

# Together let us confront it: An outbreak investigation of hepatitis B in Pathanamthitta district, Kerala

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## ABSTRACT

**Introduction:** Hepatitis B is a potentially life-threatening liver infection caused by the Hepatitis B virus (HBV). The established routes of transmission are from mother to infant, sexual contact, and exposure to blood or body fluids. Though HBV is preventable by vaccine and robust infection control practices, outbreaks of HBV infection do occur in India. However, the state of Kerala with its health parameters, one among the best in the country, cannot afford to have continuing outbreaks. An unusual increase in the reported cases of Hepatitis B in a rural area of Pathanamthitta district of Kerala, called for an outbreak investigation. **Aims:** To describe the epidemiological features, to determine the risk factors associated with HBV transmission, and to suggest measures to prevent future transmission. **Methods:** A community-based case-control study (1:2) was undertaken. A total of 162 participants (54 cases and 108 age, gender, and neighborhood matched controls) took part in the study. Focus group discussions were conducted with subject experts to develop an interview schedule assessing 40 risk factors. It was further reviewed by the University of Sydney. Data was collected by trained Junior Health Inspectors and Junior Public Health Nurses of the Primary Health Centers. Data was analyzed using SPSS v. 20. Proportions were compared by Univariate analysis, sub-group analysis, and logistic regression. Population Attributable Risk (PAR) was also calculated. **Results and Conclusion:** More than 90% of the infections were IgM anti-HBc positive, suggesting a recent infection. Interventions during hospitalization [OR: 7.98 (95% CI - 2.17--29.4)], family history of Hepatitis B [OR: 4.14 (95%CI - 1.73--9.9)], and laboratory investigations [OR: 3.99 (1.72--9.31)] were found to be significant risk factors. PAR was highest for laboratory interventions (32%). Vaccinating household contacts and strict enforcement of infection control practices could substantially reduce the burden of this fatal disease.

**Keywords:** Hepatitis B, Kerala, outbreak, Pathanamthitta district

## Introduction

Hepatitis B is a potentially life-threatening liver infection caused by the Hepatitis B virus (HBV). Around 260 million humans are chronically infected by the hepatitis B virus, causing 700,000 deaths worldwide every year. The actual number of acute

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cases is believed to be 6.5 times the number of reported cases in any year.<sup>[1]</sup> It can cause chronic infection and puts people at high risk of death from cirrhosis and liver cancer. The incubation period of the Hepatitis B virus varies from 30 to 180 days.

The major routes of transmission are from mother to infant (perinatal), sexual contact, non-sexual- person to person contact, and percutaneous exposure to blood or other body fluids.<sup>[2]</sup> Unsafe injection practices such as reuse of syringes and needles or contamination of multi-dose vials can lead to patient-to-patient transmission.<sup>[3]</sup> Transmission can also occur from interpersonal contact (e.g, sharing toothbrush or razors, contact with exudates from dermatologic lesions, or contact with HBV contaminated surfaces) and in settings such as schools, child care centres, and facilities for developmentally disabled persons.<sup>[4]</sup> The habit of sharing various personal and household articles within the home also provides an important mechanism for the transfer of HBV from carriers to other family members.<sup>[5]</sup> In the recent years, there were also postulates suggesting that deer flies could act as mechanical vectors in the transmission of Hepatitis B.<sup>[6]</sup> HBV is highly infectious, can be transmitted in the absence of visible blood, and remains viable on environmental surfaces for at least 7 days.<sup>[1]</sup> During this time, the virus can still cause infection if it enters the body of a person who is not protected by the vaccine.<sup>[7]</sup> The complete vaccine series induces protective antibody levels in more than 95% of infants, children, and young adults.<sup>[7]</sup> Immunologic memory remains intact for at least 30 years among healthy vaccinated individuals.<sup>[8]</sup>

HBV disease, though preventable by vaccine and robust infection control practices, outbreaks do occur in India. Since 2005, there are several reports of Hepatitis B outbreaks in Kerala. Some of them have been in the media, some are anecdotal, and some are even unreported. The state of Kerala which has its health parameters one among the best in the country, cannot afford to have continuing outbreaks of Hepatitis B. Though the health authorities have made attempts

to analyze the outbreaks, no consensual explanation have been brought so far.

