? (check only one)

- Less than 24 hours 24 to 48 hours Greater than 48 hours
- Not applicable

IV. Dining Information

THESE QUESTIONS REFER TO MEALS EATEN ON THE SHIP ON
FRIDAY, DECEMBER 30, 2005 (EMBARKATION DAY)

LUNCH – FRIDAY, 30 DECEMBER 2005

27. Did you eat lunch at the Lido buffet? Yes No Not sure

If yes, please check the box for ALL the food items you ate for lunch at the Lido Buffet

- | | | |
|---|--|--|
| <input type="checkbox"/> Pork escalope | <input type="checkbox"/> Watermelon | <input type="checkbox"/> Tomatoes |
| <input type="checkbox"/> Beef steak fajitas | <input type="checkbox"/> Pineapple | <input type="checkbox"/> Iceberg lettuce |
| <input type="checkbox"/> Cod fillet | <input type="checkbox"/> Fruit salad | <input type="checkbox"/> Romaine lettuce |
| <input type="checkbox"/> Rotisserie chicken | <input type="checkbox"/> Melon & orange fruit salad | <input type="checkbox"/> Prosciutto panini |
| <input type="checkbox"/> Waldorf salad | <input type="checkbox"/> Pate | <input type="checkbox"/> Thai chicken wrap |
| <input type="checkbox"/> Caesar salad | <input type="checkbox"/> Cheese, specify type
_____ | <input type="checkbox"/> Potato salad |
| <input type="checkbox"/> Mixed salad | _____ | <input type="checkbox"/> Cole slaw |
| <input type="checkbox"/> Greek salad/artichokes | <input type="checkbox"/> Boiled eggs | <input type="checkbox"/> Beef hotdog |
| <input type="checkbox"/> Tuna salad nicoise | <input type="checkbox"/> Roast beef | <input type="checkbox"/> Turkey hotdog |
| <input type="checkbox"/> Tuna salad | <input type="checkbox"/> Smoked turkey | <input type="checkbox"/> Hamburgers |
| <input type="checkbox"/> Pizza | <input type="checkbox"/> Smoked ham | <input type="checkbox"/> Chicken burger |
| <input type="checkbox"/> Pork in black bean sauce | <input type="checkbox"/> Cake | <input type="checkbox"/> Bratwurst sausage |
| <input type="checkbox"/> Kung Pao chicken | <input type="checkbox"/> Fruit of the Forest pie | <input type="checkbox"/> Bread pudding |
| <input type="checkbox"/> Mousse | <input type="checkbox"/> Chocolate mousse cake | |
| <input type="checkbox"/> Cheese cake | <input type="checkbox"/> Other,
specify _____ | |
| <input type="checkbox"/> Ice cream | | |

DINNER – FRIDAY, 30 DECEMBER 2005

28. Where did you eat dinner on Friday, 30 December? (check only one)

- At the Welcome Dinner in main dining room
- At the Lido casual dining
- At the Pinnacle Grill
- Other, specify _____

If you ate at the Welcome Dinner or at the Lido on Friday, 30 December please check the box for ALL the food items you ate

APPETIZERS

- Caribbean fresh fruit medley
- Italian prosciutto (shaved ham)
- Avocado, tomato and crab salad
- Steamed mussels

ENTREES

- Pasta & Grilled Portobello mushrooms
- Prime rib
- Grilled Mahi Mahi
- Ginger grilled chicken & mangoes
- Seafood curry
- Rack of pork
- Eggplant parmigiano
- Salmon fillet
- Broiled chicken breast
- Sirloin steak

DESSERTS

- Chocolate cake
- Black Forest cake
- Apple strudel
- Pineapple Panna Cotta
- Fresh Fruit plate
- Cheese plate

BARS – FRIDAY, 30 DECEMBER 2005

29. Did you visit any of the following bars on Friday, 30 December? *(check only one)*

- | | | |
|--|-------------------------------------|--|
| <input type="checkbox"/> Crows Nest | <input type="checkbox"/> Ocean Bar | <input type="checkbox"/> Explorers lounge |
| <input type="checkbox"/> Lido Bar | <input type="checkbox"/> Piano Bar | <input type="checkbox"/> Atrium Bar |
| <input type="checkbox"/> Seaview Bar | <input type="checkbox"/> Sports Bar | <input type="checkbox"/> Northern lights (disco) |
| <input type="checkbox"/> Windstar Cafe | | |

If yes did you eat any of the following items at the bar, please check the box for ALL the food items you ate

- | | | |
|------------------------------------|---|---|
| <input type="checkbox"/> Meatballs | <input type="checkbox"/> B.B.Q. sausage bites | <input type="checkbox"/> Pizza |
| <input type="checkbox"/> Beef | <input type="checkbox"/> Salmon | <input type="checkbox"/> Quiche |
| <input type="checkbox"/> Pork | <input type="checkbox"/> Crab cakes | <input type="checkbox"/> Sausage rolls |
| <input type="checkbox"/> Chicken | <input type="checkbox"/> Shrimp tenders | <input type="checkbox"/> Duck spring roll |

**THE FOLLOWING QUESTIONS REFER TO SATURDAY, DECEMBER 31, 2005
(THE DAY THE SHIP DOCKED AT HALF MOON CAY)**

BREAKFAST SATURDAY

30. Where did you eat breakfast on Saturday, 31 December? (check only one)

- At the Dining Room
- At the Lido
- Express Breakfast
- Other, specify _____

If you ate breakfast at any of the above on Saturday, 31 December please check the box for ALL the food items you ate

- | | | |
|---|--|---|
| <input type="checkbox"/> Eggs Benedict | <input type="checkbox"/> Pancakes | <input type="checkbox"/> Meats/sausages |
| <input type="checkbox"/> Fried eggs | <input type="checkbox"/> French toast | <input type="checkbox"/> Fajitas |
| <input type="checkbox"/> Scrambled eggs | <input type="checkbox"/> Smoked salmon | <input type="checkbox"/> Fruit |
| <input type="checkbox"/> Omelet | <input type="checkbox"/> Kipperred herring | <input type="checkbox"/> Juices |

