

Original Article

Outcome of Critically Ill Patients Admitted to Pediatric Intensive Care Unit at Basra Children's Specialty Teaching Hospital at Basra, South Iraq

Omar Salman Sabbar¹, Ansam Mahmood Saleh Al Abdullah², Rabah Salih Mohammed Al. Ali³, Rukaia Noori Almshayakhchi⁴, Reem Fawzi Nahi Al-Najim⁵

1. M.B.CH.B. CABP, department of pediatrics at Basra Children's Specialty Teaching hospital

2. M.B.CH. B, F.I.B.M. S, department of pediatrics at Basra Children's Specialty Teaching hospital

3. M.B.CH. B, F.I.C.M.F.M, Basrah General health department

4. M.B.CH. B, PhD (tumor immunology)/England, MSc. Medical microbiology, Al-Basra Children's Teaching Hospital

5. M.B.CH. B

Corresponding Author: Omar Salman Sabbar

Abstract

Background: The development of pediatric special care units (PICUs) is crucial for the recovery of seriously ill children. Over the past decade, there has been an increase in children hospitalized due to various critical diseases, and the lifespan of such patients has increased. **Aim:** To determine the primary reason for PICU admissions, the outcome of hospitalization, the main cause of death and length of stay. **Method:** In a retrospective analysis, medical records of 397 children who were admitted to a tertiary pediatric hospital in southern Iraq were evaluated between January and December, 2019. Newborn infants under 28 days of age were excluded from this study. **Result:** The main source of the PICU admissions is pediatric patients which represents 79.2% of the total cases, of which cancer accounting for almost one-third of these cases at 28.0%. Death rate is noticed to be high in our PICU at around one-quarter of the total admissions (25%). A significant high death rate at 52% is found among children suffering from cancer. Respiratory failure and sepsis are found to be the main two reasons attributed to high fatality rate. Among children admitted to the PICU, males carry more potential risk of PICU mortality than females in particularly at age 5-10 years (median age = 37.17 months). The vast majority of patients stay for fewer than 7 days across the total stay durations at approximately 82% of total cases. **Conclusion:** The most prevalent age for admission is infancy. High mortality rate is revealed at 25% of the total admissions. Most of the death occur among patients with cancer. Males at the age of around 3 years is seen as a potential risk factor for death. Short hospital stays are common. **Key words:** Outcome, mortality rate, pediatric intensive care unit, pediatric oncology, pediatric surgery.

1. INTRODUCTION

The care of children admitted to Pediatric Intensive Care Unit (PICU) is regarded as one of the biggest challenges in the field of the pediatrics, as pediatricians deal with the most critically ill children in hospital setting (1). It has been well-documented that the advancement in the PICUs facilities in the term of providing the necessary modern equipment and well-trained staff resulting in a remarkable improvement in the survival rates of these children(2).

The mortality rates in ICUs have been considered as the most important parameter in the evaluation of hospitals. In fact, literatures elucidate various levels of mortality rates depending on different PICU facilities. Other risk factors for mortality; include the severity of patient conditions at time of referral from other hospitals, multiple traumas, nosocomial infection and admission in different work shifts (3),(4),(5).

Intensive care medicine (ICM) in resource-rich countries has allocated considerable funds and amassed advance expertise in the care of seriously ill patients(6). Factors, however, such as insufficient insurances and poor national health systems unfortunately account for elevated rates of mortality and morbidity and eventually poor outcome in ICUs of resource-limited countries (7).

In addition to the disease burden, pediatric patients with cancer often face a strenuous chemotherapeutic course putting them at a significant risk of life-threatening complications, such as treatment-related toxicities. Research reported that around 40% of pediatric patients suffering from cancer require admissions to PICUs at some point during their course of the disease they have (8)(9).

The survival rate of children diagnosed with cancer has increased from an estimated overall survival rate of 20% in the late 1980s to 70 - 80% these days (10). On the other hand, children with cancer requiring PICU frequently have significantly worse outcomes in comparison to the overall children admitted to PICUs. PICU outcomes and resource operation in children with cancer have not been rigorously studied (11).

