Outbreak Reports

A Norovirus-Related Gastroenteritis Outbreak Stemming from a Potential Source of Infection — Pudong New Area, Shanghai Municipality, China, April 2024

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Summary

What is already known about this topic?

Noroviruses are highly infectious with rapid transmission capabilities, causing illness for an average duration of 12–60 hours. In China, individuals in educational agencies may return to class 72 hours after symptom resolution.

What is added by this report?

This outbreak was precipitated by a potential source of infection in a child resuming class after a 72-hour quarantine post-symptom resolution, leading to a cluster of cases within the class.

What are the implications for public health practice?

While extending the quarantine period for children may be considered from a safety perspective, it is a challenge for educational agencies. The outbreak is deemed a low-probability event; however, further investigation into the detoxification period of asymptomatic patients is warranted.

On April 27, 2024, at 13:00, the Pudong New Area Disease Prevention and Control Center (Pudong CDC), Shanghai Municipality, China, received reports from the Market Bureau of multiple children in the same class at PN Kindergarten exhibiting vomiting. Pudong CDC promptly collaborated with the community health service center to conduct an epidemiological investigation and intervention. The objectives were to identify the pathogen, delineate the outbreak's characteristics and potential transmission risks, and implement effective control strategies.

INVESTIGATION AND RESULTS

PN Kindergarten, located at 609 LS Road, Pudong New Area, Shanghai, China, is a public institution serving 219 children in four grades across nine classes. The school employs 38 faculty and staff members, including 2 health teachers. The kindergarten lacks school buses and on-site accommodations. It features a teaching building with various public classrooms, including a reading room, all of which have been in recent use. The air conditioning system was recently turned off. The kitchen and canteen provide meals for both children and staff, who dine separately in designated areas. Kitchen personnel and teachers reported good health over the previous two weeks. The kindergarten provides water cups for student use. Disinfection practices are well-maintained, with complete records.

The first case was a 4-year-old child from junior Class II who began experiencing vomiting, abdominal pain, nausea, and fatigue at home at 17:00 on April 26. The child did not exhibit chills or urgency. After experiencing 10 vomiting episodes, the child was diagnosed with acute gastroenteritis at the hospital at 20:00 that evening and presented with elevated white blood cell counts. The parents reported no history of suspicious food intake, contact with suspected cases, or recent travel. No similar symptoms were observed in the cohabiting parents, and the child had no record of recent vaccinations.

Case definition: According to the 2015 *Norovirus Outbreak Investigation and Prevention Technical Guidelines* (*1*), a suspected case of norovirus-related gastroenteritis is defined as an individual experiencing vomiting at least twice or diarrhea at least three times within a 24-hour period. Cases were identified through classroom-based searches, teacher interviews, and review of absence records.

As of 16:00 on April 27, 11 cases met the suspect case definition through case searching, all concentrated in junior Class II. The attack rate among schoolchildren was 5.02%, affecting 11 of 219 individuals. Onset times ranged from 17:00 on April 26 to 5:00 on April 27, with all cases occurring at home. Notably, 10 cases (90.91%) emerged on April 26, and 1 case (9.09%) on April 27. Among the 11

cases, there were 7 males and 4 females, with a male-to-female ratio of 1.75∶1. Clinical presentations are detailed in Table 1, with all cases presenting mild symptoms and no severe conditions reported.

Further investigation revealed that a primary case, a potential source of infection, experienced three vomiting episodes at home on Saturday, April 20. The vomiting consisted of food and lasted for one day, accompanied by two episodes of diarrhea with sticky stools, nausea, and weakness. The child rested at home, and symptoms noticeably subsided by April 21. The child continued to rest at home for three days, from April 22 to 24. After 72 hours, the child returned to kindergarten on Thursday, April 25. According to parental feedback, the child had not exhibited symptoms such as vomiting or diarrhea since April 22. Subsequently, 11 children from the same class gradually began to experience illness after 17:00 on April 26.

On April 27, an on-site investigation was conducted, and 14 samples were collected. These included one vomit sample from the index case, one anal swab sample from the suspected source of infection, one fecal sample from one of the 11 cases, and 11 environmental samples from classrooms, toilets, and dining tables. The samples were sent to the Pudong CDC Laboratory for pathogen testing, including *Norovirus*, *Rotavirus*, *Astrovirus*, *Vibrio parahaemolyticus*, pathogenic *Escherichia coli*, *Salmonella*, and other pathogens, using real-time polymerase chain reaction or bacterial culture. Testing revealed that three case samples were positive for *Norovirus* GII nucleic acid, while all environmental samples tested negative.

