

Review Article

Managing Hepatitis Outbreak in Biratnagar Nepal

Nawa Raj Subba

Tribhuvan University, Department of Psychology, Kathmandu, Nepal

Email address:

dr.subba2015@gmail.com

To cite this article:Nawa Raj Subba. Managing Hepatitis Outbreak in Biratnagar Nepal. *Science Journal of Public Health*. Vol. 3, No. 6, 2015, pp. 808-814. doi: 10.11648/j.sjph.20150306.12

Abstract: This is a review article on jaundice outbreak occurred in *Biratnagar* during April-July 2014. The study reviewed the reports on hepatitis outbreak presented by District Public Health Officer Morang during a seminar organized by Nepal Health Research Council (NHRC), District Disaster Management Committee (DDMC) meetings and HMIS (Health Management Information System) database. District Public Health Office (DPHO) recorded 2,789 Jaundice patients in Morang district including *Biratnagar* city. Most of the patients (80.67%) recorded from *Biratnagar*. In the outbreak sex ratio of female to male was 0.56:1. Hepatitis infection was highest among 15-29 age groups and noticed remarkable among 15 to 54 years age groups. District Disaster Management Committee declared the outbreak in *Biratnagar* on April 28 when 95 jaundice patients recorded in the hospitals. The number reached at peak level 176 patients on May 6 and the trend came downward to normal level on July 8, 2014. Total 12 deaths recorded in the outbreak. Of them 8 deaths recorded from *Biratnagar*, 3 deaths from *Morang* district and 1 death from *Saptari* district. In *Biratnagar* ward No. 11 listed 5 deaths, ward No. 8 listed 2 deaths and ward No. 3 listed 1 death. Case fatality rate in the *Biratnagar* outbreak calculated as 0.43%. The causes of hepatitis infection were hepatitis viruses E and A. The transmission of infection in *Biratnagar* was due to sewage contamination through leaking pipes in water distribution. The level of community awareness on taking safe water observed in the *Biratnagar*. Before the outbreak, people used to drink tap water without treatment. After the outbreak, people changed their behavior to boil or filter water to drink in houses. Many people started to purchase mineral water in jars and bottles from the market. However, government water supply system in *Biratnagar* is poor which demands an upgrade to meet WHO standard of drinking water.

Keywords: Jaundice, Hepatitis E, Fecal Contaminated Water, *Biratnagar*, Nepal

1. Introduction

Hepatitis is inflammation of the liver caused by a variety of different viruses such as hepatitis A, B, C, D, E and G. Among them hepatitis E virus (HEV) is the agent responsible for the hepatitis outbreak in developing countries. The hepatitis outbreak of Hyderabad India in 2005 was caused by Hepatitis E virus through water contamination [1].

Globally, it is an estimate of hepatitis E infections is 20 million, symptomatic cases of hepatitis E is over 3 million, and hepatitis E-related deaths are 56,600 every year. Hepatitis E is also sporadic and epidemic worldwide but common in developing countries where sanitation is poor [2].

Hepatitis has typical sign and symptoms of jaundice, fever, anorexia, and abdominal pain, nausea, vomiting, and enlarged with tender liver. It transmits through fecal-oral route via water and foods. The incubation period of Hepatitis

E is 3 to 8 weeks. It is a common infection in young adults aged 15-40 years. Usually Hepatitis E infection is a self-limiting disease but may develop into acute liver failure or death [2].

A study on hepatitis E infection and disease conducted in Kathmandu valley in 1992-93 find out seroprevalence rate 16% to 31% in age 12-48 years. Infection and disease rate was 45-99 per 1,000 persons per year[3]. The study indicated hepatitis E is responsible for both sporadic and epidemic.

Morang district has about 1 million populations and *Biratnagar* city has 200,000 populations. *Biratnagar* is referral centre in Eastern region of Nepal having public and private hospitals. The purpose of this document is to provide epidemiological and demographic details based on the official reports and records about hepatitis outbreak in *Biratnagar* which was occurred during April-July 2014.