This study aimed to determine the primary cause for hospitalization, duration of stay, and main cause of death of children who were admitted to the PICU at Basra Children's Specialty Teaching Hospital. Providing such data would raise the awareness and highlight the importance of improving planning and staff-training, as well as prioritizing resource allocation to achieve better survival for these children.

2. Methods

Setting, Study design and patients

A retrospective cross-sectional study was conducted at a tertiary level hospital- Basra Children's Specialty Teaching Hospital- located in Basra, south of Iraq. The hospital runs PICU with 8 beds capacity, which is equipped with 4 mechanical ventilators, 3 CPAP machines, a defibrillator, a portable X-ray machine, an echo machine, infusion pumps, and syringe pumps. The unit also contains 4 isolation rooms, one of these isolation room with negative pressure, and the remaining 3 rooms with positive pressure. Each bed is supplied with a screen monitor. Patients are supervised constantly by four anesthesiologists, six senior house officers, three pediatricians, and a well-trained staff on call around the clock. The nurse-to-patient ratio is 1:2.

Our PICU unit implicates a wide variety of medical pediatric conditions (including any significant complications that cancer patients might develop). In addition to medical cases, the unit also involves pediatric surgical cases. Those children may be admitted directly to our hospital or referred from nearby hospitals or may come from other provinces.

Medical records of 397 children who were admitted to the PICU were examined in a retrospective cross-sectional analysis from the period of January 1st to December 31st, 2019. Ages ranged from one month to 17 years (204 months). Neonates (newborn infants under 28 days of age) were excluded from this study.

Ethical Approval: This study was conducted according to the written approval agreement of the Training & Development Department of the Health Directory of Basra governorate and a verbal family or guardians' consent was obtained through personal communication (phone call).

Statistical analysis

All analysis was performed using SPSS version 26.0, in addition to GraphPad Prism version 8.4.3, wherein descriptive statistics were applied to analyze these data. Numerical variables were expressed as frequencies and percentages. *P-value* (probability value) was found to be significant if $P\text{-value} \leq 0.05$, very significant ≤ 0.01 and highly significant when $P\text{-value} \leq 0.001$.

3. RESULTS

3.1 Demography

Table 1 demonstrates the general demographic characteristic of population studied. A total number of 397 pediatric patients were admitted to the PICU, of which 238 (60%) were males and 159 (40%) were females. The approximate mean age was 68 months for males and 63 months for female patients. Although females

were apparently younger than male patients, this difference does not show any statistical significance (P -value = 0.613).

The main source of the PICU admissions was pediatric patients which represents 79.2% of the total cases. This admission includes both patients who were admitted due to general medical conditions (51.3%) and cancer patients (27.9%). However, only 82 patients (20.6%) were surgical pediatric patients.

Patients with cancer may require admissions to our ICU for managements of acute illness associated with underlying malignancy or due to complications of therapies they treated with. In our PICU, two types of malignancies were reported: hematological and solid types of cancer. Hematological malignancies which involve 61 patients (15.3%) of the total cases are distributed as the following: acute lymphoblastic leukemia (ALL) (10.3%), acute myelogenous leukemia (AML) (1.26%) and lymphoma (3.78%). Whereas solid tumors involve 50 patients of the total cases at (15.9%), including brain tumor (7%), neuroblastoma (3.5%), renal tumor (2.22%), bone tumor (1.6%), retinoblastoma (0.63%) patients, and miscellaneous (1.5%) patients.

Table 1: General characteristics of patients admitted to the PICU

Character	Group set	Frequency	Percent (%)
1. Gender	Females	159	40
	Males	238	60
2. Age groups (months)	1 to 12	165	41.6
	13 -60	109	27.5
	61 -120	70	17.6
	121-204	53	13.4
3. Cause of admissions	<u>General medical reasons</u>	204	51.3
	<u>Oncology reasons</u>	111	27.9
	<u>Surgical reasons</u>	82	20.6
4. Type of malignancies	<u>Hematological malignancies</u>	61	15.3
	ALL	41	10.3
	AML	5	1.26
	Lymphoma	15	3.78
	<u>Solid tumors</u>	50	15.9
	Brain Tumor	22	7
	Neuroblastoma	11	3.5
	Renal Tumor	7	2.22
	Bone Tumor	5	1.6
	Retinoblastoma	2	0.63
Miscellaneous	6	1.5	
Total		397	100.0