31. Did you visit any of the following bars on Saturday, 31 December? (please check box below)

- | | | |
|--|-------------------------------------|--|
| <input type="checkbox"/> Crows Nest | <input type="checkbox"/> Ocean Bar | <input type="checkbox"/> Explorers lounge |
| <input type="checkbox"/> Lido Bar | <input type="checkbox"/> Piano Bar | <input type="checkbox"/> Atrium Bar |
| <input type="checkbox"/> Seaview Bar | <input type="checkbox"/> Sports Bar | <input type="checkbox"/> Northern lights (disco) |
| <input type="checkbox"/> Windstar Cafe | | |

If yes did you eat any of the following items at the bar, please check the box for ALL the food items you ate

- | | | |
|------------------------------------|---|---|
| <input type="checkbox"/> Meatballs | <input type="checkbox"/> B.B.Q. sausage bites | <input type="checkbox"/> Pizza |
| <input type="checkbox"/> Beef | <input type="checkbox"/> Salmon | <input type="checkbox"/> Quiche |
| <input type="checkbox"/> Pork | <input type="checkbox"/> Crab cakes | <input type="checkbox"/> Sausage rolls |
| <input type="checkbox"/> Chicken | <input type="checkbox"/> Shrimp tenders | <input type="checkbox"/> Duck spring roll |

32. Did you attend any of the following New Years Eve parties on Saturday, 31 December?

- Vista Lounge Party
- Crows Nest Party
- Northern Lights Party
- Other, specify _____
- I did not attend a New Years Eve Party

33. Circle the average number of glasses of unbottled ship's water you drank per day

(If you were ill, circle the average per day before you became ill)

0 1 2 3 4 5 6 or more

34. Circle the average number of glasses of bottled water you drank per day

(If you were ill, circle the average per day before you became ill)

0 1 2 3 4 5 6 or more

35. Circle the average number of beverages containing ice you drank per day

(If you were ill, circle the average per day before you became ill)

0 1 2 3 4 5 6 or more

36. Did you consume ice which was ordered to you room?

- Yes No Not sure

Appendix D



Crew Questionnaire Zuiderdam, 30 Dec 2005 to 07 January 2006

Dear Crew Member:

There has been a higher than expected incidence of vomiting and diarrhea on this cruise. The staff of the Vessel Sanitation Program, Centers for Disease Control and Prevention (CDC), in collaboration with Holland America Line, has been investigating this 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 **every** crewmember complete the attached questionnaire. **Please complete this survey regardless of whether or not you have been ill during this voyage.** Please return your completed questionnaire to the **Crew Office** as soon as it is completed. If you are still ill, please have someone return the questionnaire for you.

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

Day of week	Date	Port/Location
Friday	30 December 2005	Ft Lauderdale, FL
Saturday	31 December 2005	Half Moon Cay, Bahamas
Sunday	01 January 2006	At sea
Monday	02 January 2006	St Thomas, USVI
Tuesday	03 January 2006	Phillipsburg, St Maarten
Wednesday	04 January 2006	Road Town, Tortola, BVI
Thursday	05 January 2006	At sea
Friday	06 January 2006	Nassau, Bahamas
Saturday	07 January 2006	Ft Lauderdale, 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.

If you have any questions or concerns please discuss with (e. g, Medical Doctor, supervisor, CDC staff etc.)
Sincerely,

CDC Vessel Sanitation Program and Holland America Line

***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. Last name

4. First Name

5. Age (in years)

6. Sex (Circle one)
Male Female

7. Home City

8. Home State/Province

9. Home Country

10. Zip/postal code

11. Position on the ship

12. Department you work for

II. Medical Information

13. Were you ill with vomiting or diarrhea while working on the ship?

Yes No

14. If you were ill, which of the following symptoms did you experience?

Vomiting Diarrhea Fever Stomach cramps

Blood in your stool Headache Nausea Muscle aches

15. If you had diarrhea, circle the maximum number of episodes of loose stools you had during any 24-hour period (*circle only one*)

1 2 3 4 5 6 7 8 9 10+

16. If you had vomiting, circle the maximum number of episodes of vomiting you had during any 24-hour period (*circle only one*)

1 2 3 4 5 6 7 8 9 10+

17. Were you ill with any symptoms during this sailing?

Yes When _____ No

18. When did your symptoms begin? Select the date below

- Before 30 December 2005 (Enter the date: _____)
- Friday, 30 December 2005 (Embarkation Day)
- Saturday, 31 December 2005 (New Year's Eve)
- Sunday, 01 January 2006 (New Year's Day)
- Monday, 02 January 2006
- Tuesday, 03 January 2006
- Wednesday, 04 January 2006
- Thursday, 05 January 2006
- Friday, 06 January 2006

19. Are you still ill?

- Yes No Not sure

20. If your illness is over, how many days were you ill? _____

III. Other Medical Information

21. Did you work with another crew member who was ill?

- Yes When _____ No

22. Did you share a cabin with someone who was ill with vomiting and/or diarrhea?

(check only one)

- Yes, if so how many became ill: _____ No, my cabin mates were not ill

23. Prior to the start of your illness, did you have physical contact (including your clothes, shoes or skin) with vomit or diarrhea from another person for any reason? *(check only one)*

- Yes, while cleaning up vomit or diarrhea Yes, I touched vomit or diarrhea by mistake
- Yes, for other reasons: _____
- No, I did not contact vomit or diarrhea from another person

