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Original Article

A *Norovirus* and *Rotavirus* Mixed Outbreak in a High School in Pingtung County, 2011

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Abstract

In April 2011, a gastroenteritis outbreak in school X was reported to Taiwan Centers for Disease Control, and questionnaires were released to the students in 12 classes for investigation. Among the 449 students, 248 were ill (attack rate = 55%). The most common symptoms were diarrhea (89%), poor appetite (63%), abdominal fullness (54%) and vomiting (48%). Stool specimens from ill students collected for laboratory examination found 1 *norovirus*, 3 *rotavirus*, and 2 mixed infections. There were more than 2 peaks in the epidemic curve, and the students were distributed evenly in many classes. Person-to-person transmission was suspected. Analyzing the risk factors of disease, there was no definite common source, and students washing hands less frequently and using the toilet near the gathering hall on April 22 had more illness. Sharing toilets and infrequent hand-washing may facilitate viral spread in the outbreak. Diarrhetic students should use designated toilets at school. Hand-washing should be enhanced among all students.

Keywords：Gastroenteritis outbreak, *norovirus*, *rotavirus*

Background

On the afternoon of April 30, the Centers for Disease Control, Taiwan (Taiwan CDC) received notification from a citizen in Pingtung, reporting that there were more than 10 students with gastroenteritis in a high school. The Fifth Branch of Taiwan CDC asked the local health department for confirmation. Because of epidemiological links in person, time and place, it was deemed as a gastroenteritis outbreak. Furthermore, the number of ill students were increasing, suggesting potential disease spread. The Fifth Branch of Taiwan CDC asked Field Epidemiology Training Program (FETP) for assistance. An epidemiological investigation was conducted by

FETP and Fifth Branch of Taiwan CDC and the Health Bureau of Pingtung County on May 4.

Material and Methods

The objectives were to identify risk factors, transmission mode and the causative agent. Field investigation included an assessment of the school environment, interviews with school administrators and students, and developed a questionnaire based on the information provided. There were 1,608 students in 42 classes. The questionnaires were administered to students in classes with high attack rates. Anal swabs and stool specimens were collected from symptomatic students and sent for bacterial culture, including *Salmonella* and *Shigella*, and virus detection, including *rotavirus* and *norovirus*.

Questionnaire

The study design included 2 methods of analysis. One was retrospective cohort study, which was used to analyze the risks of different exposures contributing to disease. The other was self-controlled case-control study, which compared the behaviors and food consumption between usual condition and 3 days before disease onset, to understand the possible risk behaviors or food before disease onset. The questionnaires were administered to students in classes with high disease attack rates. Questions included demographic information, symptoms, contact history, eating habits, water-use habits, hand-washing habits, participation in school gatherings, and toilet use. Usual daily habits and the exposures during the 3 days prior to disease onset were to be answered separately for questions regarding eating habits, water-use habits, and hand-washing habits. A case was defined as illness in a student with vomiting, diarrhea, or any 2 of fever, abdominal pain, and nausea in the school. The questionnaires were handed out and collected by the school administrators and members of the local health bureau, entered into Microsoft ACCESS by members of Taiwan CDC, and analyzed using STATA (College Park, TX, USA).

Results

School surveillance data revealed that more than 500 students were ill, with attack rate of more than 30% in the school. Since the beginning of the incident, cases were present in different classes. The questionnaires were given to 466 students, and 449 (96%) were returned. There were 51% male and 49% female students. The median age was 17 years (range: 16 to 20 years). The source of water intake was mainly the water fountain of the school (88%). The source of lunch was mainly the school canteen (63%). Ninety-four percent of the responders washed their hands before meals, but 34% did not use soap. There was only one person who indicated no hand-washing after toilet use; 75% washed hands with soaps after toilet use. There were 248 students meeting the case definition. The attack rate was 55%. There was no difference between sexes. The main symptoms were diarrhea (89%), poor appetite (63%), abdominal fullness (54%), weakness (50%), nausea (48%), vomiting (48%), fever (45%), and abdominal pain (42%). The average duration of illness was 3 days. Seventy-seven percent of the ill students sought medical advice. Seventy-eight percent of