Acute Lymphoblastic Leukemia (ALL), Acute Myelogenous Leukemia (AML)

3.2 Age versus sex distribution

Patients in the present study were categorized into 4 groups according to their ages (Table 2). The first set of groups constitutes the largest percentage of the admission at 41.6% of the total cases. It includes 165 children who aged between one and 12 months. There were a higher proportion of individuals in this set for being females at 44.0% compared to 39.9% males. Regarding the second group which includes children aged between 13 and 60 months, out of 109 individuals, 27.3% were males and 27.7% were females. Patients aged between 61 and 120 months, 19.7% were males and 14.5% were females out of a total of 70 individuals. Finally, children aged between 121 and 204 months constitute a small proportion of the total cases at 13.4%, of which 13.0% were males and 13.8% were females. Statistically, the distribution of these two parameters reveals no significant difference (P -value>0.05).

Table 2: Age and sex distribution

Age (months)	Males	Females	Total
1-12	95 (39.9%)	70 (44.0%)	165 (41.6%)
13-60	65 (27.3%)	44 (27.7%)	109 (27.5%)
61-120	47 (19.7%)	23 (14.5%)	70 (17.6%)
121-204	31 (13.0%)	22 (13.8%)	53 (13.4%)
Total	238 (100%)	159 (100%)	397 (100%)

P-value for chi squared test = 0.583

3.3 Stratification of the patients according to system involved

As it is illustrated in Table 3, admissions due to cancerous diseases and cancer related causes are found to be the most dominant reasons for pediatric admissions to the PICU, as it constitutes a significant proportion of the total cases at almost 28%. Respiratory and gastrointestinal (GIT) conditions constitute 19.6% and 17.9%, respectively. Conditions related to the central nervous system (CNS) and infections also comprise for notable percentages of cases, at 9.1% and 7.3%, respectively. Other systems, such as hematology, metabolic/endocrine, cardiovascular (CVS), renal, congenital/genetic issues, and miscellaneous conditions were reported in less and varying degrees.

Table 3: Distribution of the studied population in relation to system affected

System affected	Frequency	Percent (%)
Oncology	111	28.0
Respiratory	78	19.6
GIT	71	17.9
CNS	36	9.1
Infection	29	7.3
Hematology	18	4.5
CVS	17	4.3
Metabolic / endocrine	17	4.3
Renal	10	2.5
Miscellaneous	6	1.5
Congenital / genetic	4	1
Total	397	100.0

3.4 The Outcome in relation to age and sex categories

It is important to assess the outcome of admission to the ICU in relation to age and sex in order to identify the high risky group associated with a particular age and/or sex. We found that out of 165 children below one year of age, 75.1% were alive, 21.8% were deceased, and only 5.3% individuals were referred, (summarized in Figure:1A). Interestingly, a similar pattern of proportion is noticed among the second set of age group which involves children aged between 13 and 60 months (one to 5 years). Wherein, out of a total of 109 individuals, 76.1% individuals were alive, 21.1% individuals were deceased, and only 2.75% individuals were referred to other hospitals. The next set includes 70 children aged between 61 and 120 months (5 -10 years). Out of these, 62.85% individuals were alive, 34.3% individuals were deceased, and just 2.85% individuals were referred. The last group involves 53 people aged 121 to 204 months (10-17-year-old). Within this category, 66% individuals were alive, 28.3% individuals were deceased, and only 5.66% individuals were shifted to other health institutions. Though, the distributions are not statistically significant (*P-value*>0.05).

Having assessed the mortality rate in our PICU, it seems that the death rate is potentially high, as one quarter of the total cases unfortunately die (Figur:1B). It is also found that this trend is highest among children aged between 5 to 10 years, in particular children at the age of 3 years (median age = 37.17 months). Furthermore, we have also raised the question about whether the mortality rates differ in regard to sex, in general, the death rate among males is found to be higher than females at 65% versus 35%, respectively (Figure :1C). To be more specific (as it is demonstrated in the Figur:1D), the mortality rate is found to be more in males than females among different age sets we studied until the age of 10 years. Then after, it seems that the risk of fatality is fairly equal in both sexes.

