Trends, causes and outcomes of Acute Kidney Injury (AKI) among children attending University of Nigeria Teaching Hospital, Ituku-Ozalla Enugu

Henrietta U Okafor[1], Ngozi Mbanefo[1], Vivian Muoneke[1], Israel O Odetunde[1], Samuel N Uwaezuoke[1], Grace Agu[2], Edmund N Ossai[3], Josephat M Chinawa[1]

1. Department of Paediatrics, College of Medicine, University of Nigeria Enugu Campus, Nigeria.
2. Department of Paediatrics, University of Nigeria Teaching Hospital Ituku Ozalla.
3. Department of Community Medicine, College of Health Sciences, Ebonyi StateUniversity Abakaliki, Nigeria.

.

E-mail address

HO: henrietta.okafor@unn.edu.ng; NM: ngozi.mbanefo@unn.edu.ng; VM: vizym@yahoo.com; IO: israel.odetunde@unn.edu.ng; SU: snuwaezuoke@yahoo.com; GA: runningchild2000@yahoo.com; ENO: ossai_2@yahoo.co.uk; JMC: Josephat.chinawa@unn.edu.ng

Abstract

Background: Acute Kidney Injury (AKI) in children is increasingly being recognized as a major problem in resource poor countries like Nigeria. In our own setting where resources for renal replacement therapy are limited, it becomes expedient to identify the cases early, ascertain the common causes and challenges in management. This will inform early interventions and strategies for prevention.

Objectives: This study sought to describe the trends,causes and outcomes in the management of AKI among children attending pediatric nephrology unit of the University of Nigeria Teaching Hospital.

Methods: A retrospective cross- sectional study whereby case folder of children with discharge diagnosis of AKI seen in the pediatric nephrology unit of the University of Nigeria Teaching Hospital in Southeast Nigeria.

Results: 51 case folders fulfilled the inclusion criteria. The age range was 0.8-16 with a mean of 5.3±4.6. There was male predominance with M:F ratio of 2.2:1.The commonest presenting feature was fever (78.4%). Majority (82.9%) came in with greater than and equal to stage 2 AKI (KDIGO) , with mean creatinine value of 494.6±367.44 µmmol. Sepsis and malaria were common associated diagnoses. Eight patients (11.8%) were dialyzed and mortality was 3.9%.

Conclusion: Febrile illnesses such as malaria and sepsis are the commonest cause of AKI in this study and this occurs between the ages of 1 and 9 years. Few of these children with AKI benefited form dialysis. Mortality is low and outcome in this study seems good

Keywords: Children; AKI; renal replacement therapy; prevention.

DOI: https://dx.doi.org/10.4314/ahs.v24i2.43

Cite as: *Okafor HU, Mbanefo N, Muoneke V, Odetunde IO, Uwaezuoke SN, Agu G, et al. Trends, causes and outcomes of Acute Kidney Injury (AKI) among children attending University of Nigeria Teaching Hospital, Ituku-Ozalla Enugu. Afri Health Sci. 2024;24(2). 427-436. https://dx.doi.org/10.4314/ahs.v24i2.43*

Corresponding author:
Josephat M Chinawa,
Department of Paediatrics, College of Medicine,
University of Nigeria Enugu Campus. Enugu, Nigeria.
PMB 40001, Enugu, Nigeria.
Tel: +234 803 722 1864.
Email: Josephat.chinawa@unn.edu.ng

Introduction

Acute kidney injury has been identified as a global public health problem with the highest burden disproportionately fallen on low and middle income countries and associated with high morbidity and mortality.[1] Previous studies[2,3] reported a higher proportion of community acquired AKI than hospital acquired AKI from resource poor countries. In the past, the true burden of Paediatric

AKI was largely unknown due to lack of standardized and uniform definition across studies. 4-6 definitions tried to harmonize and simplify the classification which makes it easier to estimate the burden in various settings. In children and neonates both prospective and retrospective studies revealed a prevalence of about 27%. [6] Acute Kidney Injury is associated with mortality irrespective of the precipitating cause. In low income countries a lot of challenges have been noted in the management of these patients and this may vary from region to region.

