Infected food handlers led to an outbreak of hepatitis A in Ernakulam district, Kerala, Southern India, 2016

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ABSTRACT

Objective: Integrated Disease Surveillance Programme (IDSP) of Ernakulam district of Kerala, India received reports of a cluster of acute jaundice on 26th November 2016 at Panchayath A. We investigated to identify the agent, source and propose recommendations.

Method: We defined a probable case as acute onset of jaundice with or without malaise, anorexia, fever, dark urine among residents of Panchayath A, Ernakulam district, since 2nd week of November 2016.

Result: A total of 385 cases (Attack rate: 8/1000) and 3 deaths (Case fatality ratio: 0.8%) were reported from 45th week of 2016 to 1st week of 2017. The attack rate was highest among men (83%) and those aged 16–30 years (61%). The cases were clustered in ward 3 of the Panchayath, where a hotel was situated. Most case-patients interviewed (84%) stated that they dined at that hotel. The index case was a construction worker who resided with hotel staff and subsequently reported illness. We confirmed HAV IgM in all specimens tested. HAV was associated with consumption of lemon juice [OR = 17.1; 95% CI: 3.8–76.7; PAF = 61%] and drinking water [OR: 15.3; 95% CI: 3.7–63.2; PAF = 66%] at the hotel.

Conclusion: Consumption of lime juice prepared by infected food handlers led to outbreak of hepatitis A. We recommended safe food preparation, drinking boiled water and super-chlorination of wells.

1. Introduction

Hepatitis A is an enterically transmitted viral disease belonging to genus Hepatovirus family Picornaevirae.¹ More than a million cases occur worldwide annually and a high disease burden is reported in South East Asian region.²

India is hyperendemic for hepatitis A virus (HAV) with^{3,4} at least one outbreak reported from 23 states every year. States reporting the highest number of outbreaks to include Punjab, Uttarakhand, Gujarat, Maharashtra and Kerala.⁵ During 2011 to 2013, Kerala reported more than 20 HAV outbreaks.^{12–14,21} The incubation period of hepatitis A lasts 15–50 days with symptoms of fever, malaise, loss of appetite, diarrhoea, nausea, abdominal discomfort, dark-colored urine and jaundice. Risk of transmission is high prior to the onset of jaundice since the viral concentration in the stool is at its peak during that period.^{6,7,8} Though the disease is self-limiting, symptoms can last for two months; in a few cases (10–15%), it continues to six months.^{9,10} Consuming boiled water, water chlorination and good sanitation practices prevent disease transmission. Inactivated and attenuated hepatitis A vaccines are available and on completing dosage, it ensures

immunity for 5–8 years.¹¹

On 25th November 2016, hepatitis A cases were reported to Integrated Disease Surveillance Programme (IDSP) office of Ernakulam district, from a private hospital in Panchayath A having a population of 45,981 (51% male). On 29 November 2016, we investigated the outbreak to confirm the diagnosis and identify the source.

2. Methods

2.1. Descriptive epidemiology

We defined a case of probable hepatitis A as “acute onset of jaundice with or without malaise, anorexia, fever, dark urine among residents of Panchayath A, since the second week of November 2016”. We actively searched for cases through door-to-door and through passive surveillance at public, private institutions and traditional healer clinics in the surrounding block panchayath. For each case-patient, we collected information on age, gender, place of residence and time of onset. We interviewed case-patients, key informants and construction workers to generate hypotheses about potential exposures and calculated attack

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rate by age and gender. We drew an epidemic curve for distribution of cases by time of onset and plotted cases by their residence in the Panchayath A.