Collectively, the evidence we have collected show that, among children admitted to PICU, males appear to have a higher risk of PICU mortality than females in particularly at age between 5-10 years.

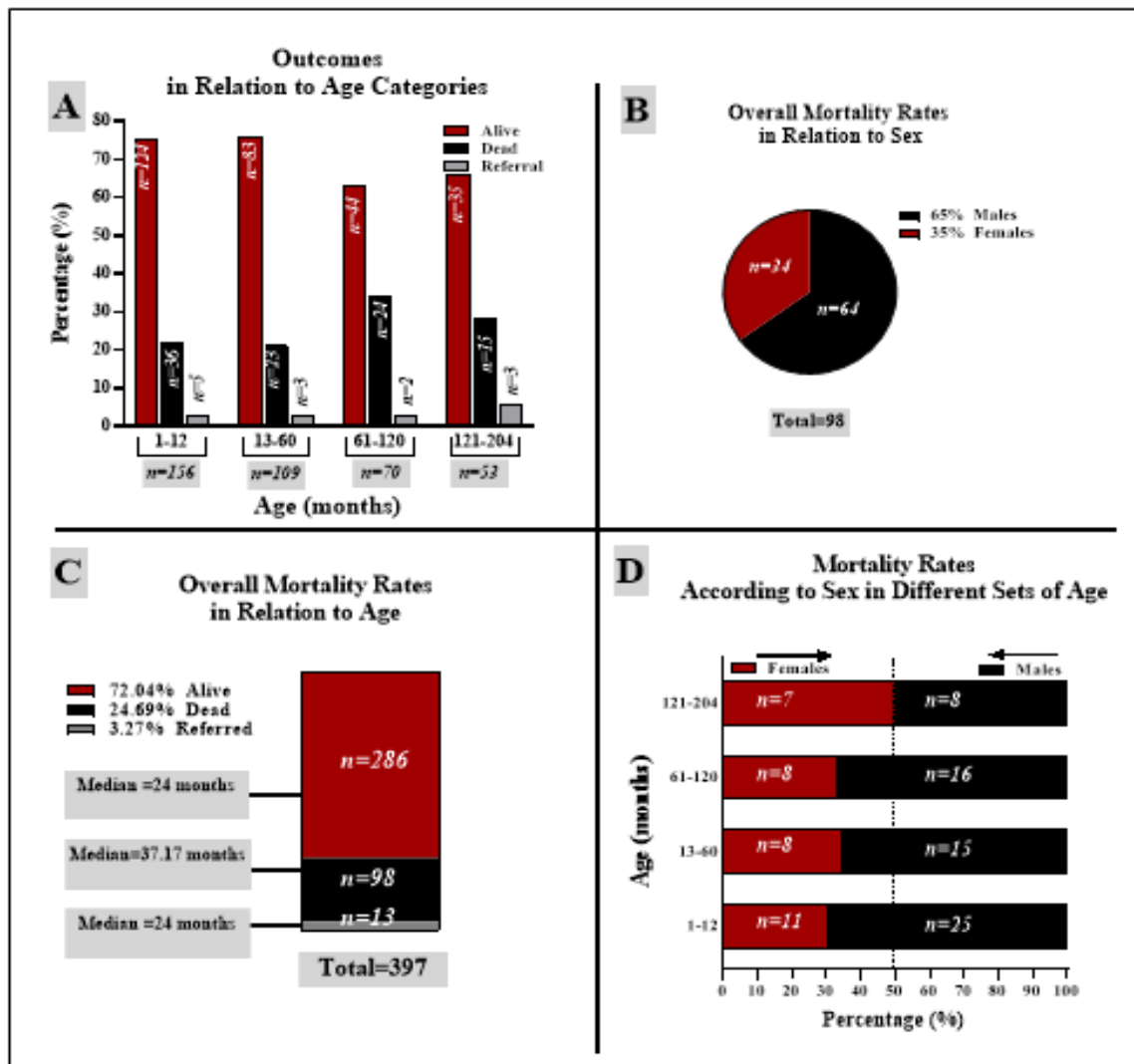


Figure 1: The outcome of admitted cases to the ICU according to age and sex.

