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Hepatitis A Outbreak Investigation at X Islamic Boarding School, Central Java, Indonesia

Bayu Satria Wiratama[1]*, Yusrizal Yusrizal[2,3], Tutik Inayah Susilaningsih[2,3], Akhmad Mukhibin[5]

[1]Department of Biostatistics, Epidemiology, and Population Health, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia,
[2]Field Epidemiology Training Program, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada, Yogyakarta, Indonesia
[3]Lhokseumawe District Health Office, Aceh, Indonesia
[4]Kulon Progo District Health Office, Yogyakarta, Indonesia
[5]Kebumen District Health Office, Central Java, Indonesia

*Corresponding Author: bayu.satria@ugm.ac.id

Abstract

Research Objective: To describe the epidemiological characteristics, identify risk factors, and recommend control measures for a hepatitis A outbreak at X Islamic Boarding School, Kebumen District, Central Java, Indonesia in 2022. **Methodology:** A descriptive and case-control study was conducted from February 12 to March 17, 2022, among 1,319 students. Cases were defined as students presenting with symptoms including fever, fatigue, nausea, vomiting, headache, decreased appetite, abdominal pain, diarrhea, joint pain, and jaundice. Laboratory confirmation was performed using IgM anti-HAV testing. A case-control study (1:2 ratio) with 39 cases and 77 controls was conducted using purposive sampling. Data were collected through structured interviews assessing demographic characteristics and behavioral risk factors. Bivariate analysis using chi-square and multivariate analysis using logistic regression were performed. **Results:** A total of 212 students developed symptoms (attack rate 16.1%), with 45 laboratory-confirmed cases. The highest attack rate occurred in females (17.5%) and students aged less than 15 years (50.5%). Four behavioral risk factors showed significant associations: not washing hands with soap before eating (OR=3.26; 95% CI=1.415-7.541), sharing eating utensils with one container (OR=3.94; 95% CI=1.749-8.889), sharing or borrowing eating utensils (OR=2.96; 95% CI=1.324-6.648), and snacking habits (OR=3.08; 95% CI=1.293-7.350). Water samples from regular wells and canteen drinking water tested positive for *Escherichia coli* contamination. The epidemic curve showed a common source pattern. **Conclusion:** The hepatitis A outbreak was confirmed through epidemiological investigation and laboratory testing, with contaminated water sources and poor hand hygiene practices identified as primary transmission routes. Implementation of water treatment, health education, and improved sanitation facilities are essential control measures to prevent future outbreaks in congregate settings.

Keywords: *hepatitis A outbreak; Islamic boarding school; risk factors; water contamination; hand hygiene*

INTRODUCTION

Hepatitis A is an acute viral infection of the liver caused by the hepatitis A virus (HAV), transmitted primarily through the fecal-oral route following close contact with infected individuals or consumption of contaminated food and water (World Health Organization, 2025). The disease manifests with symptoms including fever, fatigue, loss of appetite, nausea, right upper quadrant abdominal pain, dark-colored urine followed by jaundice, though asymptomatic presentations also occur (Kundur, Liang, and Terrault, 2021). The emergence of hepatitis A is closely associated with poor sanitation conditions and low personal hygiene standards (Centers for Disease Control and Prevention, 1998).

Hepatitis A predominantly affects developing countries, with an estimated 1.5 million cases occurring globally each year (Lemon et al., 2018; World Health Organization, 2019). According to the 2019 viral hepatitis surveillance report, hepatitis A incidence increased by 1,325% from 2015 to 2019 (Ministry of Health Indonesia, 2019). In Indonesia, the prevalence of hepatitis increased from 0.6% in

2007 to 1.2% in 2013 according to Basic Health Research (Riskesdas) data, representing a twofold increase (Ministry of Health Indonesia, 2013). Among the Indonesian population aged 15 years and above, 19.3% have been infected with hepatitis A (Ministry of Health Indonesia, 2013). Hepatitis A frequently occurs as outbreaks, with 495 cases reported across six provinces including Kepulauan Riau, Lampung, West Sumatra, Jambi, Central Java, and East Java (Ministry of Health Indonesia, 2022).

