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HIGH SEROPREVALENCE OF BLOODBORNE HEPATITIS IN DIALYSIS UNITS: A STUDY OF HBV/HCV BURDEN AND RISK FACTORS AMONG HEMODIALYSIS PATIENTS IN RAWALPINDI, PAKISTAN

Original Research

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ABSTRACT

Background: Hemodialysis (HD) patients are highly vulnerable to hepatitis B virus (HBV) and hepatitis C virus (HCV) infections due to repeated vascular access, blood transfusions, and extended healthcare exposure. While global initiatives have aimed to reduce these infections, prevalence remains disproportionately high in low- and middle-income countries (LMICs), including Pakistan, where limited epidemiological data are available for dialysis populations. Understanding local burden and risk determinants is crucial to inform targeted prevention strategies.

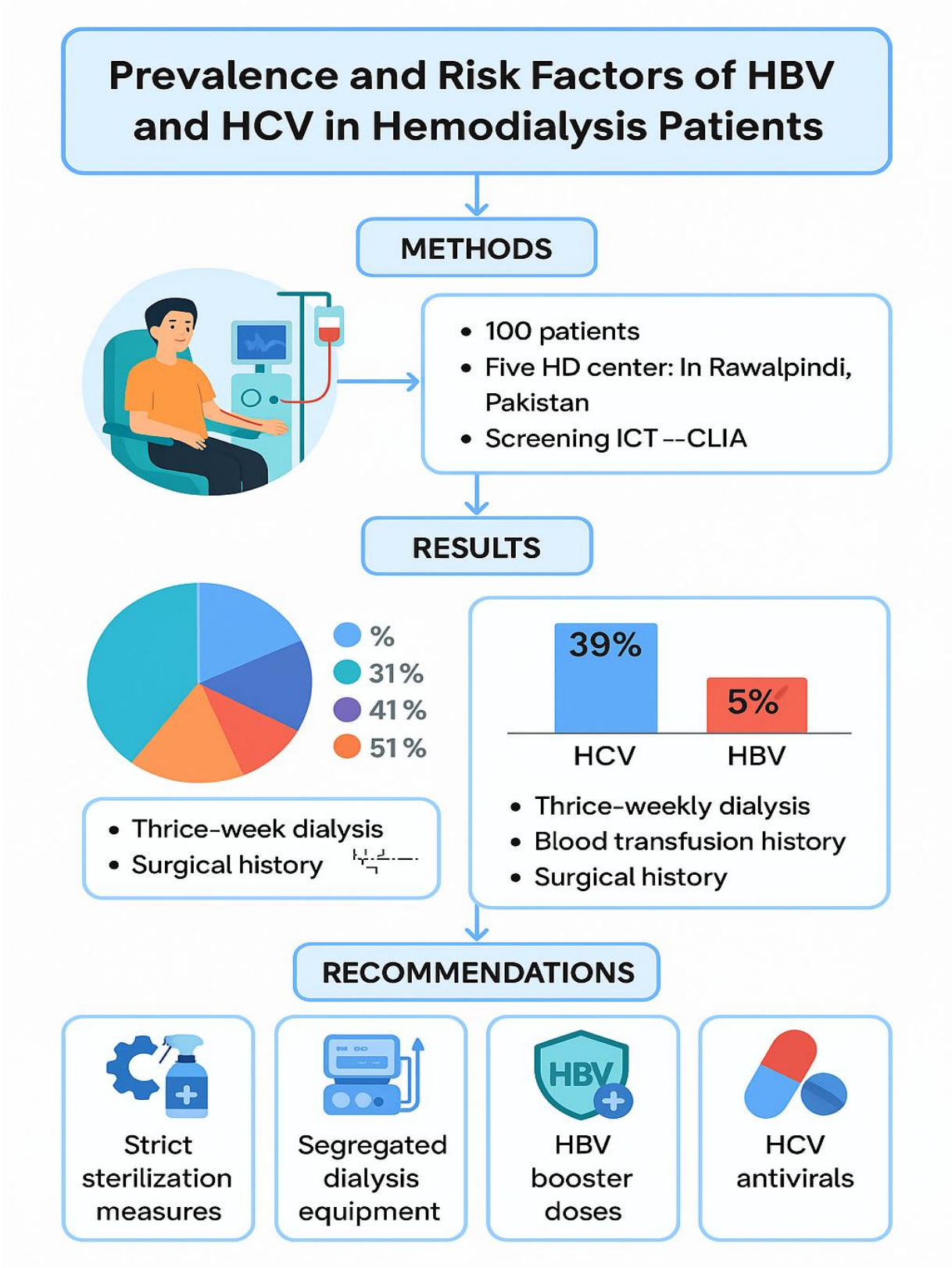
Objective: To determine the prevalence of HBV and HCV infections and identify associated risk factors among HD patients in Rawalpindi, Pakistan.