Within different age groups studied, it is evident that the majority of cases admitted to the ICU were discharged alive. Death among different age groups occupied notable percentages, and a few cases were referred, as it is shown in the bar graph (Figure:1A). More precisely, 72% of cases were alive, 24.69% Dead and 3.27% were referred, as it is demonstrated in the pie chart (Figure: 1B). Regarding mortality in relation to sex, death was more among males than females, 65% versus 35%, as it is illustrated in the part of whole graphs (Figure: 1C & 1D). P-value for Chi squared test = 0.3541

3.5 Hospital stay in relation to age groups

The majority of cases in this study shows the pattern of short stay durations. Nearly 82% of cases stayed less than one week across the total stay durations. The remaining percentage involves children who stayed between 8-30 days. No longer stay durations of more than one month is seen in this study. The observed variations do not reach statistical significance (P-value>0.05) (Table4).

Table 4: Hospital stay in relation to age groups

Age (months)	Stay		Total (%)
	1-7 days (%)	8-30 days (%)	
1-12	131 (40.2%)	34 (48.6%)	165 (41.6%)
13-60	93 (28.5%)	16 (22.9%)	109 (27.5%)
61-120	55 (16.9%)	15 (21.4%)	70 (17.6%)
121-204	48 (14.7%)	5 (7.1%)	53 (13.4%)
Total	327 (100%)	70 (100%)	397 (100%)

P-value for Chi squared test = 0.085

3.6 Causes of death

Respiratory failure and sepsis are the most common causes of death among children admitted to the ICU, each comprises a significant proportion of the cases at 37.8% and 35.7%, respectively. These two conditions represent a substantial portion of the total cases observed. Conditions like MOF (multi organ failure) and ICH (intracerebral hemorrhage) contribute notably, making up 20.4% and 4.1% of the cases, respectively, (see Figure 2).

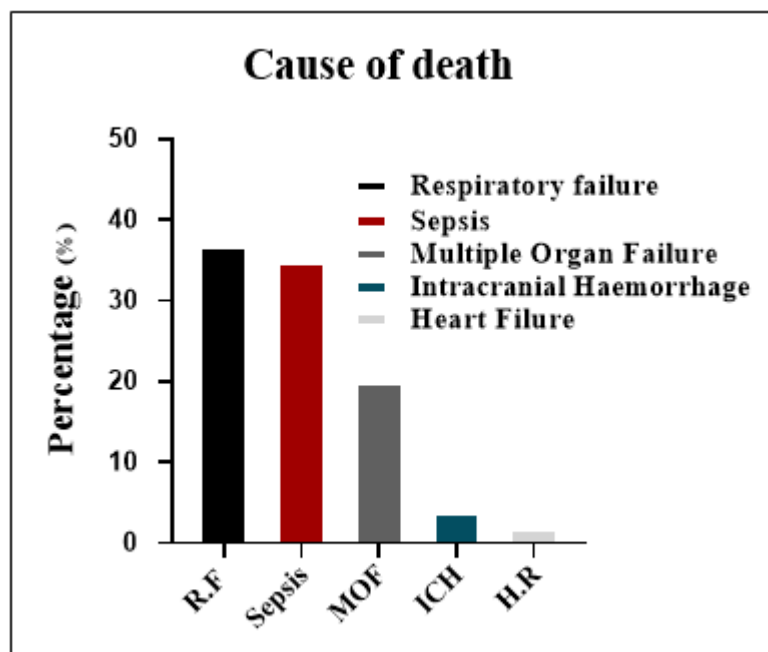


Figure 2: Cause of death among children admitted to the PICU

Respiratory failure and sepsis are the most common reasons of death in the PICU, followed by MOF (multiple organ failure). ICH (intracranial haemorrhage) and heart failure also constitute a notable proportion of death in the PICU. However, conditions such as heart failure was less common cause of death, representing only 2.0% of the cases individually.