Islamic boarding schools (pesantren) represent high-risk settings for hepatitis A transmission due to congregate living conditions, shared facilities, and challenges in maintaining adequate sanitation infrastructure (Martini et al., 2022; Mardani et al., 2024). Outbreaks in residential schools have been documented internationally, with attack rates ranging from 16% to 39%, predominantly affecting students in dormitory settings (Nair, Jayakrishnan & Rajendran, 2021; Wensley et al., 2022). Previous outbreak investigations in similar settings identified contaminated water sources, inadequate hand hygiene practices, and food handler contamination as primary transmission routes (Mardani et al., 2024; Sattar et al., 2000).

On February 6, 2022, Regional Hospital reported a student from X Islamic Boarding School, presenting with fever, nausea, tea-colored urine, yellowing of the eyes and skin. The student had previously been hospitalized on January 23, 2022, with weakness and jaundice symptoms shortly after returning from the boarding school. On February 7, 2022, Community Health Center conducted an epidemiological investigation and identified five additional students with symptoms of fever, weakness, yellow eyes, and tea-colored urine. Following instructions from the District Health Office on February 11, 2022, a Rapid Response Team was deployed to coordinate and assess available resources. On February 12 and 14, 2022, the Rapid Response Team investigated X Islamic Boarding School and identified students presenting with fever, fatigue, nausea, vomiting, dark brown urine, headache, decreased appetite, abdominal pain, yellow eyes, diarrhea, joint pain, and muscle pain. Field findings indicated a suspected hepatitis A outbreak at X Islamic Boarding School with 123 initial cases.

Despite the known risk of hepatitis A outbreaks in congregate settings, limited epidemiological data exist regarding risk factors and transmission dynamics specific to Islamic boarding schools in Indonesia. This investigation aimed to describe the epidemiological characteristics of the outbreak, identify specific behavioral and environmental risk factors associated with hepatitis A transmission, and provide evidence-based recommendations for outbreak control and prevention strategies in similar institutional settings.

METHODS

Study Design and Setting

This study employed a descriptive epidemiological analysis combined with a case-control study design. The investigation was conducted at X Islamic Boarding School, Somalangu, Kebumen District, Central Java, Indonesia, from February 12 to March 17, 2022. The boarding school housed a total population of 1,319 students residing in six dormitories with shared dining and sanitation facilities.

Case Definition and Population

A suspected case was defined as any student presenting with at least three of the following symptoms: fever, fatigue, nausea, vomiting, headache, decreased appetite, abdominal pain, diarrhea, joint pain, muscle pain, or jaundice (yellowing of eyes or skin) between January 15 and March 17, 2022. A confirmed case was defined as a suspected case with positive IgM anti-HAV (anti-HAV IgM) laboratory test results.

The study population consisted of all 1,319 students enrolled at X Islamic Boarding School during the outbreak period. A total of 212 students met the suspected case definition, with 45 laboratory-

confirmed cases. For the case-control study, sample size calculation was performed using OpenEpi software, resulting in 39 cases and 77 controls with a case-to-control ratio of 1:2. We conducted a matched case control study design with age (using five years range) and gender as matching variables. Controls were selected from asymptomatic students with no history of hepatitis A symptoms during the outbreak period using purposive sampling based on matching criteria (age and gender). To minimize selection bias, we select control who match the criteria based on the nearest age.

Data Collection

Data were collected through structured face-to-face interviews with students using a standardized questionnaire. Variables assessed included demographic characteristics (age, gender, dormitory residence, school level, class), and behavioral risk factors: hand washing habits before meals, hand washing with soap before meals, hand washing with soap after using the toilet, sharing meals with friends using one container, sharing or borrowing eating utensils with friends, washing eating utensils with soap, snacking habits, and usual snacking locations.

Environmental investigation included inspection of water sources, sanitation facilities, kitchen conditions, and food handling practices. Water samples were collected from bore wells, regular wells, and canteen drinking water sources and tested for microbiological contamination. Laboratory investigation included serological testing (IgM anti-HAV) of symptomatic students and food handlers, conducted at the District Health Laboratory and reference laboratories.