IV. Dining Places

31. Please indicate the dates and places you ate at below. (Check only one location per meal per day)

Date	Breakfast	Lunch	Dinner
Thursday Dec. 29	<input type="checkbox"/> Lido <input type="checkbox"/> Crew Mess <input type="checkbox"/> Petty Officer Mess <input type="checkbox"/> Other_____	<input type="checkbox"/> Lido <input type="checkbox"/> Crew Mess <input type="checkbox"/> Petty Officer Mess <input type="checkbox"/> Other_____	<input type="checkbox"/> Lido <input type="checkbox"/> Crew Mess <input type="checkbox"/> Petty Officer Mess <input type="checkbox"/> Other_____
Friday Dec. 30	<input type="checkbox"/> Lido <input type="checkbox"/> Crew Mess <input type="checkbox"/> Petty Officer Mess <input type="checkbox"/> Other_____	<input type="checkbox"/> Lido <input type="checkbox"/> Crew Mess <input type="checkbox"/> Petty Officer Mess <input type="checkbox"/> Other_____	<input type="checkbox"/> Lido <input type="checkbox"/> Crew Mess <input type="checkbox"/> Petty Officer Mess <input type="checkbox"/> Other_____
Saturday Dec. 31st	<input type="checkbox"/> Lido <input type="checkbox"/> Crew Mess <input type="checkbox"/> Petty Officer Mess <input type="checkbox"/> Other_____		

32. Please check ALL the food items that you ate on the dates listed in the tables below

**Thursday
Dec. 29**

Breakfast

- White rice
- Scrambled Eggs
- Boiled Eggs
- Fried Eggs
- Turkey Sausage
- Pancakes
- Mung beans
- Assorted Fruit
- Sambal

Lunch

- Salad
- Sayur Lodeh
- Mungobean soup
- Mixed vegetables
- Orange/Apples
- Sliced fruits
- Sambal
- Kecap Manis
- Patis

Dinner

- Mixed greens
- Tomato/cucumber
- Sayur Asam
- Lechon kawale
- Mixed vegetables
- Bread pudding
- Sliced fruits
- Sambal
- Kecap Manis
- Shrimp paste
- Shrimp spring roll

**Friday
Dec. 30**

Breakfast

- White rice
- Scrambled Eggs
- Boiled Eggs
- Fried Eggs
- Turkey Sausage
- Pancakes
- Oatmeal
- Assorted Fruit
- Sambal

Lunch

- Green Salad
- Sop sayur
- Empal daging
- Egg drop soup
- Beefsteak tagalog
- Mixed vegetables
- Bananas
- Sliced fruits
- Sambal
- Kecap Manis
- Patis

Dinner

- Mixed greens
- Tomato/cucumber
- Cream corn soup
- Mixed vegetables
- Crème caramel
- Sliced fruits
- Sambal
- Kecap Manis
- Shrimp Paste
- Fried Supermi/Egg

**Saturday
Dec. 31**

Breakfast

- White rice
- Scrambled Eggs
- Boiled Eggs
- Fried Eggs
- Turkey Sausage
- Pancakes
- Mung beans
- Assorted Fruit
- Sambal

Lunch

- Salad
- Nasi Goreng
- Atjar
- Macaroni Soup
- Mixed vegetables
- Ice cream
- Sliced fruits
- Sambal
- Kecap Manis
- Patis

Dinner

- Salad
- Nasi Goreng
- Atjar
- Macaroni Soup
- Mixed vegetables
- Ice cream
- Sliced fruits
- Sambal
- Kecap Manis
- Patis

V. BARS

33. Did you visit any of the following bars on Friday, 30 December? (Check all that apply)

- Crows Nest
- Ocean Bar
- Explorers lounge
- Lido Bar
- Piano Bar
- Atrium Bar
- Seaview Bar
- Sports Bar
- Northern lights (disco)
- Windstar Cafe
- Crew bar

If yes did you eat any of the following items at the bar? Please check the box for ALL the food items you ate

- Meatballs
- B.B.Q. sausage bites
- Pizza
- Beef
- Salmon
- Quiche
- Pork
- Crab cakes
- Sausage rolls
- Chicken
- Shrimp tenders
- Duck spring roll

34. Did you visit any of the following bars on Saturday, 31 December? (Check all that apply)

- | | | |
|--|-------------------------------------|--|
| <input type="checkbox"/> Crows Nest | <input type="checkbox"/> Ocean Bar | <input type="checkbox"/> Explorers lounge |
| <input type="checkbox"/> Lido Bar | <input type="checkbox"/> Piano Bar | <input type="checkbox"/> Atrium Bar |
| <input type="checkbox"/> Seaview Bar | <input type="checkbox"/> Sports Bar | <input type="checkbox"/> Northern lights (disco) |
| <input type="checkbox"/> Windstar Cafe | <input type="checkbox"/> Crew bar | |

If yes did you eat any of the following items at the bar? Please check the box for ALL the food items you ate

- | | | |
|------------------------------------|---|---|
| <input type="checkbox"/> Meatballs | <input type="checkbox"/> B.B.Q. sausage bites | <input type="checkbox"/> Pizza |
| <input type="checkbox"/> Beef | <input type="checkbox"/> Salmon | <input type="checkbox"/> Quiche |
| <input type="checkbox"/> Pork | <input type="checkbox"/> Crab cakes | <input type="checkbox"/> Sausage rolls |
| <input type="checkbox"/> Chicken | <input type="checkbox"/> Shrimp tenders | <input type="checkbox"/> Duck spring roll |

35. Did you attend any of the following New Years Eve parties on Saturday, 31 December?

- Vista Lounge Party
- Crows Nest Party
- Northern Lights Party
- Other, specify _____
- I did not attend a New Years Eve Party

VI. Water

36. Circle the average number of glasses of unbottled ship's water you drink per day

(If you were ill, circle the average per day before you became ill)

0 1 2 3 4 5 6 or more

37. Circle the average number of glasses of bottled water you drink per day

(If you were ill, circle the average per day before you became ill)

0 1 2 3 4 5 6 or more

38. Circle the average number of beverages containing ice you drink per day

(If you were ill, circle the average per day before you became ill)