2. Rationale of Study

In Hepatitis outbreak WHO recommends determining the mode of transmission, to find the population specifically exposed to increased risk of infection, to eliminate a common source of infection and improve sanitary and hygienic practices[2]. This review study uncovers how far the Rapid Response Team (RRT) mobilized by District Public Health Office (DPHO) Morang in collaboration with municipality and other stakeholders had fulfilled the requirements set by WHO standard and guidelines.

What is the diagnosis of disease? What is the cause of disease? From which geographical areas patients are coming? Which population and areas are most affected? What are demographic characteristics of patients? What and where is the source of infection? How the infection transmitted? How diseases diagnosed and managed? What is mortality in the outbreak? How had preventive measures taken? How awareness created? Above mentioned questions raised during the outbreak answered in the reports but not studied. This review study reviewed the official documents and explored further questions with experience and background of the outbreak.

3. Review of Literature

Studies show that hepatitis outbreaks are an indicator of poor water supply and degraded environmental sanitation. A study done in Ahmadabad, Gujarat, India, in 2008 showed the cause of hepatitis E was sewage contamination and higher attack rate was found in 20-29 years of age group [4]. Another study on acute hepatitis carried out in *Lalkuan* of *Nainital* district of India surveyed 2,785 people and finds 240 positive. The attack rate was much higher among those who exposed to the leaking pipeline than non-exposed ($p < .01$). Study confirmed sewage contamination in water and contaminated water transmitted the outbreak in *Nainital* India [5].

Hepatitis A viruses found in stool and blood of a patient. 555 people who dined food with green onions in a restaurant identified hepatitis A in Pennsylvania, 2003 [6].

In southern Vietnam, hepatitis transmitted by rainfall and river water in 1994. The study with 150 subjects finds out that Immunoglobulin G (IgG) was significantly higher among cases of hepatitis E. Study also find out the negative association find between boiling water and IgG [7].

Hepatitis E outbreak is even worse where displaced populations are settled. In Darfur Sudan displaced population suffered by Hepatitis E outbreak where case-fatality rate was 1.7%. Age groups of infection were 15-45 years. People who drink untreated or without chlorination got infection. Odds ratio between chlorinated and non-chlorinated was 2.13 (95% CI, 1.02-4.46). Study shows chlorination is effective in hepatitis E outbreaks[8].

In South Asia incidence of Hepatitis E characterized by seasonality mainly occurs during the monsoon or in the rainy seasons. Hepatitis epidemics documented in April and October in Bangladesh [9]. Likewise, outbreaks recorded

from May to September in the Kathmandu valley of Nepal [10]. Studies suggest the occurrence of hepatitis outbreaks with a periodicity of 5-10 years in India, China, and Nepal [11] [12].

4. Objective of the Study

The aim of this review is to uncover epidemiological factors of hepatitis outbreak and demographic characteristics of the patients. The review unearths mortality rate and assess the preventive measures undertaken during the outbreak.

5. Methods and Materials

District Public Office Morang mobilized a Rapid Response Team (RRT) in the affected areas. Teams collected data from hospitals and clusters and reported to District Public Health Office daily. Data source were OPD, emergency and laboratory. After consultation with doctors, experts and WHO guidelines, we defined the hepatitis and made a hepatitis treatment protocol for hospitals. A case of hepatitis defined as an acute illness with the discrete onset of symptoms and jaundice or higher serum aminotransferase levels, from April to July 2014 in the hospital OPD in *Biratnagar* Morang. District Disaster Management Committee requested hospitals for free treatment during outbreak.

Biratnagar municipality mobilized health workers, volunteers and ward members. They helped to raise awareness on hepatitis and advised people to consume boiled water. DPHO supplied chlorine and municipality took part in distributing to the households by volunteers, ward members and health workers. Other external supporting teams also came from WHO, UNICEF, Plan Nepal, BPKIHS, Patan hospital and others. They were coordinated with DPHO and mobilized in affected areas. Water samples collected from affected areas and sent to National Public Health Laboratory (NPHL) laboratory.

DPHO simultaneously initiated awareness campaign through media, public interaction and regular meeting with District Disaster Management Committee. DPHO also conducted the public audit and focus group discussion with different consumer groups in most affected areas.

Rapid Response Team monitored the situation and collected data from all OPDs, emergencies, and laboratories in hospitals regularly. RRT team randomly interviewed with OPD/Indoor patients, doctors and victim families. Surveillance continued until July 2014.

