

## OUTBREAK INVESTIGATION OF HEPATITIS-E AT A BOY'S TRAINING CENTER, KARACHI PAKISTAN FROM MARCH-APRIL 2017

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### ABSTRACT

**Objective:** An outbreak investigation team was deputed to assess the magnitude of disease, to evaluate risk factors and recommend control measures.

**Study Design:** Case control study.

**Place and Duration of Study:** Boy's Training Center Karachi, from 4<sup>th</sup> Apr to 28<sup>th</sup> Apr 2017.

**Material and Methods:** On 30<sup>th</sup> March 2017, 30 suspected cases of acute viral hepatitis were reported. Active case search carried out and hospitals record reviewed. Age and gender matched controls (1:1) taken. Case definition was "Sudden onset of jaundice PLUS presence of Hepatitis E IgM on ELISA in a resident of Boys vocational training center from 9<sup>th</sup> March to 12<sup>th</sup> May 2017". Total 79 blood samples collected for hepatitis screening and 5 water samples collected for microbiological/physiochemical testing. Descriptive analysis was carried out, frequencies/ attack rates were determined and odds ratios were calculated at 95% confidence interval and  $p < 0.05$ .

**Results:** Total 79 cases were identified (49 active search). All male with mean age of  $22 \pm 4.6$  years. Overall attack rate was 9% and most affected age-group was 20-29 years (AR: 11%). Significant risk factors were consumption of raw vegetables (OR: 5.39, 95% CI: 2.37-12.25) and use of tap water (OR: 2.28, 95% CI: 1.14-4.58). While hand washing (OR: 0.37, 95% CI: 0.18-0.81) and use of filtered water (OR: 0.008, 95% CI: 0.002-0.029) found protective. Total 76 (96.2%) blood samples were positive for Hepatitis E IgM while 4 (80%) water samples had coliform organisms. Environmental assessment revealed rusty and broken water pipelines running parallel to sewage line. No water decontamination and overcrowding in living areas observed.

**Conclusion:** Cross contamination between water and sewage lines was probable source of outbreak. It was recommended to replaced old pipelines, filter/decontaminate drinking water and more rooms should be constructed to avoid overcrowding.

**Keywords:** Acute viral hepatitis E, Cross contamination, Outbreak, Water contamination.

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### INTRODUCTION

Viral hepatitis is of five different types namely Hepatitis A, B, C, D & E. Hepatitis E is caused by Hepatitis-E virus (HEV) which is a single stranded RNA virus. There are four genotypes of HEV (1-4) among which genotype 1 & 2 exclusively infect humans while genotype 3 & 4 has zoonotic potential and can infect other animals also. Acute viral hepatitis is caused by HEV genotype 1 or 2 frequently occur due to feco-oral route usually through contaminated water<sup>1</sup>.

The clinical presentation of Hepatitis E usually resembles with other types of viral

hepatic illnesses. Infection with HEV is usually self-limiting but sometimes the disease progress to acute liver failure in few cases. The disease is more severe in pregnant women and the infection can be transmitted to fetus which may result in premature birth of fetus<sup>2</sup>.

The first epidemic documented was happened in New Delhi in 1955-56 in which 29,000 people were affected and the reason for this epidemic was fecal contamination of drinking water<sup>1</sup>. It is estimated that every year 20 million infections of Hepatitis-E virus occur globally out which 3.3 million develop into symptomatic disease<sup>3</sup>. World Health Organization (WHO) estimated that in 2015 approximately 44,000 death occurred due to Hepatitis-E which is 3.3% of all deaths occurred due to viral hepatitis.

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Received: 15 Oct 2018; revised received: 26 Apr 2019; accepted: 29 Apr 2019

Around one third of the world population has been infected with HEV<sup>4</sup>, making it one of the main causes of acute viral hepatitis, which in most cases follows a self-limited course<sup>5</sup>. It is also reported by WHO that highest prevalence of Hepatitis-E is found in East and South Asia<sup>6</sup>.

In Pakistan there are all types of hepatitis from A to E, with maximum morbidity in HEV and HAV and maximum mortality rate associated with HBV, HCV and HDV<sup>7</sup>. Hepatitis E is endemic in Pakistan and it affects mainly the adult population, all of small epidemics have been reported due to poor sanitary condition<sup>8</sup>. The cases of acute viral hepatitis were reported from Pakistan as early as 1950s and 1960s. Many outbreaks of Hepatitis-E were wrongly labelled to be cause by Hepatitis A virus (HAV) which was later on clarified that these outbreaks were of Hepatitis E<sup>9</sup>. It was reported in different research publications from Pakistan that there is high prevalence of Hepatitis E in the country. The pediatric population which appears to be healthy was found to be exposed to hepatitis E (HEV IgG reactive) at rate of 14 to 26%. The adults were found to have acute hepatitis due to HEV at rate of 20 to 22% while children have rate of 2.4%. Hepatitis E has more severe affects in pregnant women and resulted in maternal mortality rates ranging between 20 and 29.3% while perinatal mortality rate up to 30.3 per 1,000 live births<sup>10-12</sup>.

