



## Clinical Spectrum of Emergency Presentations in End-Stage Kidney Disease Patients on Hemodialysis: Experience from a Tertiary Care Center in Pakistan

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### Declaration

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### ABSTRACT

**Background:** End-stage kidney disease (ESKD) is associated with high morbidity and frequent emergency department (ED) utilization due to acute complications. This study aimed to evaluate the clinical profile and causes of ED visits among ESKD patients undergoing maintenance hemodialysis at a tertiary nephrology center in Peshawar, Pakistan. **Methods:** A facility-based, cross-sectional study was conducted at Khyber Teaching Hospital from November 2024 to March 2025. A total of 384 adult patients on maintenance hemodialysis who presented to the ED were enrolled. Data were collected using a structured proforma and analyzed using SPSS v24. **Results:** Most patients were male (57.8%) and hypertensive (88.0%), with diabetes mellitus (50.5%) also common. The majority were on twice-weekly in-center dialysis using arteriovenous fistulae. Infection-related complications were the leading cause of ED visits (68.5%), with respiratory tract and access-related infections most common. Electrolyte imbalances, pulmonary edema, and cardiovascular emergencies were also frequent. Catheter use and suboptimal dialysis were associated with increased acute presentations. **Conclusion:** ESKD patients face a high burden of preventable complications. Improved outpatient monitoring, individualized dialysis plans, and better infection control measures are essential to reduce ED utilization and improve outcomes in this population.

### INTRODUCTION

Chronic kidney disease (CKD) is globally acknowledged as a major contributor to mortality and the burden of disease, measured in disability-adjusted life years (DALYs). It is estimated that CKD accounts for approximately one million deaths annually.(1,2) The incidence, prevalence, and progression of CKD differ across countries, with the global prevalence estimated at approximately 13.4%.(3) This burden is rising significantly in densely populated South Asian countries, with Pakistan reporting one of the highest prevalence rates—estimated at 23.3%. (4)

CKD classification has evolved over time, and, currently, stage 3 CKD is defined as decreased kidney function with a glomerular filtration rate (GFR) of less than 60 mL/minute/1.73 m<sup>2</sup>. (5) CKD is classified into various stages, with stage 5 representing the most advanced form, characterized by a glomerular filtration rate (GFR) of less than 15 mL/min/1.73 m<sup>2</sup>. At this stage, patients are diagnosed with end-stage kidney disease

(ESKD) and become dependent on renal replacement therapy, either in the form of dialysis or kidney transplantation for survival.

In comparison to other chronic illnesses, patients with ESKD are more prone to developing subacute, acute, and potentially life-threatening complications, which frequently lead to emergency department (ED) visits and hospital admissions.(6) Multiple factors contribute to the recurrent ED visits among ESKD patients, with the most common causes including vascular access-related issues, sepsis, electrolyte disturbances, fluid overload, and associated cardiovascular and pulmonary complications.(7) A large retrospective study from the United States revealed that ESKD patients utilize emergency department services at a rate six times higher than the national average for adults. Additionally, the study reported that their hospital admission rate from the ED was four times greater than the national average. (7) The majority of these visits were attributed to preventable causes and modifiable risk factors.

## MATERIALS AND METHODS

### Study design, setting, and participants

This facility-based, observational cross-sectional study was conducted in the Emergency Department of Khyber Teaching Hospital (KTH), Peshawar. A total of 384 adult patients were enrolled consecutively using a non-probability consecutive sampling technique between November 2024 and March 2025. The study population included patients of either gender, aged 18 years or older who were undergoing maintenance hemodialysis (MHD). Individuals presenting solely for routine, scheduled dialysis sessions or those receiving peritoneal dialysis were excluded from the study.

### Sample Size Estimation

The required sample size was calculated using OpenEpi (Version 3.01) for estimating a population proportion, assuming a 95% confidence level, 5% absolute precision, and an expected frequency of 50%. Considering a design effect of 1 (non-clustered consecutive sampling), the minimum required sample size was 384 patients.

### Study Procedure

Informed written consent was obtained by a medical officer prior to enrollment. Following a detailed assessment, comprising patient history, physical examination, and relevant investigations conducted as part of the emergency department protocol, the underlying cause of the ED visit was identified and documented in the predesigned proforma.

