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Patterns and Outcomes of Acute Kidney Injury among Under-Five Children attending at Nangarhar University Teaching Hospital

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ABSTRACT

Background: Acute kidney injury defined as a rise in serum creatinine of ≥0.3 mg/dL within 48 hours, is a common but frequently overlooked complication among hospitalized children, especially in resource-limited countries. Acute Kidney Injury is associated with increased pediatric morbidity and mortality, yet data from Afghanistan are limited. This study aimed to determine patterns and outcome of Acute Kidney Injury and its associated risk factors among under-five children admitted to Nangarhar University Teaching Hospital.

Materials and Methods: This retrospective study was conducted at Nangarhar University Teaching Hospital using a census sampling method. Medical records of children aged 1–59 months admitted between 20 March 2024 and 21 March 2025 were reviewed. A total of 4191 under-five admissions were screened, and 197 children included in the study.

Results: Acute Kidney Injury was 26% (51/197). 64% were male and 36% were female, and 79.7% were settled in the rural area and 21,3% were in urban. Acute Kidney Injury showed no significant association with age, sex, anemia, leukocytosis and resident. However, significant associations were observed between Acute Kidney Injury and mortality (p = 0.001), prolonged length of hospital stay (p = 0.017), and exposure to nephrotoxic antibiotics, particularly Vancomycine and aminoglycosides (p = 0.001). Pneumonia, dehydration, and sepsis were the most frequent underlying conditions.

Conclusion: Acute Kidney Injury occurred in over one-quarter of under-five children admitted to the pediatric intensive care unit. It was significantly linked to higher mortality, longer hospitalization, and nephrotoxic antibiotic use.

Keywords: Acute Kidney Injury, Mortality, Risk Factors, Under-five Children.

INTRODUCTION

Acute kidney injury (AKI) is defined as an abrupt loss of renal function leading to a rapid reduced in the glomerular filtration rate (GFR), in which waste product are accumulated in the body such as blood urea nitrogen (BUN) and creatinine, led to the imbalance of extracellular volume and electrolyte. (Kliegman et al., 2023; Paul & Bagga, 2023). Currently The term of AKI has replaced to acute renal failure (ARF) (Kliegman et al., 2023). Once AKI has occurred then a continuum of renal dysfunction come into being i.e. a small increase in serum creatinine progress to complete renal failure (Kliegman et al., 2023). The incidence of AKI varies from 5–10% of all hospitalized children where as it occurred from 25 to 30% in those children admitted in intensive care unit (Paul & Bagga, 2023). Although the causes of AKI are varying by age, geographic region, and clinical setting, but all causes are categorized as prerenal, renal, and postrenal (Behrman et al., 2023). For definition and stage of AKI, creatinine and urine out put are determined by the Kidney Disease Improving Global Outcomes (KDIGO) (Kliegman et al., 2023; Paul & Bagga, 2023). By the KDIGO Acute kidney injury is defined as an increase in serum creatinine by ≥0.3 mg/dL from normal range within 48 hours, or an increase in serum creatinine to ≥1.5 times of normal range within the prior 7 days, or urine output ≤0.5 mL/kg/hr for 6 hours (Kliegman et al., 2023; Paul & Bagga, 2023; Parthasarathy et al., 2019). And in otherwise, if of urine excretion suddenly reduced to under 10 mL/kg body weight, is called of AKI in which marked oliguria or anuria is occurred (Suraj, 2016).

Acute kidney injury (AKI) is a common complication among hospitalized children worldwide. Meta-analyses report that approximately 26% of hospitalized children develop some degree of AKI, while 14% experience moderate to severe AKI (Meena et al., 2023). In critically ill children admitted to pediatric intensive care units (PICU), the prevalence ranges from 10% to 35%, depending on the severity of

illness and case mix (Lawson et al., 2021; Yousefifard et al., 2022). Studies revealed that the prevalence of post-traumatic AKI is about 9.9% (Yousefifard et al., 2022). the incidence of AKI is as high as 30%, in Neonates and very preterm infants especially in high-risk newborn baby (Zarei et al., 2025).

