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Epidemiology investigation of typhoid incidence in senior high school X in Magelang District

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Abstract

Purpose: This study aimed to determine the magnitude and cause of the outbreak, describe the outbreak based on person, place, and time, and implement control measures. **Methods:** This study uses descriptive epidemiology and looks for active cases to find additional cases. Cases included students with fever with or without further symptoms: dizziness, nausea, vomiting, headache, stomachache, diarrhea, and chills from September 28 to November 28. Data collection was carried out through interviews using a standard questionnaire. We took clean water, drinking water, and blood samples. The water sample was sent to the Environmental Health Laboratory, and the blood sample to a private laboratory in Magelang for an IgM anti-*Salmonella typhi* test. **Results:** The number of cases was 150 students. The highest attack rates were among women, 72/359 (20.1%), and first-year students, 139/381 (36.48%). The onset of the disease starts from 28 September to 26 October 2016. There are outbound activities on the river on 26 September, attended by all first-year and second- and third-year students, as part of the activity committee. This activity is followed by eating together before and after washing hands with soap. All cases attended outbound activities. IgM was positive in 51 students, and water samples were negative for *Salmonella typhi.* **Conclusion:** There was an outbreak of typhoid fever with 150 cases in schools from 28 September to 28 November 2016. The outbreak was caused by the lack of hand-washing with soap when eating. We provide medical and health education to students about typhoid fever. The recommendation is to make school rules about the behavior of washing hands with soap, and if you take a bath in the river, before eating, it is necessary to wash your body and hands with soap.

Keywords: epidemiology investigation; outbreak; Salmonella typhi; typhoid fever

INTRODUCTION

Typhoid fever is a life-threatening disease caused by Salmonella serotype Typhi, usually through consumption of contaminated food or water. Acute illness is characterized by prolonged fever, headache, nausea, loss of appetite, and constipation or sometimes diarrhea. Symptoms are often non-specific and clinically indistinguishable from other febrile illnesses. However, clinical severity varies and severe cases can lead to serious complications or even death [1,2].

Globally the disease is estimated to cause 220,000 deaths and 22 million illnesses per year , mainly in school-age children or younger [3]. High incidence of typhoid fever (> 100/100,000 cases/year) includes Southeast Asia and Southeast Asia. The areas with moderate incidence (10-100/100,000 cases/year) include all of Asia, Africa, Latin America and the Caribbean, and Oceania, except Australia and New Zealand [4]. Especially in developing countries where sanitation conditions are poor. Typhoid fever is endemic in Asia, Africa, Latin America, the Caribbean, and Oceania, but 80% of cases are from Bangladesh, China, India, Indonesia, Laos, Nepal, Pakistan or Vietnam [5].

In Indonesia, typhoid is an endemic disease, often affecting school-age children and productive age groups. This disease causes high absenteeism rates, on average it takes 7-14 days for treatment if someone is exposed to typhoid. If the treatment is not complete, it can lead to a career which then becomes a source of infection for other people [6].

In 2008, the typhoid morbidity rate in Indonesia was reported at 81.7 per 100,000 population, with the distribution according to the age group of 0.0/100,000 population (0–1 years), 148.7/100,000 population (2–4 years), 180, 3/100,000 (5-15 years), and 51.2/100,000 (≥16 years). In the last 12 months, clinical typhoid can be detected in Central Java Province with a prevalence of 1.6%, and is spread across districts/cities with a range of 0.2 - 3.5% [7].

On October 15, 2016, the head of the Magelang District Health Office received a report from the school that students were diagnosed with typhoid. The head of the surveillance and handling section for outbreak responded to the report and found 60 suspected cases of *Salmonella typhi* with 4 confirmation of IgM Anti Salmonella Typhi up to 17 October 2016 [8] On 18 October 2016 the outbreak team of Public Health Canter and Field Epidemiology Training Program (FETP) students started an investigation to determine the magnitude of the outbreak, the cause of the outbreak, describes the outbreak based on the person, place, time of day and implement outbreak control.