### Study Tool and Variables

A structured proforma was developed after reviewing relevant literature and was used as the primary data collection tool. It included demographic variables such as age, gender, and existing comorbidities. Clinical details related to hemodialysis were also captured, including the duration of dialysis dependence, frequency of dialysis sessions per week, and the location of dialysis (within KTH or at external centers). Information regarding vascular access, such as the current access type and catheter site—was also documented. The proforma was designed to categorize the underlying causes of emergency department visits, which were broadly grouped into electrolyte imbalances, infections, access-related issues, cardiovascular, pulmonary, neurological, and gastrointestinal complications. Each of these main categories contained specific subcategories of presenting causes. The patient's ED disposition was also recorded, categorized as admitted, discharged, referred, left against medical advice (LAMA), or discharged on request (DOR), based on their clinical evaluation during the visit.

### Statistical Methods

Data were coded, cleaned, and analyzed using SPSS version 24. Descriptive statistics were used to calculate the frequency and percentage of each major complication category, as well as the associated subcategories, based on the total number of emergency department visits. Since multiple causes could be identified in a single visit, overlapping categories were allowed in the analysis. The frequency distribution of the main complication categories was illustrated using bar charts to enhance visual clarity,

whereas detailed frequencies of subcategories were presented in tabular format.

### Ethical Consideration

This study was conducted in accordance with the ethical principles outlined in the Declaration of Helsinki. Written informed consent was obtained from all participants prior to data collection. Patient confidentiality was strictly maintained, and all data were anonymized before analysis.

## RESULTS

Table 1 summarizes the baseline characteristics of the study participants (n = 384) presenting to the Nephrology Division, Khyber Teaching Hospital, Peshawar. The majority of patients were male (57.8%), while females accounted for 42.2%. Hypertension was the most prevalent comorbidity, affecting 88.0% of patients, followed by diabetes mellitus (50.5%) and ischemic heart disease (24.7%). Hepatitis C and B were present in 17.2% and 5.5% of cases, respectively. A minority (2.3%) of patients were post-renal transplant recipients.

Regarding dialysis dependence, most patients had been on dialysis for 1–3 years, with 21.6% on dialysis for 1–2 years and 26.3% for 2–3 years. Only 9.9% had been on dialysis for less than six months. The majority (87.2%) were receiving two dialysis sessions per week, with 11.2% on once-weekly sessions, and a small proportion (1.6%) receiving thrice-weekly dialysis. In-center dialysis at KTH was reported in 66.7% of cases.

The most common vascular access was arteriovenous fistula (62.2%), followed by tunneled catheters (22.4%) and non-tunneled catheters (15.4%). No patients had an arteriovenous graft. Among catheter-dependent patients (n = 145), the internal jugular vein was the most frequently used site (60.7%), followed by femoral (31.1%) and subclavian (8.2%) veins.

**Table 1**

*Baseline Characteristics of the Study Participants (n = 384)*

| Variable                               | N (%)       |
|--|-------------|
| <b>Gender</b>                          |             |
| Male                                   | 222 (57.8%) |
| Female                                 | 162 (42.2%) |
| <b>Comorbidities</b>                   |             |
| Hypertension                           | 338 (88.0%) |
| Diabetes mellitus                      | 194 (50.5%) |
| Ischemic heart disease                 | 95 (24.7%)  |
| Hepatitis C                            | 66 (17.2%)  |
| Cardiovascular disease (non-IHD)       | 42 (10.9%)  |
| Hepatitis B                            | 21 (5.5%)   |
| Post-transplant status                 | 9 (2.3%)    |
| <b>Duration of Dialysis Dependence</b> |             |
| <6 months                              | 38 (9.9%)   |
| 6–12 months                            | 55 (14.3%)  |
| 1–2 years                              | 83 (21.6%)  |
| 2–3 years                              | 101 (26.3%) |
| 3–5 years                              | 49 (12.8%)  |
| 6–10 years                             | 37 (9.6%)   |
| >10 years                              | 21 (5.5%)   |
| <b>Dialysis Sessions per Week</b>      |             |
| One session                            | 43 (11.2%)  |
| Two sessions                           | 335 (87.2%) |
| Three sessions                         | 6 (1.6%)    |
| <b>In-center Dialysis at KTH</b>       |             |
| Yes                                    | 256 (66.7%) |
| No                                     | 128 (33.3%) |
| <b>Current Vascular Access</b>         |             |
| Arteriovenous fistula (AVF)            | 239 (62.2%) |
| Arteriovenous graft (AVG)              | 0 (0.0%)    |

|                                |            |
|--------------------------------|------------|
| Tunneled catheter              | 86 (22.4%) |
| Non-tunneled catheter          | 59 (15.4%) |
| <b>Catheter Site (n = 145)</b> |            |
| Subclavian                     | 12 (8.2%)  |
| Internal jugular               | 88 (60.7%) |
| Femoral                        | 45 (31.1%) |

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Table 2 outlines the clinical causes of Emergency Department (ED) visits among 384 patients with end-stage kidney disease (ESKD) managed at the Nephrology Division, Khyber Teaching Hospital, Peshawar. The most frequently observed category of presentation was infection-related complications, reported in a total of 263 cases, including respiratory tract infections (RTIs) in 97 patients (25.3%), access-related infections in 64 (16.7%), other infections in 34 (8.9%), acute gastroenteritis in 32 (8.3%), urinary tract infections in 19 (4.9%), and cellulitis in 17 (4.4%).