0 1 2 3 4 5 6 or more

Appendix E

Passenger Survey Case-Control Analysis

Variable	Cases n = 153 (Excludes pre-existing illness)		Controls n = 306		Odds Ratio and Confidence Interval
Age	Mean	59.6	Mean	57.6	Students t test T Stat = 1.09 P Value = 0.28
	Median	63	Median	61	
	Range	2–88	Range	5–89	
Sex	Female	80 (53%)	Female	174 (57%)	0.84 (0.57–1.24)
	Male	72 (47%)	Male	132 (43%)	
Number of people in cabin	Median	2	Median	2	
	Range	1–4	Range	1–4	
# ill prior to cruise	12				
Symptom profile (Note: %'s are % of people responding yes versus all responding)	Diarrhea	138 (90%)			
	Vomiting	114 (74%)			
	Stomach cramps	83 (54%)			
	Nausea	75 (49%)			
	Muscle ache	50 (33%)			
	Headache	48 (31%)			
	Fever	38 (25%)			
	Blood in stool	1 (1%)			
Median vomiting episodes	Median	3			
	Range	1–10+			
Median diarrheal episodes	Median	5			
	Range	1–10+			
Symptom onset	Date	Frequency	Cum. %		
	12/31/05	42 (28%)	28%		
	1/1/06	42 (28%)	55%		
	1/2/06	18 (12%)	67%		
	1/3/06	19 (12%)	79%		
	1/4/06	20 (13%)	92%		
	1/5/06	10 (6%)	99%		
	1/6/06	2 (1%)			
Illness duration	1 day	47 (31%)			
	2 days	58 (38%)			
	3 days	15 (10%)			
	4 days	6 (4%)			
	5 days	6 (4%)			
	6 days	2 (1%)			
	7 days	1 (1%)			
Number sharing cabin	56 (37%)		23 (8%)		6.30 (3.68–10.8)†

with ill person			
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Number of people ill in cabin	0 people 1 person 2 people	100 (66%) 35 (23%) 17 (11%)	0 people 1 person 2 people	287 (94%) 18 (6%) 1 (0.3%)	Referent 5.58 (3.0–10.3)† 48.8 (6.4–371)†
Number reporting traveling with group prior to embarkation	60 (40%)		67 (24%)		2.14 (1.40–3.27)†
Type of pre-embarkation group	Commercial Non-Com	14 (33%) 28 (67%)	Commercial Non-Com	18 (30%) 41 (70%)	0.88 (0.38–2.05)
Number reporting a member of pre-embarkation group was sick	15 (25%)		12 (20%)		1.36 (0.58–3.22)
Number of people in pre-embarkation group sick	Mean 0.49 Median 0 Range 0–28		Mean 0.11 Median 0 Range 0–10		Students t test T Stat = 2.18 P Value = 0.03† (Non-normally distributed data so analysis via MWW below) Mann-Whitney/Wilcoxon $X^2 = 3.88$ P-Value = 0.049
Number reporting an ill person in their traveling party aboard the ship	51 (54%)		74 (28%)		3.02 (1.97–4.62)†
Number exposed to another persons vomit or diarrhea	5 (3%)		0		N/A
Infirmary use	Visited Notified but did not visit Chose not to visit	80 (53%) 15 (10%) 56 (37%)			

Non-reporter characteristics Note: These numbers include columns for which some data was missing	Indicated self-isolation	33 (59%)		
	Duration of self-isolation < 24 Hrs. 24–48 Hrs. >48 Hrs.	10 (30%) 23 (70%) 0		
Reasons for not reporting	Self-treated	8 (18%)		
	Self-isolated / visited by medical staff	10 (23%)		
	Did not believe serious	19 (43%)		
	Other	7 (16%)		
Non-reporters who self-treated	Indicated self-isolation	3 (38%)		
	Duration of self-isolation < 24 Hrs. 24–48 Hrs. > 48 Hrs.	1 (12%) 2 (25%) 0		
Non-reporters who self-isolated or were visited by a nurse	Indicated self-isolation	7 (70%)		
	Duration of self-isolation < 24 Hrs. 24–48 Hrs. > 48 Hrs.	1 (10%) 8 (80%) 0		

Non-reporters who did not believe illness was serious	Indicated self-isolation Duration of self-isolation < 24 Hrs. 24–48 Hrs. > 48 Hrs.	8 (50%) 5 (26%) 3 (16%) 0		
Number advised to isolate due to illness (Note: % is percent of those responding to the question)	89 (93%)			
Number self isolated (Note: % is percent of those responding to the question)	71 (84%)			
Duration of isolation (all cases) (Note: % is percent of those responding to the question)	< 24 Hrs. 24–48 Hrs. > 48 Hrs.	17 (11%) 107 (70%) 16 (10%)		
Locations where people ate on the following dates:				
12/30 Lido Lunch All cases	132 (92%)		239 (82%)	2.35 (1.21–4.56)†
12/30 Lido Lunch Cases before 1/3/06	91 (95%)		239 (82%)	3.88 (1.50–10.0)†

Food items from 12/30 Lunch Using Cases before 1/3/06 Note: only food items with 10 or more responses from either cases or controls were analyzed	Note: CI's for OR's <1.0 will not be reported			
	Fruit salad	24 (26%)	53 (22%)	1.26 (0.72–2.19)
	Pizza	13 (14%)	55 (23%)	0.56
	Iceberg lettuce	16 (18%)	44 (18%)	0.94
	Watermelon	23 (25%)	36 (15%)	1.91 (1.06–3.44)†
	Tomatoes	12 (13%)	40 (17%)	0.76
	Ice cream	16 (18%)	36 (15%)	1.20 (0.63–2.29)
	Pineapple	17 (19%)	27 (11%)	1.80 (0.93–3.50)
	Romaine lettuce	6 (7%)	35 (15%)	0.41
	Mixed salad	4 (4%)	36 (15%)	0.26
	Hamburgers	7 (8%)	20 (8%)	0.91
	Cod fillet	10 (11%)	14 (6%)	1.98 (0.85–4.64)
	Rotisserie chicken	7 (8%)	16 (7%)	1.16 (0.46–2.92)
	Prosciutto panini	6 (7%)	16 (7%)	0.98
	Smoked turkey	6 (7%)	14 (6%)	1.13 (0.42–3.05)
	Melon and orange fruit salad	3 (3%)	17 (7%)	0.44
	Roast beef	7 (8%)	12 (5%)	1.58 (0.60–4.14)
	Bread pudding	4 (4%)	15 (6%)	0.69
	Greek salad	3 (3%)	13 (5%)	(*0.31)
	Beef steak fajitas	2 (2%)	11 (5%)	(*0.26)
	Kung pao chicken	6 (7%)	5 (2%)	(*0.051)
	Cheddar	6 (4%)	5 (2%)	(*0.12)
	Smoked ham	4 (4%)	6 (2%)	(*0.28)
	Sushi	1 (1%)	8 (3%)	(*0.24)
	Beef hotdog	4 (4%)	4 (2%)	(*0.15)
	Caesar salad	4 (4%)	4 (2%)	(*0.15)