During the first half of 2019, routine surveillance by the Integrated Disease Surveillance Programme (IDSP) for Hepatitis B showed an unusually high number of Hepatitis B cases, particularly in four neighboring Panchayats of Pathanamthitta District, Kerala. This was a cause for alarm in the District Health Administration and the general public. After a preliminary enquiry, it was suspected that this outbreak could be because of factors other than sexual route of transmission. Therefore, an outbreak investigation was conducted to describe the epidemiological features, to determine the risk factors that favored the transmission of Hepatitis B in the area, and also to suggest recommendations to prevent outbreaks in future.

### Methodology

This is a community-based case-control study done in four neighboring panchayats of a rural area in Pathanamthitta district of Kerala. The study was initiated after obtaining approval from Institutional Ethics Committee (IEC/2019/04/89).

Cases were identified by the IDSP from four panchayats of Konni, Pramadam, Pandalam Thekkekara, and Vallikodu [Figure 1]; between January 2019 and June 2019. They were reported HBsAg-positive patients (by laboratory-based Enzyme Immunoassay) from hospitals and laboratories that are integrated with the IDSP. This would include people with acute hepatitis- like illness as well as co-incident finding of Hepatitis B as part of another blood investigation. All cases were further tested for IgM anti-Hbc. Acute cases were those who were *positive* for IgM anti-Hbc, meaning that they had a recent acquisition of infection (within 6 months). Controls were selected by the health workers from the neighborhood of the cases after matching for age (+/-5 years), gender, and excluding



Figure 1: Map showing the affected Panchayats in Pathanamthitta District, Kerala

those who were previously vaccinated against Hepatitis B. They were subjected to HBsAg testing and only those who were “Negative” were included in the study. While testing potential controls for their HBsAg status using ELISA test, three of them were found to be positive for Hepatitis B and were eliminated from the study and three new controls were chosen. As per the reports furnished by the District Medical Office, there were a total of 57 Hepatitis B cases from the four panchayats in the abovementioned time frame and 54 gave consent to participate in the study. *Cases and Controls were chosen in a 1:2 ratio.* So, 108 age- and gender-matched neighborhood controls were selected, totalling to 162 participants.

An interview schedule was used to explore the factors that favored the transmission of Hepatitis B. It was developed using a systematic design process (AMEE Guide No. 87). Multiple Focus Group Discussions were conducted with experts in Community Medicine, Hepatology, General Medicine, Microbiology, and the District Medical Team. The content validity was further evaluated by independent reviewers from the Department of Hepatology, University of Sydney. We assessed over 40 risk factors, considering a time period of 6 months prior to their diagnosis of Hepatitis B. The interview technique was standardized through prior training of Junior Public Health Nurse (JPHN) and Junior Health Inspectors (JHI). A pilot testing of the questionnaire and a quality check was done on 2% of the questionnaires.

*Statistical analysis* was done using SPSS v 20. Odds ratio and Confidence Interval was calculated. Population Attributable Risk for Case-Control Studies [PAR<sub>cc</sub>] was calculated based on the formula:  $PAR_{cc} = P_c [OR-1] / 1 + P_c [OR-1]$ ;  $P_c = Exposure\ among\ controls$ . Multivariate logistic regression was carried out on factors that were found to have significant association in Univariate analysis.

### Results

The study participants (54 cases and 108 controls) were interviewed directly by home visits. The mean age of the reported cases was 51.65 ± 15.2 years. About 43% of them belonged to

“55 years and older” age category. The youngest case was 7 years and the oldest case was 88 years. Majority of the reported cases in the study area were males (61%) [Table 1].

Majority of the study subjects were IgM anti-Hbc positive (92.6%), which is a marker of acute Hepatitis B, suggesting a recent acquisition of infection (within 6 months of diagnosis) [Figure 2]. More than two-thirds of the cases were diagnosed because of jaundice (68.5%) [Figure 1].

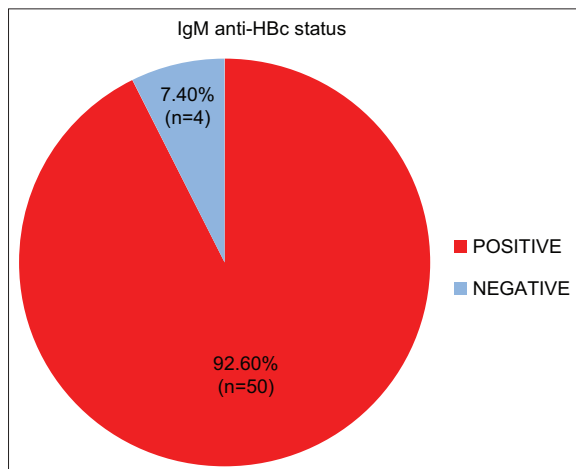
More than one-third of the cases reported a positive family history of Hepatitis B (37%) and among the affected family members, majority of them were either parents, siblings, or children (60%). Considering the factors related to transmission of Hepatitis B among close household contacts of the cases, 55% gave a history of sharing comb, 35% shared nail cutters, and 25% had contact with open sores of an infected family member. However, none of the above factors were significantly associated with the transmission of Hepatitis B. [Figure 3]