For instance,despite achieving an epidemic status, AKI remains poorly diagnosed and managed in Low and Middle Income Countries (LMICsL). [7] A study of 223 Paediatric nephrologists had revealed peritoneal dialysis as the only frequently used dialysis modality in developing countries.7 Ezesorbor et al 6 reported the lack of consumables, skilled manpower and high cost of dialysis as common challenges seen in children with AKI. They also noted non-availability of peritoneal dialysis in 50% of Nigeria Hospitals as a challange militating managment of children with AKI. [6] Similarly, Bello et al [8] had noted associated high costs in the maintenance of dialysis in Nigeria. In their reportage, more than 90% of the population live below the poverty level, subsequently, patients with kidney diseasepay out-of-pocket to continue with hemodialysis. [8]

In addition, in Nigeria, Ademola et al [9] AKI as a common disease among children in a tertiary care hospital in sub-Saharan Africa often associated with high mortality risk . The high mortality risk could be worse in settings without dialysis. Ademola et al [10] has documented a high mortality 16.3% in their reportage, and high mortality risk could be worse in settings without dialysis.

Children with acute renal failure due to acute kidney injury, needing renal replacement therapy (RRT) may die probably due to lack of dialysis facilities.[11-13] Also potentially, there are several obstacles and challenges in the early diagnosis and ancillary management of these children with AKI. Lack of laboratory and basic treatment facilities, skilled medical and para-medical personnel and medical infrastructure are factors militating early diagnosis and prompt management of children with AKI.[14 ,15] Studies from the International Society of Peritoneal Dialysis (ISPD) conference in 2014 showed substantial variations in availability of therapy and diagnostic capabilities in the management of AKI in children. [16] The unavailability of hemodialysis (HD) or peritoneal dialysis (PD) for AKI with paucity of qualified nurses or physicians has been documented in some studies.[14-16]

The burden of AKI in children from south East Nigeria remains a topical issue and inadequately explored This study sought to examine the challenges associated with the management of AKI in a tertiary institution in southeast Nigeria with the ultimate aim to provide interventions and propose strategies to mitigate the problem.

Methods & Materials

The study site was the University of Nigeria Teaching Hospital Ituku Ozalla, Enugu in Southeast Nigeria. The facility was a 500-bed tertiary health facility with a catchment area that spans over 4 states in the sub region. It has a 30 bed pediatric ward, 25 bed pediatric emergency unit and a 20 bed neonatal unit. This was a retrospective hospital based cross sectional study whereby the case notes of all pediatric patients with a discharge diagnosis of AKI over a six year period were enrolled into the study. Case notes with inadequate data to stage the AKI were excluded while those with AKI according to KDIGO creatinine classification and age ≤ 18years were included.

All patients with calculated eGFR<35ml/min were classified as stage 3 AKI. For the estimation of the urine flow rate the urine was collected in a calibrated container. Each void was measured in milliliters and recorded in the urine flow chart. After a completed 24 hours, the total volume voided is divided by the weight in kg and by 24hours and documented in mls/kg/hour.In critically ill children, a urethral catheter was passed and the urine collected in a urine bag. The total volume voided in a 24 hour period was also measured and calculated in a similar way.

For the estimation of eGFR; Schwatrz formula was used which was calculated in ml/min/1.73m2 as height in centimeter × constant divided by serum creatinine in mg/dl. Age is a factor that determines the constant applied in the calculation. For infants younger than 1 year, the constant was 0.4, for a child and female adolescents, the constant was 0.55 while male adolescents was 0.7.

Known cases of chronic kidney disease or other chronic illness were also excluded. Clinical and bio- demographic data was extracted from the case notes, cleaned, coded and computer entered using the SPSS v20 software.

