APrimeronFoodandWaterBorneIllnessesWhenDiningOut:ACaseStudyonNorovirusOutbreakonaCruiseship

Abstract

A recent outbreak of norovirus occurred approximately 24 hours into a cruise, while passengers were enroute to aNortherndestinationaboardaholidaycruiseshiponascheduledweek-longjourney.Thesymptomsofclassicnorovirusincluding watery diarrhea, severe abdominal cramps and nausea were quickly recognized, and the illness causationconfirmedviaon-boardlaboratorytestingintheshipinfirmary.Appropriatetreatmentprescribedbytheship'sphysician, and containment was realized within a few days. Because of the limited number of passengers affected (12out of over 1,000), and the timing of the incident, it was concluded that the origin of the infection likely occurred priorto or soon after the passengers boarded, possibly linked to a welcoming ceremony hosted by the ship's captain duringwhichavarietyofh'odoervestylefingerfoodsincludingsomeseafooditemsweremadeavailableduringabuffetdinner. Following the initial outbreak, no additional cases were reported or identified, no on-board origin was confirmed, andallpassengersrecovered withoutincident andcontinuedthecruise.

Keywords

Norovirus,FoodBorneIllness,Episode,CruiseShip,Outbreak.

Introduction

Foodborneandwaterborneillness(FWBI)representanever-presentpotentialriskathomeandabroadandpresentasignificantcauseofmorbidityandmortalityintheUnitedStates and other countries [1,2]. FWBI can be caused bynumerousentities,includingheavymetals,toxinsofbiological or other origin, bacteria, viruses, and parasites[3].AccordingtotheCDC,approximately48million peoplebecome ill from foodborne and waterborne diseases eachyear, stemming from 10 or more commonly reoccurringnoxiousorpathophysiologicagents.Themostcommonvectorisunintentionalconsumptionofcontaminatedfood,water,orbeveragesthathavebeenconsumedandthus introducedintothefoodchainoftheunsuspectinghostor hosts via the fecal-oral route of transmission. Of the 48millionormorecases annually, approximately 128,000require hospitalization, and unfortunately, some 3,000 ormore may succumb to a food or waterborne illness in anygiven year [1-4]. Food safety is a major concern in mostWesternized nations, where the food processing systemsandretailprovidersoftentypicallyemployanunparalleledlevel of scrutiny during manufacture, testing, storage andfinal table presentation, but when breeches in the systemoccur,theunintendedconsequencesmaybesubstantial.

Despitetheprecautions,asmanyonein6restaurantdiners may experience a food borne related illness in anygivenyearaccordingtotheCDCreports[3-5].

Contributingtothishighincidencearefactorsthatmay occur as the consumable items become contaminatedat any stage of the origination or intermediate processesleadinguptotheservingofthediningclientele[4].B ecause potential sources such as uneaten left-over fooditems are often discarded and thus no longer available forsurvey by the time symptoms are first reported, positiveconfirmationoftheoriginmaynotalwaysbereadilyat tainable.Inaddition,somepatientsandexperiencedtravelers experiencinglessseveresymptomsmayself-medicate unreported episodes without reporting to theinfirmaryforconfirmationordocumentationoftheirillne ss.Accordingly,itsometimesposesdifficultyindeterminingw hereoratwhatstageoffoodproductionthecontaminationma yhaveoccurred,andwhatspecificstepsmust be taken to contain the impending illnesses as wasthe situation in this outbreak. A brief overview of somecommoncausesofFWBI issummarizedbelow.

TypicalcommoncausesofFWBIincludeviral,microbial,p arasitic,andchemicalagents[1,3].Theseinclude such items as Listeria monocytogenes, a microbialcontamination often found in cantaloupe fruit that mayhave been surface contaminated from natural fertilizersincludingmanure,andinadequatelycleansedandd econtaminatedmelonspriortocuttingandserving[6-8]. Over 8,000 reports of 138,000 cases of listeriosis werereportedfrom2011to2020,nearly10,000hospitalizati ons,and 241 deaths. As with many types of infectious illness,those individuals who are in their later years, and thosewith compromised immunity and other comorbidities andinfantstypicallypresentthegreatestriskofmorbidityand mortalityfromtheconsequencesofFWBIs.Globally,overabill ion individuals may be infected with a parasitic illnessof one kind or another at any given time, often by way ofcompromisesinindustrialhygieneandcontaminatedfoods ,beverages,andpublicwatersources[2,3,9].

