International Journal of Contemporary Pediatrics
Kamran Z et al. Int J Contemp Pediatr. 2025 Nov;12(11):1759-1763
http://www.ijpediatrics.com
pISSN 2349-3283 | eISSN 2349-3291
DOI: https://dx.doi.org/10.18203/2349-3291.ijcp20253478

Original Research Article

Frequency of anemia in children at discharge from a pediatric intensive care unit of Pakistan

Zainab Kamran*, Sujjata Lohana, Mohammad Sartaj Aijaz, Syed Muhammad Umer, Muhammad Waqas, Anwarul Haque

Department of Pediatrics, Children Hospital Korangi, Sindh Institute of Child Health and Neonatology (SICHN), Karachi, Pakistan

Received: 21 August 2025
Revised: 03 October 2025
Accepted: 15 October 2025

***Correspondence:**
Dr. Zainab Kamran,
E-mail: zainabkamran24@gmail.com

ABSTRACT

Background: Anemia in critically-ill children is reported in one-third to three-fourth at admission and during stay in Pediatric Intensive Care Units (PICU). Limited data is available on anemia in children at discharge from PICU (post-PICU anemia). To determine the prevalence of anemia in critically-ill children discharged from a PICU of public-sector Children hospital.
Methods: A descriptive, retrospective cohort study was conducted on children (1mo-15 years) who had more than one hemoglobin (Hb) value measurement and last one was done within 24-hour of discharge in the PICU from January to December 2024. Anemia is defined as Hb <10 g/dl and severe anemia was Hb <7g/dl. Data like age, gender, admitting diagnosis and Hb prior to discharge were recorded.
Results: A total of 457 patients met the eligibility criteria. The median age at admission was 10 (IQR 5.0-24.0) months, and 57.5% (n=263) were male. The most common admitting diagnoses were respiratory illnesses (52.7%, n=241), followed by infections related illnesses (23.2%, n=106), and neurological disorders 17.3% (n=79). At admission, 259 patients (56.7%) had anemia, of whom 35 (13.5%) had severe anemia (Hb <7 g/dl). At the time of discharge, anemia was present in 288 patients (63%), including 13 patients (4.5%) with severe anemia. Only 14.6% (29) developed anemia during PICU stay. However, there were fewer patients have severe anemia at discharge than at admission.
Conclusions: Nearly two-third of critically-ill children have anemia at discharge from a PICU of low-middle income countries. More studies required to analyze post-PICU anemia to prevent significant reversible morbidity associated with it.

Keywords: Anemia, Critically-ill children, Discharge, Pediatric intensive care unit

INTRODUCTION

The epidemiology of anemia in critically-ill children has been studied extensively.[1,2] Batesman et al reported 33% of anemia in children on admission and an additional 41% developed anemia during the PICU stay.[3] The etiology of anemia in critically-ill children is multifactorial, including hemodilution, reduced erythropoiesis and blood loss.[1,4] The rate of transfusion of PRBC in critically-ill children is nearly half-of children during stay in PICU, range reported from 33.36-66.07% in PICUs.[3,5,6]

However, transfusion of packed red blood cell in critically-ill anemic children was not associated with improvement in oxygen delivery, rather was associated with adverse effects like multiorgan dysfunction syndrome.[7] Various guidelines recommended restricted

use of blood transfusion in critically-ill pediatric patients. The adherence to restrictive-transfusion of blood practices has been implemented in many PICUs for the last two decades.[8,9] There is a high potential of developing anemia on discharge in critically-ill children with restricted blood transfusion guidelines from PICU.

The prevalence anemia in critically-ill children at discharge (post-PICU anemia) had published from developing countries, ranged from 24 to 60%.[10-12] Local data is scarce on post-PICU anemia. The objective of this study was to assess the frequency and severity of anemia among critically ill children discharged from a PICU of public-sector Children hospital of Karachi.

METHODS

Study design

A retrospective descriptive cohort study.

Setting

This was conducted at the PICU of Children Hospital of Korangi, under the management of Sindh Institute of Child Health and Neonatology (SICHN). SICHN is an organization of acute neonatal and pediatric health care under Govt. of Sindh. PICU is a closed, multidisciplinary, 28 bedded unit with 4-S framework.[13]

Study duration

For one-year; from January 1 2024 to December 31, 2024

Intervention

None.