Checklist, forms based on HMIS, questionnaire, water samples collection bottles, blood test kits and verbal autopsy form used in the outbreak. GPS also used to map outbreak sites. SPSS software analyzed the data in computer.

Epidemiology and Disease Control Division monitored the outbreak and provided logistics and guidelines to the District Public Health Office (DPHO). UNICEF, UNHCR, Plan Nepal also supplied additional chlorine and laboratory kits to DPHO for distribution in the outbreak.

Ethical Consideration

The writer as a District Public Health Officer had presented the hepatitis outbreak report to Honorable Minister of Health in District Disaster Management Committee (DDMC) meeting held in *Biratnagar*. Report was also presented in Nepal Health Research Council (NHRC) seminar. DDMC had approved the report. District Public Health Office (DPHO) Morang gave consent to review and make it public.

6. Findings

6.1. Geographical Distribution

Biratnagar is headquarter of Morang district. It has several tertiary care hospitals, so it is referral site for eastern Nepal. Patients also come here from India for treatment.

Table 1. Geographical information of hepatitis patients.

Place	Number	Percentage
Biratnagar	2250	80.67
Morang (Biratnagar excluded)	293	10.49
Other districts	234	8.39
India	12	0.44
Total	2789	100

Table 1 shows 2,789 jaundice patients registered in DPHO Morang from different geographical areas. Most of the hepatitis patients from *Biratnagar* 2,250 (80.67%), from

Morang district apart from *Biratnagar* 293 (10.49%), from other districts 234 (8.39%) and from India 12 (0.44%) recorded in different public and private hospitals in *Biratnagar*.

6.2. Sex

Both male and female affected in the hepatitis outbreak.

Table 2. Sex Ratio of outbreak affected patients.

Jaundice	Frequency	%
Total	2789	
Male	1785	64%
Female	1004	36%

Table 2 shows the total number of hepatitis 2,789. Male were 1,785 (64%) and female were 1,004 (36%) affected in the outbreak. Sex ratio of female to male was 0.56:1. Mobile population who often take food in hotels in *Biratnagar* suffered more from hepatitis. Nonresident but who come to work daily in *Biratnagar* also affected. Women those who consumed tap water without treatment infected.

6.3. Population Pyramid of Patients

All age groups were affected in the jaundice outbreak.

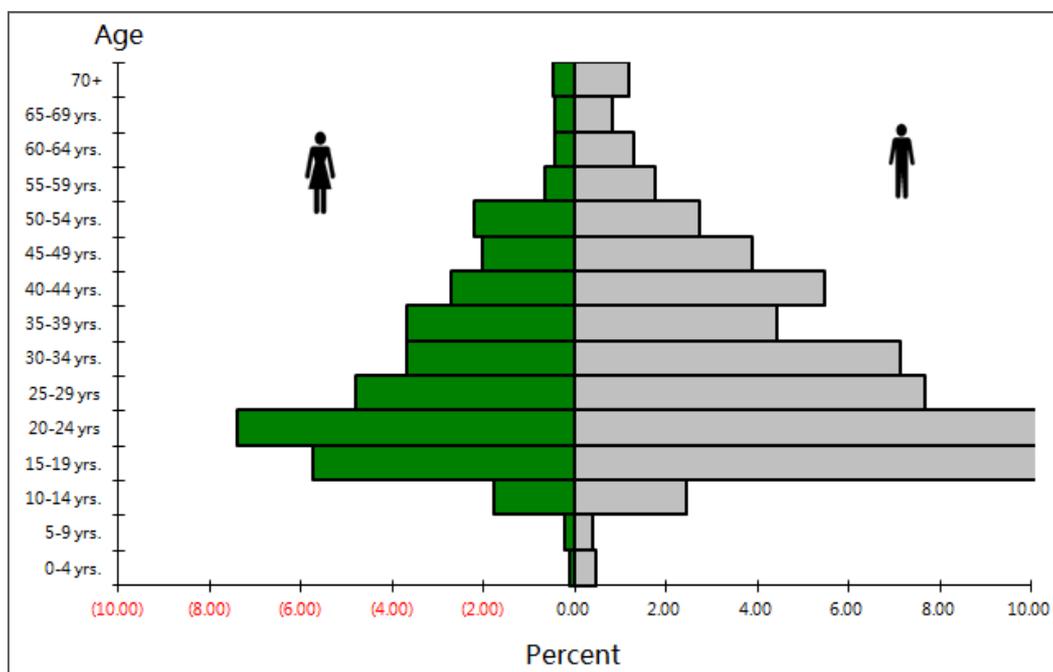


Figure 1. Population pyramid of hepatitis patients during outbreak.