It is obvious that Acute and chronic health problems in under five children remain a major public health problem in Afghanistan in which, high rates of infectious diseases, undernutrition, and limited healthcare facilities contribute to morbidity and mortality in our country Afghanistan (WHO,2021). Acute kidney injury in children does not only affect the children themself but these children led to profound medical professional's responsibilities for their management and follow up because, AKI is associated with high mortality and morbidity (Kaddourah et al., 2017; Sutherland et al., 2017). The factors that causes life threatening condition in AKI are, severe electrolyte disturbances, fluid overload and metabolic acidosis (El-Nawawy et al., 2014). Childrens who are survived after AKI management has risk of developing chronic kidney disease, hypertension, and impaired growth, which may negatively affect their future quality of life (Cooper et al., 2022; Harambat et al., 2015; Robinson et al., 2024). From the one hand some factors such as recurrent hospitalizations, long durations of hospital stay, and the need for invasive interventions such as dialysis also led to psychological distress for both the child, their family, and medical professional (Lozano et al., 2021). on the other hand, Limited resources, such as pediatric dialysis equipment, trained or specialized staff, and appropriate laboratory services, causes further complicate care and management (Olowu et al., 2023). Clinical management need for precise drug dosing and fluid balance, which is technically demanding in pediatric patients (Suraj, 2016). Also, physicians often face to ethical and emotional problems while counseling the patients' families about the prognosis of theirs affected children when sufficient optimal therapy are not available (Meena et al., 2023; Lawson et al., 2021).

MATERIALS AND METHODS

***Study Design Study Setting*:** This was a retrospective study conducted to determine the patterns, outcomes and risk factors of Acute Kidney Injury (AKI) in under-five patients were admitted to PICU The study was carried out at Nangarhar University Teaching Hospital, Jalalabad, Afghanistan, using patient records of children admitted between 20 march 2024 and 21 march 2025**.**

Study Population: The study population included all children under five years of age who were admitted to the pediatric ICU during the study period.

Sampling and Sample Size: A census sampling approach was employed**.** A total of 197 patient files were reviewed. This constituted the complete available population of admitted in PICU under-five children during the defined period

Inclusion criteria: According to Kidney Disease Improving Global Outcomes (KDIGO) criteria, all of those children aged between 1 months to 5 years age were included (Kliegman et al., 2023; Paul & Bagga, 2023).

A child is considered to have pneumonia if they present with cough or difficulty breathing and age-specific fast breathing (≥50 breaths/min for children aged 2–11 months, ≥40 breaths/min for children aged 1–5 years). If lower chest wall indrawing or nasal flaring is present, the condition is classified as severe pneumonia. Additional indicators include oxygen saturation (SpO_2) <90% in room air, chest X-ray findings consistent with consolidation or infiltrate, fever (>38°C), and abnormal lung sounds such as crackles or bronchial breath sounds (WHO, 2021).

A child is considered to have sepsis if they are a patient with suspected or probable infection who exhibits evidence of a systemic inflammatory response (≥2 SIRS criteria) and at least one indicator of organ dysfunction, hypotension, or hypoperfusion, in the absence of an alternative explanation (Reinhart et al., 2017). In this study, anemia was defined as a hemoglobin concentration <10 g/dL for children aged 1–5 months and <11 g/dL for children aged 6–59 months, in accordance with WHO criteria and pediatric hematology references (World Health Organization, 2024; American Academy of Family Physicians, 2016).

Leukocytosis in infants aged 1–5 months was defined as a total white blood cell count exceeding 19.5 × 10^9/L at 1 month of age or 17.5 × 10^9/L at 2–5 months of age. These measurements were obtained using an automated hematology analyzer and are consistent

with pediatric reference ranges (Kliegman et al., 2023).

Exclude criteria: Patients who did not meet the KDIGO criteria.

Data Collection

Data were extracted retrospectively from medical records using a structured checklist. AKI cases were identified and verified from diagnostic notes and laboratory results. For all included patients, details of their history, clinical features, and laboratory examination such as Complete Blood Count, kidney function test, liver function test, blood electrolytes, C-reactive protein, procalcitonin, routine urine and stool examinations, in some condition chest x-ray, brain CT scan, echocardiography were done for patient. The data are gathered and the patients age, sex, address (urban, rural), Clinical features, BUN, serum creatinine, hemoglobin, white blood cell count, prescribed antibiotics during ICU admission, length of hospital stay, and mortality were extracted from medical records and recorded in a structured questionnaire for analysis.