Of common parasitic illnesses, helminthic tapewormsreignamongthesupreme[3,8,9].Thebeef/porkta pewormsTaenia saginata (beef origin), Taenia solium (pork origin)andTaeniaasiatica(Asiantapeworm)areclassedasce stodes, causing mostly intestinal illness with significantgastrointestinaldistress,while*Taeniasolium*canal socausecysticercosis. In addition, prolonged duration of cestodalinfectionmayalsobemarkedwithnutritionaldeficie ncies,astherapidlydevelopingparasitesconsumevitaminB1 2 and other essential nutrients during their life cycle,therebypreventingtheirintestinalabsorptionbytheiru nsuspecting host. The protozoal agent Giardia Lamblia isoften found in contaminated, unprotected and untreatedwatersourcesincludingrivers,streamsandunprotect ed

springs due to human and animal contamination, and alsocausestypicalgastroenteritisillness[9,10].Whilebothintestinal cestodes and protozoal infestations are readilytreatedwithantiparasiticagents,caremustbetakentoensureclothingandlinensareadequatelycleansedanddecontaminatedtopreventre-exposurethatcouldpredisposeto fecal-oralreinfection.

Inaddition,infectionwithcryptosporidiumspeciesorganisms (due to C. hominis or C. parvum) ranks amongthemostcommonrecreationalwaterborneparasiticinfectionstooccurintheUnitedStates,andalsooccursviaconsumption or exposure to water sources includingpublic pools that have become contaminated [11,12]. Theparasite causes gastroenteritis and watery diarrhea thatthat may persist for up to two weeks following infection,and often fails to fully resolve in the absence of definitivepharmacotherapy. The parasite is relatively resistant tocommonwaterchlorinationasiscommonlyappliedinprivate or public pools as a disinfection agent with proveneffectivenessformanyotherpotentialcontaminatingorganisms.Symptomsofacutediarrheaandenteritistypicallycommenceaboutaweekafterexposuretoinfectiveoocytesofcryptosporidiaspeciesifconsumedvia ingestion of the polluted water or by person-to-persondirectcontactvia thefecal-oralroute[9].

Entamoebahistolyticaisanotherinfectiousparasitethat can cause amoebiasis followed by severe intestinalinflammation[9,13,14].Itisananaerobicparasiticamoebozoanorganismthatcansurviveoutsidethebodyfor a considerable time, and can infect humans andotherprimatesincludingcanines.Because*Entamoeba histolytica* can survive outside the body for a time, it canbe readily transmitted by the fecal-oral ingestion routefrom contaminated food or fingers. Amoebiasis has beenestimated to infect about 35-50 million people worldwide,resultinginapproximately55,000deathsannuallydueto the severity of the pathobiologic consequences of theorganism.Thetrophozoiteformoftheparasitecanmigratefrominfectedintestinaltissueswhereitmultipliesandcantravel via the circulatory system to infect other tissuesdistantfromitsoriginincludinglungs,brain,andliver[9,13,14].

Bacilluscereusspeciesareyetanotheroccasionalculprit in the area of food-borne illnesses [9,15]. ThesebacteriaareGram-positiverod-shaped,spore-formingmicrobesthatmaybecommonlyfoundinsoil,food, andmarinesponges, and because they are capableofformingpersistentbiofilmsonglasssurfacestheymayposecomplicationsofcontaminationriskduringpharmaceutical manufacturing processes. The spores areeasilyspreadviaairbornedropletsandcanalsocausemoderate,typicallynon-life-threateninggastrointestinalinfectionwhenpresentinimproperlystoredorleft-

over foods. The bacterium readily utilizes glucose as itsprimary energy source, which represents approximately98%ofitsmetabolizableenergypathways[9]. Whileordinary cooking temperatures can kill the bacteria, thespores are typically somewhat hardier, require a longerand higher temperature to inactivate, and often survivelower cooking and warming temperatures and emerge asactive bacterial colonies in stored or warmed foods.
TheiruniquecontributionstoFWBIremainanongoingthreat to pharmaceutical manufacturers, restaurants, and otherinstances where foods may be left open to airborne sporecontaminationonwarmingtables,servingtrays,andot hersuitableenvironments [15].