Data Analysis

Descriptive analysis was conducted using person, place, and time (PPT) epidemiological framework. Attack rates were calculated by gender, age group, and dormitory location. An epidemic curve was constructed based on symptom onset dates to determine outbreak pattern. Bivariate analysis using simple conditional logistic regression was performed to assess associations between behavioral risk factors and hepatitis A infection, with statistical significance set at $p<0.05$. Odds ratios (OR) and 95% confidence intervals (CI) were calculated to measure the strength of associations. Variables with p-value <0.25 in bivariate analysis were included in multivariate conditional logistic regression analysis to identify independent risk factors. We evaluate model diagnostic using Hosmer-Lemeshow test.

Research Ethics

This investigation was conducted as a primary public health emergency response to an acute outbreak, mandated by the XX District Health Office in Central Java. As the primary objective was the identification of the source of the outbreak and the implementation of immediate control measures to prevent further morbidity, the activity was classified as non-research public health surveillance. Consequently, formal institutional review board (IRB) approval was not required.

Despite the emergency nature of the response, ethical principles were strictly upheld. Verbal informed consent was obtained from all participants (or guardians for minors) prior to any interview or specimen collection. Verbal consent was deemed appropriate given the urgency of the field investigation and the need to minimize administrative delays during the containment phase. Participants were informed of the voluntary nature of their involvement and the intended use of the data for public health action.

To protect participant privacy, all data were anonymized during analysis, and individual identities are not disclosed in this report. All diagnostic procedures and field materials were provided at no cost to the participants.

RESULTS

Descriptive Epidemiology

Clinical Presentation

Among 212 symptomatic students, the most frequently reported symptoms were fever (159 cases, 75.0%), dark tea-colored urine (146 cases, 68.9%), fatigue (146 cases, 68.9%), nausea (142 cases, 67.0%), yellow eyes (101 cases, 47.6%), and headache (95 cases, 44.8%). Additional symptoms included decreased appetite (72 cases, 34.0%), vomiting (68 cases, 32.1%), right upper quadrant abdominal pain (46 cases, 21.7%), diarrhea (37 cases, 17.5%), muscle pain (13 cases, 6.1%), and joint pain (13 cases, 6.1%).

Distribution by Person

Table 1: Distribution of Hepatitis A Cases by Demographic Characteristics

Characteristic	Population	Cases	Attack Rate (%)	CFR (%)
Gender				
Male	598	86	14.4	0
Female	721	126	17.5	0
Age Group				
< 15 years	107	107	50.5	0
15-24 years	1212	105	49.5	0
Total	1319	212	16.1	0.5

Table 1 showed that females had a higher attack rate (17.5%) compared to males (14.4%), with 126 female cases and 86 male cases. Age distribution revealed that students aged less than 15 years had the highest proportion of cases (50.5%), while the 15-24 years age group represented 49.5% of cases. The overall attack rate among the boarding school population was 16.1%.

Distribution by Place

Table 2: Distribution of Hepatitis A Cases by Dormitory Location

Dormitory	Population	Cases	Attack Rate (%)	Deaths	CFR (%)
Abdul Kahfi	195	26	13.3	1	3.8
Abdurrahman	143	36	25.2	0	0
Ibrahim	260	24	9.2	0	0
Saiyidah Umu Khasum	359	77	21.4	0	0
Saiyidah Zulaikha	135	11	8.1	0	0
Saiyidah Umi Lathifah	227	38	16.7	0	0
Total	1319	212	16.1	1	0.5

Table 2 showed distribution based on place. Spatial distribution analysis revealed that Saiyidah Umu Khasum dormitory had the highest number of cases (77 cases) and the highest attack rate (21.4%), followed by Abdurrahman dormitory with an attack rate of 25.2% (36 cases). One fatality occurred in Abdul Kahfi dormitory, resulting in a case fatality rate of 3.8% for that dormitory and an overall case fatality rate of 0.5%.