Data analysis

Descriptive statistics and frequencies were reported as means and proportions for continuous and categorical variables respectively. Non parametric data were summarized as minimum, maximum and median.

Results

Within the study period January 2013 and June 2018, 51 children met the inclusion criteria , of the 10,619 children admitted within the period. The majority (62.7%) of patients were between 1-9 years of age. 4.8 per 1000 children were admitted into the Paediatric wards and mortality was about (2/51) 3.9%. The remaining 96% were discharged home to be followed up in the nephrology clinic.

Basic characteristics of study population are shown in Table 1.

Table 1: Socio-demographic characteristics of respondents

Variable	Frequency (n=51)	Percent (%)
Age of respondents (years)		
Minimum	0.8	
Maximum	16	
Median	4.0	
Age of respondents in groups		
<1 year	10	19.6
1-9 years	32	62.7
10-16 years	9	17.6
Gender		
Male	35	68.6
Female	16	31.4
Weight (kg)		
Minimum	3.1	
Maximum	62.0	
Median	17.0	
Height (cm)		
Mean (±SD)	106.3±32.3	
Systolic blood pressure		
Mean (±SD)	106.0±24.0	
Diastolic blood pressure		
Mean (±SD)	67.0±19.0	
Duration of hospitalization (days)		
Minimum	2	
Maximum	34	
Median	11	

Major presenting complaints and associated diagnosis are shown in Table 2

Fever was the commonest (78.4%) presenting complaint, followed by reduced urine output and body swelling (56.4%) Sepsis is the commonest cause of AKI 17(33.3 %) followed by Complicated malaria 9 (17.6%)

Table 2: Presenting complaints

Variable	**Frequency (n=51)**	**Percent (%)**
Presenting complaints		
Fever	40	78.4
Decreased urine output	29	56.4
Body swelling	28	54.9
Vomiting	16	31.4
Diarrhoea	13	25.5
Respiratory distress	10	19.6
Coke coloured urine	9	17.6
Paleness of the body	8	15.7
Cough	7	13.7
Convulsion	6	11.8
Seizures	6	11.8
Altered level of consciousness	4	7.8
Abdominal pain	3	5.9
Weakness	3	5.9
Palor	3	5.9
Melena stool	1	2.0
Yellowness of eyes	1	2.0
Co-morbidities		
Sepsis	17	33.3
Seizures	2	3.9
Sickle cell disease	1	2.0
Hyperpigmented papular rashes	1	2.0
Acyanotic heart disease	1	2.0
Respiratory tract infection	1	1.0
Others (not specified)	6	11.8
Possible cause of AKI		
Sepsis	17	33.3
Complicated malaria	9	17.6

Hemolytic uremic syndrome	4	7.8
AGN	3	5.9
Gastroenteritis	3	5.9
Nephrotoxicity	2	3.9
Urinary tract infection	2	3.9
Obstructive uropathy	1	2.0
Pyelonephritis	1	2.0
AKI secondary to hypovolemia	1	2.0
Herbal concoction	1	2.0
Sickle cell disease	1	2.0
Others (not specified)	4	7.8

Majority (70.6%) of the patients were managed conservatively while only 27.4% had access to any form of renal replacement therapy. Of these 23.5% had hemodialysis while 3.9% had peritoneal dialysis. Furosemide was the commonest drug administered as part of the conservative management.

Table 3a: AKI stage, treatment provided and outcome

Variable	**Frequency (n=51)**	**Percent (%)**
Kidney stage of AKI		
Stage 1	7	13.7
Stage 2	4	7.8
Stage 3	35	68.6
Not specified	5	9.0
Treatment provided		
Conservative management	36	70.6
Hemodialysis	6	11.8
Peritoneal dialysis	2	3.9
Renal biopsy	1	2.0
Not specified	6	11.8
Treatment outcome		
Satisfactory	39	76.5
Death	2	3.9
Residual symptoms	3	5.9
Not indicated	7	13.7