12/30 Dinner	Main Dining Lido Pinnacle Vista Lounge Room Service	142 (95%) 4 (3%) 1 (1%) 2 (1%) 0	Main Dining Lido Pinnacle Vista Lounge Room Service	266(91%) 10 (3%) 10 (3%) 4 (1%) 2 (1%)	1.98 (0.84–4.68) (*0.46) (*0.07) (*0.66) N/A
All cases					
12/30 Dinner	Main Dining Lido Pinnacle Vista Lounge Room Service	95 (96%) 2 (2%) 1 (1%) 1 (1%) 0	Main Dining Lido Pinnacle Vista Lounge Room Svc.	266(91%) 10 (3%) 10 (3%) 4 (1%) 2 (1%)	2.32 (0.79–6.82) (*0.38) (*0.19) (*0.62) N/A
Cases before 1/3/06					
12/31 Breakfast	Main Dining Lido Express Bkfst Neptune Lounge Room Service Windstar Cafe	17 (12%) 110 (75%) 5 (3%) 1 (1%) 13 (9%) 0	Main Dining Lido Express Bkfst Neptune Lounge Room Service Windstar cafe	38 (14%) 186(67%) 10 (4%) 5 (2%) 38 (14%) 2 (1%)	0.84 1.53 (0.97–2.40) 0.95 (*0.30) 0.61 N/A
12/31 Breakfast	Main Dining Lido Express Bkfst Neptune Lounge Room Service Windstar Cafe	14 (14%) 71 (72%) 5 (5%) 0 8 (8%) 0	Main Dining Lido Express Bkfst Neptune Lounge Room Service Windstar Cafe	38 (14%) 186(67%) 10 (4%) 5 (2%) 38 (14%) 2 (1%)	1.06 (0.54–2.05) 1.31 (0.79–2.18) 1.45 (0.48–4.34) N/A 0.55 N/A
Cases before 1/3/06					
Bars visited on 12/30	65 (42%)		115 (38%)		1.23 (0.83–1.82)
Bars visited on 12/30	41 (40%)		115 (38%)		1.12 (0.70–1.76)
Cases before 1/3/06					
Bars visited on 12/31	86 (56%)		167 (55%)		1.07 (0.72–1.58)
Bars visited on 12/31	56 (55%)		167 (55%)		1.01 (0.64–1.59)
Cases before 1/3/06					
Attendance at a New Year's Eve party	Vista Lounge Crows Nest Northern Lights Other	60 (52%) 56 (48%) 18 (25%) 6 (4%)	Vista Lounge Crows Nest Northern Lights Other	106(49%) 117(54%) 34(24%) 12 (4%)	1.11 (0.71–1.75) 0.79 1.02 (0.53–1.97) 1.00
All cases					
Attendance at a New Year's Eve party	Vista Lounge Crows Nest Northern Lights Other	43 (54%) 38 (48%) 11 (22%) 5 (5%)	Vista Lounge Crows Nest Northern Lights Other	106(49%) 117(54%) 34(24%) 12 (4%)	1.21 (0.72–2.02) 0.76 0.88 (*0.43)
Cases before 1/3/06					

Number of glasses of <u>unbottled</u> water consumed All cases	Mean Median	3.1 3.0	Mean Median	3.1 3.0	Students t test T Stat = 0.02 P Value = 0.98
Number of glasses of <u>unbottled</u> water consumed Cases before 1/3/06	Mean Median	3.1 3.0	Mean Median	3.1 3.0	Students t test T Stat = 0.15 P Value = 0.88
Number of glasses of <u>bottled</u> water consumed All cases	Mean Median	2.0 2.0	Mean Median	1.9 1.0	Students t test T Stat = 0.79 P Value = 0.43
Number of glasses of <u>bottled</u> water consumed Cases before 1/3/06	Mean Median	2.1 2.0	Mean Median	1.9 1.0	Students t test T Stat = 0.90 P Value = 0.37
Number of drinks <u>containing ice</u> consumed All cases	Mean Median	4.3 4.0	Mean Median	4.0 4.0	Students t test T Stat = 1.31 P Value = 0.19
Number of drinks <u>containing ice</u> consumed Cases before 1/3/06	Mean Median	4.3 4.0	Mean Median	4.0 4.0	Students t test T Stat = 1.19 P Value = 0.23
Consumption of ice delivered to room All cases	96 (70%)		168 (60%)		1.55 (1.00–2.40)†

Consumption of ice delivered to room	65 (71%)	168 (60%)	1.59 (0.96–2.64)
Cases before 1/3/06			