During last week of March 2017, a medical officer from a tertiary care hospital in Karachi informed the In-charge Medical officer that frequency of case presentation with fever, jaundice, abdominal pain and nausea/vomiting from residents of boy's vocational training center was increased since last one month. In response, an initial visit was carried out by In-charge Medical officer on 30th March 2017 and afterwards a team comprising of a medical specialist and a pathologist was deputed by hospital for verification of the disease outbreak. The team confirmed the outbreak and directed to shut down all water filtration plants. The team also instructed administration of the training center to use alternate drinking water sources

until completion of the outbreak investigation and control of disease outbreak. After confirmation of the disease outbreak, FELTP Pakistan was being contacted to conduct outbreak investigation. On 04th April 2017, a team was deputed by FELTP which started its work on same day with the objectives to search all cases, to assess magnitude of disease, to evaluate risk factors associated with the disease outbreak and to recommend control measures it.

## **MATERIAL AND METHODS**

It was a case-control study. The study was approved by ethical review committee and Institutional Research Board (IRB). The study was conducted from 4<sup>th</sup> to 28<sup>th</sup> April 2017 with active case finding at training center Karachi. A total 900 individuals were in living in the training center at the time of outbreak. All 79 cases were included in a study. A total of 83 age and gender matched controls were recruited from Training center with 1:1 for identification of the potential risk factors related to this outbreak of disease. A case was defined as "Sudden onset of jaundice with or without fever, nausea, vomiting, loss of appetite, malaise, diarrhea and abdominal pain among residents of training center, Karachi from 9th March to 12th May 2017". The cases were confirmed by laboratory testing for presence of Hepatitis-E IgM antibodies. Suspected cases were defined as cases qualifying case definition and having epidemiological link with confirmed case of Hepatitis-E but do not have laboratory confirmation test results. Confirmed cases were defined as cases qualifying case definition with laboratory confirmation test for presence of Hepatitis-E IgM antibodies. Controls were defined as residents of training center present without having any sign/symptoms of Hepatitis-E. A pre-tested WHO modified questionnaire was used to collect demographic characteristics, clinical data for sign & symptoms, laboratory finding and risk factor information from both cases and controls. All residents of training center who were present during period of epidemiological investigation were included in the study. Blood samples were taken from cases

and sent to a teaching hospital laboratory, Rawalpindi. The samples were tested through 3rd generation ELISA technique for Hepatitis E. Blood samples were also tested for Liver function tests, Hepatitis A, B & C. The water samples from different water sources were taken and were analyzed through Physiochemical and Microbiological techniques at Pathology department of a tertiary care hospital, Karachi. Active search for cases was carried out among the residents of the training center. Record review of health facility for hospital admission during period of outbreak

Data was tabulated in MS Excel and was analyzed in Epi Info (Version 7). Descriptive analysis was carried out, cases were classified into age-groups, frequencies were calculated and attack rates were determined. Odd ratios were calculated for risk factor analysis at 95% confidence interval and *p*-value less than or equal to 0.05 and Chi-Square was used as a test of significance.

**RESULTS**

A total of 79 cases were identified out of which 49 were found through active search and

**Table-I: Age-groups and attack rates of cases.**

Age range	Frequency	Population	AR per 100
<10	-	-	-
10-19	11	250	4.4%
20-29	63	590	11.0%
30 and above	5	60	8.3%
Total	79	900	9.0%

**Table-II: Results of water sample analysis (n=5).**

S. No.	Source	MPN of Coliforms	Physiochemical Characteristics
1.	Main Reservoir	-	Satisfactory / Fit for drinking
2.	Mess Area (Filtered Water)	5	Borderline Satisfactory
3.	Living Area (Tap Water)	70	Unsatisfactory / Unfit for drinking
4.	Training Area (Water Chiller)	70	Unsatisfactory / Unfit for drinking
5.	Training Area (Tap Water)	80	Unsatisfactory / Unfit for drinking