Figure 1 indicates that Jaundice infected all age groups, but 15-24 age groups affected most. Working age groups of 15-59 years affected in noticeable proportion.

6.4. Hepatitis by Ward

Hepatitis outbreak affected all 22 wards of *Biratnagar*.

Top 10 wards were following:

Table 3 shows the frequency of hepatitis by ward in *Biratnagar*. The highest number of hepatitis recorded 219 from ward No. 10 and then second highest 184 from ward No. 11 and third highest 114 recorded from ward No. 13.

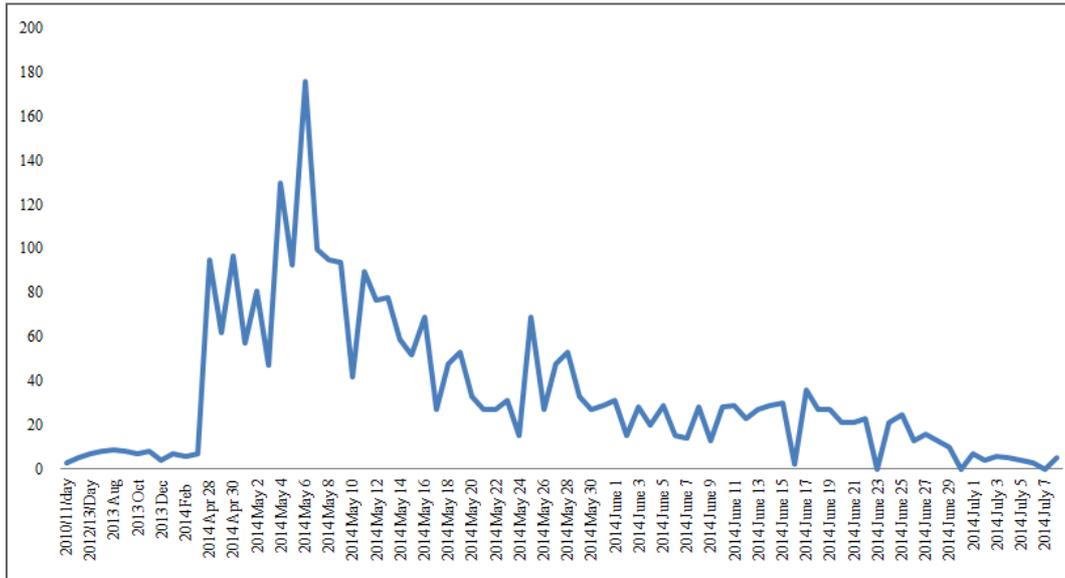
Table 3. Top ten outbreak affected wards in Biratnagar.

Ward No.	Patients	%
10	219	0.109
11	184	0.092
13	114	0.057
2	85	0.042
9	72	0.036
14	71	0.035
3	68	0.034
12	66	0.033
8	46	0.023
1	46	0.023

6.5. Period Incidence

Incidence of jaundice from April 28 to July 8 made an incidence curve showing inclination, peak and declined levels.

The District Disaster Management Committee (DDMC) declared the outbreak in *Biratnagar* on April 28 when 95 jaundice patients recorded in Morang. The number reached at peak level 176 patients on May 6 and that came down to the normal level on July 8, 2014.