During the investigation, the Pudong CDC implemented several public health responses, including: 1) strengthening morning checks and full-day observations at the kindergarten, with immediate reporting of new cases; 2) quarantining cases at home, mandating a 72-hour symptom-free period before resumption of activities; 3) setting disinfection standards for environmental surfaces at 1,000 mg/L for classrooms and 2,000 mg/L for bathrooms; 4) suspending collective activities and public classroom use, and promptly issuing parental notices to manage public perception; 5) actively promoting awareness of intestinal infectious diseases and hand hygiene; and 6) maintaining close communication with the kindergarten and Pudong CDC. As of May 6, all cases associated with this outbreak had recovered and resumed classes, with no new cases reported. All control measures have been implemented, and this outbreak is considered closed.

DISCUSSION

Norovirus is a member of the genus *Calicivirus* and is recognized as a significant pathogen causing non-bacterial acute gastroenteritis (*2*), as well as a common agent in foodborne infectious diseases (*3*). In developed countries, norovirus is responsible for over 50% of non-bacterial diarrhea outbreaks (*4*). With advancements in detection technology, norovirus has come under increased scrutiny as a key pathogen in viral diarrhea. Characterized by its potent pathogenicity, infection can occur with as few as 10–100 viral particles (*5*–*6*), leading to gastrointestinal symptoms such as nausea, vomiting, and diarrhea. These characteristics make norovirus particularly prone to outbreaks in settings with dense populations, such as kindergartens, schools, and restaurants.

Norovirus, characterized by its high infectivity and rapid transmissibility, is a predominant cause of sporadic and outbreak-related cases of acute gastroenteritis globally, posing a substantial health burden. Since 2013 in China, norovirus infection has been the primary cause of outbreaks of other infectious diarrhea diseases (infectious diarrhea diseases other than cholera, bacterial and amoebic dysentery, typhoid

TABLE 1. Distribution of clinical manifestations.

Symptoms	Number of cases (*N*=11)	Percentage (%)	Remarks
Vomiting	11	100	Occurred 3 to 20 times
Abdominal Pain	9	82	–
Leukocytosis	9	90	10 cases visited the hospital, 8 cases with white blood cells over 20×10^9/L
Nausea	6	55	–
Fatigue	3	27	–
Diarrhea	1	9	Occurred 4 times

Note: the dash indicates no remarks.

and paratyphoid fever), with a significant increase in the number of outbreaks compared to previous years (*7*–*9*).

This outbreak event was confirmed based on clinical symptoms, epidemiological investigations, and laboratory testing results. Supporting evidence includes: 1) all cases occurring within the same class; 2) the synchronized onset of symptoms within a 12-hour window after returning home, consistent with the typical norovirus incubation period; 3) no close contact between the affected class and other classes; 4) a thorough case search ensuring identification of all cases; and 5) the prompt response, early reporting, and effective preventive measures implemented by the kindergarten.

The outbreak was hypothesized to originate from a potential source of infection within the class following an individual's return after the 72-hour quarantine period post-symptom resolution. This assumption is supported by: 1) the predominant symptom of vomiting among the children, corroborated by laboratory findings confirming norovirus infection; 2) the timing of the potential source's return to class coinciding with the outbreak's start and genetic alignment with other outbreak isolates; and 3) the exclusion of other exposure possibilities, such as dining conditions and the health status of cooks, teachers, and children in other classes.

Post-infection, individuals can shed norovirus during the incubation period, peaking 2–5 days after symptom onset and persisting for approximately 2–3 weeks, with the longest reported shedding period exceeding 56 days (*10*). Standardized management protocols are crucial for controlling transmission and minimizing environmental contamination. The current guideline in China dictates a quarantine period extending from the acute phase until 72 hours after symptom resolution, as viral shedding significantly decreases thereafter. However, given norovirus's extended shedding time, transmission may still occur beyond the 72-hour mark, potentially contributing to the source of infection in this outbreak.

However, this investigation had limitations. Although the outbreak was traced to an early case (a potential source of infection), positive norovirus tests do not guarantee infectivity, and not all cases underwent testing, particularly asymptomatic carriers. Furthermore, the potential source of infection was asymptomatic upon returning to the kindergarten. This, along with the lack of positive environmental findings, suggests that the evidence linking this individual to the outbreak is inconclusive.

Norovirus currently comprises at least six genogroups, further classified into at least 30 genotypes (*11*), with GI, GII, and GIV known to infect humans. The confirmed pathogen of this outbreak is norovirus GII. Norovirus mutates rapidly, and new variants that can cause global epidemics emerge every 2–3 years.

Norovirus infection presents with fever, diarrhea, nausea, vomiting, and abdominal pain, often accompanied by secondary symptoms such as headache, discomfort, and fatigue, typically manifesting as acute gastroenteritis. Although China classifies norovirus as a Class C infectious disease for reporting and management, detection and reporting may be delayed, particularly when vomiting is the primary symptom. In this outbreak, vomiting was ubiquitous, while other symptoms were notably absent, consistent with literature indicating that children exhibit vomiting more frequently than adults (*12*).

In light of the findings, we advocate for further research into the viral shedding duration in asymptomatic norovirus gastroenteritis cases, which is essential for refining outbreak detection and containment strategies.

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