Methods: A descriptive cross-sectional study was conducted across five HD centers representing public, private, and charitable healthcare sectors. A total of 100 patients aged ≥18 years, on maintenance HD for at least one month, were recruited using quota sampling. Screening for HBV surface antigen (HBsAg) and anti-HCV antibodies was performed using immunochromatographic tests (ICT), with all reactive cases confirmed via chemiluminescent immunoassay (CLIA). Demographic, clinical, and dialysis-related data were collected through structured questionnaires and verified from medical records. Statistical analysis included descriptive measures and Chi-square tests for associations, with $p<0.05$ considered significant.

Results: CLIA-confirmed HCV prevalence was 39% (39/100), HBV prevalence was 5% (5/100), and co-infection occurred in 3% (3/100). Thrice-weekly dialysis was associated with higher HCV prevalence (58.1%) compared to twice-weekly (30.4%) ($p=0.009$). HBV was significantly associated with blood transfusion history (8.8% vs. 0%, $p=0.045$) and surgical history (10.8% vs. 1.6%, $p=0.041$). HBV vaccination coverage was 65%, with no significant protective effect ($p=0.229$).

Conclusion: The substantial burden of HCV and ongoing HBV transmission in HD units indicates persistent infection control gaps. Strengthened sterilization protocols, dedicated equipment for infected patients, improved HBV vaccination strategies, and expanded access to antiviral therapy are urgently required to reduce transmission in resource-limited dialysis settings.

Keywords: Blood Transfusion, Chemiluminescent Immunoassay, Cross-Sectional Studies, Hemodialysis Units, Hepatitis B, Hepatitis C, Pakistan.



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INTRODUCTION

Hepatitis B virus (HBV) and hepatitis C virus (HCV) remain among the most significant global public health concerns, with a particularly heavy burden observed in individuals undergoing maintenance hemodialysis (HD). These bloodborne pathogens are leading causes of chronic liver disease, cirrhosis, and hepatocellular carcinoma, with an estimated 292 million people infected with HBV and approximately 58 million living with chronic HCV worldwide (1,2). HD patients face an elevated risk of acquiring these infections due to frequent vascular access, repeated blood transfusions, prolonged healthcare exposure, and potential lapses in infection control measures within dialysis facilities (3). The immunocompromised status associated with end-stage renal disease (ESRD) further amplifies their susceptibility to these infections (4,5). In hemodialysis populations, infection rates for HBV and HCV are consistently higher than in the general community, particularly in low- and middle-income countries (LMICs) where infection control infrastructure may be suboptimal (6). Studies have reported HCV prevalence as high as 62.7% and HBV rates up to 20.7% among HD patients in such settings (7,8). In Pakistan, the burden is similarly concerning, with regional estimates showing HCV seroprevalence ranging from 18.31% to 39% and HBV prevalence between 1.5% and 5.4% in dialysis populations (9,10). These figures point to persistent challenges in HBV vaccination coverage, consistent sterilization of dialysis equipment, and adherence to universal precautions, especially in resource-limited healthcare systems (11,12).