Electrolyte abnormalities were also prominent, with hyperkalemia observed in 83 patients (21.6%), followed by metabolic acidosis in 63 (16.4%), hyponatremia in 41 (10.7%), hypocalcemia in 27 (7.0%), hypercalcemia in 19 (4.9%), and hypernatremia in 4 (1.0%).

Pulmonary complications accounted for a substantial number of ED visits, with pulmonary edema being the leading cause in 93 patients (24.2%), and pleural effusion reported in 20 (5.2%).

Cardiovascular complications included hypertensive urgency in 45 patients (11.7%), hypertensive emergency in 30 (7.8%), acute coronary syndrome in 20 (5.2%), arrhythmias in 16 (4.2%), heart failure in 7 (1.8%), and pericardial effusion in 4 (1.0%).

Gastrointestinal presentations were noted in 32 patients, including gastritis in 21 (5.5%), pancreatitis in 6 (1.6%), and upper gastrointestinal bleeding in 5 (1.3%).

Neurological complications were reported in 42 patients, with seizures in 15 (3.9%), cerebrovascular accidents in 14 (3.6%), and encephalopathy in 13 (3.4%).

**Table 2**

*Causes of Emergency Department (ED) Visits Among Patients with End-Stage Kidney Disease (n = 384)*

| CATEGORY                        | CAUSE                         | n (%)           |
|---------------------------------|-------------------------------|-----------------|
| Electrolyte Abnormalities       | Hyperkalemia                  | 83 (21.6%)      |
|                                 | Metabolic acidosis            | 63 (16.4%)      |
|                                 | Hyponatremia                  | 41 (10.7%)      |
|                                 | Hypocalcemia                  | 27 (7.0%)       |
|                                 | Hypercalcemia                 | 19 (4.9%)       |
|                                 | Hypernatremia                 | 4 (1.0%)        |
|                                 | Pulmonary Complications       | Pulmonary edema |
| Pleural effusion                |                               | 20 (5.2%)       |
| Infection-related Complications | RTI                           | 97 (25.3%)      |
|                                 | Access-related infection      | 64 (16.7%)      |
|                                 | Other infections*             | 34 (8.9%)       |
|                                 | Acute gastroenteritis         | 32 (8.3%)       |
|                                 | Urinary tract infection (UTI) | 19 (4.9%)       |
|                                 | Cellulitis                    | 17 (4.4%)       |
| Cardiovascular Complications    | Hypertensive urgency          | 45 (11.7%)      |

|                                |                                |           |
|--------------------------------|--------------------------------|-----------|
|                                | Hypertensive emergency         | 30 (7.8%) |
|                                | Acute coronary syndrome        | 20 (5.2%) |
|                                | Arrhythmias                    | 16 (4.2%) |
|                                | Heart failure                  | 7 (1.8%)  |
|                                | Pericardial effusion           | 4 (1.0%)  |
| Gastrointestinal Complications | Gastritis                      | 21 (5.5%) |
|                                | Pancreatitis                   | 6 (1.6%)  |
|                                | Upper gastrointestinal bleed   | 5 (1.3%)  |
| Neurological Complications     | Cerebrovascular accident (CVA) | 14 (3.6%) |
|                                | Encephalopathy                 | 13 (3.4%) |
|                                | Seizures                       | 15 (3.9%) |

*Nephrology Division, Khyber Teaching Hospital, Peshawar, Pakistan*

### Abbreviations

ED = Emergency Department; RTI = respiratory tract infection; UTI = urinary tract infection; PVD = peripheral vascular disease; AVF = arteriovenous fistula; AVG = arteriovenous graft

\* Other infections include: diabetic foot, bed sores, facial bulla, fever of unknown origin, gluteal abscess, neck abscess, and psoas abscess.

### DISCUSSION

This study presents a comprehensive analysis of the clinical profile and acute presentations of end-stage kidney disease (ESKD) patients visiting the Emergency Department (ED) of a tertiary nephrology center in Peshawar. The findings underscore the significant burden of comorbidities, dialysis-related complications, and acute intercurrent illnesses in this high-risk population.