Distribution by Time

The epidemic curve (fig 1) constructed based on symptom onset dates demonstrated a common source outbreak pattern, with cases occurring after exposure to a shared contamination source. The outbreak began with the first suspected case on January 15, 2022, the first laboratory-confirmed case on February 14, 2022, and the last case reported on April 17, 2022. The epidemic curve showed a rapid increase in cases during the third week of February, followed by a gradual decline, characteristic of a point source outbreak pattern. The outbreak was classified as a point source because the distribution of cases showed a single, rapid peak with all illness onset occurring within one known incubation period of the suspected exposure. This pattern distinguishes it from a continuous common source, which would manifest as a prolonged plateau on the epidemic curve, indicating an ongoing exposure to the contaminated vehicle over an extended timeframe.

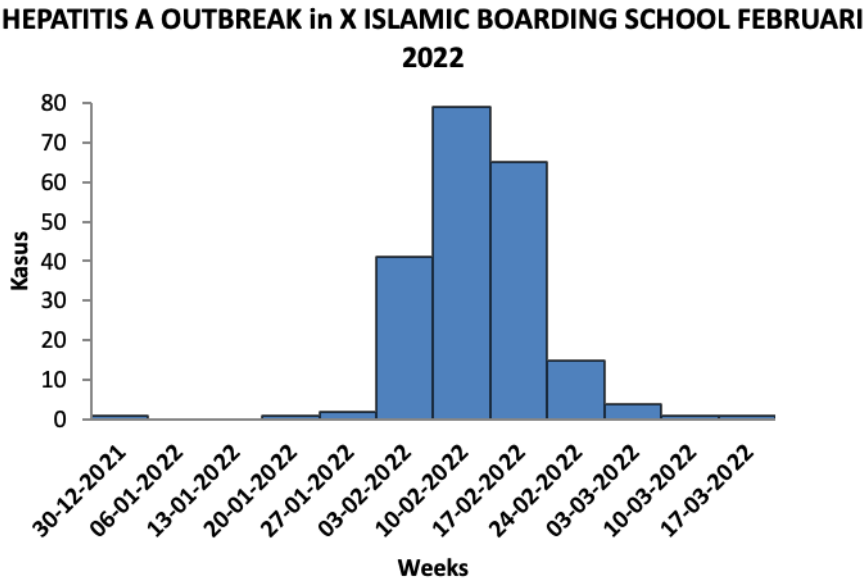

Figure 1. Epidemic curve

Risk Factor Analysis

Bivariate Analysis

Table 3. Bivariate Analysis of Behavioral Risk Factors Associated with Hepatitis A Infection

Risk Factor	Cases	Controls	p-value	OR	95% CI
Hand washing before meals					
Yes	24	40	0.327	1.48	0.630-3.523
No	15	37			
Hand washing with soap before meals					
Yes	18	16	0.005	3.26	1.301-8.197

No	21	61			
Hand washing with soap after toilet					
Yes	21	36	0.470	1.32	0.572-3.096
No	18	41			
Sharing meals (one container)					
Yes	25	24	0.001	3.94	1.626-9.676
No	14	53			
Sharing/borrowing eating utensils					
Yes	26	31	0.007	2.96	1.236-7.256
No	13	46			
Washing utensils with soap					
Yes	33	62	0.588	1.33	0.434-4.851
No	6	15			
Snacking habits					
Yes	30	40	0.009	3.08	1.212-8.327
No	9	37			
Snacking location					
Boarding school canteen	10	15	0.721	0.80	0.444-1.440
Outside canteen	20	25			

Table 3 showed the result of bivariate analysis. Bivariate analysis identified four behavioral factors significantly associated with hepatitis A infection ($p<0.05$ and $OR>2$): not washing hands with soap before meals (OR=3.26; 95% CI=1.301-8.197; p=0.005), sharing meals with friends using one container (OR=3.94; 95% CI=1.626-9.676; p=0.001), sharing or borrowing eating utensils (OR=2.96; 95% CI=1.236-7.256; p=0.007), and snacking habits (OR=3.08; 95% CI=1.212-8.327; p=0.009).