Table 3b: Medications given during and after presentation

Variable	Frequency (n=51)	Percent (%)
Drugs given during treatment		
Frusemide	29	56.9
Dopamine & frusemide	3	5.9
Slow K	3	5.9
Dopamine	1	2.0
Lasix	1	2.0
Others (not specified)	6	11.8
Drugs given before presentation		
Antibiotics	16	31.4
ACE inhibitors	3	5.9
Anti-malaria	2	3.9
Diazepam	1	2.0
Others (not specified)	5	5.9
Unknown	1	2.0
Not indicated	9	17.6

Table 4: Size of kidneys and Electrolyte/Urea/creatinine of respondent

Variable	Frequency (n=51)
Right kidney (width)	
Mean (±SD)	8.8±2.4
Right kidney (length)	
Mean (±SD)	4.9±2.3
Left kidney (width)	
Mean (±SD)	8.7±2.4
Left kidney (length)	
Mean (±SD)	5.3±2.2
Calcium	
Mean (±SD)	1.2±0.4
Phosphorus	
Mean (±SD)	4.5±2.1

Chloride	
Mean (±SD)	101.3±20.7
Urea	
Minimum	2.2
Maximum	100.0
Median	31.4
Creatinine	
Minimum	52.0
Maximum	1520.2
Median	479.0
Urine flow rate	
Minimum	0.1
Maximum	11.4
Median	0.5
e GFR at presentation	
Minimum	2.8
Maximum	178.5
Median	10.5
e GFR at discharge	
Minimum	5.6
Maximum	96.3
Median	40.0

Discussion

This study was aimed at determining the trends, causes and outcome of AKI among children attending a tertiary hospital in Enugu. Most cases were associated with febrile illnesses most likely malaria and sepsis. It is documented that certain patient-context-specific factors can modify the risk and aetiology of AKI. [17] Apart from the illness recorded at extreme of ages 18-22 , AKI is commonly associated with sepsis. Ezeonwu et al [22] also noted complicated malaria among the commonest causes of AKI in southern Nigeria. Muithya et al [23], Evans et al [24], Anigilaje et a l [25] and Mehta et a l18 all documented malaria and sepsis as common etiological correlates among children with AKI. Furthermore, children with AKI in this study presented late and this could be explained by wrong diagnosis, poor referral practice and late identification of cases.[26,27] Early recognition and intervention is associated with better outcome. For instance, Vijay et al [28] noted that timely recognition of patients at risk or with possible acute kidney injury (AKI) is essential for early intervention to minimize further damage and improve outcome. Initial management of patients with suspected and persistent AKI should include thorough clinical assessment of all patients with AKI to identify reversible factors, including fluid volume status, potential nephrotoxins, and an assessment of the underlying health of the kidney. [27]

The majority of the children with AKI in this study were managed conservatively while a few had access to any form of renal replacement therapy with a very small number of them having the privilege to benefit from peritoneal and hemodialysis. Studies have shown that delays in patients seeking treatment and inability of patients to pay for dialysis poses a great challenge in the man-

agement of children with AKI. However, the mortality in our case would have been worse without dialysis. Children with AKI with end stage disease may die because dialysis is simply not available, accessible or even affordable. Besides, Olowu et al [19] in a systematic review noted that out of 3,340 subjects with AKI admitted to hospital in 13 countries in Africa, dialysis was indicated in about 66% of the them, nevertheless only about 50% of them received dialysis when needed.

The majority of the children with AKI in this study were between 1-9 years of age. The possible aetiology and insults to the kidneys normally occur at this age group. This has been corroborated by other researchers. Esezobor et al [6] also noted similar age range among children with AKI while Obichukwu et al [21] noted that AKI in critically ill children also commonly occurs in children less than five yeas of age.