† Significant at 95% two-tailed confidence interval

Appendix F

Passenger Survey Cohort Analysis

Variable	Cases N = 153 (Excludes pre-existing illness)		Controls N = 676		Risk Ratio and CI
Age	Mean	59.6	Mean	59.4	Students t test T Stat = 0.10 P Value = 0.92
	Median	63	Median	63	
	Range	2–88	Range	5–89	
Sex	Female	80 (53%)	Female	359 (54%)	0.96 (0.72–1.28)
	Male	72 (47%)	Male	309 (46%)	
Number of people in cabin	Median	2	Median	2	
	Range	1–4	Range	1–4	
Number sharing cabin with ill person	56 (37%)		57 (9%)		3.34 (2.57–4.33)†
Number reporting traveling with group prior to embarkation	60 (40%)		160 (26%)		1.66 (1.24–2.21)†
Number reporting a member of pre-embarkation group was sick	15 (26%)		29 (20%)		1.27 (0.78–2.07)
Number of people in pre-embarkation group sick	Median 0	Range 0–28	Median 0	Range 0–10	Students t test T Stat = 1.76 P Value = 0.08 (Data not normally distributed; analysis from MWW below) Mann-Whitney/Wilcoxon X ² = 0.2711 P-Value = 0.60
Number reporting an ill person in their traveling party while aboard the ship	78 (54%)		164 (30%)		2.22 (1.66–2.96)†
Number exposed to another person's vomit or diarrhea	5 (6.6%)		0		NA

Locations where people ate on the following dates:			
12/30 Lunch	133 (92%)	530 (83%)	2.02 (1.16–3.53)†
All cases			

12/30 Lunch	91 (95%)	530 (83%)	3.34 (1.39–8.04)†
Cases before 1/3/06			
Food items from 12/30 Lunch			
Using Cases with onset before 1/3/06			
Note: only food items with 10 or more responses from either cases or controls were analyzed			
Fruit salad	24 (26%)	131 (25%)	1.08 (0.70–1.65)
Ice cream	16 (18%)	116 (22%)	0.79
Pizza	13 (14%)	117 (22%)	0.63
Iceberg lettuce	16 (18%)	104 (20%)	0.89
Watermelon	23 (25%)	92 (17%)	1.49 (0.97–2.28)
Tomatoes	12 (13%)	90 (17%)	0.77
Pineapple	17 (19%)	73 (14%)	1.36 (0.84–2.18)
Romaine lettuce	6 (7%)	80 (15%)	0.44
Mixed salad	4 (4%)	74 (14%)	0.32
Hamburgers	6 (7%)	48 (9%)	0.74
Rotisserie chicken	7 (8%)	45 (8%)	0.91
Bread pudding	7 (8%)	42 (8%)	0.97
Mellon and orange fruit salad	3 (3%)	39 (7%)	0.47
Cod fillet	10 (11%)	30 (6%)	1.79 (1.01–3.18)†
Roast beef	7 (8%)	24 (4%)	(*0.15)
Prosciutto panini	6 (7%)	31 (6%)	1.11 (0.52–2.38)
Smoked turkey	6 (7%)	24 (4%)	(*0.27)
Kung pao chicken	6 (7%)	20 (4%)	(*0.17)
Greek salad	3 (3%)	23 (4%)	(*0.46)
Beef steak fajitas	2 (2%)	23 (4%)	(*0.26)
Sushi	1 (1%)	23 (4%)	(*0.11)
Caesar salad	4 (4%)	19 (4%)	(*0.44)

Cheddar Cheese	6 (7%)	13 (2%)	2.24 (1.12–4.46)† (*0.046)
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Cake	2(2%)	16 (3%)	(*0.49)
Tuna Salad	3 (3%)	15 (3%)	(*0.50)
Swiss Cheese	2 (2%)	15 (3%)	(*0.53)
Beef hotdog	4 (4%)	14 (3%)	(*0.26)
Smoked ham	4 (4%)	12 (2%)	(*0.20)
Cole Slaw	3 (3%)	12 (2%)	(*0.38)
Pate	1 (1%)	13 (2%)	(*0.37)
Pasta	1 (1%)	13 (2%)	(*0.37)
Pork Escalope	0	12 (2%)	N/A
Tuna Salad Nicoise	1 (1%)	10 (2%)	(*0.50)
Cheese Cake	0	11 (2%)	N/A

* Fischer's 1-tailed p value used instead of OR because of a value ≤ 5

† Significant at 95% two-tailed confidence interval

Appendix G

Passengers with prior illness and passengers with illness onset while onboard

Variable	Illness prior to boarding N = 13		Illness after boarding N = 153	
Age	Mean	57.3	Mean	59.6
	Median	62	Median	63
	Range	27–86	Range	2–88
Sex	Female	7 (54 %)	Female	80 (53%)
	Male	6 (46 %)	Male	72 (47%)
Number of people in cabin	Median	2	Median	2
	Range	1–2	Range	1–4
Symptom profile (Note: %s are % of people responding “yes” versus all responding)	Diarrhea	6 (46%)	Diarrhea	138 (90%)
	Vomiting	3 (23%)	Vomiting	114 (74%)
	Nausea	2 (15%)	Nausea	83 (54%)
	Stomach	3 (23%)	Stomach	
	Cramps		Cramps	75 (49%)
	Headache	0	Headache	50 (33%)
	Muscle aches	1 (8%)	Muscle aches	48 (31%)
	Fever	0	Fever	38 (25%)
	Blood in stool	1 (8%)	Blood in stool	1 (1%)
	Median vomiting episodes	Median	1	Median
Range		1–10+	Range	1–10+
Median diarrheal episodes	Median	4	Median	5
	Range	3–10+	Range	1–10+
Symptom onset (Note: %s are % of people responding “yes” versus all responding)	12/25	2 (25%)	12/31	42 (28%)
	12/28	4 (50%)	1/1	42 (28%)
	12/29	2 (25%)	1/2	18 (12%)
			1/3	19 (12%)
			1/4	20 (13%)
			1/5	10 (6%)
			1/6	2 (1%)
Illness duration	1 day	8 (62%)	1 day	47 (31%)
	2 days	2 (15%)	2 days	58 (38%)
	3 days	1 (8%)	3 days	15 (10%)
	4 days	0	4 days	6 (4%)
	5 days	0	5 days	6 (4%)
	6 days	0	6 days	2 (1%)
	7 days	1 (8%)	7 days	1 (1%)
	10 days	1 (8%)		
Number sharing cabin with ill person	4 (33%)		56 (37%)	
Number exposed to another person’s vomit or diarrhea	0		5 (3%)	