Multivariate Analysis

Table 4. Multivariate Logistic Regression Analysis of Risk Factors for Hepatitis A Infection

Risk Factor	Adjusted OR	p-value	95% CI
Not washing hands with soap before meals	3.26	0.006	1.415-7.541
Sharing meals (one container)	3.94	0.001	1.749-8.889
Sharing/borrowing eating utensils	2.96	0.008	1.324-6.648
Snacking habits	3.08	0.011	1.293-7.350

Multivariate logistic regression (table 4) analysis confirmed that all four risk factors remained independently associated with hepatitis A infection. Students who did not wash hands with soap before meals had 3.26 times higher risk of hepatitis A infection compared to those who practiced hand washing with soap (adjusted OR=3.26; 95% CI=1.415-7.541; p=0.006). Students who shared meals with friends using one container had 3.94 times higher risk (adjusted OR=3.94; 95% CI=1.749-8.889; p=0.001). Students who shared or borrowed eating utensils had 2.96 times higher risk (adjusted OR=2.96; 95% CI=1.324-6.648; p=0.008). Students with snacking habits had 3.08 times higher risk compared to those without snacking habits (adjusted OR=3.08; 95% CI=1.293-7.350; p=0.011). The model diagnostic result from Hosmer-Lemeshow test showed a good model with p>0.05.

Laboratory Investigation

Table 5: Laboratory confirmation of hepatitis A (IgM anti-HAV testing)

Sample Type	Male	Female	Positive	Negative
Students	13	40	45	8
Food handlers (internal)	7	4	3	8
Food handlers (external)	5	3	1	7
Total	25	47	49	23

Laboratory testing (table 5) of 72 individuals revealed 49 positive IgM anti-HAV results, including 45 students and 4 food handlers. Among food handlers, 3 internal food handlers (who were also students working in the kitchen) and 1 external food handler (a beverage vendor) tested positive for hepatitis A. The external food handler reported experiencing fever and fatigue symptoms in early January 2022.

Environmental Investigation

Table 6. Microbiological Water Quality Testing Results

Water Source	Result (CFU/100mL)	Standard	Status
Clean water (bore well)	0	< 50	Compliant
Clean water (regular well)	≥ 1898	< 50	Non-compliant
Drinking water (canteen)	265	0	Non-compliant

Environmental investigation (table 6) revealed significant water quality issues. The bore well water met quality standards with no *Escherichia coli* contamination detected. However, the regular well water showed severe contamination with ≥1,898 CFU/100m*L E. coli*, far exceeding the standard of <50 CFU/100mL. The canteen drinking water (depot water) showed contamination with 265 CFU/100mL *E. coli*, attributed to contamination during storage in unwashed gallon containers. Interviews with boarding school administrators revealed inadequate water supply as a persistent challenge for the

institution, particularly given the large student population. Although the school operated a branded water depot, contamination occurred at the point of use due to improper container hygiene.

DISCUSSION

This investigation confirmed a hepatitis A outbreak at X Islamic Boarding School through epidemiological analysis, laboratory testing, and environmental assessment. The overall attack rate of 16.1% (212 cases among 1,319 students) falls within the range reported in similar institutional outbreaks in residential schools and boarding facilities (Nair, Jayakrishnan & Rajendran, 2021; Wensley et al., 2022; Martini, Lestyorini & Artanti, 2021). The common source epidemic pattern observed in this outbreak is consistent with waterborne or foodborne transmission routes characteristic of hepatitis A virus spread in congregate settings (Fiore, 2004).

Epidemiological Characteristics

The higher attack rate among female students (17.5%) compared to male students (14.4%) may reflect gender-specific behavioral patterns, dormitory conditions, or differential exposure to contaminated sources. Similar gender differences have been documented in other boarding school outbreaks, potentially related to hygiene practices, food preparation involvement, or shared facility usage patterns (Mardani et al., 2024; Peters, Huxley & Woodward, 2014). The predominance of cases among students aged less than 15 years (50.5%) aligns with established epidemiological patterns of hepatitis A, as younger individuals in endemic areas often lack prior immunity and experience higher susceptibility to infection.