**Table-III: Analysis of risk factors associated with outbreak of Hepatitis-E (n=79).**

Risk Factors	Cases exposure n=79	Controls exposure n=83	OR / (95% CI) / <i>p</i> -value
Consumption of raw vegetables (washed with contaminated water)	Yes = 70 (89%) No = 09 (11%)	Yes = 49 (59%) No = 34 (41%)	5.39 / (2.37 - 12.25) / <i>p</i> <0.001
Contaminated tap water	Yes = 62(78%) No = 17 (22%)	Yes = 51 (61%) No = 32 (39%)	2.28 / (1.14-4.58) / <i>p</i> =0.01
Frequent Hand washing	Yes = 53 (67%) No = 26 (33%)	Yes = 70 (84%) No = 13 (16%)	0.379 / (0.18-0.81) / <i>p</i> =0.01
Consumption of filtered water	Yes = 14 (18%) No = 65 (82%)	Yes = 80 (96%) No = 03 (04%)	0.008 / (0.002 - 0.02) / <i>p</i> <0.001

was conducted. Data about demographic characteristics, clinical information, laboratory findings and risk factor information for both cases and controls was collected on pre-tested WHO modified questionnaire. Interviews were conducted with cases, controls and all other stakeholders.

rest were identified from hospital reports and records during period of outbreak. All the cases were above 18 years of age with mean age of 22 ± 4.6 years (range: 18-45) and all cases were males. The cases were classified into age-groups and it was found that most affected age-group was of 20-29 years with attack rate of 11% while overall

attack rate was 9%. The data for age-groups and attack rates is tabulated in table-I.

The first case was reported on March 21, 2017 and the last case was reported on April 22, 2017. Maximum no. of cases i.e. 8 cases were reported on April 4, and April 8, 2017. The period of exposure of Hepatitis-E was found to be most

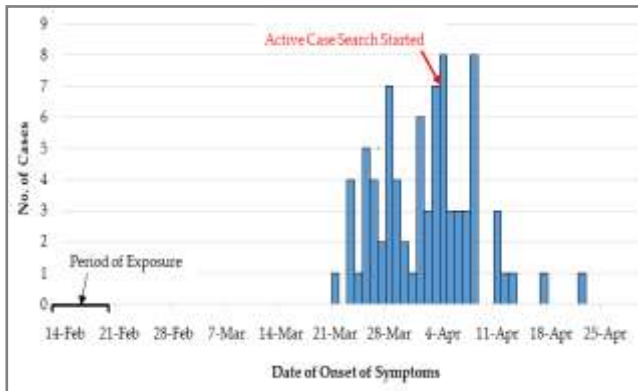


Figure-1: Distribution of cases of Hepatitis E by date of onset of symptoms in a boys training centre, Karachi, Mar-Apr 2017.

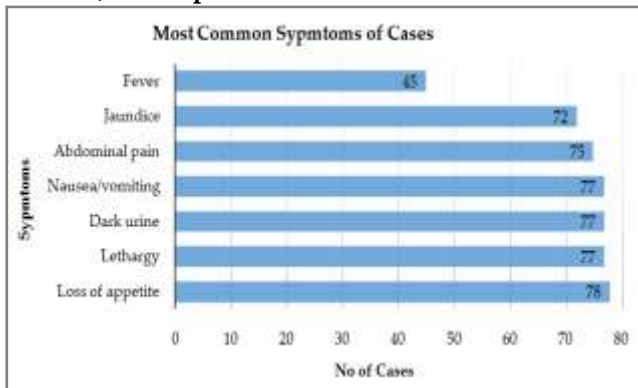


Figure-2: Most common symptoms of cases.

likely between 14<sup>th</sup> to 21<sup>st</sup> Feb, 2017. No new cases were found after April 22, 2017. Epi-curve showing distribution of cases by date of onset of illness along with period of exposure is presented as fig-1.

Clinical feature of the cases revealed that 72 (91%) cases had severe jaundice while 7 (9%) cases had no clinical signs of Jaundice but had complaints of acute viral hepatitis. Most common symptom presented was loss of appetite reported by 78 (99%) cases followed by nausea / vomiting in 77 (97.5%) and abdominal pain in 75 (95%)

cases. The details of clinical feature are presented in fig-2.

All the cases were presented to tertiary hospital for treatment and laboratory confirmation tests. Regarding outcome of patient out of total 79 cases, 42 (53.2%) cases were discharged after complete recovery while 36 (45.6%) were admitted for treatment and 1 (1.2%) case progressed to acute fulminant hepatic failure who finally recovered after treatment. Blood samples from all cases were taken and tested for presence of Hepatitis-E IgM antibodies. The test results revealed that 76 (96.2%) samples were positive for Hepatitis-E IgM antibodies, while 1 (1.2%) sample was positive for Hepatitis-A IgM and 2 (2.5%) samples were negative for both Hepatitis A & E IgM antibodies. All samples were negative for both Hepatitis B and C sero-markers.

Water samples were taken from different water sources and tested for physical, chemical and microbiological characteristics. A total No. of 5 water samples were collected; the microbiological examination showed presence of coliforms in 4 water samples while physiochemical characteristics revealed that 3 water samples were unfit for drinking, 1 water sample was borderline satisfactory while 1 water sample was found fit for drinking. The results of water sample testing are presented in table-II.

