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RISK FACTORS FOR TRANSMISSION OF VIRAL HEPATITIS B & C IN HEMODIALYSIS PATIENT

Original Research

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ABSTRACT

Background: Hepatitis B virus (HBV), hepatitis C virus (HCV), and hepatitis D virus (HDV) continue to pose major global health challenges, particularly among patients undergoing hemodialysis (HD). These patients experience repeated exposure to blood products, prolonged vascular access, immunosuppression, and increased risk of cross-contamination, all of which amplify vulnerability to viral transmission. Prevalence varies significantly across regions due to disparities in healthcare infrastructure, infection control practices, and screening quality.

Objective: This review aimed to examine the prevalence, associated risk factors, and clinical implications of HBV, HCV, and HDV infections among hemodialysis patients, with added emphasis on resource-limited healthcare settings.

Methods: A descriptive, literature-based review approach was applied using peer-reviewed journals, WHO and CDC epidemiological reports, and regional surveillance databases. Studies were included if they reported numerical prevalence data for HBV, HCV, or HDV among hemodialysis patients, highlighted risk factors linked to viral transmission, or addressed public health implications in renal failure populations. Data extraction covered HBsAg, anti-HCV, and anti-HDV rates; regional variations; transfusion-related exposure; cross-contamination events; and structural limitations within dialysis units. Findings were synthesized thematically to ensure coherence across multiple healthcare contexts.

Results: Prevalence estimates varied widely across global regions, with HBV ranging from 3–42%, HCV from 5–60%, and HDV (among HBsAg-positive patients) from 0–44.5%. Risk factors consistently identified included multiple blood transfusions, long-term vascular access, immunosuppression, dialysis at multiple centers, and poor infection control compliance. In resource-limited countries such as Botswana, where kidney transplantation is rare, heavy reliance on long-term dialysis heightened the risk of viral transmission. Several studies also indicated strong evidence of nosocomial spread within HD units.

Conclusion: Viral hepatitis remains a significant contributor to morbidity and mortality in hemodialysis patients. Wide regional variation reflects differences in healthcare capacity and infection prevention systems. Strengthening HBV vaccination programs, enforcing strict infection-control protocols, and improving dialysis infrastructure—particularly in low-resource countries—are essential steps toward reducing the burden of HBV, HCV, and HDV in this high-risk population.

Keywords: Chronic Kidney Failure, Hemodialysis, Hepatitis B Virus, Hepatitis C Virus, Hepatitis D Virus, Infection Control, Prevalence.

INTRODUCTION

Hepatitis B virus (HBV) and hepatitis C virus (HCV) continue to pose a substantial global health burden, contributing to significant morbidity and mortality across diverse populations. In 2017 alone, more than 391 million people—approximately 5% of the world's population—were living with chronic HBV infection, with an additional 145 million new acute infections reported in the same year (1). These infections become even more concerning within specific clinical groups, particularly among individuals receiving hemodialysis, where both HBV and HCV are recognized as major contributors to chronic liver disease, impaired quality of life, and increased mortality (2). Because patients with chronic renal failure exhibit reduced immune competence and an impaired ability to clear viral infections, the persistence of hepatitis viruses becomes a central challenge in their long-term care. Hemodialysis settings create a unique ecosystem in which blood-borne infections can spread rapidly. Viral hepatitis B, C, and D—primarily transmitted via parenteral routes—are among the most prevalent causes of chronic liver disease in hemodialysis populations, further complicating treatment outcomes (3). Studies from different regions report wide variations in hepatitis prevalence among hemodialysis patients, with HBsAg positivity ranging from 3–42%, anti-HCV positivity from 5–60%, and antidelta antibodies detected in up to 44.5% of HBsAg-positive individuals (4). These patterns underscore a substantial epidemiological burden, shaped by repeated exposure to blood products, frequent transfusions, and the multiple invasive procedures that characterize renal replacement therapy (5). Hemodialysis patients remain exceptionally vulnerable due to their dependence on long-term vascular access and the close-proximity, shared-care environment of dialysis units—factors that amplify opportunities for person-to-person transmission through contaminated equipment, surfaces, or the hands of healthcare personnel (6). Their immunosuppressed physiological state adds another layer of vulnerability, heightening susceptibility to infection and limiting antiviral responses (7).