The pathogenic 0157:H7 serotype of Escherichia colialso forms a constant threat for FWBI illness in raw orundercooked beef, milk, salads, and other vegetables thatmayhavebecomeinadvertentlycontaminatedbydirecto r indirect exposure to bovine manure residues duringvegetablepropagation,ortomeatprocessing[9].Thec ontamination occurs from storm or water run-off duringheavy rains or irrigation processes. This serotype strainproducesaShiga-liketoxinthatmayresultinhemorrhagicdiarrhea,hematologi curemicsyndrome(HUS)inwhichredblood cells are destroyed, resulting in kidney failure. Themost susceptible include young children, the elderly, andimmunocompromised adults. The mode of transmission isvia the fecal–oral route, and most reported illnesses haveoccurredviacommercialdistributionofcontaminatedr awleafygreenvegetables,undercookedgroundmeatandraw milk.IntheUS,2-7%ofchildrendevelopHUS,whichistheleadingcauseofacute kidneyfailureamongyoungchildren.Children under the age of 5 years are at significant risk forthe direst of consequences when exposed to this microbe[3,9].

Additionalcausesofgastrointestinalinfectionofbacterial origin include Shigella (shigellosis), Salmonella(salmonellosis),andCholera(cholera)andarecau sedby facultative, anerobic gram negative bacteria that mayinhabit the intestinal tract of humans and occasionally afew other primates [9]. Shigellosis species comprises ofdifferent 4 strains of the organism that result in varyingdegreesofillnessfromamildtraveler'sdiarrheatoase vere diarrhea. Shigella bacteria appear to be geneticallyrelatedtoenterohemorrhagicE.coli(E.coli0157: H7)and represent a common cause of diarrheal illness. Theorganisms produce variable strain-specific syndromes ofdiarrhea and bacillary dysentery, gastroenteritis, and istypically characterized by abdominal pain and discomfort,bloodydiarrhea(<20bowelmovements/day),na usea,fever, and vomiting. The onset of symptoms may occurfrom 12 hours to two weeks following exposure, whichmay occur with an inoculum of only 10 or more of themost virulent infective bacteria. The most virulent strain(S.dysenteriae)producesaninflammatoryShigatoxin

that attaches to M cells in the epithelial lining of the smallintestine, where the organism multiplies rapidly, and cancause breaks in rRNA and intestinal lining, and enhancethe release of inflammatory cytokines. The inflammatorycytokinescanalsodamagerenalepithelium andcontributetohemolyticuremicsyndrome.Shigellaorg anismsarenotoriouslyresistanttomacrophageinactivati on,andusuallyrequireantimicrobialandrehydrationther apy.The CDC reports that Shigellosis may affect up to 450,000individualsperyearandmortalitycanbeashighas 20% in those most severely affected. Young children andtheelderly/immunocompromisedareamongthemos tsusceptible groups and is easily spread via the fecal-oralrouteviacontaminatedfoodsandfingers [1-3,9].

Salmonellosisiscausedbyanothergroupoffacultative, anaerobicgram-negativebacterialorganisms,resultinginstrainspecificill nessesincludinggastroenteritis(s.enteritidis; dysentery) and typhoid fever (S. typhi) in themost pathogenic strains [9]. Of the approximately 2,000serovarsofSalmonellaorganisms,onlyabout50arec ommonly isolated from human feces. They are commonasymptomaticinhabitantsinpoultryandarediffi cultto control in the commercial poultry industry and thusmandatethoroughsanitationmeasuresandcookingt emperatures during preparation. That rare celebratorydelicacy of 'pheasant under glass" or holiday 'turkey w/gravy'banquetmaybejusttheopportunityyoursalmon ellahas been waiting for! The Salmonella organisms infect theintestinalliningofhumans,wheretheycanmultiplywit hinintestinal epithelial cells and M cells and can enter thecirculation via the intestinal vascular/lymphatic network,andtraveltomanytissuesdistantfromtheintesti naltract,including the spleen, liver, and other organs. Once in thecirculation, the bacteria may cause bacteremia and septicshock[1-3,9].Ofthe1.4millioncasesreportedannuallyintheUS,less than1%(~400)provetobefatal.Theorganisms may survive asymptomatically in the humanintestinaltractin1to3%ofpreviouslyinfectedindiv idualsformanymonthswhichlikelycontributestotheirpe rsistence among human populations. Classic symptomsofsalmonellainfectionincludediarrheaandmo deratefeverandmayrequirerehydrationandantimicrobi altherapytoresolve theproblem.