Risk factor analysis was carried out and it was found that significant risk factor associated with spread of disease was consumption of raw vegetables washed with contaminated water (OR: 5.39, 95% CI: 2.37-12.25,  $p < 0.001$ ) and usage of tap water (OR: 2.28, 95% CI: 1.14-4.58,  $p = 0.01$ ). While hand washing (OR: 0.379, 95% CI: 0.18-0.81,  $p = 0.01$ ) and usage of filtered water (OR: 0.008, 95% CI: 0.002-0.029,  $p < 0.001$ ) had protective effect for the residents of training center during course of outbreak of disease. The results of risk factor analysis are shown in table-III.

**DISCUSSION**

The risk factor analysis of this study revealed that consumption of raw vegetables were associated with outbreak of the disease in the training

area. Previously published literature supports the evidence that Hepatitis A & E spreads through food borne transmission routes<sup>13</sup>. The already published study reported that potential source of contamination in supply chain was investigated at both pre-harvest stage i.e. in the field and at post-harvest stage. It was found that during the pre-harvest stage, pathogenic organisms establish themselves on growing crops and the risk could be further amplified after harvest either by direct contamination or by proliferation of existing pathogenic organisms during processing and handling procedures. It was also found that water was likely to be an important source of contamination in the field. The other possible sources of contamination would be run-off from nearby animal pastures and irrigation from a contaminated water sources<sup>13,14</sup>. The results of this study also showed that consumption of tap water which was found to be contaminated with coliforms (the indicative micro-organism for fecal contamination) was responsible for outbreak and spread of disease. An outbreak investigation for Hepatitis E was conducted in India among factory workers and researcher found that probable cause of the outbreak was drinking water from factory and eating from factory canteen. In factory canteen tap water was used for cooking and that water was positive for coliforms<sup>15</sup>. An outbreak investigation for Hepatitis E was conducted in Iraq and the researcher found that bacteriologically unsafe drinking water was significant cause for outbreak of the disease<sup>16</sup>. It was also observed during environmental assessment that there was overcrowding in boys hostel that contributed in spread of the disease. Similarly a study reports that in Nigeria Hepatitis E outbreak propagated rapidly due to the ongoing humanitarian crisis in the region and as a result there is over crowding which is overwhelming the already weak systems in place<sup>17</sup>. An outbreak investigation for Hepatitis E conducted in men working in gold mining at Darfur, Sudan and in these areas the men live in non-hygienic conditions, in crowded places, without latrines and may easily become infected by the fecaloral route<sup>18</sup>. It was

found in epidemiological investigations of this outbreak that persons who practiced hand washing frequently were remained safe from catching Hepatitis E infection and becoming ill. An outbreak investigation of Hepatitis E was carried out in Chad and it was in it that cases were not always washing their hands before meals as compared to controls<sup>19</sup> and these findings support the results of our study. Use of filtered water by trainees was found to be a protective factor in outbreak investigation conducted for this study. The trainees who consumed filtered water were not affected by Hepatitis E spread as compared to trainees who consumed un-filtered water. Another study found that spread of Hepatitis was linked with the consumption of unsafe and contaminated water and it can be concluded that the population who consume safe and clean water were remain protected from the disease<sup>16</sup>.

#### **Impact / Measures Taken**

Control measures taken were chlorination of all water sources, removal of logged water, and repair of damaged water and sewage pipelines. Health awareness sessions were conducted to impart education / awareness regarding importance of safe and clean drinking water, methods of water decontamination, chlorination of water and importance of hygiene and sanitation for personal health. The health care staff was advised to ensure chlorination of water, conduction of health awareness sessions on regular basis and implementation of sanitation and hygiene procedures.

#### **RECOMMENDATION**

It was recommended that water and sewerage lines should be separated and old pipelines should be replaced. Decontamination of water reservoirs should be conducted on regular basis and drinking water should be filtered or chlorinated or both on routine basis. Consumption of food and vegetables/fruits from authorized source. It should be adequately and properly washed. Health education/awareness sessions should be conducted by health care staff on regular basis regarding decontamination of

drinking water, personal hygiene and hand washing, and clean environment by improving sanitary conditions.

## CONCLUSION

The epidemiological findings of this outbreak investigation suggested that the most probable cause of disease spread was contaminated tap water which was used as drinking water source in living area of individuals. All the individuals were using the water from same water source without any treatment. It was observed that water lines were running parallel to the sewage lines. The sewage lines running parallel to water lines were choked, the gutters were full of garbage and human excreta was spilled over the ground. This situation suggested that cross contamination between the water and sewage lines took place. Awareness of all individuals about water hygiene, sanitation and clean drinking water was unsatisfactory. Health awareness sessions regarding healthy environment and safe drinking water were not conducted by health care staff on regular basis.

## CONFLICT OF INTEREST

This study has no conflict of interest to be declared by any author.

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