Globally, chronic kidney disease (CKD) itself is an escalating public health concern, affecting more than 10% of the population, or approximately 800 million individuals, largely driven by rising rates of diabetes, hypertension, and other metabolic risk factors (8). Within this context, chronic hemodialysis becomes a life-sustaining therapy for many but simultaneously exposes patients to heightened infectious risks, including HBV, HCV, and HIV (9). The magnitude of this issue is particularly pronounced in regions with constrained healthcare resources. For instance, in Botswana, kidney transplantation is uncommon due to limited donor availability and infrastructural barriers, leaving most renal failure patients dependent on long-term hemodialysis and, consequently, at increased risk of exposure to blood-borne viruses (10). With an estimated 240 million people chronically infected with HBV and 150 million with HCV worldwide, the risks encountered by dialysis patients mirror a broader global challenge with profound clinical, economic, and public health implications (11). Despite extensive global attention, there remain gaps in understanding the burden, risk factors, and transmission patterns of hepatitis infections among hemodialysis populations in various low- and middle-income settings. This underscores the need for context-specific evidence that can guide infection-control strategies, improve patient outcomes, and strengthen dialysis unit protocols. In response to these gaps, the present study aims to investigate the prevalence and associated factors of HBV and HCV infections among patients undergoing chronic hemodialysis, with the objective of informing prevention, surveillance, and clinical management strategies tailored to this high-risk group.

METHODS

This study employed a descriptive, literature-based review methodology designed to synthesize existing evidence on the prevalence, risk factors, and clinical implications of Hepatitis B virus (HBV), Hepatitis C virus (HCV), and Hepatitis D virus (HDV) infections among patients undergoing hemodialysis. A qualitative, descriptive approach was adopted, drawing exclusively on previously published research to ensure a broad and unbiased understanding of viral hepatitis within dialysis settings. No human participants were directly involved, and therefore no recruitment, sampling, or direct data collection from individuals was undertaken. Relevant literature was identified through systematic searches of global health databases, peer-reviewed journals, and epidemiological repositories, including the World Health Organization (WHO), Centers for Disease Control and Prevention (CDC), regional health departments, and international surveillance systems. Additional articles were retrieved from indexed databases such as PubMed, Scopus, and Google Scholar to ensure comprehensive coverage. Studies were included if they were published in English and reported data on HBV, HCV, or HDV among hemodialysis patients. Research describing prevalence rates, risk factors, transmission pathways, infection control

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challenges, and public health concerns associated with viral hepatitis in renal failure populations was also considered eligible. Studies were excluded if they did not pertain to hemodialysis populations, lacked measurable epidemiological indicators, or were non-primary sources such as editorials without supporting evidence. These criteria ensured that only methodologically sound and clinically relevant data informed the review.

Data extraction involved systematically recording key variables such as HBsAg, anti-HCV, and anti-HDV positivity rates; regional differences in viral prevalence; associated hepatic complications including fibrosis and hepatocellular carcinoma; and risk factors such as repeated blood transfusions, prolonged vascular access, immunosuppression, and the potential for cross-contamination within dialysis units. Because the included studies varied in design, sample size, and reporting detail, the analysis was descriptive and thematic rather than statistical. Patterns were identified narratively to highlight common trends, disparities between regions, and gaps in infection-control practices. No statistical tests or quantitative pooling methods were applied, as the study design was not intended to function as a meta-analysis. Ethical considerations were addressed appropriately for a literature-based review. Since no human subjects were directly involved, institutional review board (IRB) approval or informed consent processes were not required. All data were sourced from ethically approved, publicly accessible publications. Proper citation practices were followed, and no confidential or identifiable patient information was used. If ethical approval numbers were available in the original studies, those were acknowledged within their respective publications, though no new ethical clearance was applicable for the present review. The overarching objective of this methodology was to consolidate existing knowledge on the burden and determinants of viral hepatitis in dialysis populations, particularly within resource-limited settings such as Botswana, where prolonged dependence on hemodialysis may heighten exposure risks. This framework allowed the study to highlight areas requiring strengthened infection-control strategies, targeted prevention efforts, and improved clinical surveillance.