The mortality from AKI in this study was 3.9%. Mortality rates are usually high in critically ill children with AKI, ranging between 9% and 67%.[28]

Recent reviews emphasize that disparities in the definition of AKI have resulted in large variations in reported incidence and outcomes. Acute kidney injury has been linked with greater mortality in children . For instance, Chawla et al 16 found that AKI events were associated with a mortality rate more than double that of myocardial infarctions . Similarly in a retrospective study, Alkandari et al[29] noted that children admitted to the intensive care unit who developed AKI were 4–8 times more likely to die than those who did not.[29]

Conclusion

Febrile illnesses such as malaria and sepsis are the commonest cause of AKI in this study and this occurs between the ages of 1 and 9 years. Few of these children with AKI benefited from dialysis. Mortality is low and outcome in this study seems good Recommendations

We recommend a high index of suspicion for AKI when reviewing febrile cases. Renal function tests to for early identification of AKI in all febrile cases that present to health facilities is recommended. To create awareness among other cadres of health workers for early identification of cases.To conduct prospective and longitudinal studies to assess actual burden in our children and long term outcome.

Declaration

Consent for publication:

Not applicable

Availability of data and materials

The data will be shared by the corresponding author.

Funding

This work was not funded by any organization. We bore all expenses that accrue from this study.

Conflict of interest

The authors declare no conflict of interest.

Author contributions

HO, NM, VM, IO, SU, GA, ENO, JMC conceived the study, drafted the manuscript, and gave final approval of the version to be published. HO and ENO collected and interpreted the data and gave final approval of the current version. ENO analyzed the data.

Acknowledgments

We are grateful to the research assistant who helped in distributing the questionnaire

Funding

This work was not funded by any organization. We bore all expenses that accrue from this study.

Ethical Approval and Consent to participate

Ethical approval on was sought from the Ethics and Research committee of University Of Nigeria.

Conflict of interest

The authors declare no conflict of interest.

Author contributions

HO, NM, VM, IO, SU, GA, ENO, JMC conceived the study, drafted the manuscript, and gave final approval of the version to be published. HO and ENO collected and interpreted the data and gave final approval of the current version. ENO analyzed the data.

References

1. Mehta RL, Burdmann EA, Cerdá J, Feehally J, Finkelstein F, García-García G et al. Recognition and management of acute kidney injury in the Interna-

tional Society of Nephrology 0by25 Global Snapshot: a multinational cross-sectional study. Lancet. 2016 May 14;387(10032):2017-25. doi: 10.1016/S0140-6736(16)30240-9. Epub 2016 Apr 13. Erratum in: *Lancet*. 2016 May 14;387(10032):1998. PMID: 27086173.

2. Basu RK, Kaddourah A, Terrell T, Mottes T, Arnold P, Jacobs J, Andringa J et al. Prospective Pediatric AKI Research Group (ppAKI). Assessment of Worldwide Acute Kidney Injury, Renal Angina and Epidemiology in critically ill children (AWARE): study protocol for a prospective observational study. *BMC Nephrol*. 2015 Feb 26;16:24. doi: 10.1186/s12882-015-0016-6. PMID: 25882434; PMCID: PMC4355130.

3. Jetton JG, Guillet R, Askenazi DJ, Dill L, Jacobs J, Kent AL et al.Neonatal Kidney Collaborative. Assessment of Worldwide Acute Kidney Injury Epidemiology in Neonates: Design of a Retrospective Cohort Study. *Front Pediatr*. 2016 Jul 19;4:68. doi: 10.3389/fped.2016.00068. PMID: 27486571; PMCID: PMC4950470.

4. Selewski DT, Cornell TT, Heung M, Troost JP, Ehrmann BJ, Lombel RM et al. Validation of the KDIGO acute kidney injury criteria in a pediatric critical care population. *Intensive Care Med*. 2014 Oct;40(10):1481-8. doi: 10.1007/s00134-014-3391-8. Epub 2014 Jul 31. PMID: 25079008.

5. Kidney Disease: Improving Global Outcomes (KDIGO) Acute Kidney Injury Working Group. KDIGO clinical practice guideline for acute kidney injury. *Kidney Int Suppl*. 2012;2(1):1–138.