Number reporting traveling with group prior to embarkation	6 (46%)		60 (40%)	
Type of pre-embarkation group	Commercial Non-Comm.	2 (50%) 2 (50%)	Commercial Non-Comm.	14 (33%) 28 (67%)
Number reporting an ill person in their traveling party aboard the ship	9 (75%)		51 (54%)	
Number eating lunch in the Lido on 12/30/05	11 (85%)		133 (92%)	

Appendix H

Crew Cohort Analysis

Variable	Cases n = 50		Controls n = 570		Significance and CI
Age	Mean Median Range	30.2 29 19–56	Mean Median Range	32.9 31 20–80	Students t test T Stat = 2.32 P Value = 0.0205† Mann-Whitney X ² = 6.1458 P Value = 0.013
Sex	Female Male	8 (16%) 41 (84%)	Female Male	65 (12 %) 490 (88 %)	1.42 (0.69–2.91)
Number sleeping in cabin	Median Range	2 1– 2	Median Range	2 1–3	
Major Countries Represented	Indonesia Philippines United States	28% 28% 10%	Indonesia Philippines United States	47% 34% 4%	
Departments	Food and Beverage Kitchen Entertainment Housekeeping Deck/Engine	20% 16% 16% 10% 8%	Food and Beverage Kitchen Entertainment Housekeeping Deck/Engine	31% 14% 5% 17% 13%	6.70 (1.32–34.2) †
Symptom profile (Note: %s are % of people responding “yes” versus all responding)	Diarrhea Headache Vomiting Muscle aches Stomach cramps Nausea Fever Blood in stool	30 (60%) 26 (52%) 22 (44%) 17 (34%) 16 (32%) 16 (32%) 14 (28%) 1 (2%)			
Median vomiting episodes	Median Range	2 1–10+			
Median diarrheal episodes	Median Range	3 1–10+			
Symptom onset	12/30 12/31 1/01 1/02 1/03 1/04 1/05	2 (9%) 3 (13%) 8 (35%) 3 (13%) 1 (4%) 3 (13%) 2 (9%)			

	1/06	1 (4%)		
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Number sharing cabin with ill person	6 (12%)		16 (3%)		3.4 (1.6–7.0)†
Number exposed to another person’s vomit or diarrhea	1 (2.4%)		2 (0.7%)		2.7 (0.54–13.8)
Number who worked with a sick crew member	9 (18%)		44 (8%)		2.2 (1.1–4.2)†
Illness reporting habits	Visited Infirmary	29 (67%)			
	Reported illness	2 (5%)			
	Did not report	12 (28%)			
Reasons for not reporting	“Because I am not sick” 6 (75%)				
	“Not sure if I was ill” 1 (12%)				
Illness duration	< 24 Hrs.	6 (17%)			
	24 – 48 Hrs.	12 (60%)			
	> 48 Hrs.	8 (23%)			
Helped clean up public vomiting episode	0		1 (0.3%)		N/A
Locations where people ate on the following dates:					
12/29 Breakfast	Lido	6 (21%)	Lido	41 (10%)	2.3 (1.0–5.4)†
	Crew Mess	17 (60%)	Crew Mess	327 (78%)	0.47
	Petty Officer Mess	5 (18%)	Petty Officer Mess	54 (13%)	1.4 (0.6–3.6)
12/29 Lunch	Lido	12 (30%)	Lido	80 (17%)	2.0 (1.0–3.7)†
	Crew Mess	22 (55%)	Crew Mess	339 (71%)	0.53
	Petty Officer Mess	6 (15%)	Petty Officer Mess	60 (13%)	1.2 (0.5–2.8)
12/29 Dinner	Lido	13 (33%)	Lido	82 (17%)	2.2 (1.2–4.1)†
	Crew Mess	21 (54%)	Crew Mess	344 (72%)	0.48
	Petty Officer Mess	5 (13%)	Petty Officer Mess	51 (11%)	0.49
12/30 Breakfast	Lido	7 (24%)	Lido	35 (8%)	3.1 (1.4–6.7)†
	Crew Mess	18 (62%)	Crew Mess	331 (79%)	0.45
	Petty Officer Mess	4 (14%)	Petty Officer Mess	54 (13%)	1.1 (0.4–3.0)
12/30 Lunch	Lido	13 (32%)	Lido	78 (16%)	2.3 (1.2–4.2)†
	Crew Mess	21 (52%)	Crew Mess	344 (71%)	0.48
	Petty Officer Mess	6 (15%)	Petty Officer Mess	62 (13%)	1.2 (0.5–2.7)