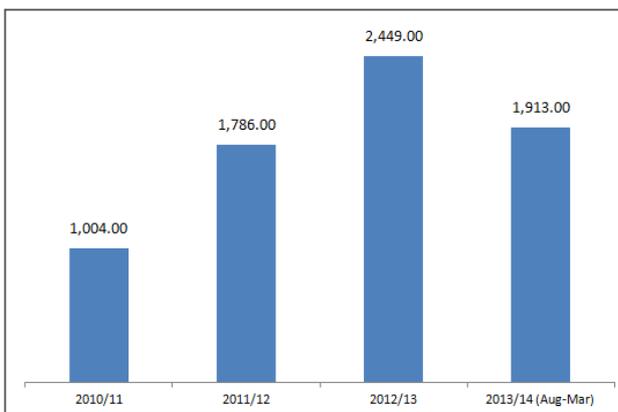


Trend of jaundice during the outbreak

Figure 2. Incidence of jaundice during an outbreak.

6.6. Prevalence of Jaundice

Database available in District Public Health Office Morang, Health Management Information System (HMIS) shows the prevalence of jaundice in the district over past three years until onset of outbreak.



Trend of Jaundice patients over the past 4 years in Morang

Figure 3. Trend of Jaundice in Morang district.

Figure 3 indicates the trend of jaundice. Jaundice recorded

1004 in 2010/11, 1786 in 2011/12, 2449 in 2012/13 and 1913 in 2013/14 (August-March) until the onset of the outbreak. Trend was increasing over past three fiscal years in the district. It indicates that viruses causing hepatitis are prevalent in the district.

6.7. Jaundice by Month

Health institutions reported jaundice in all months over three years in Morang district.

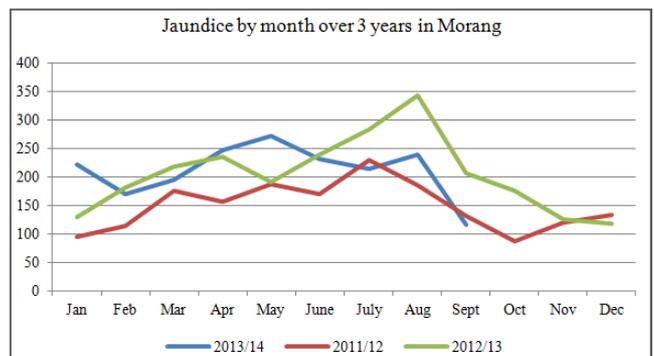


Figure 4. Jaundice by month in Morang.

Figure 4 displays trend of jaundice round the year over

past three fiscal years 2011/12, 2012/13 and 2013/14 in Morang district. Jaundice trend was high during March to September and noticed highest during April to August in the past three years.

6.8. Jaundice by Water Source

In *Biratnagar* water tanks were at Deokota chowk, Tinpaini, Rani, Jamungachhi and Mangadh. Of them 4 tanks Deokota chowk, Tinpaini, Rani, and Jamungachhi run by government and Mangadh run by private sector. Among 4 government tanks, Jamungachhi managed by consumers group.

Table 4. Jaundice by water source during outbreak.

Water source	Jaundice	Percentage
Deokota chowk	1305	58
Tinpaini	495	22
Rani	156	7
Jamungachhi	91	4
Mangadh	113	5
Tubewell	90	4
Total	2250	100

Table 4 indicates that highest jaundice reported from the catchment areas of Deokota chowk and Tinpaini. People using Mangadh, Jamungachhi and tube well reported less jaundice during the outbreak.

6.9. Compare of Water Sources

Most affected ward No. 11 records 5 deaths. Deokota chowk supplied water in ward No. 11. This water supply compared with a private sector water supply Mangadh with hepatitis. The sample was 40 taken for the statistical test.

Table 5. Comparing water sources during outbreak.

Water Source	Jaundice	No Jaundice	P-value
Deokota Chowk	7	13	P=<.05
Mangadh water	1	19	
Total	8	32	

Table 5 shows characteristics of samples. In samples 20 households taken from Deokota chowk catchment area and another 20 households taken from Mangadh catchment. 7 jaundice patients from Deokota chowk area and 1 jaundice from Mangadh supply recorded. Statistically, Deokota chowk water supply is significant to cause jaundice in the outbreak.

6.10. Laboratory Test of Water

We collected water samples from different reservoirs and outlets. Samples sent to National Public Health Laboratory Kathmandu for laboratory test. The results obtained from laboratory compared with the standard of World health organization (WHO) for drinking water.