Inclusion criteria

Patients were eligible only if they had at least two documented hemoglobin (Hb) values, and the final one recorded within 24 hours of discharge.

Exclusion criteria

All children who expired in PICU, stayed less than 48 hours, had only one Hb and last Hb was measured before 24 hoys of discharge from PICU.

Sample size calculation and sampling technique

A minimum sample size of 381 patients was calculated if 45% prevalence of anemia in critically ill children, with a 95% confidence interval and a 5% margin of error. Non-probability consecutive sampling technique was used.[14]

Operational definition

Anemia was defined as Hb <10 g/dl, severe anemia as Hb <7 g/dl for study purpose, which is in clinical practice of most of PICUs.

Data collections and statistical analysis

Medical records were reviewed of eligible patients (aged 1 month to 15 years). The following demographic data (age and gender), admitting diagnostic categories and pertinent study variables (Hb on admission (T1) and Hb on discharge from PICU (T2) were extracted from medical records. Descriptive statistics were performed using SPSS version 25.0. The categorical variables were expressed as frequency (n) and percentage (%) while continuous variables were reported as mean with SD or median with IQR.

Ethical consideration

Ethical approval for the study was obtained from the institutional review board of SICHN (SICHN/Ex-015/2024). This study followed the guideline of STROBE cohort studies.[15]

RESULTS

A total of 457 patients met the eligibility criteria. The median age at admission was 10 (IQR:5.0–24.0) months, and 57.5% (n=263) were male. The following common admitting diagnostic categories were respiratory illnesses (52.7%, n=241), followed by severe tropical infections (23.2%, n=106), neurological disorders (17.3%, n=79), cardiovascular conditions (6.6%, n=30). At admission, 259 patients (56.7%) had Hb <10 g/dl, of whom 35 (13.5%) had severe anemia (Hb <7 g/dl). The remaining 198 patients (43.3%) had Hb >10 g/dl. The overall incidence of anemia (Hb <10 g/dl) was present in 288 patients (63%), including 13 patients (4.5%) had severe anemia (Hb <7 g/dl) at the time of discharge. 37% (169) patients had Hb >10 g/dl at discharge as shown in Table 1.

Table 1: Frequencies of Hb values at admission and discharge from PICU.

Hb range	Admission N (%)	Discharge N (%)
>10	198	169
7-10	224	275
< 7	35	13

Table 2: Characteristics of study participants.

Age at admission (in month)	N (%)
Median (IQR)	10 (5– 24)
Min-Max	0.9-168
Gender	
Male	263 (57.5)
Female	194 (42.5)
Total	457 (100)
Admitting diagnostic categories	
Respiratory illness	241 (52.7)
Neurological	79 (17.3)
Cardiac	30 (6.6)
Other	107 (23.4)
Hb range at admission	
< 7	35 (8)
7-10	224 (49)
>10	198 (43)
Hb range at discharge	
< 7	13 (3)
7-10	275 (60)
>10	169 (37)

Among those with Hb <10 g/dl at admission, 76% remained anemic at discharge, while 22.4% showed improvement with Hb >10 g/dl. Conversely, among those with Hb >10 g/dl at admission, 43.9% developed anemia by discharge, whereas 56.1% maintained normal hemoglobin levels as shown in Figure 1. Only 14.3 % (n=29) of children developed anemia during the PICU stay.

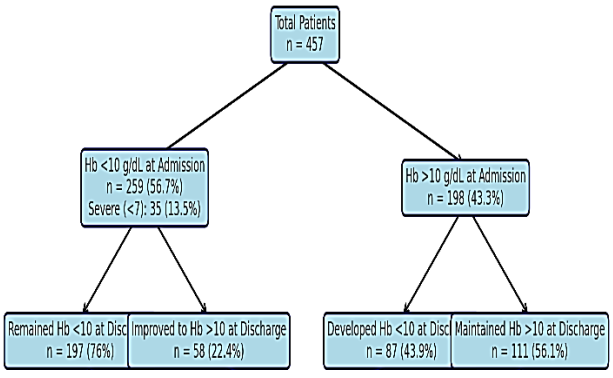

Figure 1: Pattern of no anemia, anemia and severe anemia in PICU.