3. DISCUSSION

This study is conducted to understand the admission pattern, outcome and the main cause of death among children who were admitted to PICU at Basra Children's Specialty Teaching Hospital.

Our results indicate that the majority of the admitted patients were young infants at 41% of the total patients, findings are consistent with a study conducted by Edea et al. (38.7%)(12) and Rady et al. (43%)(13). This result; however, is higher than a percentage reported by Ayar et al. at 28% (14), and smaller than findings stated by Ankireddy et al.(15)(54%). Infants in our PICU were already suffering from major respiratory issues, mainly pneumonia and other infectious illnesses, and due to the lack of immunizations, decrease breast feeding strategy, poor sanitation and malnutrition may all possible reasons of the high percent of admission noticed in children below one year.

Children aged between 13 and 60 months are also shown to comprise a noticeable percent at 27%, a proportion is almost close to data demonstrated by Ankireddy et al.(15) at 25% and higher than a result mentioned by Rady et al.(13)(44.7%). The overall percentage of admissions of children below 60 months (under 5 years) is nearly 70%. This proportion is close to findings obtained by Begum et al.(2) 71%, but less than data reported by El Halal et al.(16)and Ankireddy et al.(15) at 78.3% and 83%, respectively.

Regarding gender distribution, male admissions into our PICU is 1.5-fold greater than females. This observation is comparable to findings stated by Malhotra et al.(17)and Edea et al.(12) wherein both studies showed a ratio of 1.4. Male admissions are predominance at 60% in comparison to 40% for female admissions, this suggests that males are substantially at a higher risk of having severe illness and subsequent admission into PICU more than females. Similar findings are shown by Kalzén et al.(18), Haque et al.(19)and Rady et al. (13) at 56.9%, 60.9% and 57%, respectively. Though, Demirkiran et al.(20)reveals that both sexes are at equal risk of PICU admission.

It is clear that the medical pediatrics conditions (including oncology cases) constitute the majority of admission in our PICU (79%). This result is in parallel to finding shown by Lanetzki et al.(21) with 75.5%. Edea et al.(12) however, finds a higher proportion with 86%, Volakli et al.(22) reported even a greater percent with 92%. In fact, oncology-related reasons made up the majority of admission in our study with 27.45% of the total cases. This observation is considerably more than results demonstrated by Hao et al.(1), Lanetzki et al.(21), and Ramnarayan et al.(23), who they showed only 9.8%, 8% and 12%, respectively.

On the other hand, the percent of pediatric surgical cases in the current study comprises 20.6%. While Lanetzki et al.(21) also showed a very related percent to our results at 19.4%, Volakli et al.(22)reported a lower percentage at 7.7%.

The most common primary admitting diagnosis was complications due to the respiratory involvement which makes up 25.2% of the total number of cases. This observation is relatively close to a study conducted by Bilan et al.(24)(29.86%), Valavi et al. (11), (31%), and Lanetzki et al. (21)(33%). On the contrary, Hao et al.(1) shows a higher percentage of admissions due to respiratory reasons by 59%, which is much lower to Demirkiran et al.(20). Moreover, Demirkiran et al. (20) reported a higher proportion of CNS involvement at 16% in comparison to ours at approximately 9%.

Cardiovascular involvement from the same reference also stated a higher proportion (9%) than ours at 4.4%. We found 18.2% of patients admitted into PICU was due to GIT-related complications. This result is inferior to what was stated by Hao et al.(1) who reported 1% and 4.3% by Demirkiran et al.(20).

Large a proportion (82%) of children admitted into our ICU stayed on an average of 7 days, Edea et al.(12)and Haque et al.(19)in two separated studies found lower percentages than what we found at 62%, and 54.9%, respectively.

Similar to findings by Ayar et al.(14), the second predominant cause of death after respiratory failure was sepsis, which was occur mainly in patients suffering from malignancy. It has been found that nearly 50% of these individuals unfortunately died at a similar proportion reported by Dursun et al.(25)(55.5%). Higher malignancy mortality rates among oncology patients in the PICU might be attributed to these cases being admitted at terminal stages or in a complicated condition. It is preferable for these patients to be admitted to the PICU, firstly to provide a close monitoring, and secondly to avoid upsetting other children because of anxiety and fear of death for both nearby children and their families.