The demographic distribution revealed a male predominance, consistent with existing regional data on dialysis populations. This male predominance among ESKD patients has been reported in studies from the United States and Japan as well. (8)

Hypertension and diabetes mellitus were the most prevalent comorbid conditions, affecting 88.0% and 50.5% of patients respectively. These figures align with the established etiological profile of chronic kidney disease (CKD) in South Asia, where hypertensive and diabetic nephropathy remain the leading causes of ESKD. The leading causes of CKD were diabetic nephropathy (30.6%) and hypertensive nephrosclerosis in a studies in same region of Pakistan. (9)

Ischemic heart disease and other cardiovascular comorbidities were also notably frequent, highlighting the bidirectional relationship between CKD and cardiovascular disease. Cardiovascular disease alone has a strong association with ESKD and is a significant cause of mortality among them. (10)

A substantial proportion of patients had been on dialysis for more than one year, with the majority receiving two dialysis sessions per week—reflecting current resource limitations and common practice patterns in the public healthcare sector. The majority of patients were receiving in-center dialysis, and arteriovenous fistula (AVF) remained the predominant vascular access (62.2%). Findings from another study conducted in a similar setting also reported consistent results. (9) However, a significant number (37.8%) were dependent on central venous catheters, which continues to

pose a risk for infection-related complications and highlights ongoing challenges in vascular access planning. A study on ED utilization patterns by ESKD patients showed that the presence of hemodialysis catheters was associated with 22% higher odds of ED presentation.(6)

Electrolyte abnormalities, particularly hyperkalemia and metabolic acidosis, were among the leading causes of ED visits, affecting 21.6% and 16.4% of patients, respectively. Metabolic acidosis in end-stage renal disease (ESRD) patients is primarily due to impaired renal excretion of hydrogen ions. (11) Our findings are clinically significant, as such disturbances are not only life-threatening but also often indicative of missed or delayed dialysis. Pulmonary edema (24.2%) was another common cause of acute decompensation, suggesting frequent volume overload and suboptimal fluid management. Together, these complications point to potential gaps in outpatient dialysis adequacy, monitoring, and patient education.

Infection-related complications were strikingly common, with respiratory tract infections (25.3%) and access-related infections (16.7%) being major contributors to ED utilization. In another Pakistani study, infection-related issues were responsible for 57.2% (111 cases) of emergency department visits (12) and Catheter-associated bacteremia has a significant contribution to morbidity and mortality among patients with ESKD (13) These figures are particularly concerning given the immunocompromised state of ESKD patients and the high morbidity associated with infection in this cohort. Moreover, gastrointestinal presentations such as gastroenteritis (8.3%) and gastritis (5.5%) further highlight the susceptibility of these patients to fluid and electrolyte disturbances resulting from acute infections.

Cardiovascular emergencies including hypertensive crises and acute coronary syndromes were frequently observed, reflecting the heightened cardiovascular risk profile of the dialysis population. Cardiovascular disease

represents a leading cause of morbidity and mortality in patients with end-stage kidney disease (ESKD), with a prevalence exceeding 50% and a mortality risk approximately 20 times greater than that of the general population.(14) Numerous factors contribute to the development of cardiovascular disease, including left ventricular hypertrophy, advancing age, male sex, anemia, high blood pressure, diabetes, abnormal lipid levels, accumulation of uremic toxins, disturbances in mineral and bone metabolism, and oxidative stress.(14) Neurological presentations such as seizures, cerebrovascular events, and encephalopathy also featured prominently, underlining the multisystemic vulnerability of ESKD patients during acute decompensation.

The collective burden of these acute complications not only increases hospital admissions but also underscores the critical need for timely outpatient follow-up, individualized dialysis prescriptions, and strengthened infection control practices. The data presented here offer valuable insight into the common patterns of emergency presentation in our local context and emphasize the importance of early recognition and multidisciplinary intervention to reduce morbidity and healthcare utilization among ESKD patients.

## CONCLUSION

This study highlights the significant burden of comorbidities and complications among ESKD patients on dialysis at Khyber Teaching Hospital. Most were male, hypertensive, and receiving twice-weekly in-center dialysis via arteriovenous fistula. Infections, especially respiratory tract infections, were the leading cause of Emergency Department visits, followed by pulmonary and electrolyte disturbances. These findings emphasize the need for improved outpatient care, infection control, and early management of complications to reduce ED visits and enhance patient outcomes.

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