6. Esezobor CI, Ladapo TA, Osinaike Bet al. Paediatric Acute Kidney Injury in a Tertiary Hospital in Nigeria: Prevalence, Causes and Mortality Rate. *PLoS*. 2012; ONE 7(12): e51229.

7. Raina R, Chauvin AM, Bunchman T, Askenazi D, Deep A, Ensley MJ et al. Treatment of AKI in developing and developed countries: An international survey of pediatric dialysis modalities. *PLoS One*. 2017 May 30;12(5):e0178233. doi: 10.1371/journal.pone.0178233. PMID: 28557999; PMCID: PMC5448754.

8.Bello BT, Raji YR, Sanusi I, Braimoh RW, Amira OC, Mabayoje OM. Challenges of providing maintenance hemodialysis in a resource poor country: Experience from a single teaching hospital in Lagos, Southwest Nigeria. *Hemodial Int*. 2013 Jul;17(3):427-33.

9.Ademola AD, Asinobi AO, Ekpe-Adewuyi E, Ayede AI, Ajayi SO, Raji YR et al. Acute kidney injury among paediatric emergency room admissions in a tertiary hospital in South West Nigeria: a cohort study. *Clin Kidney J*. 2019 Aug; 12(4): 521–526.

10.Ademola A, D, Asinobi A, O, Alao M, A, Wade A, W: Paediatric Dialysis at a Tertiary Hospital in South-West Nigeria: A 4-Year Report. *Blood Purif*. 2022.

11.Abdelraheem M, Ali el-T, Osman R, Ellidir R, Bushara A, Hussein R et al. Outcome of acute kidney injury in Sudanese children - an experience from a sub-Saharan African unit. *Perit Dial Int*. 2014 Jul-Aug;34(5):526-33. doi: 10.3747/pdi.2013.00082. Epub 2014 Mar 1. PMID: 24584611; PMCID: PMC4114669.

12. Lunyera J, Kilonzo K, Lewington A, Yeates K, Finkelstein FO. Acute Kidney Injury in Low-Resource Settings: Barriers to Diagnosis, Awareness, and Treatment and Strategies to Overcome These Barriers. *Am J Kidney Dis*. 2016 Jun;67(6):834-40. doi: 10.1053/j.ajkd.2015.12.018. Epub 2016 Jan 29. PMID: 26830256.

13.Ponce D, Balbi A. Acute kidney injury: risk factors and management challenges in developing countries. *Int J Nephrol Renovasc Dis*. 2016;9:193-200 PubMed

14. Schroeder LF, Amukele T. Medical laboratories in sub-Saharan Africa that meet international quality standards. *Am J Clin Pathol*. 2014;141(6):791–795. 19. PubMed

15. Daniela P, Andre B . Acute kidney injury: risk factors and management challenges in developing countries. *Int J Nephrol Renovasc Dis*. 2016; 9: 193–200.

16. Chawla L.S., Bellomo R., Bihorac A. Acute kidney disease and renal recovery: guideline report of the Acute Disease Quality Initiative (ADQI) 16 Workgroup. *Clin J Am Soc Nephrol*. 2017;13:241–257. PubMed Google Scholar

17. Corbett RW, Goodlet G, MacLaren B, Jolliffe A, Joseph A, Lu C et al. International Society for Peritoneal Dialysis Practice Recommendations: The view of the person who is doing or who has done peritoneal dialysis. *Perit Dial Int*. 2020 May;40(3):349-352. doi: 10.1177/0896860820918822. Epub 2020 Apr 17. PMID: 32301374.

18. Mehta RL, Cerdá J, Burdmann EA, Tonelli M, García-García G, Jha V et al.. International Society of Nephrology's 0by25 initiative for acute kidney injury (zero preventable deaths by 2025): a human rights case for nephrology. *Lancet*. 2015 Jun 27;385(9987):2616-43. doi: 10.1016/S0140-6736(15)60126-X. Epub 2015 Mar 13. PMID: 25777661.