2.2. Analytical epidemiology

Findings from the descriptive study resulted in generating a hypothesis which we tested using a case-control study. We defined case as that probable case with HAV specific IgM and we defined controls as those without hepatitis A disease. We collected information regarding socio-demographic characteristics and food items consumed using a standardized questionnaire. We compared cases with that of controls and calculated odds ratio (OR) with 95% confidence interval (CI). We calculated adjusted ORs and 95% CIs by age and gender using the Mantel-Haenszel method. We calculated the fraction of cases attributable to the risk factors in the population [Populated Attributable Fraction (PAF)] by multiplying the proportion of cases exposed by the attributable fraction among the exposed [(OR–1) divided by OR]

2.3. Laboratory investigations

We collected blood specimens of case-patients and tested for HAV specific IgM using ELISA at the District public health laboratory. The team was conducting the outbreak investigation as a part of a public health emergency response, hence the procedure and aim of blood collection was well explained to the participant, however ethical clearance was not obtained *a priori*.³⁰

2.4. Environmental investigations

We collected water specimen from the wells located in hotel premises and an ice factory that supplied ice to the hotel. The samples were tested for contamination by testing for the presence of fecal *Escherichia coli*. We interviewed and examined the construction workers and staff members from the hotel and ice factory. We conducted a sanitary inspection of the hotel premises and an ice factory.

3. Results

3.1. Descriptive epidemiology

We identified 385 cases in Panchayath A (Attack rate: 8 per 1000 population) and 3 deaths (Case fatality ratio: 0.8%). We did not observe any recent changes in population or migration. We compared number of reported cases with that of surveillance data and ruled out any artefacts. The most common symptom was fever(95%) followed by jaundice (90%) and dark urine (76%). The attack rate (Table 1) was highest among persons aged 16–30 years (61%). Women were less affected than men (17% versus 83%). The patients have mainly sought

treatment from traditional medical systems. The first case-patient developed the illness during the last week of October (Fig. 1). The outbreak peaked during week 47 and subsequently started declining by week 49. The shape of the curve suggested a point source outbreak. According to the spot map, cases clustered around ward 3 of the Panchayath, where the hotel was located. In-depth interviews with a subset of the case-patients indicated that most had dined at the hotel (84%). The index case was a construction worker who resided with the food handlers in the hotel. Of the nine working at the hotel, three cooks, two service staff and the manager contracted the disease; all of them continued working in the hotel during the period of illness.

3.2. Analytical epidemiology

Review of the descriptive epidemiology led us to suspect the food item that was served at a particular hotel in Panchayath A to be associated with the spread of the infection. We recruited 22 cases and 27 controls for the case-control study. They differed by age and gender (Table 2). Compared with controls, cases were more likely to be exposed to drinking lemon juice [OR = 17; 95% CI: 4–77; PAF = 61%] and drinking the served water [OR: 15; 95% CI: 4–63; PAF = 66%] [Table 3].

3.3. Laboratory investigations

All the 15 blood specimens collected from the case patients tested positive for HAV specific IgM.

3.4. Environmental investigations

Wells are the main source of drinking water supply in the Panchayath A but there is a pipeline supply from the government water authority to one area within the Panchayath A. No cases were reported from this area. We collected 19 water specimens during surveillance week 49–51 of 2016 from the wells of the hotel, ice factory and nearby water bodies. Total coliform testing of these water samples were conducted in District Public health laboratory, Ernakulam to check the microbiological contamination of water.³² Testing of specimens confirmed *E.coli* in four specimens suggesting faecal contamination. However the water of the wells used at the ice factory and the hotel were contaminated with non fecal coliforms. Sanitary survey of the hotel suggested that the well in the hotel did not meet the objective criteria of a sanitary well. Based on the criteria the well was less than a metre away from a water canal, which was a common spot for waste disposal, the inner lining of the wall was made of mud allowing water seepage from the side and there was no cement cover over the well allowing a risk of contamination. Water from this well was used for cooking, washing and drinking requirements in the kitchen. The well was not chlorinated and there was a practice of consuming unboiled water. The well was located a meter away from the runoff to the village canal where frequent dumping of waste was reported by the residents.

We identified that the ice factory used both filtered and unfiltered water from a nearby well. Ice prepared from this factory was used for storage and sold for use during local functions. We checked for availability of purchase receipts to confirm the use of ice prepared at the ice factory in the concerned hotel and other local sites. However, such receipts were not maintained.

Our interview of construction workers who resided in the area led to the identification of the primary case. The primary case gave a history of hepatitis A in the family and a local hepatitis A outbreak in the area of residence during the last week of August, epi week 33, 2016. Following a probable exposure to hepatitis A affected family member, the patient worked at the hotel from 1 to 23 October 2016, (corresponding to epi week 38–42) and shared residence with staff members of the hotel. The patient identified as primary case developed symptoms on 23 October 2016 after which he returned to his residence. This

Table 1
Attack rate of hepatitis A by age and gender in Panchayath A of Kerala, India, 2016.