Multiple factors contribute to the elevated transmission risk among HD patients, including extended duration of dialysis, repeated exposure to shared medical devices, frequent transfusions, and inconsistent disinfection protocols (13,14). Socioeconomic constraints, disparities in healthcare quality between public and private dialysis centers, and inadequate implementation of standardized screening and isolation policies further exacerbate the problem (15,16). While HBV vaccination and the advent of highly effective direct-acting antivirals (DAAs) for HCV have revolutionized prevention and treatment strategies, their optimal utilization remains hindered in LMIC settings due to financial, logistical, and policy limitations (17,18). Given these gaps, there is a critical need for region-specific epidemiological data to inform targeted interventions. This study was designed to determine the prevalence of HBV and HCV infections among hemodialysis patients in Rawalpindi, Pakistan, and to identify associated risk factors, including dialysis duration, transfusion history, and facility-based practices. By employing a two-step diagnostic approach—initial immunochromatographic testing (ICT) followed by confirmation with chemiluminescent immunoassay (CLIA)—the research aims to provide reliable prevalence estimates and highlight modifiable risk determinants, thereby supporting evidence-based strategies to reduce the hepatitis burden in vulnerable dialysis populations.

METHODS

Study Design and Setting

This descriptive cross-sectional study was conducted across five tertiary care hospitals in the Rawalpindi region of Pakistan: Benazir Bhutto Hospital (BBH), Bilal Hospital (BH), Al-Khidmat Razi Hospital, Pakistan Kidney and Liver Institute (PKLI), and District Headquarter Hospital (DHQ). These facilities were selected to represent diverse healthcare settings (public, private, and charitable) to assess the prevalence of Hepatitis B Virus (HBV) and Hepatitis C Virus (HCV) among hemodialysis (HD) patients.

Sample Size and Sampling Technique

A total of 100 patients undergoing regular hemodialysis were enrolled using quota sampling to ensure proportional representation across the five centers. The distribution was as follows: BBH (n=25), PKLI (n=20), DHQ (n=20), Al-Khidmat Razi Hospital (n=20), and BH (n=15).

INCLUSION AND EXCLUSION CRITERIA

Inclusion Criteria: Patients aged ≥18 years, receiving hemodialysis for ≥1 month, and providing informed consent.

Exclusion Criteria: Patients with a recent (≤6 months) HBV/HCV diagnosis/treatment, those on dialysis for <1 month, or declining consent.

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Data Collection and Laboratory Procedures

Blood Sample Collection: Venous blood (5 mL) was drawn under aseptic conditions during routine dialysis sessions, stored in sterile vacutainers, and transported at 2–8°C to Nayyab Diagnostic Lab, Rawalpindi.

Screening: Initial testing used Immunochromatographic Test (ICT) kits (Abbott) for HBsAg and anti-HCV antibodies.

Confirmation: Positive cases were retested via Chemiluminescent Immunoassay (CLIA; Mindray CL-900i) using Ray Biotech kits. Internal controls and weekly calibrations ensured accuracy.

Quality Assurance

Controls were run with each CLIA batch.

Equipment was calibrated weekly.

Data entry was cross verified by two independent personnel.

Risk Factor Assessment

Demographic (age, gender), clinical (comorbidities, transfusion history), and dialysis-related variables (frequency, duration) were recorded via structured questionnaires.

Statistical Analysis

Data were analyzed using descriptive statistics (frequencies, percentages) and inferential tests (Chi-square for categorical variables, mean ± SD for continuous variables). Associations between risk factors (e.g., blood transfusion, dialysis duration) and HBV/HCV status were evaluated.

Ethical Considerations

Approval was obtained from institutional review boards of all participating hospitals. Written informed consent was secured, and confidentiality maintained via anonymized identifiers. Newly diagnosed patients were referred to for clinical management.