METHOD

This study used descriptive epidemiology and active case finding to find additional cases. Cases were students who had fever with or without any of the additional symptoms: dizziness, nausea, vomiting, headache, stomachache, diarrhea, and chills from September 28 to November 28, 2021. Data were collected by interview using a standard questionnaire. We took clean water, drinking water and blood samples. The water sample was sent to the Environmental Health Laboratory and the blood sample was sent to a private laboratory in Magelang for IgM anti *Salmonella typhi* test. The TUBEX test is a semi-quantitative competitive agglutination test that is simple, fast (approximately 5 minutes) and very accurate in the diagnosis of acute typhoid fever because it only detects the presence of Anti Salmonella IgM antibodies and does not detect IgG antibodies within a few minutes2.

RESULTS

Epidemiology

Based on the identification results obtained symptoms such as fever, dizziness, nausea, vomiting, headaches, abdominal pain, diarrhea and chills (Table 1). As of 26 November 2016 (2x incubation period), 150 cases had been identified, and 51 positive cases of typhoid were found from laboratory tests using Igm anti-Salmonella typhi. The highest attack rate was women 72/359 (20.1%), while men 78/715 (10.4%). Table 2 shows that the highest attack rate is in class x-1 (59.4%). The average case was in class x 139/381 (36.48%).

Table 1. Distribution of symptoms and signs of cases (n=187)

Symptoms and signs	%
Dizzy	54.0
Nausea	23.3
Headache	22.7
Stomach ache	10.0
Diarrhea	6.7
Vomiting	6.0
Shivering	2.0

Table 2. Distribution of cases and attack rates by class

Class	Population at risk	Case	%	Attack rate (%)
x-1	32	19	12.67	59.4
x-2	32	11	7.33	34.4
x-3	32	17	11.33	53.1
x-4	32	15	10.00	46.9
x-5	31	10	6.67	32.3
x-6	31	9	6.00	29.0
x-7	31	10	6.67	32.3
x-8	32	13	8.67	40.6
x-9	32	11	7.33	34.4
x-10	32	10	6.67	31.3

Class	Population at risk	Case	%	Attack rate (%)
x-11	32	8	5.33	25.0
x-12	32	6	4.00	18.8
xi mipa 2	31	1	0.67	3.2
xi mipa 4	31	1	0.67	3.2
xi mipa 5	31	1	0.67	3.2
xi mipa 6	31	1	0.67	3.2
xi mipa 7	30	2	1.33	6.7
xi mipa 8	30	1	0.67	3.3
xi ips 1	31	1	0.67	3.2
xi ips 2	31	1	0.67	3.2
xii mipa 3	31	1	0.67	3.2
xii mipa 5	31	1	0.67	3.2
Total	658	150	100	

Table 3. Distribution of cases and attack rates by barracks

Barracks	Population at risk	Case	Percent	Attack rate (%)
c-1	41	17	11.3	41.5
c-2	41	29	19,.3	70.7
c-3	42	19	12.7	45.2
g-5	34	1	0.7	2.9
g-8	36	2	1.3	5.6
g-11	35	1	0.7	2.9
g-14	36	1	0.7	2.8
g-15	36	10	6.7	27.8
g-16	38	12	8.0	31.6
g-17	36	13	8.7	36.1
g-18	37	12	8.0	32.4
g-19	38	10	6.7	26.3
g-20	36	10	6.7	27.8
g-21	37	6	4.0	16.2
t-1	59	2	1.3	3.4
k-1	39	2	1.3	5.1
k-2	39	2	1.3	5.1
k-3	38	1	0.7	2.6
Total	698	150	100.0	

Table 3 shows that the highest attack rate is at C-2 (70.7%) and the lowest is at the K-3 barracks (2.6%). Barak C is a bedroom for class X women. Barak g-15 s.d. 21, the male bedroom of class X. The average cases were in the barracks occupied by class X students.

Figure 1 shows that disease transmission is a common source. Disease onset starts from 28 September to 27 October 2016. Incubation period 2-30 days. At the beginning of school entry on June 16, 2016, there was a student diagnosed with typhoid. Still, if the student were not likely to be the source of transmission because of the long distance and the epidemic curve, it would be person-to-person transmission.