Cholerainfectioncommonlyfollowsenvironmentaldi sastersandcanpersistformanyyearsfollowinganoutbrea k[9,16,17].Choleraoutbreakscanoccurwherevercontam inatedwatercaninfiltratethedomesticwaterandfoodsup plyincludingtypicalhomeorcommercialusage of unclean water. Cholera is caused by the 0.1 AndO:139 strains of Vibrio cholerae, a motile, morphologicallycurvedgram-negativeorganism.Anactiveinfectionusuallyrequires a large number of organisms (~100,000) to beconsumedasstomachacidcaninactivatetheorganism;o fthosethatsurvivethegastricenvironment,thereadily

multiplyintheintestinaltract,wheretheyproduceapotenten dotoxin capable of causing extraordinary and profoundloss of water and electrolytes via vomiting and diarrhea,withespeciallyseverelossofpotassiumalongwiths odiumwithinonlyhoursafterinfection.Theextraordinarylos sofwater and electrolytes can cause hypovolemic shock andbecomefatalinupto50%ofpreviouslyhealthyindividuals ,butearlyinterventionwithbothoralandintravenousrehydr ationcanpreventmostdeaths.Becauseofthesodium loss, oral rehydration should contain 5% glucoseinordertosupportsodium-glucosecotransportacrosstheluminalepithelium.Therecent epidemicofCholerainHaitiwas caused by fecal contamination of a community watersupply and persisted for nearly a decade (2010-2019) andresultedinXXXXinfections XXXdeaths[16,17].

Unlike most infectious agents, histamine poisoning viacontaminatedfishisaheat-stablechemicallymediatedagentandthusisnotdestroyedby ordinarycookingtemperatures[18].Decomposingfish(most oftenindecomposing mackerel, grouper, and amberjack species)mayenzymaticallyconverttheendogenousaminoac idhistidinetohistamine,resultinginacutesympathetic,hista minergic reactions, and occasional hospitalizations.In addition, Ciguatera fish poisoning, or CFP representsyet another form of chemical fish poisoning. This FWBIagentisfoundinherbivorousfishfoundinreefwaters.T heciguatoxins are originally made by, *Gambierdiscus toxicus*,a small marine organismthat grows on and around coralreefsin tropicaland subtropicalwaters. The suspect fishfleshbecomescontaminatedwiththeciguatoxinsproduc edvia bioconcentration as larger, carnivorous fish dine ontheherbivores.Theagentcausesdiarrhea,vomiting,numb ness, heat sensitivity to hot and cold, cardiovascular,and other symptoms including hypotension, which maypersistforseveralweeksorlongerfollowingrecoveryfro mthe acute effects. The diagnosis of histamine or ciguatoxinpoisoning is typically based on a person's symptoms andrecent history of fish consumption [9,18,19]. If a numberof individuals consumed the same fish during the sametimeframe also develop symptoms, the diagnosis becomesmore probable without further testing, but if some of thequestionablefishisstillavailableitcanbetestedtofurtherc onfirm the presumptive diagnosis of histamine or CFPpoisoning[9,18,19].

Aflatoxins,ergotalkaloids,andbotulinumpoisoningarea dditionalchemicalentitiesthatcancauseseriousillnessinma nandanimals[8,20-23].Aflatoxinsconsistofagroupofpoisonous,mutagenic,mit otoxicandcarcinogenicchemicals that are produced by various species of aerobicAspergillus fungi. The notorious fungi are also sometimesreferredtoasmoldsthatnormallygrowinsoilandd ecayingvegetation,andtheycaneasilythriveonvirtuallyanyu nrefrigerated or inadequately stored foodstuff, includingvegetables,grains,nuts,andspices.Ofthevariouschem ical

forms including AF B_1, B_2, G_1, G_2 M_1, M_2, L, and Q_1, AflatoxinB_1 is produced by both *A. flavus* and *A. parasiticus* strainsandisconsideredthemosttoxicformtoaffecthumansandanimals,whereitcausesoftenfatalcarcinomasoftheliverandother organs[20,22].

