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SEROPREVALENCE OF HBV, HCV, AND HIV IN PATIENTS WITH DIALYSIS

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Abstract

Blood-borne viral infections remain a significant public health concern among patients receiving maintenance dialysis because of repeated vascular access, frequent blood exposure, and prolonged interaction with healthcare systems. Worldwide, hepatitis B, hepatitis C, and HIV continue to contribute substantially to morbidity and mortality, with a particularly high burden reported in low- and middle-income countries. Individuals undergoing hemodialysis are at increased risk of acquiring these infections compared with the general population due to potential nosocomial transmission and reduced immune function.

This cross-sectional study evaluated the seroprevalence of hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV) in 245 patients undergoing maintenance dialysis at a tertiary care hospital using enzyme-linked immunosorbent assay (ELISA). The prevalence rates were 8.6% for HBV, 56.7% for HCV,

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and 6.5% for HIV, indicating that HCV was the most common infection in this cohort. Age-based analysis revealed a statistically significant association between age and HCV positivity ($p = 0.016$), with the highest frequency observed among patients aged 41–60 years. No significant relationship was identified between age and HBV or HIV status.

Biochemical findings, including elevated serum urea and creatinine levels, confirmed severe renal impairment consistent with end-stage kidney disease. The high prevalence of HCV observed in this population suggests possible gaps in infection prevention practices within dialysis settings. These findings highlight the importance of strengthening routine viral screening, enhancing infection control measures, promoting HBV vaccination, and improving patient and staff awareness. Effective preventive strategies and timely management are essential to reduce transmission risk and improve health outcomes among dialysis patients.

INTRODUCTION

Blood-borne viral infections remain a major threat to patients undergoing dialysis due to repeated vascular access, exposure to blood products, and impaired immune function. Hepatitis B virus (HBV), hepatitis C virus (HCV), and human immunodeficiency virus (HIV) are among the leading causes of chronic liver disease, cirrhosis, hepatocellular carcinoma, and infection-related mortality worldwide. Globally, approximately 296 million people live with chronic HBV, 58 million with chronic HCV, and about 39 million with HIV, with a disproportionate burden in low- and middle-income countries (WHO, 2023).

Patients receiving hemodialysis face a significantly higher risk of acquiring these infections than the general population due to prolonged treatment duration, repeated invasive procedures, and potential healthcare-associated transmission. Chronic HBV infection is a well-established risk factor for hepatocellular carcinoma, increasing the

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risk of liver cancer up to 200-fold compared with uninfected individuals. HCV infection, often asymptomatic in early stages, frequently progresses to chronic liver disease and remains a major cause of cirrhosis-related mortality. HIV further complicates clinical outcomes by weakening immune defenses and increasing susceptibility to opportunistic infections.

Chronic Kidney Disease (CKD) continues to rise globally, with dialysis remaining the most widely used renal replacement therapy. The growing population of dialysis-dependent patients, combined with the high transmissibility of blood-borne viruses, underscores the need for continuous surveillance and effective infection control measures in dialysis units.

This study aims to determine the seroprevalence of HBV, HCV, and HIV among patients undergoing maintenance dialysis and to provide evidence that may support improved screening strategies, infection prevention policies, and patient management practices.

Multiple studies confirm that patients undergoing maintenance dialysis have a substantially higher burden of blood-borne viral infections than the general population. Early evidence from a hospital-based study of 196 end-stage renal disease patients reported an overall viral seropositivity of 19.38%, with HCV (15.3%) as the most prevalent infection, followed by HBV (3.06%) and HIV (1.02%) (Kansay et al., 2019). A systematic review and meta-analysis of 39 studies among hemodialysis populations in Africa estimated pooled prevalence rates of 9.88% for HBV and 23.04% for HCV, highlighting wide regional variation and the persistent role of healthcare-associated transmission (Adane & Getawa, 2021).

Large cross-sectional studies further demonstrate considerable heterogeneity across regions. Among 748 hemodialysis patients, 31.1% had at least one viral infection, with HCV (23.9%) being the most common (Pereson et al., 2021). Conversely,

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some settings report lower prevalence where strict infection control policies are implemented, including rates below 1% for HBV, HCV, and HIV in certain dialysis cohorts (Nsangou et al., 2021; Shamsdin et al., 2022). Studies from the Middle East and South Asia, however, continue to report moderate to high infection frequencies, with HCV seroprevalence ranging from 5.6% to 30% and HBV from 4% to 13%, reflecting disparities in screening, vaccination, and biosafety practices (Qureshi et al., 2023; Khorrami et al., 2023; Al-Shahethi et al., 2023).

Evidence from Pakistan also indicates rising trends of HBV, HCV, and HIV in screened populations, underscoring ongoing public health challenges (Waheed et al., 2024). Collectively, these findings demonstrate that dialysis patients remain a high-risk group for transfusion-transmissible infections, emphasizing the need for region-specific prevalence data, continuous surveillance, and strengthened infection control measures within dialysis units.