12/30 Dinner	Lido Crew Mess Petty Officer Mess	14 (36%) 19 (49%) 6 (15%)	Lido Crew Mess Petty Officer Mess	83 (17%) 345 (72%) 52 (11%)	2.4 (1.3–4.5)† 0.40 1.4 (0.6–3.3)
12/31 Breakfast	Lido Crew Mess Petty Officer Mess	10 (26%) 23 (61%) 6 (16%)	Lido Crew Mess Petty Officer Mess	54 (12%) 337 (76%) 57 (13%)	2.3 (1.2–4.6)† 0.52 1.2 (0.5–2.9)
Bars 12/30	Any Bar Crows Nest Lido Seaview Windstar Ocean Piano Sports Crew Explorers Atrium N. Lights	20 (40%) 3 (6%) 4 (8%) 2 (10%) 4 (20%) 4 (20%) 3 (15%) 4 (20%) 14 (70%) 1 (5%) 1 (5%) 4 (20%)	Any Bar Crow's Nest Lido Seaview Windstar Ocean Piano Sports Crew Explorers Atrium N. Lights	145 (25%) 25 (4%) 18 (3%) 10 (7%) 12 (8%) 15 (10%) 7 (5%) 13 (9%) 90 (62%) 9 (6%) 4 (3%) 20 (14%)	1.8 (1.0–3.1)† 1.3 (0.4–4.1) 2.4 (0.9–6.0) 1.4 (0.4–5.4) 2.3 (0.9–6.1) 1.9 (0.7–5.1) 2.7 (1.0–7.8) 2.2 (0.8–5.8) 1.4 (0.6–3.4) 0.8 1.7 (0.3–10.2) 1.5 (0.5–4.0)
Bars visited 12/30 (% = % of all crew members visiting/working at these locations)	0 Bars 1 Bar ≥ 2 Bars	30 (60%) 11 (22%) 9 (18%)	0 Bars 1 Bar ≥ 2 Bars	425 (75%) 117 (20%) 28 (4%)	Referent 1.3 (0.6–2.9) 3.7 (1.9–7.2)† $X^2 = 10.35$ P Value = 0.001†
Bars 12/31	Any Bar Crows Nest Lido Seaview Windstar Ocean Piano Sports Crew Explorers Atrium N. Lights	23 (46%) 8 (35%) 4 (17%) 2 (9%) 2 (9%) 4 (17%) 3 (13%) 3 (13%) 12 (52%) 2 (9%) 2 (9%) 5 (22%)	Any Bar Crow's Nest Lido Seaview Windstar Ocean Piano Sports Crew Explorers Atrium N. Lights	152 (27%) 69 (45%) 23 (15%) 7 (5%) 10 (7%) 35 (23%) 8 (5%) 13 (9%) 64 (42%) 10 (7%) 4 (3%) 22 (14%)	2.2 (1.3–3.7)† 0.7 (0.3–1.5) 1.1 (0.4–3.1) 1.8 (0.5–6.4) 1.2 (0.3–4.9) 0.7 (0.3–2.0) 2.2 (0.8–6.4) 1.5 (0.5–4.5) 1.4 (0.7–3.0) 1.3 (0.3–4.9) 2.7 (0.8–8.9) 1.5 (0.6–3.8)
Bars visited 12/31 (% = % of all crew members visiting/working at these locations)	0 Bars 1 Bar ≥ 2 Bars	27 (54%) 15 (30%) 8 (16%)	0 Bars 1 Bar ≥ 2 Bars	418 (73%) 95 (17%) 57 (10%)	Referent 2.2 (1.2–4.1)† 2.0 (1.0–4.3)† $X^2 = 6.59$ P Value = 0.01†
New Years Parties	Vista Lounge Crows Nest N. Lights Crew	5 (19%) 9 (35%) 4 (15%) 17 (65%)	Vista Lounge Crows Nest N. Lights Crew	51 (23%) 67 (31%) 16 (7%) 135 (61%)	0.8 1.2 (0.6–2.5) 2.0 (0.8–5.4) 1.2 (0.5–2.5)

Number of glasses of <u>unbottled</u> water consumed	Mean Median	2.4 2.0	Mean Median	3.0 3.0	Students t test T Stat = 1.61 P Value = 0.11
Number of glasses of <u>bottled</u> water consumed	Mean Median	3.4 3.0	Mean Median	2.8 2.0	Students t test T Stat = 1.91 P Value = 0.6
Number of drinks <u>containing ice</u> consumed	Mean Median	2.0 2.0	Mean Median	1.8 2.0	Students t test T Stat = 0.77 P Value = 0.44

† Significant at 95% two-tailed confidence interval

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

Emergency Epidemic Investigations Form

OMB No. 0920-0008

EMERGENCY EPIDEMIC INVESTIGATIONS

EPI-AID NO.: 2006-028

TITLE OF INVESTIGATION:

Investigation of gastrointestinal illness aboard cruise ship *MS Zuiderdam*; Fort Lauderdale, Florida, and Nassau, Bahamas, January 6–7, 2006.

USED FOR THE FOLLOWING PURPOSE:

On January 1, 2006, Holland America Line contacted the VSP to report 53 cases (2.81%) of gastrointestinal illness among passengers and 15 cases (1.84%) among crew aboard their ship the *MS Zuiderdam*. On December 30, 2005, the ship sailed from Fort Lauderdale, Florida, with 1,888 passengers and 814 crew members. The gastrointestinal (GI) illness log faxed to CDC from the ship revealed that the first case was reported on December 30, 2005. Between December 30, 2005, and January 2, 60 passenger cases (3.18%) and 27 crew cases (3.31%) were reported. A single peak of 59 persons reported GI illness onset on January 1, 2006.

At the request of the CDC VSP environmental health officer, EIS officers from EHSB/NCEH and FDDB/DMB/NCID assisted with an investigation to determine the characteristics and extent of GI aboard the *MS Zuiderdam*, the causal pathogen, and the potential modes of transmission of illness, as well as enact public health intervention and control.

DATE OF INVESTIGATION: BEGINNING: January 5, 2006 ENDING: January 7, 2006

Complete this section for each instrument used during the investigation

DATA COLLECTION METHOD:

PERSONAL INTERVIEW

TELEPHONE

MAIL

OTHER (please specify): Paper survey distributed on ship

A. DESCRIPTION OF RESPONDENTS (i.e., individuals, households, physicians, state and local governments, etc.)

Passengers and crew aboard *MS Zuiderdam* sailing between the dates of December 30, 2005 and January 7, 2006

B. ESTIMATED NUMBER OF RESPONDENTS:

2702 (1,888 passengers and 814 crew)

C. NUMBER OF RESPONSES PER RESPONDENT (i.e., one time only, once a week for 2 weeks, 6 times, etc.)

One time only

D. BURDEN PER RESPONSE (i.e., time taken for a respondent to complete the data collection instrument)

38 Minutes

TOTAL ANNUAL BURDEN (Multiply B X C X D):

102,676 Minutes / 1711.3 Hours

PROJECT OFFICER:

Name: Antonio Neri, MD
Title: Epidemic Intelligence Service Officer
CIO: NCEH via OWCD/EIS
Phone: 770-488-7065