the ill students had been contact with ill classmates within three days before disease onset. Analyzing the condition of water-drinking, water-use and lunch-eating of the responders, there was no statistical difference between ill and healthy students. As for the students who became ill during April 20–23, they washed hands less frequently during the 3 days before disease onset then usual (odds ratio = 0.30; 95% confidence interval (95%CI): 0.08–0.98). Using the toilet near the gathering hall was associated with illness (relative risk: 2.8; 95%CI: 1.42 to 5.51). Washing hands after using toilets did not decrease the risk. As for the students who used the toilet near the gathering hall, the relative risk of becoming ill during April 23 and April 24 was 3.34, with 95% CI 1.51 to 7.38. There were no specific risk factors among the late onset students. Using information from the questionnaire, there was 232 ill students with definite disease onset dates, and the epidemic curve is as Figure 1. The symptom distribution is presented in Figure 2. The risk analysis is in Tables 1 and 2.

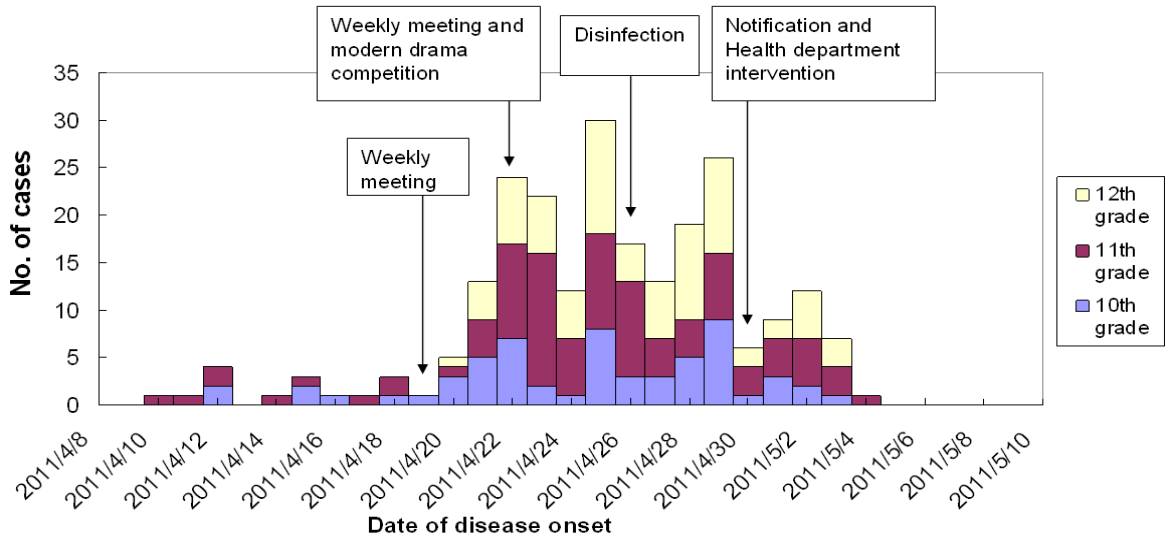

Figure 1. Epidemic curve of the diarrhetic outbreak in School X, Pintung, 2011 (n=232)