Generally, the death rate is found to be high in our pediatric intensive care unit, which was approximately one quarter of admitted cases (25%). This rate is near to 21% and 20.3% reported by Edea et al.(12)and Haque et al.(19), respectively. But it is shown to be greater than the 18% over 6 years reported by Ayar et al.(14) and Marwah et al.(26)(18%). Regarding sex related death, in opposition to El Halal et al.(16), our results indicate that male patients die at a higher rate than female patients.

In conclusion, this study showed that the most common causes of admissions and death are respiratory failure and sepsis, mainly among cancer patients. We have also found that the mortality rate is notably high in our PICU as it involves around one quarter of the total admissions. Most importantly, we have revealed that male

children aged at around 3 years old admitted to our PICU may regarded as risk factor of death, however; further studies are needed to confirm this assumption. Finally, we have also demonstrated that short hospital stays are the most common kind of stays in our PICU.

We have many limitations in this study, it is a retrospective study with small sample size done in only one year, data were collected manually from patients' record files (unfortunately not computerized data), and so we excepting some missing information.

4. RECOMMENDATIONS

Through collaboration between oncologists and intensivists, earlier diagnosis and recognition of severely affected cancer patients (particularly in males under the age of five who may necessitate rushing to the PICU) could be better achieved and maybe enhance the survival of these children. We also suggest that mortality due to sepsis could be reduced in PICU by implementing strict hygiene measures for both patients and medical staffs. Furthermore, patients with compromised respiratory effort may benefit from assisted ventilation, which could prevent such exhausted instances from dying. Finally, the load on the PICU may be reduced by the developing an exclusive ward for terminally ill oncology patients (palliative care).

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REFERENCES

1. HS N. Mortality Pattern at Pediatric Intensive Care Unit Of Hue Central Hospital, Vietnam. *Biomed J Sci Tech Res.* 2018;11(5):8750–3.
2. V S, Begum A, Suresh Kumar C. " Analysis of Mortality in PICU of A Tertiary Care Teaching Hospital, Telangana– An Introspection " *IOSR J Dent Med Sci [Internet].* 2016;15(5):2279–861. Available from: www.iosrjournals.org
3. Jacobs S, Arnold A, Clyburn PA, Willis BA. The Riyadh Intensive Care Program applied to a mortality analysis of a teaching hospital intensive care unit. *Anaesthesia.* 1992;47(9):775–80.
4. Odetola FO, Rosenberg AL, Davis MM, Clark SJ, Dechert RE, Shanley TP. Do outcomes vary according to the source of admission to the pediatric intensive care unit? *Pediatr Crit Care Med.* 2008;9(1):20–5.
5. Chen YC, Lin SF, Liu CJ, Jiang DDS, Yang PC, Chang SC. Risk factors for ICU mortality in critically ill patients. *Journal-Formosan Med Assoc.* 2001;100(10):656–61.
6. Fowler RA, Adhikari NKJ, Bhagwanjee S. Clinical review: critical care in the global context–disparities in burden of illness, access, and economics. *Crit Care.* 2008;12(5):1–6.
7. Dünser MW, Baelani I, Ganbold L. A review and analysis of intensive care medicine in the least developed countries. *Crit Care Med.* 2006;34(4):1234–42.
8. Dalton HJ, Slonim AD, Pollack MM. Multicenter outcome of pediatric oncology patients requiring intensive care. *Pediatr Hematol Oncol.* 2003;20(8):643–9.
9. Tamburro RF, Barfield RC, Shaffer ML, Rajasekaran S, Woodard P, Morrison RR, et al. Changes in outcomes (1996–2004) for pediatric oncology and hematopoietic stem cell transplant patients requiring invasive mechanical ventilation. *Pediatr Crit Care Med.* 2008;9(3):270–7.
10. Bhosale SJ, Joshi M, Patil VP, Kothekar AT, Myatra SN, Divatia J V, et al. Epidemiology and predictors of hospital outcomes of critically ill pediatric oncology patients: a retrospective study. *Indian J Crit Care Med Peer-reviewed, Off Publ Indian Soc Crit Care Med.* 2021;25(10):1183.
11. Madhooshi S, Valavi E, Jaafari L, Shirvani E, Aminzadeh M. The Main Causes of Mortality in Pediatric Intensive Care Unit in South West of Iran. 2018;
12. Edae G, Tekleab AM, Getachew M, Bacha T. Admission Pattern and Treatment Outcome in Pediatric Intensive Care Unit, Tertiary Hospital, Addis Ababa, Ethiopia. *Ethiop J Health Sci.* 2022;32(3):497–504.
13. Rady HI. Profile of patients admitted to pediatric intensive care unit, Cairo University Hospital: 1-year study.