Ergotism is caused by ergot alkaloids, toxic chemicalsthat are formed by molds that often grow on rye plantsand inadvertently become carried over to rye flour duringitsmanufacture[9,22].Whenergotsareaccidentallyconsumed in sufficient quantities, they typically cause avariable,doserelatedrangeofvasoconstrictionsintheCNSand peripheral tissues, causing hallucinations, peripheralvasoconstriction, vascular collapse and often death. Thetoxicalkaloidsmaybeblendedinsuchthatuseoftheflourin baking bread and other baked goods resulted in ergottoxicity in the baked goods primarily intended for humanconsumption.Theearliesthistoricalreportsofwhatnow appears to have been ergot poisoning in rye breadextends back for many centuries, over 1000 years, untilthesourceandcompositionactiveprinciplewasultimatelydiscovered[8,22-25].Scientificstudyoftheergotalkaloidseventually gave rise to the development of LSD (lysergicacid diethylamide) by Hofman, and continue to be studiedfor possible therapeutic benefits for certain psychologicalandpsychiatricdisorders includingPTSD[26].

Botulinum poisoning represents yet another potentialsourceofsevereadverseeffects,asthetoxinisformedby *Clostridium botulinum* [27]. *C. botulinum* is an obligateanaerobic endospore-forming gram-positive bacillus thatiscommonlyfoundrecentlytilledsoilandaquaticdrainagesediments, where the heat stable endospores can becometransmittedtofoodcropsnourishedbythenutrientsfound in the soil and aquatic resources [9]. When presentin anaerobic environments such as sealed canned goods,themicroorganismsreleaseapotentneuroinhibitoryexotoxin that is highly specific for synaptic acetylcholinereceptors, thereby blocking the parasympathetic elementofneuromusculartransmission.Toxicitywiththeexotoxinresults in a flaccid paralysis of muscle fibers, which maypersist for 1 to 10 days, dependent on the magnitude ofthe inhibition [9]. The neuromuscular blockade becomesclinicalapparentwithsecondarysymptomssuchasnauseaand generalized weakness within the first day of exposurebut left untreated can result in fatal respiratory distressand cardiac failure within a few days of exposure. Thepharmacologic effects of botulinum toxin gave way to thepharmaceutical development of Botox, where extremelysmall doses are injected into specific muscle groups as acosmeticproceduretocontrolunsightlywrinkles[27].

*Clostridiumtetani*isanotherstrainof*Clostridiasp.*that presents as an obligate anaerobic endospore-forminggram-positive bacillus that is commonly found recentlytilledsoilandaquaticdrainagesediments[9,28].*C.tetani*

producestheneurotoxin*tetanospasmin*,thedefinitivecause of tetanus, which like botulinum toxin, also affectsskeletal muscles, but by blocking muscle relaxation ratherthan excitatory pathways. Early symptoms produce theconditionknownaslockjaw,aconditioninwhichthemouth can no longer open, and swallowing is inhibited, followedby spasms of muscles of the back, head, extremities, andheels to bow in a backward position (*opisthotonos*), anddeathviaspasmsoftherespiratorymuscles.Theorganis mflourishesinanaerobicenvironmentsincludingdeeppunct ure wounds, where it can continue to produce theneurotoxin,andunlikebotulinumpoisoning,althoughph ylogeneticallyrelated,*C.tetani*doesnotcommonlyoccurined iblefoodsandtetanusiseasilypreventedbyvaccinationearlyi nlifeaspartoftheDPTvaccinefollowedbyperiodicboostersfo rmostindividuals,therebypreventingmostcasesnowadays[9,28].