Ethical Considerations

This study was conducted after obtaining formal approval from the Ethical Review Committee of Nangarhar Medical Faculty, Jalalabad, Afghanistan.

Statistical Analysis

Data were entered into a Statistical Package for the Social Sciences (SPSS) version 26. Categorical variables such as sex, residence (urban/rural), family history of AKI, drug history, anemia, leukocytosis, clinical features, and mortality outcome were compared with AKI status using the **Chi-square test.** Quantitative variables including age (in months/years) and hospital stay (in days) were changed into catagorical data and analysed by Chi-square test between AKI and non-AKI.

RESULTS

Out of a total of 4191 under-five children admitted to the general pediatric ward, 197 patients met the inclusion criteria and were enrolled in the study. The age of the participants ranged from 1.5 months to 54 months. Among them, 36% were female and 64% were male.

Regarding place of residence, 79.7% of the participants were from rural areas, while 20.3% resided in urban areas. Hematological findings revealed that 66% of the children were anemic, whereas 34% were non-anemic. In addition, 53.8% of participants had leukocytosis, while 46.2% had normal leukocyte counts.

With respect to clinical diagnoses, pneumonia (58.9%) was the most common condition, followed by dehydration (15.7%) and sepsis (13.2%).

The mean duration of hospital stay among children with acute kidney injury (AKI) was 4.4 days, ranging from 2 to 24 days.

Among the 197 participants, 51 children (26%) were diagnosed with AKI, while 146 (74%) did not develop AKI. Of the AKI cases, 19 (9.6%) were female and 32 (16.4%) were male. The Chi-square test was used to assess associations between AKI and selected variables.

There was no statistically significant association between AKI and gender ($p = 0.834$), anemia ($p = 0.421$), leukocytosis ($p = 0.246$), place of residence ($p = 0.584$), or age group ($p = 0.334$). Similarly, no significant association was found between AKI and clinical diagnoses, including pneumonia, sepsis, dehydration, or seizures ($p = 0.103$).

However, a significant association was observed between AKI and mortality ($p = 0.001$), indicating a higher risk of death among children with AKI. In addition, duration of hospitalization was significantly associated with AKI ($p = 0.017$), with affected children requiring longer hospital stays.

Regarding medication exposure, 59.4% of the participants received Cephalosporin's, followed by Carbapenems (21.3%), Vancomycine (16.2%), and Aminoglycosides (2.5%). Only 0.5% of patients received antibiotics from other classes.

Table 1. Demographic, Clinical, Laboratory and Drugs History with Acute Kidney Injury (AKI) in Children admitted in PICU (n = 197)

Variable	Category	AKI (Yes)	AKI (No)	χ^2	P-value
Gender	Female	26.8 %	73.2 %	0.44	0.834
	Male	25.4 %	74.6 %		

Outcome	Death	53.1 %	46.9 %	14.772	**0.001**
	Discharge	20.6 %	79.4 %		
Anemia	Yes	27.7 %	72.3 %	0.648	0.421
	No	22.4 %	77.6 %		
Leukocytosis	Yes	29.2 %	70.8 %	1.348	0.246
	No	22.0 %	78.0 %		
Address	Rural	26.8 %	73.2 %	0.30	0.584
	Urban	22.5 %	77.5 %		
Age (months)	1–10	28.8 %	71.2 %	5.725	0.334
	11–20	21.9 %	78.1 %		
	21–30	30.8 %	69.2 %		
	31–40	10.0 %	90.0 %		
	41–50	0.0%	100.0 %		
	51–60	50.0 %	50.0 %		
Length of Hospital stay	0–5 days	21.1 %	78.9 %	8.202	0.017
	6–10 days	37.2 %	62.8 %		
	>10 days	57.1 %	42.9 %		
Clinical Features at the time of admission	ABM	100.0 %	0.0%	16.819	0.078
	Acute diarrhea	100.0 %	0.0%		
	CHD/CHF	100.0 %	0.0%		
	Dehydration	35.5 %	64.5 %		
	Hepatitis	0.0%	100.0 %		
	Pneumonia	19.8 %	80.2 %		
	Respiratory	100.0 %	0.0%		
	Seizure	27.3 %	72.7 %		
	Sepsis	25.9 %	74.1 %		
	Shock	50.0 %	50.0 %		
	UTI	33.3 %	66.7 %		
Drug History	Vancomycine Aminoglycosides	53.1 % 60.0 %	46.9 % 40.0 %	23.974	0.001
	Carbapenem	26.2 %	73.8 %		
	Cephalosporin's	16.2 %	83.8 %		
	Others drugs	100.0 %	0.0 %		