19. Olowu WA, Adefehinti O, Bisiriyu AL. Hospital-acquired acute kidney injury in critically ill children and

adolescents. *Saudi J Kidney Dis Transpl*. 2012;23:68-77. PubMed.
20. Alkandari O, Eddington KA, Hyder A, Gauvin F, Ducruet T, Gottesman Ret al. Acute kidney injury is an independent risk factor for pediatric intensive care unit mortality, longer length of stay and prolonged mechanical ventilation in critically ill children: a two-center retrospective cohort study. *Crit Care*. 2011 Jun 10;15(3):R146. doi: 10.1186/cc10269. PMID: 21663616; PMCID: PMC3219018.
21. Obichukwu CC, Odetunde OI, Chinawa JM, Okafor HU, Adiele DK, Ibe BC. Community-Acquired acute kidney injury in critically Ill children as seen in the emergency unit of a tertiary hospital in Enugu, Southeast Nigeria. *Niger J Clin Pract*. 2017 Jun;20(6):746-753. doi: 10.4103/njcp.njcp_293_16. PMID: 28656931.
22. Ezeonwu BU, Abonyi LE, Odetunde OI, Nnodim IJ, Nwafor IO, Ajaegbu OC et al. Epidemiology of community-acquired acute kidney injury in children as seen in an emergency room of Tertiary Hospital in South-South Nigeria. *Saudi J Kidney Dis Transpl*. 2021 Mar-Apr;32(2):428-436. doi: 10.4103/1319-2442.335455. PMID: 35017337.
23. Muithya C, Admani B, Were F. Prevalence of acute kidney injury in critically ill children at tertiary hospital in Kenya. *Afr J Paed Nephrol* 2015;2:6-12 PubMed .
24.Evans RDR, Docherty M, Seeley A, Craik A, Mpugna M, Mann S et al. Incidence, Etiology, and Outcomes of Community-Acquired Acute Kidney Injury in Pediatric Admissions in Malawi. *Perit Dial Int*. 2018 Nov-Dec; 38(6):405-412. doi: 10.3747/pdi.2017.00253. Epub 2018 Sep 25. PMID: 30257995.
25.Anigilaje EA, Adebayo AI, Ocheni SA. Acute kidney injury in children: A study of etiology, clinical profile, and short-term outcomes at the University of Abuja Teaching Hospital, Gwagwalada, Abuja, Nigeria. *Saudi J Kidney Dis Transp*l. 2019;30:421-39.
26.Ricci Z, Cruz DN, Ronco C.Classification and staging of acute kidney injury: beyond the RIFLE and AKIN criteria..*Nat Rev Nephrol*. 2011 Apr; 7(4):201-8.
27.Sadeghi-Bojd S, Noori NM, Mohammadi M, Teimouri A. Clinical characteristics and mortality risk prediction in children with acute kidney injury. *Niger Med J*. 2015 Sep-Oct;56(5):327-32. doi: 10.4103/0300-1652.170381. PMID: 26778883; PMCID: PMC4698847.
28.Vijay K, Nattachai S, Eisei N, Mohammed BG, Manjunath SS, Li Y, et al and Acute Disease Quality Initiative (ADQI) Consensus Group. Prevention and Therapy of Acute Kidney Injury in the Developing World *Kidney Int Rep*. 2017 Jul; 2(4): 544–558.
29. Alkandari O, Eddington KA, Hyder A, Gauvin F, Ducruet T, Gottesman R et al.. Acute kidney injury is an independent risk factor for pediatric intensive care unit mortality, longer length of stay and prolonged mechanical ventilation in critically ill children: a two-center retrospective cohort study. *Crit Care*. 2011 Jun 10;15(3):R146. doi: 10.1186/cc10269. PMID: 21663616; PMCID: PMC3219018.