RESULTS

The study analyzed data from 100 hemodialysis patients recruited from five dialysis centers in Rawalpindi, Pakistan. The mean age of participants was 45.2 years (±13.2), with the largest proportion (27%) aged 31–40 years, followed by 23% aged 41–50 years, 21% aged 51–60 years, 16% aged 18–30 years, and 13% aged 61–80 years. Males represented 53% of the study population, while females accounted for 47%. CLIA-confirmed testing revealed an HCV prevalence of 39% (39/100) and an HBV prevalence of 5% (5/100), with co-infection detected in 3% (3/100) of patients. Initial ICT screening slightly overestimated prevalence, identifying 42% HCV-positive and 6% HBV-positive cases, corresponding to positive predictive values of 92.9% for HCV and 83.3% for HBV. Analysis of risk factors demonstrated that a history of blood transfusion was present in 57% of participants and showed a statistically significant association with HBV infection ($\chi^2 = 4.017$, $p = 0.045$). Patients undergoing dialysis thrice weekly had significantly higher HCV prevalence (58.1%) compared with those dialyzed twice weekly (30.4%) ($\chi^2 = 6.864$, $p = 0.009$). Surgical history was also significantly associated with HBV infection (10.8% vs. 1.6%; $p = 0.041$). Hypertension was the most frequently reported comorbidity (41%), followed by combined hypertension and diabetes mellitus (33%), isolated diabetes mellitus (8%), and absence of comorbidities (5%). HBV vaccination coverage was reported in 65% of patients; however, no statistically significant protective association with HBV status was observed ($p = 0.229$).

Table 1: Age and Gender Distribution

Variable	Category	Frequency (n)	Percentage (%)
Age Group (Years)	18–30	16	16%
	31–40	27	27%
	41–50	23	23%
	51–60	21	21%
	61–80	13	13%
Gender	Male	53	53%

	Female	47	47%

Table 2: Seroprevalence of HBV and HCV

Virus	ICT-Positive	CLIA-Confirmed	False Positives	PPV
HBV	6% (6/100)	5% (5/100)	1 (16.7%)	83.3%
HCV	42% (42/100)	39% (39/100)	3 (7.1%)	92.9%

Table 3: Association between Risk Factors and Infections

Risk Factor	HBV+ (%)	HCV+ (%)	Statistical Significance
Blood Transfusion	8.8% (5/57)	31.6% (18/57)	HBV: p = 0.045
Dialysis ≥3x/week	3.2% (1/31)	58.1% (18/31)	HCV: p = 0.009
Surgical History	10.8% (4/37)	29.7% (11/37)	HBV: p = 0.041

Table 4: Comorbidities among Participants

Comorbidity	Frequency (n)	Percentage (%)
Hypertension	41	41%
Hypertension + Diabetes	33	33%
Diabetes Mellitus	8	8%
No Comorbidities	5	5%

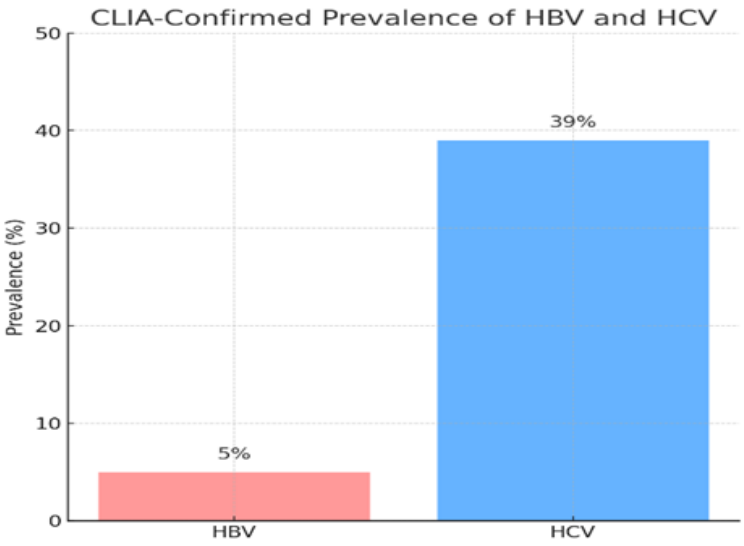

Figure 1: Bar graph comparing HBV and HCV prevalence (ICT vs. CLIA).