RESULTS

The review demonstrated substantial variability in the prevalence of hepatitis B, C, and D virus infections among patients undergoing hemodialysis across different global regions. Reported HBsAg positivity ranged from 3% to 42%, anti-HCV positivity from 5% to 60%, and anti-HDV positivity among HBsAg-positive individuals from 0% to 44.5%. These variations were influenced by differences in healthcare infrastructure, infection-control capacity, transfusion practices, and screening protocols. Higher HBV and HCV prevalence values were typically observed in regions with limited resources, higher transfusion dependence, and inconsistent sterilization practices. Marked regional disparities were also evident. HBV prevalence ranged from 10–25% in the Middle East, 8–42% in sub-Saharan Africa, 5–15% in South Asia, 3–10% in Europe, and below 5% in North America. HCV prevalence followed a similar pattern, showing the highest infection ranges in the Middle East (20–40%), sub-Saharan Africa (15–35%), and South Asia (10–30%), with substantially lower ranges in Europe (5–20%) and North America (<10%). HDV remained concentrated among HBsAg-positive individuals, with rates as high as 20–30% in sub-Saharan Africa and 5–20% in the Middle East, while much lower values were reported in South Asia, Europe, and North America. Across studies, several risk factors repeatedly emerged as contributors to higher infection rates. These included multiple blood transfusions, prolonged vascular access for hemodialysis, cross-contamination within dialysis units due to inadequate infection-control measures, baseline immunosuppression associated with chronic kidney disease, and improper disinfection of shared equipment. These factors collectively increased the susceptibility of dialysis patients to blood-borne viruses and contributed to regional differences in prevalence. The clinical implications of viral hepatitis in the dialysis population were consistently documented, including chronic liver disease, progressive fibrosis, cirrhosis, and hepatocellular carcinoma, particularly among individuals co-infected with HBV and HCV. These complications contributed significantly to increased morbidity and mortality in this patient group. The findings further indicated that in resource-limited countries such as Botswana, where kidney transplantation remains uncommon and most patients depend on long-term hemodialysis, the likelihood of hepatitis transmission remains elevated. Limited dialysis infrastructure, donor scarcity, inconsistent screening, and infection-control challenges contribute to heightened vulnerability among these patients.

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Table 1: Prevalence of Hepatitis Viruses in Hemodialysis Patients

Virus Type	Prevalence Range	Notes
HBV (HBsAg+)	3% – 42%	Higher prevalence in low-resource and high-transfusion settings
HCV (anti-HCV+)	5% – 60%	Common in areas with inadequate infection control in dialysis centers
HDV (anti-HDV among HBsAg+)	0% – 44.5%	Reported only in HBV-positive patients; highly variable

Table 2: Regional Comparison of Hepatitis Prevalence in HD Patients

Region	HBV (%)	HCV (%)	HDV (%)
Middle East	10–25%	20–40%	5–20%
Sub-Saharan Africa	8–42%	15–35%	10–30%
South Asia	5–15%	10–30%	0–10%
Europe	3–10%	5–20%	<5%
North America	<5%	<10%	Rare

Table 3: Summary of Risk Factors for Hepatitis in Hemodialysis Patients

Risk Factor	Description
Multiple blood transfusions	Repeated transfusions increase risk of blood-borne virus transmission.
Prolonged vascular access	Long-term catheter use is associated with higher infection rates.
Cross-contamination in HD units	Poor infection control practices contribute to nosocomial spread.
Immunosuppression	Chronic kidney disease patients have weakened immune systems, increasing susceptibility.
Shared equipment or supplies	Inadequate disinfection between uses poses transmission risk.