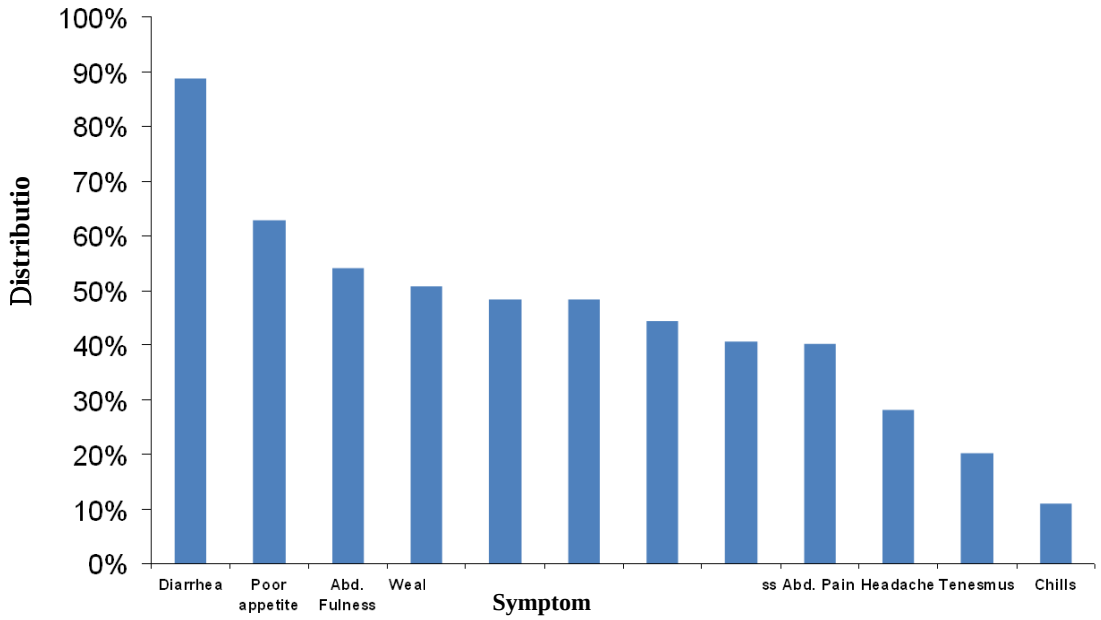

Figure 2. Symptom distribution

Table 1. Risk factors analysis of the ill students during April 20 to April 23

	A. usual habits of the students becoming ill during Apr. 20 and Apr. 23 (n=64)	B. Students not getting ill during April 20 and April 23 (n=385)	C. The behaviors during the 3 days before disease onset of students becoming ill during Apr. 20 and Apr. 23 (n=64)	Relative risk of A and B (95% CI)	Odds ratio of C and A (95%CI)
Drinking water from water dispensers	59	338	58	1.54(0.65-3.67)	0.82 (0.19-3.42)
From bottle water*	5	26	2	1.14(0.49-2.64)	0.38 (0.04-2.45)
From home	9	74	7	0.72(0.37-1.40)	0.75 (0.22-2.45)
Used tap water for drinking or gargling	26	136	24	1.22(0.77-1.95)	0.88 (0.41-1.90)
Drinks from bubble tea Café	17	92	6	1.10(0.66-1.83)	0.29 (0.09-0.84)
LunchFrom school canteen	42	241	40	1.12(0.69-1.81)	0.87 (0.40-1.91)
From home	9	85	9	0.62(0.62-1.20)	1 (0.32-3.08)
From vendors*	7	38	3	1.10(0.53-2.27)	0.40 (0.06-1.87)
From lunchbox	13	90	10	0.86(0.49-1.51)	0.73 (0.26-1.98)
Distributor A	8	65	6	0.74(0.37-1.48)	0.72 (0.19-2.56)
Distributor B*	6	29	4	1.22(0.57-2.63)	0.64 (0.13-2.89)
Washed hands before meals	59	360	50	1.05 (0.67-1.66)	0.30(0.08-0.98)
Washed hands with soaps before meals	38	254	16	0.61 (0.28-1.36)	0.22(0.10-0.50)
Washed hands after using toilets	64	381	62	0.88 (0.14-5.33)	0.48 (0.04-3.53)
Washed hands with soaps after using toilets	44	288	19	0.83 (0.46-1.49)	1.83 (0.74-4.60)
Used swimming pool	27	202	17	0.70 (0.44-1.11)	0.50 (0.22-1.11)
Used the toilets near the swimming pool	13	125	10	0.57 (0.32-1.02)	0.73 (0.26-1.98)
Washed hands after using the toilets near the swimming pool	16	136	13	0.65 (0.38-1.11)	0.76 (0.30-1.90)