Study Design and Setting: This cross-sectional study assessed the seroprevalence of Hepatitis B virus (HBV), Hepatitis C virus (HCV), and Human Immunodeficiency Virus (HIV) among patients undergoing maintenance dialysis at a tertiary care hospital. Data collection was completed over a three-month period following synopsis approval.

Materials and Methods

Study Population and Sampling: A total of 245 male and female patients receiving maintenance dialysis were enrolled using a convenience sampling technique. Eligible participants included individuals of all age groups who had been on dialysis for at least three months and were receiving treatment during the study period.

Inclusion Criteria

- Patients undergoing regular dialysis
- Dialysis duration ≥ 3 months
- Provided informed consent

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Exclusion Criteria

- Known HBV, HCV, or HIV infection prior to dialysis initiation
- Refusal to participate
- Incomplete clinical or laboratory records

Data Collection and Laboratory Analysis: Venous blood samples were collected under aseptic conditions. Serological screening for HBsAg, anti-HCV, and anti-HIV antibodies was performed using Enzyme-Linked Immunosorbent Assay (ELISA) due to its high sensitivity and specificity. Biochemical parameters, including serum urea and creatinine, were recorded to evaluate renal status.

Sample Size Determination

Sample size was calculated using the standard formula:

n=Z2×p(1−p)E2n = \frac{Z^2 \times p (1-p)}{E^2}n=E2Z2×p(1−p)

Where Z = 1.96 (95% confidence level), p = 0.20 (expected prevalence from literature), and E = 0.05 (margin of error). The estimated sample size was **245 patients**.

Statistical Analysis: Data were analyzed using IBM SPSS Statistics version 27. Descriptive statistics were used to summarize demographic and laboratory variables. Associations between categorical variables were assessed using chi-square tests, and independent samples t-tests were applied for group comparisons. A p-value < 0.05 was considered statistically significant.

Ethical Considerations: Ethical principles of confidentiality, informed consent, and participant safety were strictly maintained. Standard biosafety protocols and personal protective equipment were used during sample collection and processing.

Results

A total of 245 maintenance dialysis patients participated in the study, aged 20–83 years (*M* = 49.35, *SD* = 13.88). Biochemical assessment showed severe renal impairment: serum urea ranged from 11 to 259 mg/dL (*M* = 99.10, *SD* = 49.85), and creatinine

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ranged from 0.6 to 19.3 mg/dL (*M* = 8.30, *SD* = 3.54) (Table 1). These findings confirm the expected metabolic consequences of end-stage renal disease.

Table 1: Descriptive Characteristics of Dialysis Patients (N = 245)

Variable	Min	Max	Mean	SD
Age (years)	20	83	49.35	13.88
Serum Urea (mg/dL)	11	259	99.10	49.85
Creatinine (mg/dL)	0.60	19.30	8.30	3.54

***Note**. Elevated urea and creatinine reflect advanced renal dysfunction typical of long-term dialysis patients.*

Serological screening revealed that **HCV is the most prevalent infection**, affecting more than half of the cohort (56.7%, *n* = 139), followed by HBV (8.6%, *n* = 21) and HIV (6.5%, *n* = 16) (Table 2). While HBV and HIV prevalence remain relatively low, the high rate of HCV indicates an urgent need for infection control and regular monitoring in dialysis units.

Table 2: Seroprevalence of Blood-Borne Viral Infections

Infection	Reactive n (%)	Non-reactive n (%)
HBsAg (HBV)	21 (8.6)	224 (91.4)
Anti-HCV	139 (56.7)	106 (43.3)
Anti-HIV	16 (6.5)	229 (93.5)

Note. HCV demonstrated a significantly higher prevalence than HBV or HIV, indicating it is the dominant blood-borne infection among dialysis patients.

Age-related trends were analyzed using chi-square tests. HCV infection showed a significant association with age group, $\chi^2(2) = 8.32$, $p = .016$, with the 41–60 years age group most affected (Table 3). HBV and HIV did not show significant age-related

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differences (p > .05), suggesting that age may not be a major risk factor for these infections in this cohort.

Table 3: Association Between Age Group and Viral Infection Status

Infection	χ^2	df	p
HBV	3.70	2	.157
HCV	8.32	2	.016*
HIV	4.61	2	.100

Note. Only HCV prevalence was significantly associated with age, highlighting middle-aged dialysis patients as a high-risk group.

Independent samples *t*-tests showed no statistically significant differences in mean age between reactive and non-reactive patients for HBV, HCV, or HIV (Table 4). Effect sizes were small across all comparisons (Cohen's *d* range: −0.24 to 0.31), indicating negligible clinical differences in age between infected and non-infected groups.