DISCUSSION

This study assessed the patterns and outcomes of acute kidney injury (AKI) among under-five children admitted to the Pediatric Intensive Care Unit (PICU) at Nangarhar University Teaching Hospital. The findings revealed that 26% of the studied children developed AKI, indicating that it is a common complication among critically ill children in this setting. Pneumonia (58.9%), dehydration (15.7%), and sepsis (13.2%) were the leading underlying conditions.

The proportion of AKI observed in this study is comparable to reports from neighboring and similar settings. AKI was reported in 27% of hospitalized children in Pakistan (Hussain et al., 2019), 23% in India (Sreedhar et al., 2018), and 29% in Egypt (El-Gamasy et al., 2020). In contrast, studies from developed countries, such as the United States, have reported lower rates of 10–15% in pediatric ICUs (Akcan-Arikan et al., 2017). These differences likely reflect variations in healthcare infrastructure, patient monitoring, early diagnosis, disease patterns, and parental health-seeking behaviors.

A statistically significant association was found between AKI and mortality ($p = 0.001$), highlighting that children with AKI are at substantially higher risk of death. This finding aligns with previous studies identifying AKI as an independent predictor of mortality in pediatric ICUs (Lameire et al., 2015; Sutherland et al., 2021). Additionally AKI was significantly associated with prolonged hospital stay ($p = 0.017$), indicating that affected children require more intensive management and longer hospitalization. Similar findings were reported by (Chowdhary et al,2017), who noted that AKI extended hospital stays by approximately two to three times compared with children without AKI.

No significant associations were observed between AKI and demographic factors, including age, gender, and place of residence, nor with laboratory parameters such as anemia or leukocytosis. These results are consistent with prior research indicating that demographic characteristics alone are not strong predictors of AKI in pediatric populations (Imtiaz et al., 2020; Rahman et al., 2018).

The history of antibiotic use indicated that broad-spectrum antibiotics, particularly Cephalosporin's (59.4%) and Carbapenems (21.3%), were frequently administered, whereas nephrotoxic antibiotics such as Vancomycine (16.2%) and Aminoglycosides (2.5%) contributed to AKI development. These findings are consistent with previous studies demonstrating the role of nephrotoxic drugs in pediatric AKI (Jetton et al., 2017; Lafrance & Miller, 2018). The relatively low proportion of Aminoglycoside use in this Retrospective may reflect increased clinician awareness and cautious prescribing practices.

Limitations of this study: This study was conducted in a single tertiary care center, which may limit the generalizability of its findings to larger populations. Nevertheless, it provides important baseline data for conducting further research in the eastern region of Afghanistan. Prompt identification of acute kidney injury (AKI) and appropriate management of contributing factors, including infections, dehydration, and exposure to nephrotoxic medications, are crucial to minimize both morbidity and mortality. Healthcare facilities in resource-constrained settings should adopt standardized screening and monitoring protocols for AKI. Moreover, future multicenter prospective studies are needed to assess long-term outcomes and to establish evidence-based preventive strategies for pediatric AKI in Afghanistan.

CONCLUSIONN

In conclusion, nearly one-quarter of hospitalized children at Nangarhar University Teaching Hospital experienced acute kidney injury (AKI). The presence of AKI was significantly linked to higher mortality rates and prolonged hospital stays, while no significant associations were observed with demographic or hematological factors. These results highlight the critical need for early identification and implementation of preventive measures against AKI, particularly among pediatric patients suffering from infectious conditions such as pneumonia and sepsis.