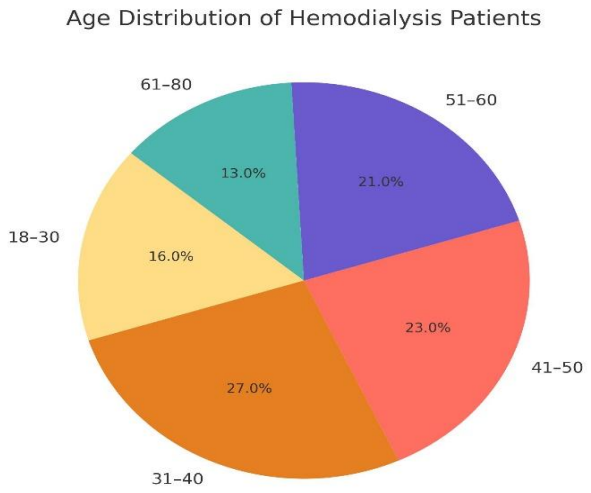

Figure 2: Pie chart of age distribution among hemodialysis patients. with age groups: 18–30, 31–40, 41–50, 51–60, 61–80.)

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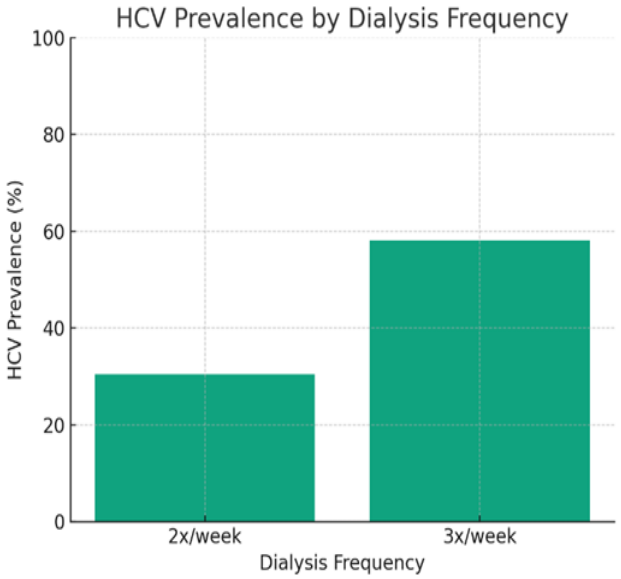

Figure 3: Histogram of HCV prevalence by dialysis frequency (2x/week: 30.4%, 3x/week: 58.1%).

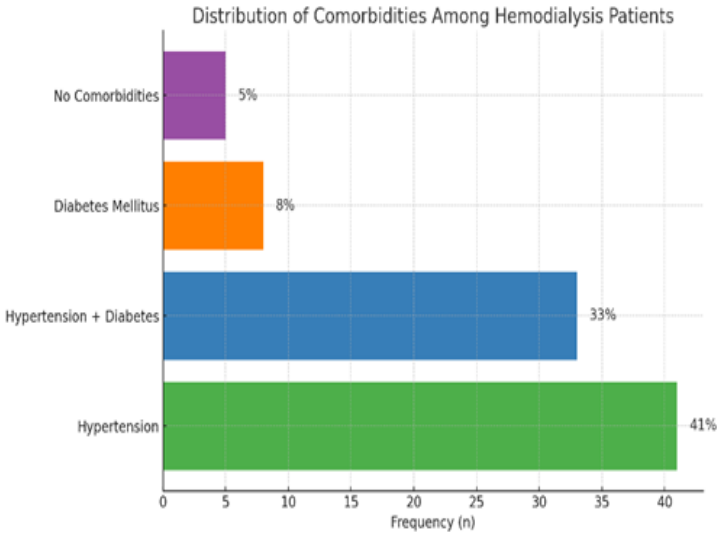

Figure 4: Horizontal bar chart showing the distribution of comorbidities among hemodialysis patients, with frequencies and labeled percentages for each category.