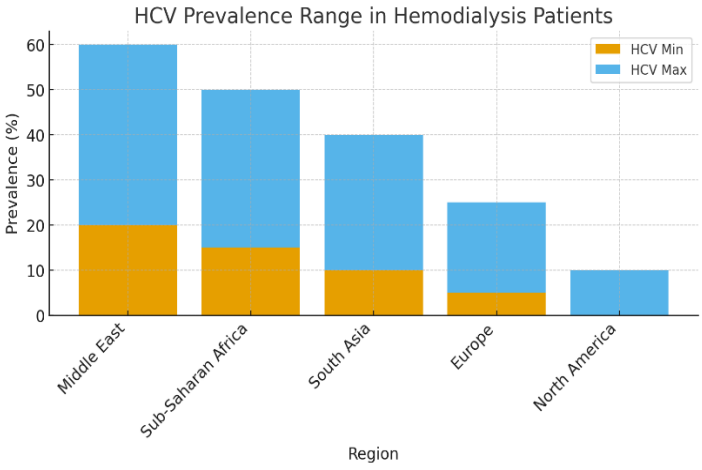

Figure 2 HCV Prevalence Range in Hemodialysis Patients

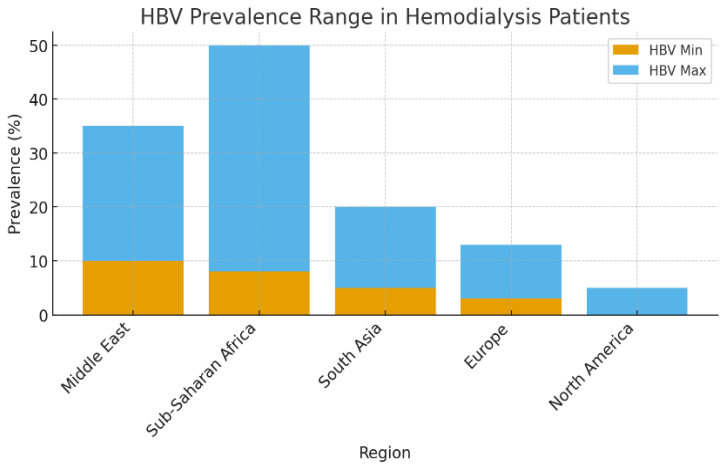

Figure 2 HBV Prevalence Range in Hemodialysis Patients

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DISCUSSION

The findings of this review demonstrated considerable variation in the prevalence of HBV, HCV, and HDV infections among hemodialysis patients across different regions, reflecting both structural and procedural disparities within global dialysis systems. These results aligned closely with earlier work showing that the majority of patients acquired viral hepatitis after initiating hemodialysis, with most infections occurring within the first year of treatment (11). The consistent identification of blood transfusion as a primary risk factor, followed by treatment across multiple dialysis centers, reinforced the notion that exposure-related variables within hemodialysis environments significantly influence infection risk. Previous evidence from the Gaza Strip reported substantially higher hepatitis prevalence among hemodialysis patients compared to the general population, suggesting a direct association between hemodialysis exposure and viral transmission (12). The present review confirmed that inadequate infection control practices, insufficient screening, and infrastructural constraints amplify transmission risks. These findings were consistent with research indicating that hemodialysis sessions themselves serve as a major mechanism of viral spread, followed by exposure to infected individuals and contaminated injectable medications (13). The persistence of these risk factors across time and geographic contexts highlighted longstanding systemic vulnerabilities within dialysis care. This review further revealed that regional differences in viral prevalence were strongly shaped by variations in healthcare resources. Findings from Zabeed City demonstrated higher prevalence rates compared to many other countries, attributed primarily to blood transfusion history and the number of units transfused (14,15). These observations mirrored the current review's findings, which emphasized the need to strengthen infection control protocols and reduce transfusion dependence. In resource-limited settings such as Botswana, where transplantation options are scarce and long-term hemodialysis is the primary treatment modality, the likelihood of hepatitis transmission remains amplified due to infrastructural limitations, workforce constraints, and inconsistent adherence to infection control standards (16,17).