*Fisher’ s exact statistics

Table 2. Risk factors of gathering and toilet sharing of the students getting ill between April 20 and April 23

	Students getting ill between April 20 and April 23(n=64)	Students not getting ill between April 20 and April 23(n=385)	Relative risk (95% CI)	P value
Joined weekly meeting on April 19	48	330	0.56 (0.33-0.93)	0.03
Used toilets near the hall on April 19*	1	14	0.46 (0.07-3.10)	0.39
Washed hands at washing basins near the hall on April 19 *	1	23	0.28 (0.04-1.94)	0.15
Washed hands with soaps at washing basins near the hall on April 19*	1	13	0.49 (0.07-3.31)	0.44
Joined weekly meeting on April 22	27	203	0.69 (0.44-1.10)	0.12
Joined modern drama competition on April 22	20	87	1.45 (0.90-2.35)	0.13
Used toilets near the hall on April 22	6	10	2.80 (1.42-5.51)	0.007
Washed hands at washing basins near the hall on April 22	6	12	2.47 (1.2-4.97)	0.02
Washed hands with soaps at washing basins near the hall on April 22*	2	2	2.42(1.05-5.59)	0.08

*Fisher’ s exact statistics

Environmental investigation revealed that the school had a dormitory, but less than 10% of the students lived there. Students were free to choose bringing lunch from home, eating lunchboxes from contracted distributors, school canteen, or vendors near the school. Student activities included classes in the classrooms, school-wide gatherings in the hall every Tuesday and Friday, free-for-all group study and swimming in the evenings. There was no tap water in this town. The residents mainly used ground water without chlorination. The distance between the septic tank and the well was more than 15 meters. The drinking water was cleaned with reverse osmosis technology, and the water quality passed spot checks. The space was not crowded in the school. The bathrooms needed to be improved because of the wet floors, inadequate soap or liquid hand soap, and lack of hand wipes.

For laboratory examination, 13 stools were collected for bacterial culture and virus detection. No bacteria associated with gastroenteritis were isolated. There were one norovirus, 3 rotavirus, and 2 mixed norovirus and rotavirus infections. After the notification, the health department investigated and recommended to improve washing facilities, enhance health education, disinfect the environment using standards used for norovirus outbreaks and designate specific toilets for ill students, and strongly recommended to hold off the school-wide gathering for the school anniversary. The outbreak was subsided after May 6.

Discussion

In this diarrhetic outbreak, the risk of disease spreading by sharing toilets near the gathering hall was proved using questionnaire investigation. Students who used the said toilets were 3 times as likely to become ill then those who did not use the toilets. The risk of disease was not decreased by washing hands with or without soap. This may be because of the shortage or contamination of soap, or because the students did not fully practice the standard hand-washing procedures. Inadequate hand-washing practice, survival ability of *norovirus* and *rotavirus* in the environment, and the ability of disease spread with few viral particles [1] all contribute to further disease dissemination. The ill students commonly considered they had less hand-washing 3 days before disease onset then usual. Although recall bias could not be excluded, the result indicates that the students recognize the linkage between hand-washing and illness. Analysis of the hand hygiene revealed inadequate hand-washing even though the responders were all high school students.

The outbreak persisted for 2 weeks. The prolonged disease spreading may be secondary to not only toilet sharing of ill and healthy students, poor hand hygiene, but also delayed reporting which caused delayed public health intervention. The epidemic curve showed 4 peaks, indicating person-to-person transmission; this is characteristic of norovirus infection, known to have a high secondary attack rate. The first wave of ill students was evenly distributed in different grades and many classes. Common source outbreak for the first wave of ill students could not be excluded. However, the questionnaire did not reveal any specific food or water causing the first wave of disease. Recall bias and lack of food, water, or environmental

sampling are the main limitations of this investigation, which were secondary to delayed reporting.