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AUTHORS CONTRIBUTIONS:

Massih Massihullah: Concept and study design; supervision of data collection; data interpretation; critical revision and final approval of the manuscript. **Ameen Najeebullah:** Methodological support, data analysis review, and intellectual guidance during manuscript preparation. **Nasiri Ajmal:** Data collection and validation; coordination with HMIS unit; contribution to results interpretation. **Shirzad Abdul ghafar**: Assistance in data extraction, tabulation, and literature review; helped draft parts of the results section.

REFERENCES

Abdelraouf, K., Brunner, M., Kassem, A., et al. (2020). Patterns of antibiotic use and nephrotoxicity in hospitalized children in low-resource settings. *Pediatric Nephrology*, *35*(9), 1663–1672.

Akcan-Arikan, A., Zappitelli, M., Loftis, L. L., Washburn, K. K., Jefferson, L. S., & Goldstein, S. L. (2007). Modified RIFLE criteria in critically ill children with acute kidney injury. *Kidney International*, *71*(10), 1028–1035.

Alhwiesh, A., Abdul-Rahman, I., Al-Harbi, A., et al. (2019). Drug-induced acute kidney injury in pediatric intensive care unit: Prevalence and risk factors. *Saudi Journal of Kidney Diseases and Transplantation*, *30*(5), 1045–1052.

American Academy of Family Physicians. (2016). Iron deficiency and other types of anemia in infants and children. *American Family Physician, 93*(4), 270–278.

Askenazi, D. J., & Goldstein, S. L. (2016). Acute kidney injury in critically ill children: Implications and management. *Pediatric Nephrology, 31*(5), 791–801.

Behrman, R. E., Levin, M. J., & Mark, M. J. (2023). *Current diagnosis & treatment: Pediatrics* (26th ed., p. 726). McGraw Hill.

Chowdhary, S., Singh, G., & Sharma, A. (2017). Impact of acute kidney injury on pediatric hospitalization outcomes. *Indian Pediatrics, 54*(12), 1013–1018.

Cooper, D. S., Holgersson, J., Clancy, A. A., et al. (2022). Long-term outcomes of acute kidney injury in children: Review of recent findings. *Pediatric Nephrology, 37*(8), 1585–1595.

El-Gamasy, M. A., El-Hawary, M. A., & Ibrahim, N. A. (2020). Acute kidney injury in critically ill children: A single-center experience from Egypt. *Egyptian Pediatric Association Gazette, 68*(1), 12–18.

El-Nawawy, A., Abdel Hady, H., Nasef, N., et al. (2014). Outcome of pediatric acute kidney injury: A multicenter prospective cohort study. *Clinical Nephrology, 82*(6), 379–386.

Harambat, J., van Stralen, K. J., Kim, J. J., & Tizard, E. J. (2015). Long-term risk of chronic kidney disease and mortality in children after acute kidney injury: A systematic review. *BMC Nephrology, 16*, 428.

Hussain, S. M., Ahmed, J., Khan, F., & Shah, S. H. (2019). Incidence and outcome of acute kidney injury among hospitalized children in Pakistan. *Journal of Ayub Medical College Abbottabad, 31*(4), 559–563.

Imtiaz, S., Nasir, K., & Hussain, I. (2020). Risk factors and outcome of acute kidney injury in children admitted in a tertiary care hospital. *Pakistan Journal of Medical Sciences, 36*(2), 210–215.

Jetton, J. G., Boohaker, L. J., Sethi, S. K., et al. (2017). Incidence and outcomes of neonatal acute kidney injury (AWAKEN): A multicenter, multinational study. *Clinical Journal of the American Society of Nephrology, 12*(10), 1552–1562.

Kaddourah, A., Basu, R. K., Bagshaw, S. M., & Goldstein, S. L.; AWARE Investigators. (2017). Epidemiology of acute kidney injury in critically ill children and young adults. *The New England Journal of Medicine, 376*(1), 11–20. https://doi.org/10.1056/NEJMoa1611391

Kliegman, R., St Geme, J. W., Blum, N. J., Shah, S. S., Tasker, R. C., & Wilson, K. M., et al. (2023). *Nelson textbook of pediatrics* (22nd ed., p. 3242). Elsevier.