DISCUSSION

This study revealed a significantly high prevalence of anemia at discharge from the PICU, with nearly two-third of children (63%) exhibiting subnormal hemoglobin levels and 4% meeting criteria for severe anemia. There are few studies of the epidemiology of anemia after ICU discharge.[11,16,17] In 2017 Demaret et al observed 57% of

the prevalence of post-PICU anemia in their cohort of critically-ill children over one-year period and significant association was noted with anemia at admission and in adolescent age category.[16] Two large sample size (over 3000 participants in each report) studies from PICU over five-year periods demonstrated more than half of survivors have post-PICU anemia (50.9% and 58.9%) from Canada and France.[11,18] Meji et al found the frequency of post-PICU anemia 64.8% in 54 critically-ill children over 3-month period from a PICU of India in retrospective cohort.[19] Walsh et al has reported the overall prevalence rate of anemia at discharge from adult ICU was 74.4-87% in two cohort of survivors.[17,20] The awareness of post-PICU anemia is rising in clinical practice during the last decade.

Most of the epidemiological studies on anemia at discharge from adult and pediatric ICUs had found presence of anemia at ICU admission was the strongest risk factor associated with post-PICU anemia on the multivariate logistic regression model.[16,17] Jutras et al reported post-PICU anemia occurred in 81.6% and 24.7% of patients who had anemia and who had no anemia at PICU admission respectively.[18] Similarly, we observed anemia at discharge in 76% (n=197) and 44% (n=87) in anemic and non-anemic group on admission respectively.

More than half of the children in this cohort have anemia on admission as compared to previously reported 33% of children have anemia on admission. One significant

observation in this study was the very low rate (<15%) of anemia developed during PICU stay, while few studies reported 27%-41% prevalence of anemia during PICU stay in their cohort.[3,11,16] There is no universal definition of anemia or standard cut-off of Hb value for critically-ill children.[11] The age-stratified value of Hb for anemia does not exist in the clinical practice of PICUs. There are many other questions to be answered in the evaluation and management of post-PICU anemia. Anemia persisting at discharge should never be trivialized. The adverse effects of Iron Deficiency anemia were described extensively in pediatric literature. Many studies have reported that Iron-deficiency anemia in infant and children is associated with impaired growth and development, decrease motor activity, social inattention and cognitive delay.[21] Jutras et al reported the severe anemia at discharge 3.6% in their cohort of post-PICU anemia like current study (4%).[18]

However, the limitations in the present study are several. Most important, single center, retrospective and small sample size which limits external validity. The trends of Hb values during the PICU stay, the record of blood transfusion was not reported. Similarly, the illness-severity score like PRISM-III or organ dysfunction score like p-SOFA or PELOAD-2 were not recorded that might predict a higher chance of post-PICU anemia which was described in adult and pediatric studies. Anemia at admission in PICU, presence of multiorgan dysfunction and prolong stay in PICU are few risk factors have been identified in published studies.[11,16,18]

Another limitation was also not described the type of anemia based on morphology from peripheral smear. Walsh et al described the normocytic-normochromic indices similar to the anemia of chronic disease in most of patients (88%) with anemia at discharge from ICU in their cohort. There is high probability of nutritional anemia in these children until prove otherwise. This study is also lacking follow-up study in post-PICU anemia. However, few clinical reports have also done 6-month follow-up on these children with mixed results about recovery from anemia.

The strength of this study is thar it will be first epidemiological-clinical report on post-PICU anemia from Pakistan.

There is an urgent need to do comprehensive analysis, including standardized definition of anemia in critically-ill children, diagnostic work-up, management to enhance the recovery from this major morbidity.

CONCLUSION

Nearly two-third of critically-ill children have anemia at discharge from a PICU of low-middle income countries. More studies required to analyze post-PICU anemia to prevent significant reversible morbidity associated with it.

Funding: No funding sources
Conflict of interest: None declared
Ethical approval: The study was approved by the Institutional Ethics Committee

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Cite this article as: Kamran Z, Lohana S, Aijaz MS, Umer SM, Waqas M, Haque A. Frequency of anemia in children at discharge from a pediatric intensive care unit of Pakistan. Int J Contemp Pediatr 2025;12:1759-63.