Norovirus-induced diarrhea and vomiting are common in adult patients and outbreaks [2]. The average incubation period is 24 to 48 hours. Rotavirus infection is common in young children, who may be complicated with severe disease or death; disease is seen less in adults, and often with milder symptoms [3]. Mixed *norovirus* and *rotavirus* infection is seldom seen in gastroenteritis outbreaks. In this outbreak, students were infected with *norovirus*, *rotavirus*, or both. A study to identify viral infections among children hospitalized with gastroenteritis showed 34% had single virus infection, of which, most commonly were *rotavirus* (51%) and *norovirus* (32%). Mixed infection occurred in 3%, of which half were mixed *rotavirus* and *norovirus* infection; mixed *rotavirus* and *adenovirus* infection, and mixed *rotavirus* and *astrovirus* infection accounted for 16% and 13% respectively. Furthermore, 9% had mixed infection with 3 viruses [4]. Thus, even though most gastroenteritis were caused by single viral infection, sometimes 2 or more than 2 virus mixed infection may also occur.

Using reverse osmosis technology can filter out viruses effectively, including *rotavirus* and *norovirus* [5]. However, it is not cost-effective to use the technology for all water, especially that used for daily cleaning and washing. In general, *norovirus* is more resistant to disinfectant than other viruses. However, recent research revealed that chlorination of water could reduce the amount of *norovirus*. In 2010, M. Kitajima et al. showed that with 0.1 mg/L chlorine , it takes 120 minutes to decrease *norovirus* level to 10^{-5}; with 0.5 mg/L chlorine, it takes only 0.5 minutes [6]. Thus, testing chloride level in water can help to understand the possibility of water-born transmission, and chlorination of water may be considered in controlling outbreaks.

In diarrhetic outbreaks, disinfection is one of the ways to control disease spread. Proper isolation is the key to blocking person-to-person transmission. In a school setting, all ill students are recommended to stay at home. If the ill person is a cook, he or she should practice good hand hygiene, stop working immediately, and restart resume working only if after symptoms had subsided for 48 hours [7]. If the ill student must be in school, the student should be isolated, and use designated toilets. Avoiding extensive large gatherings in schools can also prevent further spreading of the disease spreading. In this outbreak, scheduled school anniversary celebration was cancelled under the strong recommendation of the health departments; the decision was supported by the education department, the school, students and their parents. Consequently, the outbreak was controlled.

Conclusion

When diarrhetic outbreak is suspected, timely surveillance and reporting facilitate the promptly intervention of health departments. Inadequate hand hygiene and toilet-sharing of ill and health students can contribute to disease spreading. Proper environmental disinfection, isolation of ill students, designating toilets for ill students, and avoiding large gatherings are all

important to control virus transmission. Furthermore, hand hygiene should be stressed not only during outbreaks but also daily.

Acknowledgement

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Outbreak Investigation Express

Sapovirus Cluster in a Chain Buffet Restaurant, 2012

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Abstract

Since June 8, the news media reported several food poisoning events which were associated with a chain buffet restaurant in Taiwan. Many people were sick suspecting after eating raw oyster. To estimate the scope, identify the etiological pathogen, determine the responsible food item, we conducted an epidemiologic investigation along with Food and Drug Administration.A case control study was conducted on attendees from four universities. All attendees were interviewed regarding their basic characteristics, time of exposure, food items, onset date, symptoms and medical treatment. A case was defined as a person who had diarrhea or vomiting within one week after dining in any branch of this restaurant. Laboratory testing of stools, anal swabs and vomituses were performed by the Research and Diagnostic Center.Among the 169 party attendees, 100 (59%) were interviewed. Of the 48 persons who met the case definition, 42 (88%) had diarrhea, 38 (81%) had vomiting and 20 (43%) had fever. The mean incubation time was 37.9 hours. Illness was associated with eating raw oyster (odds ratios: 20.5, 95% confidence interval: 5.6-74.4). Three of four vomituses and five of seven stools tested positive for sapovirus. According to the symptoms, incubation time, statistical analysis and laboratory results, we concluded the cluster was related to sapovirus and eating raw oyster was associated with illness.

Keywords：Sapovirus, Cluster

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