DISCUSSION

The findings of this study demonstrated a considerable burden of hepatitis C virus (HCV) and hepatitis B virus (HBV) infections among hemodialysis patients in Rawalpindi, Pakistan, with prevalence rates of 39% and 5%, respectively. These figures were notably higher than those reported in the general population, reaffirming the heightened susceptibility of this patient group to bloodborne infections due to repeated vascular access, frequent blood transfusions, and potential breaches in infection control measures (13). The observed prevalence was consistent with data from low- and middle-income countries (LMICs), where HCV rates among hemodialysis populations have ranged from 18.31% to 62.7%, and HBV from 1.5% to 20.7% (17-19). The elevated HCV prevalence indicated persistent challenges in curbing nosocomial transmission within dialysis facilities. The significant association between higher dialysis frequency and increased HCV rates suggested that cumulative procedural exposure remains a major risk factor for transmission. This association mirrored findings from previous LMIC studies, where limitations in resources and infrastructure hindered full compliance with universal precautions, leading to ongoing outbreaks linked to shared equipment and suboptimal sterilization (20,21). The comparatively lower HBV prevalence could, in part, be attributed to the impact of vaccination initiatives, as 65% of participants reported prior immunization. However, the absence of statistically significant protective effects implied possible factors such as reduced vaccine responsiveness in immunocompromised individuals, incomplete vaccination schedules, or waning immunity over time. Such patterns have been documented in hemodialysis populations where booster doses and post-vaccination antibody titer monitoring were required to maintain immunity (22,23). The significant association between HBV infection and a history of blood transfusions underscored the importance of stringent donor screening protocols, while the link with surgical history indicated the potential role of perioperative exposure to infected blood or contaminated surgical instruments.

These findings have important clinical and public health implications. Strengthening infection control protocols, ensuring dedicated dialysis machines for HBV/HCV-positive patients, and implementing regular environmental disinfection could significantly reduce transmission risks. Furthermore, ensuring the availability of booster HBV doses and expanding access to direct-acting antivirals (DAAs) for HCV-positive patients within dialysis units may help reduce disease burden. Adopting confirmatory testing methods such as CLIA

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for all ICT-positive results was also highlighted as a strategy to improve diagnostic accuracy and minimize unnecessary interventions. The study's strengths included the use of a confirmatory two-step diagnostic approach and inclusion of diverse healthcare facilities, which enhanced the reliability and representativeness of the findings. However, limitations were evident. The relatively small sample size restricted statistical power for subgroup analyses, and the non-probability sampling technique limited generalizability. Data on infection control practices, vaccination schedules, and post-vaccination seroconversion rates were not collected, which restricted assessment of modifiable facility-level risk factors. Additionally, no multivariate analysis was conducted to control for potential confounding variables such as age, comorbidity burden, and duration of dialysis, which could have refined the interpretation of associations. Future research should incorporate larger, multicenter probability-based sampling with detailed assessments of dialysis unit protocols, staff training compliance, and patient vaccination histories, including antibody titer monitoring. Studies integrating molecular epidemiology could also help trace transmission dynamics and guide targeted interventions, ultimately contributing to improved infection prevention strategies in high-risk dialysis populations.

CONCLUSION

This study concluded that hepatitis B and C infections remain a pressing concern among hemodialysis patients in Rawalpindi, with transmission strongly linked to procedural exposures and gaps in infection control. The findings reinforced the urgent need for strengthening preventive measures through rigorous sterilization practices, segregation of dialysis equipment for infected patients, optimization of vaccination strategies including booster doses, and expanded access to curative therapies for HCV. Ensuring confirmatory testing for accurate diagnosis, alongside targeted staff training and supportive policy reforms, holds the potential to substantially reduce the hepatitis burden in this high-risk population. These measures, if implemented consistently, could improve patient safety and long-term outcomes in resource-limited dialysis settings.

AUTHOR CONTRIBUTION

Author	Contribution
Trabish Saeed	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Meh Jabeen	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Sufian Ayub	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Muhammad Zulqarnain	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Safdar Ali	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Maimona Sadia*	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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