CommonlyoccurringviralagentsthatcauseFWBIinclude bothnorovirusandrotavirus,RNAvirusesthatposesignifican triskstoinfants,youngchildrenandolderadults[9,29].Norovi rusinfectioniscausedbyhighlytransmissiblestrains of the RNA-norovirus and typically presents as afood borne illness that is responsible for approximately50%oftheFWBIillnessescausingnonbacteri alfoodbornegastroenteritisthatarereportedintheUnitedSta tes;norovirusisresponsibleforover80%ofFWBIepisodestha toccur on board of International Cruise ships, a staggeringincidence [2,4,5]! Norovirus infection typically producessymptoms of nausea, intestinal cramps, diarrhea, malaise,and dehydration ± a low-grade fever within 18-48 hourspostexposuretotheinfectiousviralagent.Thediagnosi sisreadilyconfirmedviaasensitive,rapidRIAorPCRanalysiso f stool specimens, which facilitates an early onset of anappropriate treatment regimen [9]. Norovirus infection isconsideredthemostcommonnon-bacterialcauseofFWBIinfection in the US, where it is linked to approximately 20millioncasesannually,withapproximately300deathsres ulting from the infection [29]. Norovirus infection canbe transmitted via food, water and aerosol contaminatedsurfaces, thus accounting for the high incidence of FWBIinfectionsonInternationalcruiseships(95outbreaksb etween 2011-2019) [2]. Infection with norovirus causesinjury and inflammation to the microvilli lining the smallintestine,resultingintheclassicsymptomsofwaterydia rrhea, severe cramps, low grade fever, and generalizedabdominaldistress.Cleanupfollowinganoutbre akischallenging due to the aerosol microdroplet nature thatcontributestoitsdissemination[4,5].Understandably,cr uise ships that are bound for international destinationstakeconsiderabletimetoprepareforthe intende djourney,spend many days away from port while at sea, and mustloadenormousquantitiesoffoodandotherediblecons uma blespriortodeparture,sincewhileonboarddining options are limited to only what the vessel diningservicescanprovide.Onboardstorageandpreparation

maynotalwaysoccurunderopportuneenvironmentalor working conditions and may be further compromisedbytheloadingschedulesandrestockingoptionsatportsofcall,whichmayleadtointerruptionsinrefrigerationor optimal transit conditions. Vessels often travel greatdistances *en route*, where unforeseen environmental andhumanconditionsthatcouldcompromisefoodstorage and preservation may also occur. The overall complexityof the procurement, monitoring and delivery of the diningoptions poses opportunities for the weakest link in thesystemto materialize.

In addition to noroviruses summarized above, infantsandyoungchildrenarealsosusceptibletorotavirus infection,anotherviralspeciesphylogeneticallyrelatedto thenorovirus[9,29-34].Rotavirus infection canalsocauseanacutegastroenteritismostlyinchildren.Rotavirusinfectionsarelikelythemostcommoncauseofviralgastroenteritisinchildren,contributingtoanapproximately three million cases annually in the US, andsadlyarelinkedtoapproximately100fatalitiesintheunder 3y.o.population,wheresome90%showimmunologicevidence of exposure . Natural immunity occurs followinginfectionandisbelievedtoprotectindividualsfromrepeatinfections following an initial episode. Typical symptomsinclude vomiting, diarrhea, and dehydration that persistfor a week or more, and necessitate prompt attention torehydration early in the course of illness. In contrast tonoroviruswhereaninfectivedosemaybeasfewas10viralparticles,rotavirusinfectiontypicallyrequiresalargerinfective dose, and occurs following an infective exposureof up to 100 viral particles. In both viral infections, theduration of incubation is 2 to 3 days in otherwise healthyindividuals[9].

CaseStudy:DiningOutonacruiseship

Ms. J T was A 62 Y.O. retired female who presented atthe Ship infirmary on the second day of her voyage. Uponarrival at the infirmary, she presented with complaints ofsevere abdominal cramps, watery diarrhea, and nausea,with an onset of early symptoms of nausea approximately18 hours after embarking on the cruise, which she wasunable to control by rest and fluids, and which becameemergentwithin24hoursoftravel.Uponfurtherinvestigation,shereportedattendingabuffetdinnerhosted by the Ship's Captain the evening before, duringwhichshereportedconsumingportionsofvariousseafooditems, including what appear to be uncooked shrimp andoysters. Ms. J.T.'s vital signs were generally normal withtheexceptionofamildfevertypicallynotexceeding102°F,abdominaltendernessuponpalpitation,lethargy,milddehydration,andnon-life-threateninghypotension.Ms.J.Twasfollowedby11additionalpassengersonthesamedaywhopresentedwithsimilarsymptomsandchiefcomplaintsofmildfever,lethargy,waterydiarrheamilehypotension