Demographic characteristics		Cases	2016 population	Attack rate per 100,000
Age (years)	0–5	1	3208	31
	6–15	47	6703	701
	16–30	236	9858	2393
	31–45	92	10,762	854
	45–60	11	9296	118
	> 60	2	6154	32
Gender	Male	321	23,200	1383
	Female	64	22,781	280
Total		385	45,981	837

Fig. 1. Incidence of Hepatitis A by week of reporting; in Panchayath A, Ernakulum District, Kerala, India, 2016–2017.

Table 2

Frequency of consumption of food items among Hepatitis A cases and controls, case control study, Kerala, India, 2016.

Food items taken	Cases (n = 22)		Controls (n = 27)		Odds ratio	95% Confidence Interval
	Number	%	Number	%		
Drinking water	16	73	4	15	15.3	(3.7–63.2)
Lemon juice	15	68	3	11	17.1	(3.8–76.7)
Beef fry	2	9	2	7	2.1	(0.2–9.7)
Milk shake	0	0	2	7	1.1	(0.9–1.2)
Fried rice	2	9	1	4	2.6	(0.2–30.7)
Grilled chicken	2	9	3	11	0.8	(0.1–5.3)
Kuboos/flat bread	7	31	5	19	2.1	(0.5–7.7)
Biryani	6	27	10	37	0.6	(0.2–2.1)
Chicken curry	1	5	1	4	1.2	(0.1–20.9)
Chapatti/Indian bread	3	14	1	4	4.1	(0.4–42.6)
Vegetable Salad	9	41	10	37	1.2	(0.4–3.7)
Mayonnaise	7	32	10	37	0.8	(0.2–2.6)
Shawarma/Grilled chicken	4	18	2	7	2.8	(0.5–16.8)
Alfam/barbeque chicken	8	36	12	44	0.7	(0.2–2.3)

Table 3

Crude and Adjusted estimates of OR for suspected food items.

Food Item	Crude OR	95% CI	Adjusted OR by age	95% CI	Adjusted OR by gender	95% CI
Lemon juice	17.14	3.8–76.7	15.8	3.4–73.8	10.3	2.3–45
Drinking water	15.3	3.7–63.2	13.7	3.2–58.5	9.6	2.1–43.6

information was used to develop the case definition for epidemiological purpose. According to the staff members the hotel was inaugurated on 24 October and all the staff members were living together in the room within the hotel premises provided by the owner during this period. They complained of overcrowding and lack of cleanliness during their stay and mentioned about the practice of drinking unboiled water daily from the hotel.

Further, Investigator revealed that that lukewarm water was routinely served to the customers. Ice purchased from a local factory was used for the first week and subsequently suspected contaminated well water was used. As part of personal protection they reported the use of hairnets while handling food. Food samples could not be tested for contamination with HAV as it was not available at the time of visit.

4. Discussion

We confirmed one of the largest outbreak of hepatitis A in Panchayath A, reported in the state of Kerala. The attack rate was highest among men in the economically productive age group and most of them had dined at a hotel. We identified that consumption of lemon juice and drinking water served at the hotel as risk factors among cases as compared to controls.

The attack rate of HAV was higher among adults and less among children. This could be due to the fact that in Kerala, the overall improved hygienic conditions and socio-economic development, could have reduced the risk of HAV infection in childhood.²² Most of the time, Hepatitis A infection is asymptomatic among children. The severity of hepatitis A increases with age and infections in adults are often symptomatic. Hence, an occurrence of HAV in any such population may lead to outbreaks as reported from other parts of India.^{23,24} As stated earlier,

Kerala has indeed experienced several HAV outbreaks in the recent past with fatality among adults.^{21,25}

In the current investigation, we argue that hand hygiene could have played a significant role in the transmission of HAV. Several published studies documented the higher HAV transmissibility potential of soiled and unwashed or disinfected hands.¹⁸ However, the minimum infectious dose of HAV needed for resulting in disease remains unknown.^{19,20}

Based on the evidence, the most probable source of contamination of the food prepared at a hotel was through poor hand hygiene of the food handlers.^{5,15–17}

Though the main risk factors for the disease transmission were lemon juice and water that were served at the restaurant, these routes of transmission existed due to a combination of factors such as overcrowding, drinking unprotected water and lack of personal hygiene among hotel food handlers and that of probable use of contaminated ice could have facilitated this transmission. Further evidence also suggests that little over 60% of the cases in the community could be explained by drinking lemon juice or the served water.