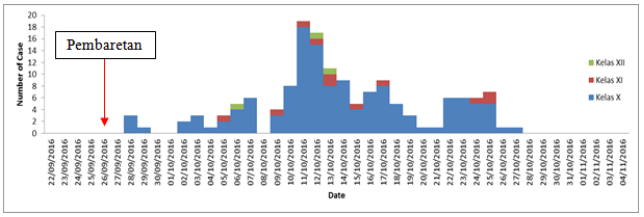

Figure 1. Typhoid outbreak epidemic curve

Environment

Students who are known to have typhoid symptoms during the investigation will have a blood sample and/or rectal swab taken. The results of the interview in class: Students sometimes and rarely wash their hands before eating (51.4%); Students have the habit of often sharing food with friends (60.7%); Students involved in caring for sick friends (81%); Students/students have the habit of sharing cutlery with family members/friends who are sick without washing it first (74.9%); Students said that soap was not available in the bathroom (83.4%)

The school's clean water source comes from groundwater, but Reverse Osmosis (RO) water is for drinking. Water samples taken for microbiological examination were water in the kitchen before entering the RO treatment, RO drinking water, water from the kitchen faucet, ready-to-eat drinking water in the dining room, drinking water in the men's barracks and drinking water in the women's barracks.

Investigation in the kitchen, dining room and canteen: a) Kitchen or cooking room. The school kitchen is in pretty clean condition. Food handlers rarely wash their hands and rarely wash their hands using soap. Washing cutlery such as plates, cups, spoons soaked in a bucket then poured with hot water. The number of trash cans is still insufficient and the trash can is not closed. The food handler cooks every day for all the students on the same menu; b) The dining room. The dining table is dusty and dirty because it is rarely cleaned. The dinner plate smells musty because the plate after being poured with hot water is immediately revealed. The tablespoon was found to have leftovers and seemed oily; c) The school

canteen is still not worthy of being called a canteen because it is dirty. Students who are allowed to go to the canteen are students of class XI and XII.

September 22, 2016, class X students visited the Military Academy from 7.00-15.00. After the event, it was continued with the directions for the Sudirman Commander Route (RPS) activities. RPS is about 17 kilometers of walking through hills and steep roads with 3x breaks. The RPS was held on September 24, 2016. After the RPS was completed the students headed to the *plempungan* shooting range, shaking hands for cleaning and preparing for the Tangkas Ksatria Tangkas (PKT) activity. Food and beverage consumption for this activity is supplied from the school kitchen. PKT activities were held on September 25, 2016. PKT activities are like ropes, overcoming obstacles and orientation.

September 26, 2016, the peak of the activity was the *pembaretan* tradition. These activities include getting into the mud, creeping, rolling around, lying on the ground and finally kissing the flag. After this activity was completed, the students were asked to take a shower or enter an irrigation canal to reduce the mud sticking to it. Then the students were taken to the field to be flushed with clean water from the PDAM. Finally, the students had lunch together in the field. All of these activities are consumed by the students in the form of snacks and meals are supplied from the school kitchen.

Investigation of the location of the planting activity. A possible place as a source of transmission is an irrigation channel that is used to bathe the students in the pavement activities. The irrigation channel is used daily by local residents for bathing, washing clothes and defecating, and there are those who throw garbage there. Discarded waste such as pampers, plastics, household waste. Irrigation canal water samples were taken on 3 November 2016 at 5 points. Around the irrigation canal there are several cases of typhoid in the community. However, there is still no link with typhoid outbreaks in schools.

Laboratory

Table 4 shows that the result of the rectal swab is negative. Negative rectal swabs are possible because rectal swabs are generally considered to be less sensitive, however there is no data that directly compares human rectal swabs with stool samples for detection of Salmonella1. Examination of blood samples with Tubex IgM anti salmonella typhi was 51 positive. Tubex test, which is the product name of the IgM Anti Salmonella test.