Comment [V1]: Explain the methods of diagnosing the cause of the disease

and abdominal tenderness upon palpitation, and who hadattended and consumed the same buffet dinner, includingtheseafoodentrees.Thetimingandclusterofpatients wassuggestive of an on-board food or water borne illness, andstoolspecimenswerecollectedfromtheentirepatientcluster for laboratory analysis in the infirmary laboratory.Initialon-boardRIArapidtestsfornoroviruswerepositive for all 12 patients, including Ms. J T. The medicalteamadministeredsupportivetherapeuticmeasuresincluding 1) administering intravenous fluids to restorehydration; 2) immediate administration of Compazine (10to 20 mg., I.M.); Sachets of 20.5 mg of WHO low osmolarformulaeoralrehydrationsolutions(lowosmolarOralRehydration Solution consisting of 2.6 g/L NaCl, 2.9 g/LNa-disodium citrate dihydrate, 1.5 g/L KCl, and 13.5 g/Lanhydrousglucose)asneededtorestorehydration[31].3)In addition. Patients were administered two 20 mg tabletsof loperamide initially and an additional tablet after eachsubsequentwaterybowelmovementthereafteruntilsymptoms subsided; and 4, an 8 mg tablet of ondansetronwas administered every 8 hours for symptoms of nauseauntil gastrointestinal symptoms subsided. Patients werereleased to their quarters within 4 hours to continue theiroraltreatmentregimenandreturnedtotheinfirmaryperiodically (~ 8 hours) to continue to monitor vital signsforupto3daysthereafter.Allpatientscontinuedthevoyage and experienced a full recovery by the final port ofcall.

Asaresultoftheoutbreak,theon-boardmedicalteamimplementedstrictinfectioncontrolmeasures,including isolation of affected passengers in the infirmaryor their quarters, enhanced cleaning protocols in the foodpreparation and dining areas, care to dispose of uneatenleftovers,andpromotedhandhygienemeasuresforallfood service personnel, with recommendations for shipwide attention to periodic hand washing especially beforedining.InaPublicHealthResponse,theship'smedicalstaff promptly reported the outbreak to relevant healthauthoritiesatthenextportofcall.Passengerswereadvisedon proper hygiene practices, and the ship implementedadditionalsanitationmeasurestocontainthespreadofthevirus.

TheOutcomeoftheon-boardincidentwaschalkedup to experience. Over the following days, the number ofreportedcasesdecreasedprogressivelyastheimplementedmeasurestookeffect.Mrs.J.T.andotheraffectedpassengersshowed gradual improvement with supportive care. Thecruiselinefacedscrutinyandimplementedchangestofoodhandlingpracticestopreventfutureoutbreaksofnorovirus or other common food borne agents that couldnegatively impact ocean going voyages. In our experience,ORStreatmentmaylowerthemortalityrateofdiarrheabyasmuchas93%.Casestudiesinfourdevelopingcountriesalsohavedemonstratedanassociationbetween increased

useofORSandreductioninmortality.ORTusingtheoriginal ORS formula has no effect on the duration of thediarrheicepisodeorthevolumeoffluidloss[12],although reduced osmolarity solutions have been shown to reducebothemagnitudeofvomitingandstoolvolume.

Conclusion

In conclusion, this clinical case and the accompanyingoverviewofagentslinkedtofoodandwaterborneillnessesunderscoresthechallengesofmanaginginfectiousoutbreaksonnotonlycruiseshipsbutalsoexercisingdiligenceduringcasualdiningoutatyourfavoriterestaurant.Swiftidentification,isolation,andpublichealthinterventions are crucial in preventing further spread offWBIandensuringthewell-beingofpassengers,crewmembersandcasualdinersespeciallywhileenjoyingtravelabroad.

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