Laboratory report showed that water supplied from Deokota chowk and Tinpaini tanks were heavily fecal contaminated (>180 Coliform/100 ml by MPN method). But sample taken from reservoirs were normal. Therefore, leakage of water pipes and mixing of sewage is the cause of

transmission.

6.11. Identification of Virus

We collected total 90 blood samples of symptomatic and exposed cases from OPD, IPD, jail and District Police Office and sent for laboratory test in BPKoirala Institute of Health Science Dharan. The result was as below:

Table 6. Types of virus identified during outbreak.

Virus types	Frequency	Percentage
Hepatitis E	45	50
Hepatitis A	9	10
Mixed	3	3.33
Negative	33	36.67
Total (n=90)	90	100

Table 6 indicates that the infection was mainly due to Hepatitis E(50%). Hepatitis A (10%) also caused the infection. Mixed infection (3.33%) also noted in the outbreak. However, these infections are transmissible by fecal-oral route mainly through water.

6.12. Mortality

Total 12 deaths were recorded in Morang. Of them 8 deaths from *Biratnagar*, 3 deaths from Morang district and 1 death from Saptari district recorded. In *Biratnagar* ward No. 11 listed 5 deaths, ward No. 8 listed 2 deaths and ward No. 3 listed 1 death. Case fatality rate calculated 0.43% in the *Biratnagar* outbreak.

6.13. Cultural Practice of Consuming Water

Biratnagar has ever experienced such kind of waterborne outbreak before. People assumed that tap water is clean to drink directly and it is pure to worship god. Most of the people have both piped water and tube-well. But they use tap water to drink. Some people use the filter and most of them drink without treatment. Such behavior is also one of the major causes of transmission during the outbreak.

We had interviewed with household members in different places. A housewife whose family members including her were affected by jaundice said:

'Khanepanisasthan' (public water supply authority) is not able to supply us drinkable water. Water is yellow in color, mostly turbid mixed with mud. We put water on the pot and allow settle till it becomes clearer. We take water directly. Sometimes we use filter also. We don't have boiling practice. But we started to boil water to drink after this outbreak.

A housewife from Biratnagar ward no. 11

We also observed above stated things in the sites. A medical team came from WHO concluded the incubation period of heavily polluted water supply and the onset of infection matched. Therefore, turbid water complained by households is a cause of spreading infection. The team reported as:

During our field visit, many housewives reported that before one and half month it was very turbid water came from their tape and they complained to 'Khanepani Sansthan'. Now,

It is likely to match its incubation period of Hepatitis E. Member of the family using tap water had jaundice but family using tube well are not reporting Jaundice in ward no. 11 and 13. A medical team from WHO.

6.14. Awareness and Preventive Measures

DPHO Morang took the prompt initiative of preventive measures and awareness campaign at the beginning of the outbreak in the city. Tools like mike and pamphlet used for quick dissemination. Radio, TV and newspapers used to give the message about preventive measures during hepatitis outbreak. Messages were mainly focused on boiling water and personal hygiene and sanitation.

In the beginning, many people did not accept boiling water easily. They asked to have chlorine drops or tablets, which was freely distributed by DPHO and municipality. However, later people realized the boiling method and adopted as a habit. One significant change of this awareness campaign was that now people do not consume tap water directly they boil water or filter. Consumer groups are giving pressure to the government for good water supply in the city.

7. Discussion

In the hepatitis outbreak in *Biratnagar*, a total of 2,789 patients registered in public and private hospitals, of them 2,250 (80.67%) patients' accounts from the municipality. In the outbreak male 1,785 (64%) and female 1,004 (36%) and sex ratio of female to male was 0.56:1. Outbreak was caused by Hepatitis A, E viruses. Age group of 15-24 years affected most. In *Biratnagar*, the highest number recorded from ward No. 10, 11 and 13 respectively. The outbreak began on April 28 and reached a peak level on May 6 with 176 patients and that came down to the normal level on July 8, 2014.

Hepatitis reported highest from government supplied areas *Deokota chowk* and *Tinpaini*. Water distributed from these sources reported highest mortality and morbidity. Laboratory report of *Deokota chowk* and *Tinpaini* areas were heavily fecal contaminated (>180 Coliform/100 ml).