Table 4: Independent Samples t-Test for Age by Infection Status

Infection	Mean Age Reactive	Mean Age Non-reactive	p	Effect Size (Cohen's d)
HBV	50.33	49.25	.734	0.08
HCV	47.93	51.21	.067	−0.24
HIV	53.31	49.07	.238	0.31

Note. Age does not appear to significantly influence susceptibility to HBV, HCV, or HIV among dialysis patients, although the slightly younger mean age in HCV-positive patients suggests a trend worth monitoring.

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Correlational analysis confirmed expected renal patterns. Serum urea and creatinine showed a moderate positive correlation (r = .297, p < .001), reflecting the cumulative effects of renal failure. A weak negative correlation between age and creatinine (r = −.186, p = .003) suggests slightly lower creatinine levels in older patients, possibly due to reduced muscle mass (Table 5). No significant correlation was found between age and urea.

Table 5: Pearson Correlations Among Age and Renal Parameters

Variable	Age	Urea	Creatinine
Age	—	−.038	−.186**
Urea	—	—	.297**
Creatinine	—	—	—

***Note. p** < .01. Positive correlation between urea and creatinine reflects renal impairment severity; age is weakly negatively associated with creatinine.*

The above tables reveal **HCV as the dominant infection**, particularly in middle-aged dialysis patients. Despite relatively lower HBV and HIV prevalence, the potential risk of transmission underscores the importance of stringent infection control practices. Biochemical analysis confirms severe renal compromise in all patients, which correlates with expected infection susceptibility and highlights the vulnerability of this population.

Discussion

This study revealed a high seroprevalence of blood-borne viral infections among dialysis patients, with HCV being the most prevalent (56.7%), followed by HBV (8.6%) and HIV (6.5%). Compared to previous reports, these rates are substantially elevated. Earlier

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research reported HCV prevalence of 22.1% and HBV prevalence of 3.2% (Altinawe et al., 2024), while several regional studies from Palestine (7.4% HCV), Iraq (3.4% HCV), Lebanon (4.7% HCV), Egypt (34.8% HCV), and Kosovo (53% HCV) indicate a comparatively lower burden. The HCV rate in this study surpasses both national and international averages, signaling an alarming level of infection among dialysis patients. The HBV prevalence, although lower than HCV, is higher than reported in developed countries but remains below rates observed in regions of Syria, emphasizing persistent regional variability in infection control practices. HIV prevalence (6.5%) aligns with global trends, though it remains a concern due to its potential impact on immune function in this vulnerable population (Adane & Getawa, 2021).

The significantly higher prevalence of HCV compared to HBV and HIV underscores dialysis-related transmission risks, including repeated vascular access, exposure to contaminated equipment, and inadequate infection control practices. Middle-aged patients (41–60 years) were the most affected, consistent with prior findings suggesting age-related cumulative exposure during long-term dialysis (Shamsdin, Fatahi, Ansari, & Safarpour, 2022). Chi-square analyses confirmed a statistically significant association between age group and HCV infection ($p = .016$), whereas HBV and HIV showed no age-based correlation, highlighting HCV as the predominant age-sensitive infection in this population.

Comparisons with Asian and Western countries further emphasize the disparity in infection burden. HCV prevalence in this study (56.7%) exceeds rates in China (41.1%), Vietnam (32.6%), Pakistan (32.33%), and the Asian average (31%), and is markedly higher than in the USA and Europe, where HCV prevalence among dialysis patients typically ranges from 5% to 10%. These differences likely reflect variations in blood screening

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protocols, infection control measures, healthcare infrastructure, and staff training, highlighting the urgent need for stringent preventive strategies in regions with elevated HCV rates.

The study also confirms a relationship between viral infection and renal impairment, as evidenced by significant correlations between serum creatinine and urea levels ($r = .297$, $p < .001$). The weak negative correlation between age and creatinine ($r = -.186$, $p = .003$) suggests slightly lower creatinine in older patients, likely reflecting reduced muscle mass. While the cross-sectional design limits causal inference, the findings align with longitudinal studies showing that HCV infection may both contribute to and exacerbate chronic kidney disease progression, particularly in high-risk groups such as patients with diabetes or glomerulonephritis (Nawaz et al., 2024).

This research provides region-specific, updated epidemiological data, highlighting the high burden of HCV and reinforcing the vulnerability of dialysis patients to blood-borne infections. The elevated prevalence rates indicate systemic shortcomings in infection control, including inadequate screening, suboptimal disinfection practices, and limited healthcare resources. Proactive measures, such as rigorous HCV screening, patient education, staff training, and standardized dialysis protocols, are essential to reduce infection rates and improve patient outcomes.

In summary, this study contributes significantly to the understanding of blood-borne viral infections in dialysis populations, revealing an urgent need for targeted interventions, particularly for HCV, to mitigate the risk of transmission and protect a highly susceptible patient group. By combining quantitative seroprevalence data with clinical correlates, these findings offer a comprehensive framework for improving infection control strategies in dialysis settings.

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