Ain Shams J Anesthesiol. 2014;7(4).

14. Ayar G, Yazici MU, Sahin S, Gunduz RC, Yakut HI, Akman AO, et al. Six year mortality profile of a Pediatric Intensive Care Unit: Association between out-of-hours and mortality. *Arch Argent Pediatr*. 2019;117(2):120–5.
15. Ankireddy K. A study on clinical profile and outcome of patients in PICU (paediatric intensive care unit) at tertiary care unit. 2019;
16. El Halal MG dos S, Barbieri E, Mombelli Filho R, de Andrade Trotta E, Carvalho PRA. Admission source and mortality in a pediatric intensive care unit. *Indian J Crit Care Med peer-reviewed, Off Publ Indian Soc Crit Care Med*. 2012;16(2):81.
17. Malhotra D, Nour N, El Halik M, Zidan M. Performance and analysis of pediatric index of mortality 3 score in a pediatric ICU in Latifa Hospital, Dubai, UAE. *Dubai Med J*. 2020;3(1):19–25.
18. Kalzén H, Larsson B, Eksborg S, Lindberg L, Edberg KE, Frostell C. Survival after PICU admission: The impact of multiple admissions and complex chronic conditions. *PLoS One*. 2018;13(4):e0193294.
19. Haque A, Jafri SK, Hoda M, Bano S, Mian A. Clinical profiles and outcomes of children admitted to the pediatric intensive care unit from the emergency department. *JCPSP J Coll Physicians Surg Pakistan*. 2015;25(4):301.
20. Demirkiran H, Kilic M, Tomak Y, Dalkiran T, Yurttutan S, Basaranoglu M, et al. Evaluation of the incidence, characteristics, and outcomes of pediatric chronic critical illness. *PLoS One* [Internet]. 2021;16(5 May 2021):1–13. Available from: <http://dx.doi.org/10.1371/journal.pone.0248883>
21. Lanetzki CS, Oliveira CAC de, Bass LM, Abramovici S, Troster EJ. The epidemiological profile of pediatric intensive care center at hospital israelita albert einstein. *Einstein (São Paulo)*. 2012;10:16–21.
22. Volakli E, Sdougka M, Tamiolaki M, Tsonidis C, Reizoglou M, Giala M. Demographic profile and outcome analysis of pediatric intensive care patients. *Hippokratia*. 2011;15(4):316.
23. Ramnarayan P, Craig F, Petros A, Pierce C. Characteristics of deaths occurring in hospitalised children: changing trends. *J Med Ethics*. 2007;33(5):255–60.
24. Bilan N, Galehgoiab BA, Emadaddin A, Sh S. Risk of mortality in pediatric intensive care unit, assessed by PRISM-III. *Pak J Biol Sci*. 2009;12(6):480–5.
25. Dursun O, Hazar V, Karasu GT, Uygun V, Tosun O, Yesilipek A. Prognostic factors in pediatric cancer patients admitted to the pediatric intensive care unit. *J Pediatr Hematol Oncol*. 2009;31(7):481–4.
26. Marwah H, Arora R. Factors related to ICU admissions of childhood cancer patients in tertiary preferred hospital in the private sector of India. In: *GW Research Days 2016 - 2020*. 2019