Random blood sample showed Hepatitis E positive in 50% samples and Hepatitis A positive in 10% samples and mixed was in 3.33% samples. In this outbreak laboratory test for Immunoglobulin and HEV strains were not managed. So, we do not have the information. A study on hepatitis outbreak in Kathmandu identified HEV strains was genotype 1, and subgroup 1a and 1c in 1997 [13].

The mortality rate of the outbreak calculated as 0.43%. Studies said the mortality rate of hepatitis E is 1%–3% (Mast). The mortality rate in *Biratnagar* is lower than the reference. It is due to measures taken during the outbreak. However, this outbreak was a new experience for *Biratnagar*.

The following environmental conditions [14] similar to *Biratnagar* helps in transmitting the hepatitis E and A: (i) through leaky water pipes, proximity sewerage and intermittent flow of water (ii) mixing of sewage into water pipes during road or house repair or renovation (iii) improper or failure of the chlorination at reservoirs or tanks. (iv) mixing

of sewage into drinking water pumping station following flooding or heavy rains, (v) crowded living conditions and poor environment with unsafe water supply and (vi) failure in disposal of human wastes.

A study conducted in Nigeria showed contamination of drinking water by dumping of domestic and industrial wastes into the lake. Study emphasized to educate people on dangers of contaminated water [15].

DPHO Morang took a prompt initiative on awareness and preventive measures in the city. Street mikes, pamphlets, street drama and media used to give health message in the city. DPHO requested people to drink boil water and take care of personal hygiene and sanitation through the messages.

8. Limitation

The study lacks the investigation of immunoglobulin (Ig) and HEV strains.

9. Conclusion

The review on the hepatitis outbreak in *Biratnagar* 2014 is based on district's presentation and HMIS reports. It gives you an epidemiological and demographic overview of the outbreak.

The outbreak recorded 2,789 Jaundice patients and most of the patients (80.67%) recorded from *Biratnagar*. Sex ratio of female to male was 0.56:1. Infection was among age groups of 15 to 54 years and highest infection noticed among 15-29 age groups. District Disaster Management Committee (DDMC) declared the outbreak on April 28 when 95 jaundice patients recorded in hospitals. The number reached at peak level 176 patients on May 6 and the trend came down to normal level on July 8, 2014. Total 12 deaths recorded in the outbreak. Of them 8 deaths from *Biratnagar*, 3 deaths from *Morang* district and 1 death from *Saptari* district recorded. In *Biratnagar* ward No. 11 listed 5 deaths, ward No. 8 listed 2 deaths and ward No. 3 listed 1 death. Case fatality rate calculated 0.43% in the *Biratnagar* outbreak. Hepatitis viruses E and A caused the outbreak. The sewage contamination through leaking pipes in water distribution transmitted the infection in outbreak.

After this outbreak the community awareness on using safe water been increased. Behavior change also observed in the areas. Before this outbreak, people used to drink tap water without treatment. Now, people boil or filter water in houses. Many people started to consume mineral water from the market in jars and bottles. However, government water supply system in *Biratnagar* is poor which calls for improvement to meet WHO standard of drinking water.

Definitions of Keywords

BPKIHS: BPKoirala Institute of Health Science

DPHO: District Public Health Office

DDMC: District Disaster Management Committee

EDCD: Epidemiology and Disease Control Division

HMIS: Health Management Information System
 IPD: Indoor Patient Department
 Khanepanisasthan: Government water supply authority
 NHRC: Nepal Health Research Council
 OPD: Out Patient Department
 RRT: Rapid Response Team
 UNHCR: United Nations High Commission for Refugees
 UNICEF: United Nation's Children Fund
 WHO: World Health Organization

Acknowledgements

The writer is thankful to the members of Rapid Response Team (RRT). I thank Santosh Gautam, Utsav Pokhrel, Dashi Lal Majhi, Haidar Ali, and all DPHO staffs who contributed in outbreak management including data collection. I also thank Dr. Kedar Baral, Dr. Dipak Yadav, Dr. Dipak Sigdel for their technical support. I thank DDMC, WHO, UNICEF, UNHCR, Plan Nepal, *Biratnagar* municipality, BPKIHS, Patan hospital, Epidemiology and Disease Control Division for the support and guidance during the outbreak.