In univariate analysis, those who had undergone interventions during hospitalization had 7.42 times the odds of contracting Hepatitis B (OR: 7.42; 95% C.I: 2.27--24.34). Exposure to surgical procedures (OR: 5.36; 95% C.I 1.01--28.5), family history of Hepatitis B (OR: 4.29; 95% C.I: 1.93--9.57), contact with persons

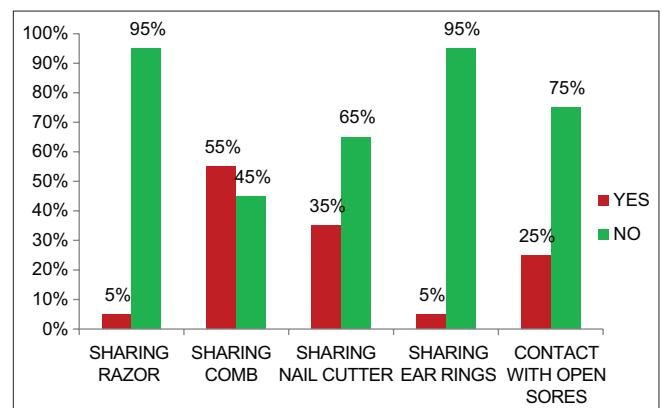
**Table 1: Age and Gender Distribution of the study subjects**

	Cases (n=54)		Controls (n=108)	
	n	Percentage	n	Percentage
Age (years)				
<18	1	1.9%	2	1.9%
18-34	5	9.3%	9	8.3%
35-54	25	46.3%	50	46.3%
>55	23	42.6%	47	43.5%
Gender				
Male	33	61.1%	33	61.1%
Female	21	38.9%	21	38.9%
Total	54	100%	108	100%

Mean age of the cases=51.65±15.2 years, Median age of the cases=52 years, IQR=18.25 years



**Figure 2: IgM anti-HBc status of the cases (n = 54)**



**Figure 3: Factors linked to intra-familial transmission of hepatitis B in cases**

who had jaundice (OR: 2.35; 95% C.I: 1.15--4.80), undergoing dental procedures (OR: 2.8; 95% C.I: 1.19--6.58), and laboratory investigations (OR: 2.05; 95% C.I: 1.05--3.99) were significant risk factors in contracting Hepatitis B. Multivariable logistic regression showed that those who underwent interventions during hospitalization (OR: 7.98), family history of Hepatitis B (OR: 4.14), and exposure to laboratory investigations (OR: 3.99) were the most at risk of contracting Hepatitis B and these were the factors that favored the transmission of Hepatitis B in the current outbreak. Population Attributable Risk revealed that 32% of the Hepatitis B cases were attributed to- undergoing laboratory investigations. This implies that 32% of the cases could have been avoided if laboratory investigations were avoided from this locality [Table 2].

Deerfly bite, visit to medical camps, visit by palliative care personnel, history of lancet use, blood donation or blood transfusion, dialysis, endoscopy, electromyography, injection for arthritis, visit to barbershops and beauty parlours, occupational status, and the diabetic status of the individuals did not have any significant association with the transmission of Hepatitis B.

None of the study subjects had history of tattooing, acupuncture, drug abuse, or reported extra-marital affairs nor was involved in any contact sports. None of the adults had taken vaccination for Hepatitis B in the past. There is also no perinatal transmission of Hepatitis B among the study subjects.

## Discussion

The WHO issued the Glasgow Declaration on Hepatitis Elimination, which outlines the commitments necessary to eliminate viral hepatitis as a public health concern by 2030. Sporadic outbreaks of Hepatitis B do occur in Kerala and they continue to smoulder in spite of best efforts to keep them at bay. The concentrated efforts by the health system of Kerala has reduced the burden of hepatitis B to a large extent. Not a single case of vertical transmission has been reported in the present study. Despite these preventive efforts, outbreaks of Hepatitis B caution us about the continuing presence of some factors that favor the transmission of Hepatitis B in the district.