The result of the river water is negative, it is possible because the river flow is too heavy and does not know when to open and close the river dam. Action that has been taken: 1) Treatment of sufferers and advise students to rest at barrack until they recover; 2) Epidemiological investigation and taking water samples, rectal swabs and blood and sending them to BBTKL & PP in Yogyakarta; 3) Blood examination at the private laboratory of Prodia Magelang; 4) Providing education to class X students about typhoid, how it is transmitted, how to prevent it and how to wash hands properly; 5) Providing classrooms with leaflets about typhoid.

Table 4. Sample examination results

Sample Type	Number of samples	Test results		
		S. typhi	E. coli	IgM anti S. typhi
Drinking water	4	Negative	Negative	
Groundwater	2	Negative	Negative	
Rectal swab	8	Negative	Negative	
Blood	86			51 positive
River water	5	Negative	Positive	

DISCUSSIONS

The results of the diagnosis were 51 positive IgM anti salmonella typhi students with tubex showed that there had been an outbreak of typhoid fever in high schools in Magelang Regency from 28 September to 28 November 2016. The epidemiological curve leads to transmission with 1 source or common source. The highest attack rate was women with 20.1% while men 10.4%. According to Vollaard et al, (2004) that female sex has a 1.79 times greater risk of developing typhoid than men (OR, 1.79; 95% CI, 1.04-3.06) [9]. However, this study is not in line with the results of Pramitasari's (2013) study which states that the risk of typhoid fever in men who are male is 3.841 times higher than that of women [10]. Typhoid is a geographically spread disease that affects both sexes and all age groups [11].

The behavior of these high school students is sometimes and rarely wash their hands before eating at 51.4%. The results of the study by Vollaard et al (2004) show that people who do not use soap to wash their hands have a 1.9 times greater risk than people who use soap to wash their hands (OR, 1.91; 95% CI, 1.06-3.46). before eating, the risk of getting typhoid fever increases 2,625 times (Rakhman, 2009) and according to Seran (2015) respondents who have a bad habit of washing their hands before eating are 5.2 times more likely to get typhoid fever than respondents who have a good habit of washing their hands before eating [9,12,13].

Febriana (2013) said that 71.4% (10 people), rivers are garbage dumps for people suffering from typhoid fever who are at risk of causing disease [14]. Dewan (2013) found that most of the people living near the rivers Buriganga, Turag, and Balu had a higher risk of typhoid infection compared to people in other locations [15]. The use of river water for various necessities of life increases the spread of infectious diseases that attack the digestive system [16]. So it is likely that river water is a place that is at risk as a source of transmission of typhoid fever.

When conducting an investigation, the school fully supports to find the source of the cause of this typhoid outbreak. This support is very important for the initial steps of conducting an investigation. There are several challenges in proving this investigation; the first is related to collecting in-depth data/information on several students/cases because some are being treated at the hospital and are at home or outside the city so that the investigation team seeks information by calling students and using secondary data recorded at the high school clinic; both investigations on irrigation used for raiding activities. The investigation team suspected whether there was a connection between students bathing in the irrigation canal and the incidence of typhoid, so the investigation team sought information at the puskesmas regarding the community around the irrigation canal who suffered from typhoid before the attack. Then we interviewed several people as well as observed household waste disposal channels and irrigation canals from the shooting location upstream as far as 1-2 kilometers as well as the discovery of feces and pempers which were possible sources of transmission; third, in the support of personnel and laboratories of the puskesmas and local health offices, which are limited because they have to investigate all possible aspects as causes or risk factors for this typhoid outbreak so that the investigation involves several parties such as FETP UGM lecturers, FETP class 2015, BBTKL & PP Yogyakarta and private laboratories.

CONCLUSION

There was an epidemic of typhoid fever with 150 cases in schools from 28 September to 28 November 2016. The outbreak was caused by outbound activities and not washing hands with soap when eating. We provide medical and health education to students about typhoid fever. The recommendation is to make school rules about the behavior of washing hands with soap and if you take a bath in the river, before eating it is necessary to wash your body and wash your hands with soap. The experience gained in proving this investigation is that there is full support from the school so that it is easier to retrieve data/information, the investigation team is required to speculate what might be the source of transmission related to typhoid and the support of personnel and laboratories from several parties is very helpful.