The spatial distribution of cases, with the highest attack rates in Saiyidah Umu Khasum (21.4%) and Abdurrahman (25.2%) dormitories, suggests differential exposure to contaminated water sources or food items. Previous outbreak investigations have demonstrated that dormitory-specific attack rates often correspond to proximity to contaminated water sources, shared dining facilities, or common sanitation infrastructure (Nair, Jayakrishnan & Rajendran, 2021; Sattar et al., 2000). The single fatality (case fatality rate 0.5%) is consistent with the typically self-limited nature of hepatitis A, though severe outcomes can occur, particularly in individuals with underlying health conditions or immunosuppression (Cosentino et al., 2020).

Transmission Routes and Risk Factors

The multivariate analysis identified four independent behavioral risk factors significantly associated with hepatitis A infection, all related to fecal-oral transmission pathways. Not washing hands with soap before meals (adjusted OR=3.26) represents a critical breakdown in personal hygiene practices that directly facilitates viral transmission. The hepatitis A virus can survive on hands and surfaces for extended periods, and inadequate hand hygiene after toilet use or before food handling provides an efficient route for fecal-oral spread (Kampf et al., 2020; Curtis & Cairncross, 2003). Studies have demonstrated that proper hand washing with soap can reduce enteric pathogen transmission by 40-50%, making this a key intervention point for outbreak control (Freeman et al., 2014).

Sharing meals using one container (adjusted OR=3.94) and sharing or borrowing eating utensils (adjusted OR=2.96) represent cultural practices common in communal settings that significantly increase transmission risk. These behaviors facilitate direct transfer of infectious viral particles from infected individuals to susceptible students through contaminated saliva and food contact surfaces (Koopmans & Duizer, 2004; Green et al., 2020). Similar risk factors have been identified in other boarding school and military barracks outbreaks, where communal dining practices contributed to rapid disease spread (Mardani et al., 2024; Martini, Lestyorini & Artanti, 2021).

The association between snacking habits and hepatitis A infection (adjusted OR=3.08) likely reflects consumption of contaminated food or beverages from external vendors or the school canteen. The identification of a positive IgM anti-HAV result in an external beverage vendor who experienced symptoms in early January 2022 suggests that contaminated food products may have served as vehicles for initial viral introduction into the school community (Sánchez, Elizaquível & Aznar, 2012). Foodborne hepatitis A outbreaks have been extensively documented, with infected food handlers representing the most common source of contamination at the point of sale or service (Fiore, Wasley & Bell, 2006).

Environmental Factors

The severe contamination of the regular well water (≥1,898 CFU/100mL *E. coli*) and canteen drinking water (265 CFU/100mL *E. coli*) provides strong evidence for waterborne transmission as a primary outbreak mechanism. The presence of *E. coli* in water sources indicates fecal contamination and suggests potential co-contamination with hepatitis A virus, which shares similar fecal-oral transmission routes (Leclerc, Schwartzbrod & Dei-Cas, 2002; Craun et al., 2010). Waterborne hepatitis A outbreaks are typically associated with sewage contamination or inadequate water treatment, conditions identified in this investigation (Mellou et al., 2021; Bosch, Pintó & Abad, 2006).

The finding that internal food handlers (who were also students) tested positive for IgM anti-HAV suggests secondary transmission or common source exposure rather than primary foodborne introduction. However, infected food handlers who continue working can amplify outbreak spread by contaminating food preparation surfaces, utensils, and ready-to-eat items (Fiore, Wasley & Bell, 2006; Stals et al., 2012). The contamination pathway likely involved: (1) contaminated water sources introducing HAV into the school community, (2) inadequate hand hygiene practices facilitating person-to-person transmission, (3) shared eating practices amplifying spread, and (4) infected students working as food handlers creating additional exposure opportunities (Khetsuriani et al., 2007).