Robust reporting can account for the increased number of cases, which can be old infections coming to limelight by way of blood investigations. But to our surprise, more than 90% of the cases were IgM anti-Hbc positive, suggesting a recent acquisition of infection. This points to the fact that some recent-onset factors might have triggered off a series of Hepatitis B infections in the district.

The current study found that 42.6% of the people infected were above the age of 55 years and none gave a history of extra-marital relationships or intravenous drug abuse (self-reported). Also, nearly one-third (32%) of the cases were diagnosed incidentally. Since majority of patients with acute HBV are asymptomatic, clusters of patients infected in healthcare settings might be unrecognized. Hospital-based surveys by Centre for Disease Control points out that healthcare-related transmission should be suspected when cases are detected among persons without traditional risk factors for infection,<sup>[3]</sup> such as in the current scenario.

To add strength to our supposition that healthcare settings might be the hub of HBV transmission, we found that those who underwent hospitalization (OR: 7.98, 95% C.I: 2.17--29.4) were the most at risk of contracting Hepatitis B. Similar to our findings, during 2008–2011 in USA, a total of 31 outbreaks of HBV or HCV infection identified healthcare-related factors as the cause for the outbreak.<sup>[9]</sup> Improperly sterilized needles and syringes could still be an important cause of transmission of hepatitis B in India, as demonstrated by the recent outbreak of hepatitis B in Modasa Town of Gujarat.<sup>[10]</sup> Public health investigations suggested the need to identify unsafe practices and control healthcare-associated viral hepatitis transmission.<sup>[11-13]</sup> Health care should provide no avenue for transmission of blood-borne pathogens, yet transmission of HBV and HCV in healthcare settings is an increasingly recognized problem, despite of using disposable syringes and needles. Why does this happen? The only possible reason could be the breach in implementation of strict infection control practices and quality check of consumables used in health care. This warrants urgent attention.

**Table 2: Risk Factors Associated with Hepatitis B in the study**

Univariate Analysis				
Factors	Cases (n=54)	Controls (n=108)	OR (95% CI)	P
Underwent hospitalisation	12 (22.2%)	4 (3.7%)	7.42 (2.27-24.34)	0.001
Exposure to major or minor surgical procedures	5 (9.3%)	2 (1.9%)	5.36 (1.01-28.5)	0.030
Family history of Hepatitis B	20 (37%)	13 (12%)	4.29 (1.93-9.57)	0.001
Underwent dental procedures during six months prior to diagnosis	14 (25.9%)	12 (11.1%)	2.80 (1.19-6.58)	0.015
Contact with jaundiced persons	21 (38.9%)	23 (21.3%)	2.35 (1.15-4.80)	0.018
Laboratory investigations during six months prior to diagnosis	34 (63%)	49 (45.4%)	2.05 (1.05-3.99)	0.035
Multivariable Logistic Regression and PAR <sub>cc</sub>				
Factors	PAR <sub>cc</sub>	Odds Ratio	95% CI of OR	P
Underwent hospitalisation	17.3%	7.98	2.17-29.4	0.002
Family history of hepatitis B	28%	4.14	1.73-9.9	0.001
Laboratory investigations	32%	3.99	1.72-9.31	0.05

Family history of Hepatitis B (OR: 4.14, 95% CI: 1.73--9.9) is found to be an important risk factor in this study. Sampliner *et al.* in a prospective study has shown that intra-familial clustering of HBV infection was documented in two-thirds of the family members of asymptomatic HBsAg carriers.<sup>[14]</sup> Family members in small dwellings facilitate close interpersonal physical contacts. Presence of HBV DNA has been documented in saliva, sweat, and urine of HBV-infected persons, making it highly probable for an intra-familial route of transmission, through any of these vehicles.<sup>[15,16]</sup> By sequencing the viral genome, it has been shown that the HBV genome of patients bears 100% sequence homology with their infected family members.<sup>[17]</sup> HBV DNA was also detected on 27% of nail scissors and in 50% of nail specimens from HBV DNA-positive patients and may play an important role in household transmission of HBV.<sup>[18]</sup> This suggests that all family members should be offered blood investigations and Hepatitis B vaccination immediately, which could play a big role in preventing horizontal transmission among family members. Although sharing of nail cutters, earrings, combs were assessed in our study to explore the routes of intra-familial transmission, these were not found to have a significant role in the transmission of Hepatitis B.