References

- [1] Sarguna P, Rao A, Sudha Ramana KN. Outbreak of acute viral hepatitis due to hepatitis E virus in Hyderabad. *Indian Journal of Medical Microbiology*. 2007 Oct; 25(4): 378-82.
- [2] WHO. Hepatitis E. Fact sheet N°280, Updated July 2015. website browsed on Sept. 23, 2015. www.who.int.
- [3] Clayson ET, Shrestha, MP, Vaughn DW, Snitbhan, R, Shrestha KB, Longer CF. Rates of Hepatitis E Virus Infection and Disease among Adolescents and Adults in Kathmandu, Nepal. *Journal of Infectious Diseases* 1997;176 (September).
- [4] Chauhan, NT, Prajapati P, Trivedi AV, Bhagyalaxmi A. Epidemic Investigation of the Jaundice Outbreak in Girdharnagar, Ahmedabad, Gujarat, India, 2008. *Indian Journal Community Medicine*. 2010 Apr; 35(2): 294-297.
- [5] Awsathi S, Rawat V, Rawat C, Semwal V, Bartwal S. Epidemiological Investigation of the Jaundice Outbreak in Lalkuan, Nainital District, Uttarakhand. *Indian Journal of Community Medicine*. 2014 Apr-Jun; 39(2): 94-97. doi: 10.4103/0970-0218.132725.
- [6] CDC. Hepatitis A outbreak associated with green onions at a restaurant--Monaca, Pennsylvania, 2003. Centers for Disease Control and Prevention (CDC). *MMWR Morb Mortal Weekly Report*. 2003 Nov 28; 52(47): 1155-7.
- [7] CDC. Hepatitis A outbreak associated with green onions at a restaurant--Monaca, Pennsylvania, 2003. Centers for Disease Control and Prevention (CDC). *MMWR Morbidity Mortality Weekly Report*. 2003 Nov 28; 52(47): 1155-7.
- [8] Guthmann J, Klovstad H, Boccia D, Hamid N, Pinoges L, Nizou J, et al. A Large Outbreak of Hepatitis E among a Displaced Population in Darfur, Sudan, 2004: The Role of Water Treatment Methods. *Oxford Journals of Clinical Infectious Diseases*, Volume 42, Issue 12Pp. 1685-1691.
- [9] Hlady WG, Islam MN, Wahab MA, et al. Enterically transmitted non-A, non-B hepatitis associated with an outbreak in Dhaka: epidemiology and public health implications. *Tropical Doctor* 1990; 20: 15-17.
- [10] Kainer M. Hepatitis E study in Nepal. Travellers Medical and Vaccination Centre Pty. Ltd. and the Victorian Infectious Diseases Service, Royal Melbourne Hospital, Melbourne, Victoria, Australia, 1998. (<http://www.tmvc.com.au/ref3.html>).
- [11] Margolis HS, Alter MJ, Hadler SC. Viral hepatitis. In: Evans AS, Kaslow RA, eds. *Viral infections of humans: epidemiology and control*. 4th ed. New York, NY: Plenum Medical Book Company, 1997: 400-6.
- [12] Mast EE, Krawczynski K. Hepatitis E: an overview. *Annual Review Medicine* 1996; 47: 257-66.
- [13] Ouvea V, Snellings N, Popek MJ, Longer CF, Innis BL. 1998. Hepatitis E virus: complete genome sequence and phylogenetic analysis of a Nepali isolate. *Virus Res* 57: 21-26.
- [14] Shrestha SM. Hepatitis E in Nepal. *Kathmandu University Medical Journal* (2006), Vol. 4, No. 4, Issue 16, 530-544.
- [15] Okorundu S. I., Anyadoh-Nwadike S. O., Bacteriological and Physiochemical Analysis of Oguta Lake Water, Imo State, Nigeria, *Science Journal of Public Health*. Special Issue: Who Is Afraid of the Microbes. Vol. 3, No. 5-1, 2015, pp. 14-19. doi: 10.11648/j.sjph.S.2015030501.13.