Our investigation suffers from the most common difficulty faced while investigating the root cause of the HAV transmission everywhere. For instance, recent study of surveillance data from India's IDSP suggested that even in a setting like Kerala state with strong public health system, the causes of the many hepatitis A outbreaks in the last five years were attributed to the poor status of water quality.²¹ Hence, outbreaks of food-borne/food handlers are generally under-investigated or under-reported in Kerala. Almost one fifth of the HAV outbreaks in the United States during 1993–2001 were attributed to food handlers.¹⁷ However poor reporting and publication of HAV outbreaks due to food handlers had been documented in a review from Canada.²⁶ This was similar with the pattern we observed in this reported outbreak. In this context, evidence for food-borne transmission from our investigation suggests the importance of implementing public health measures at food establishments to reduce the transmission hepatitis A. World Health Organization has highlighted the importance of vaccination with Hepatitis A. Many countries have documented marked reduction in HAV incidence following mass vaccination. But vaccination for HAV in the Indian context is not considered due to hyperendemic status of the disease and life-long immunity offered to children as a result of subclinical infection.²¹ Looking into the outbreak data for the last 5 years, in the state of Kerala, the shift in age of hepatitis A infection has been documented.²¹ Thus raising the debate of HAV vaccination. In addition, there also exists a lack of studies that has looked on cost-effectiveness of HAV vaccination as compared to the out of pocket expenditure in a large outbreak.²¹

A report on a 2001 hepatitis A outbreak due to food handler transmission from a restaurant in Massachusetts evaluated the societal costs to be as high as 800,000 US\$, which was paid by the public health agency.²⁷ In addition a study that was done later that looked into the economic burden due to food borne illness in the United States, estimated the cost of a hepatitis A case in 2010 to be 37,073\$ (95% CI 9033–71,112) and posed a high economic burden to the country itself along with other similar illness.²⁸ In a country like India there are very limited studies that have looked into the economic implications of food borne transmission of diseases. Looking into the studies conducted in high income countries and previous outbreak reports of hepatitis A in India we can estimate that the financial burden Hepatitis A poses for the public health agency and the public would be staggering.²¹

It is worth referring to the local cultural practices that might naturally promote the prevention of diseases. In Kerala, one is often greeted in a household or a hotel with drinking water, which may be hot or lukewarm water. According to reports, such practice is prevalent in 65% of urban and 49% of rural settings.³¹ In the current episode, we were informed by participants that lukewarm water was served at the hotel. However, further enquiries with the hotel staff identified that there was mixing of the boiled hot water before serving the customers.

Therefore, such information adds to the importance of the role of cultural practices in preventing such disastrous consequences.

Our study has few limitations. While wells were reported to be the main source of drinking water, we could not collect well water samples prior to chlorination. We identified most of them with fecal contamination and hence, reflected on poor quality of chlorination methods. We would also like to point to previous published evidence that shows the molecular existence of HAV in environment is longer than fecal coliform bacteria. Hence the wells that showed a non fecal contamination as seen in the wells of the hotel and ice factory could also be HAV contaminated but we were unable to elicit this due to the lack of molecular investigation in our study.²⁹ There was a lack of information about the other sites where ice from ice factory had been supplied, apart from the hotel, this hampered our investigation as we were unable to ascertain any other focal points of HAV infection. Further we could not obtain food samples for testing. However, the prevailing circumstances as per the interviews and population attributable risk suggest that substantial transmission could be explained through the identified sources.

On the basis of our findings, we conclude that the HAV outbreak in Panchayath A could be due to food and water-borne. We recommend avoidance of consuming unboiled water from sources such as well water.

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Conflicts of interest

None.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.cegh.2019.08.001>.

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