Lafrance, J. P., & Miller, D. R. (2018). Acute kidney injury associated with nephrotoxic antibiotic use: A population-based study. *Clinical Journal of the American Society of Nephrology, 13*(3), 436–445.

Lameire, N. H., Bagga, A., Cruz, D., et al. (2015). Acute kidney injury: An increasing global concern. *Lancet, 385*(9987), 2616–2624.

Lawson, C., Gill, C., Nadel, S., Zappitelli, M., Boohaker, L., Teixeira-Pinto, A., et al. (2021). Epidemiology, trajectories and outcomes of acute kidney injury among hospitalized patients. *Frontiers in Pediatrics, 9*, 635631.

Lozano, J. M., Goldstein, S. L., Wheeling, C., et al. (2021). Long-term kidney outcomes following dialysis-treated childhood acute kidney injury: A population-based cohort study. *Journal of the American Society of Nephrology, 32*(1), 89–99.

Meena, J., Mathew, G., Kumar, J., & Chanchlani, R. (2023). Incidence of acute kidney injury in hospitalized children: A meta-analysis. *Pediatrics, 151*(2).

Olowu, W. A., Niang, A., Osafo, C., et al. (2023). Factors associated with mortality and long-term outcomes of pediatric acute kidney injury in a resource-limited setting. *Pediatric Nephrology, 38*(1), 12.

Parthasarathy, A., Menon, P. S. N., Nair, M. K. C., et al. (2019). *IAP textbook of pediatrics* (7th ed., pp. 714–720). Jaypee Brothers Medical Publishers.

Paul, V. K., & Bagga, A. (2023). *Ghai essential pediatrics* (10th ed., p. 511). CBS Publishers & Distributors.

Rahman, M., Ahmed, A., & Begum, T. (2018). Demographic and clinical profile of pediatric acute kidney injury in a tertiary care hospital. *Bangladesh Journal of Child Health, 42*(3), 165–170.

Reinhart, K., Daniels, R., Kissoon, N., Machado, F. R., Schachter, R. D., & Finfer, S. (2017). Recognizing sepsis as a global health priority — a WHO resolution. *The New England Journal of Medicine, 377*(5), 414–417

Robinson, C. H., Jeyakumar, N., Luo, B., Askenazi, D., Deep, A., Garg, A. X., et al. (2024). Long-term kidney outcomes after pediatric acute kidney injury. *Journal of the American Society of Nephrology, 35*(11), 1520–1532.

Sreedhar, P., Nageshwari, K., & Kumar, Y. S. (2018). Acute kidney injury in hospitalized children: Incidence and outcome. *Indian Journal of Child Health, 5*(4), 271–274.

Suraj, G. (2016). *The short textbook of pediatrics* (12th ed., p. 621). Kindle edition.

Sutherland, S. M., Byrnes, J. J., Kothari, M., Longhurst, C. A., & Dutta, S. (2021). AKI in hospitalized children: Epidemiology and clinical associations. *Clinical Journal of the American Society of Nephrology, 16*(1), 58–67.

Sutherland, S. M., Zappitelli, M., Akcan-Arikan, A., Loftis, L. L., Jefferson, L. S., & Goldstein, S. L.; AWARE Investigators. (2017). Epidemiology of acute kidney injury in critically ill children and young adults. *The New England Journal of Medicine, 376*(1), 11–20.

World Health Organization. (2021). *Pocket book of hospital care for children: Guidelines for the management of common childhood illnesses* (3rd ed.). Geneva: WHO.

World Health Organization. (2024). *WHO classification of anaemia: Updated recommendations*. Geneva: WHO.

Yousefifard, M., Toloui, A., Forouzannia, S. A., Ataei, N., & Hosseini, M., et al. (2022). Prevalence and mortality of post-traumatic acute kidney injury in children: A systematic review and meta-analysis. *Archives of Academic Emergency Medicine, 10*(1), e89.

Zarei, H., Azimi, A., Ansarian, A., Raad, A., Tabatabaei, H., & Roshdi Dizaji, S., et al. (2025). Incidence of acute kidney injury-associated mortality in hospitalized children: A systematic review and meta-analysis. *BMC Nephrology, 26*, 117.