Undergoing dental procedures (OR: 2.8) may also increase the risk of contracting Hepatitis B. (OR: 2.05) Literature shows that the issue of viral hepatitis infection in dentistry is an important one.<sup>[19]</sup> Viral hepatitis particles are present in oral fluids and can be transmitted via saliva and gingival cervical fluid (GCF).<sup>[20]</sup> A study from India in 2011 reported dental treatments as a risk factor for HBV infection in pregnant women.<sup>[21]</sup>

Many at times, laboratories are incriminated in spreading Hepatitis B. HBV can remain on the environmental surfaces for up to 7 days. Infection Control Practices may be extremely important in such a scenario. Undergoing laboratory procedures were a significant risk factor in acquiring Hepatitis B in the present study. This could be because of the lack of strict laboratory regulations and very low entry barrier to open up labs-which led to the proliferation of a large number of laboratories offering various degrees of quality and reliability with no specific minimum standard that the patient can expect.<sup>[22]</sup> If the laboratories were providing a good quality of service to its people, 32% of the Hepatitis B cases in the area could have been avoided, as is evident from the PAR.

Our study did not find visit to barbershop as a risk factor for acquiring Hepatitis B. But HBV transmission can occur by razor sharing and beauty treatments. A survey of barbers in India and Pakistan revealed that they commonly re-use razors by dipping in Dettol.<sup>[23,24]</sup> The provision of repeated health education to the barbers by the District Administration and their awareness might be the reason for discordance in our study.

Kerala is the “Diabetic Capital of India” with a prevalence of diabetes as high as 20%, (double the national average of 8%). However, in the present study, diabetes did not play a significant

role in pre-disposing oneself to acquire Hepatitis B infection. Although indirectly, diabetes may be responsible for contracting Hepatitis B by increasing exposure to laboratory investigations and hospitalizations.

One of the key priority action area in Hepatitis B elimination is “Advocacy” which emphasises on empowering communities and conducting community-led research and monitoring,<sup>[25]</sup> which is exemplified here. This paper highlights the importance of adhering to strict Infection Control Practices and adopting safe injection practices in hospitals, laboratories, and dental clinics to break the chain of transmission of this notorious, but preventable blood-borne pathogen.

### Strengths

This study was conducted as a result of Community Participation and their interest to explore the risk factors of Hepatitis B transmission. A systematic 7-step approach to Questionnaire development was used to develop the interview schedule.<sup>[26]</sup> Prior training of the persons involved in data collection ensured data accuracy. This study was also a perfect example of Public--Private Partnership in exploring, fostering and building the health of the community.

### Limitations

Sub-group analysis was unable to detect any significant association due to the small sample size of the outbreak.

### Conclusion

This study identifies the presence of factors favoring the transmission of Hepatitis B in Pathanamthitta district, the most important being: Interventions during hospitalization, Undergoing Laboratory Investigations and presence of family members with Hepatitis B, who have not received Hepatitis B vaccination. In light of the above situation, the government must resort to stringent regulations to uphold highest quality of standard in healthcare-related services to its people. This could be brought about by continuous Infection Control surveillance of laboratories and hospitals throughout the district and implementing strict action against the offenders. It is also mandatory to provide vaccination to household contacts of all Hepatitis B cases, which could be even implemented at the Policy level.

### Recommendations

1. Screening for Hepatitis B<sup>[27]</sup> and vaccination of household members living with HBV infected people.
2. Hospitalization, laboratory investigations, and dental appointments expose the patients to invasive procedures which puts them at a higher risk for contracting Hepatitis B. Since disposable syringes, needles, and drip sets are used, we may underestimate the possibility of transmission of Hepatitis B via this route. However, it is necessary to

investigate the quality of the consumables, the systems, and processes involved in the manufacture of these products.

3. Develop an administrative code rule in all healthcare-associated institutions stating the requirement of an on-site staff member to direct infection control activities and complete a state-approved infection control course.<sup>[28]</sup>
4. General awareness to the community regarding the modes of transmission, complications associated with chronic Hepatitis B, and the effectiveness of the Hepatitis B vaccine could go a long way in preventing further cases of Hepatitis B in the community. This could be done in collaboration with local private hospitals and medical colleges, thus portraying a Public--Private Partnership model in Health Care.

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### Conflicts of interest

There are no conflicts of interest.

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