REFERENCES

1. World Health Organization *(*WHO). 2018. Available from:https://www.who.int/teams/immunization-vaccines-and-biologicals/diseases/typhoid.
2. Centers for Disease Control and Prevention (CDC). 2018.Available:https://www.cdc.gov/typhoid-fever/index.html.
3. Ochiai, L., Khan, M. I., Sahastrabuddhe, S. & Wierzba, T. Epidemiology of typhoid fever. International Journal of Infectious Diseases. 2012;16**:** e29.
4. Crump JA, Luby SP, Mintz ED. The global burden of typhoid fever. Bulletin of World Health Organization. 2004;82(5):346-53.
5. Chau TT, Campbell JI, Galindo CM, Van Minh Hoang, N, Diep TS, Nga TT, Dolecek C. Antimicrobial drug resistance of Salmonella enterica serovar Typhi in Asia and molecular mechanism of reduced susceptibility to the fluoroquinolones. Antimicrobial agents and chemotherapy. 2007;51(12): 4315-4323. DOI: https://doi.org/10.1128/aac.00294-07
6. Kementerian Kesehatan RI. Rencana aksi program pengendalian penyakit dan penyehatan lingkungan tahun 2015-2019. Jakarta: Direktorat Jenderal Pengendalian Penyakit Dan Penyehatan Lingkungan. 2015.
7. Badan Litbangkes. Riset Kesehatan Dasar 2013. Jakarta: Kementerian Kesehatan RI. 2013.
8. Dinas Kesehatan Kabupaten Magelang, 2016. Laporan sementara kasus tifoid di SMA X. Mungkid: Dinas Kesehatan Kabupaten Magelang
9. Vollaard, A. M., Ali, S., Van Asten, H. A., Widjaja, S., Visser, L. G., Surjadi, C., & Van Dissel, J. T. Risk factors for typhoid and paratyphoid fever in Jakarta, Indonesia. Jama. 2004;291(21): 2607-2615. DOI: https://doi.org/10.1001/jama.291.21.2607
10. Pramitasari, O. P. Faktor risiko kejadian penyakit demam tifoid pada penderita yang dirawat di Rumah Sakit Umum Daerah Ungaran. Jurnal Kesehatan Masyarakat Universitas Diponegoro. 2013;*2*(1): 18787.
11. Mermin, J. H., Villar, R., Carpenter, J., Roberts, L., Samaridden, A., Gasanova, L., ... & Mintz, E. D. A massive epidemic of multidrug-resistant typhoid fever in Tajikistan associated with consumption of municipal water. The Journal of Infectious Diseases.

1999;179(6):1416-1422.DOI:https://doi.org/10.1086/314766

12. Rakhman, A., Humardewayanti, R., & Pramono, D. Faktor–faktor risiko yang berpengaruh terhadap kejadian demam tifoid pada orang dewasa. Berita Kedokteran Masyarakat (BKM). 2012;*25*(4):167. DOI: https://doi.org/10.22146/bkm.3550
13. Seran, E. R., Palandeng, H., & Kallo, V. Hubungan personal hygiene dengan kejadian demam tifoid di wilayah kerja Puskesmas Tumaratas. Jurnal Keperawatan.2015;3(2).DOI:https://doi.org/10.35790/jkp.v3i2.7449
14. Febriana D, Siswanto Y, Pranowowati, P. Hubungan antara sanitasi lingkungan dengan kejadian demam tifoid di wilayah kerja Puskesmas Lerep Kabupaten Semarang. Semarang: STIKES Ngudi Waluyo; 2013.
15. Dewan, A. M., Corner, R., Hashizume, M., & Ongee, E. T. Typhoid fever and its association with environmental factors in the Dhaka metropolitan area of Bangladesh: a spatial and time-series approach. PLoS Neglected Tropical Diseases. 2013;7(1):e1998.DOI:https://doi.org/10.1371/journal.pntd.0001998
16. Soedarto. Penyakit Menular di Indonesia. Jakarta: CV Sagung Seto; 2009.