Comparison with Similar Outbreaks

This outbreak shares epidemiological similarities with other documented hepatitis A outbreaks in boarding schools and residential facilities. A 2019 outbreak investigation at a residential school in Palakkad, India, reported 565 affected individuals (attack rate 22.09%) with contaminated water sources confirmed as the primary transmission vehicle (Nair, Jayakrishnan & Rajendran, 2021). Similarly, a 2023 outbreak at an Islamic boarding school in Rokan Hilir, Indonesia, identified contact history and poor nail hygiene as significant risk factors, consistent with fecal-oral transmission patterns (Mardani et al., 2024). An outbreak in a secondary school demonstrated foodborne transmission with limited person-to-person spread, emphasizing the importance of food handler screening and exclusion policies (Wensley et al., 2022).

These comparative findings underscore common themes in congregate setting outbreaks: inadequate water treatment infrastructure, challenges in maintaining hygiene standards with large populations, cultural practices facilitating transmission, and the critical role of early detection and rapid response. The consistency of risk factors across multiple outbreak investigations provides strong evidence for targeted intervention strategies focused on water quality, hand hygiene promotion, and modification of high-risk communal practices.

Limitations

The findings of this investigation should be interpreted in light of several limitations. First, the case-control study utilized a relatively small sample size of 39 cases and 77 controls, which may have limited the statistical power necessary to detect significant associations for variables with more modest

effect sizes. Second, while 212 students met the clinical case definition, laboratory confirmation was obtained for only 45 cases (21.2%). This constraint was primarily due to limited resources and the difficulty of optimal timing for specimen collection relative to the onset of symptoms, which may have resulted in some case misclassification.

Third, the cross-sectional nature of the behavioural risk factor assessment introduces the potential for recall bias, as participants may not have accurately remembered or reported their past hygiene and snacking behaviours during the outbreak period. Finally, the investigation could not definitively establish the exact temporal sequence of environmental contamination events or identify a single index case, which limits our conclusions regarding the precise initial source of the viral introduction into the school environment

Public Health Implications

This outbreak demonstrates the vulnerability of congregate living settings to hepatitis A transmission when water quality, sanitation infrastructure, and hygiene practices are suboptimal. The identification of modifiable behavioral risk factors provides actionable targets for intervention. Islamic boarding schools and similar residential educational institutions require comprehensive prevention strategies including: regular monitoring of water quality with prompt remediation of contaminated sources, installation of adequate water treatment systems, provision of sufficient hand washing facilities with soap at strategic locations, health education programs addressing fecal-oral disease transmission, modification of communal eating practices to reduce shared utensil use, exclusion of symptomatic food handlers until medically cleared, and consideration of hepatitis A vaccination programs for students in endemic areas.

CONCLUSION

The hepatitis A outbreak at X Islamic Boarding School affected 212 students with an overall attack rate of 16.1% and was confirmed through epidemiological investigation and laboratory testing. The outbreak exhibited a common source epidemic pattern consistent with contaminated water sources and amplified transmission through poor hand hygiene practices and communal dining behaviors. Multivariate analysis identified four independent risk factors: not washing hands with soap before meals, sharing meals using one container, sharing or borrowing eating utensils, and snacking habits. Environmental investigation revealed severe *E. coli* contamination in water sources, confirming inadequate water quality as a primary transmission route.

These findings emphasize the critical importance of integrated prevention strategies in congregate settings, including water treatment infrastructure, hand hygiene promotion, modification of high-risk cultural practices, food handler health screening, and consideration of hepatitis A vaccination programs. Boarding schools and similar residential institutions must prioritize adequate sanitation infrastructure, regular water quality monitoring, and comprehensive health education to prevent future outbreaks. Early outbreak detection through enhanced surveillance and rapid implementation of control measures are essential to minimize attack rates and prevent severe outcomes in vulnerable populations.

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Ethical Approval Statement: This investigation was conducted as a public health emergency response to an outbreak. All participants provided informed consent before data collection. Confidentiality and anonymity of participants were maintained throughout the investigation process.

Informed Consent Statement: Verbal informed consent was obtained from all participants involved in the study. For minor participants, consent was obtained from school administrators and guardians.

Data Availability Statement: The data presented in this study are available from the corresponding author upon reasonable request. The data are not publicly available due to ethical considerations and privacy protection of participants.

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