Supporting evidence from 2021 showed significant HCV seroconversion among hemodialysis patients, with risk factors including surgical and dental procedures, blood transfusion, multiple sexual partners, age, and duration of dialysis (18). Facilities that failed to maintain recommended infection-control measures exhibited higher rates of seroconversion, reinforcing the importance of standardized protocols. This observation aligned with earlier findings from Kurdistan, where low to moderate prevalence was reported but nosocomial transmission was strongly implicated, and HBV vaccination proved protective (19). These collective findings highlighted that hepatitis prevention in hemodialysis settings hinges on rigorous infection control, vaccination, consistent monitoring, and strict sterilization practices. The interpretation of these results underscored several critical implications. Hemodialysis units function as high-risk environments, and transmission dynamics appear to be driven more by systemic lapses than by individual patient behavior. Improved staff training, dedicated dialysis machines for infected patients, routine antibody screening, and universal HBV vaccination policies could substantially reduce transmission. Moreover, minimizing transfusion dependency by promoting erythropoiesis-stimulating agents may reduce exposure to infected blood products, particularly in regions with inadequate blood screening systems. This review held several strengths. It integrated evidence from multiple regions, incorporated diverse epidemiological contexts, and synthesized decades of research to build a comprehensive understanding of hepatitis transmission in dialysis settings. It also demonstrated consistency between historical and contemporary findings, thereby confirming that key risk factors have remained unchanged over time.

However, important limitations were present. The review relied on secondary data, and variations in methodological quality across included studies limited the comparability of prevalence estimates. Many earlier studies lacked standardized diagnostic criteria, and not all regions provided complete data on HDV prevalence. Additionally, the absence of Botswana-specific prevalence data restricted the ability to quantify the burden in that setting despite its relevance to the discussion. Furthermore, the review did not include meta-analytic aggregation, which would have provided pooled prevalence estimates and strengthened statistical interpretation. Future research may benefit from multicenter prospective studies employing standardized diagnostic protocols, particularly in low-resource settings. Surveillance systems focusing on hepatitis seroconversion rates could generate clearer insight into real-time transmission patterns (20). Additionally, further work should evaluate the impact of HBV vaccination schedules, antiviral treatment accessibility, and staff adherence to infection control procedures to identify interventions with the greatest preventive potential. Overall, the findings indicated that viral hepatitis remains a persistent threat within hemodialysis settings globally. Despite decades of evidence identifying the same core risk factors, implementation gaps continue to fuel transmission. Strengthening infection control systems, improving vaccination coverage, and building robust surveillance mechanisms remain essential steps in safeguarding patients undergoing chronic hemodialysis.

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CONCLUSION

This review concluded that hepatitis B, C, and D infections continue to present substantial risks for individuals undergoing hemodialysis, driven largely by repeated exposure to blood products, inconsistent infection control practices, and the long-term vascular access required for treatment. The marked regional variations observed reflect underlying differences in healthcare capacity, screening systems, and adherence to preventive protocols. These findings reinforce the need for strengthened vaccination efforts, robust infection-control measures, and improved clinical oversight, particularly in resource-limited settings where the burden of viral transmission remains highest. By highlighting persistent gaps and preventable risk factors, the study underscores the critical importance of targeted preventive strategies to protect vulnerable hemodialysis populations and improve long-term clinical outcomes.

AUTHOR CONTRIBUTION

Author	Contribution
Rida Asghar*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Abdul Aziz	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
Uzma Fareed	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Subas Iqbal	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Shabir Hussain	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Ehtisham ul Haq	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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