



# Clinical and Demographic Evaluation of Patients Admitted to the Pediatric Intensive Care Unit

## Çocuk Yoğun Bakım Ünitesine Yatan Hastaların Klinik ve Demografik Değerlendirilmesi

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### Abstract

**Purpose:** This study aimed to evaluate the patients who received health services in the pediatric intensive care unit (PICU) of Ankara City Hospital's Pediatrics Department in a 2-year period and the outcomes of these cases by examining their clinical and demographic characteristics.

**Material and Method:** This retrospective study was carried out in the 32-bed tertiary PICU of xxxxxx Hospital. The records of 2280 patients between the ages of 1 month and 18 years who were hospitalized in the PICU between September 1, 2019, and September 1, 2021, were retrospectively analyzed. Age, sex, presence of chronic disease, reason for hospitalization in the intensive care unit, length of stay, status and duration of respiratory support, and mortality rates were evaluated.

**Results:** The mean age of the patients was  $5.16 \pm 5.12$  years and the mean PICU stay was  $12.47 \pm 20.16$  days. Bronchiolitis, sepsis, pneumonia, trauma, congenital heart disease, status epilepticus, hematological diseases, oncological diseases, diabetic ketoacidosis, and metabolic diseases were found to be the most common reasons for hospitalization in the PICU. The most frequent underlying diseases were neurological, respiratory, hematological, cardiological, endocrinological, nephrological, gastrointestinal system, oncological, and metabolic diseases. The mortality rate of these patients was 10.8%. Underlying oncological or hematological diseases and immunodeficiency, higher susceptibility to infection, longer hospital stay, and longer duration of mechanical ventilation were found to be statistically significantly higher in deceased patients compared to survivors.

**Conclusion:** The profile of patients admitted to PICUs is expanding day by day. A significant decrease in mortality was observed in all patient groups as a multidisciplinary approach was implemented. It was also observed that most of the patients had an underlying chronic disease and this condition was associated with mortality.

**Keywords:** Pediatric Intensive Care Unit, Mortality, Respiratory Support Devices

### Öz

**Amaç:** Bu çalışmada Ankara Şehir Hastanesi Çocuk Sağlığı ve Hastalıkları Anabilim Dalı, Çocuk Yoğun Bakım Ünitesi'ne (ÇYBÜ)'ne 2 yıl içinde yatan hastaların klinik ve demografik özellikleri incelenerek hangi hastalara hizmet verildiğinin ve sonuçlarının değerlendirilmesi amaçlanmıştır.

**Gereç ve Yöntem:** Bu retrospektif çalışma xxxxxx Hastanesi 32 yataklı 3. basamak çocuk yoğun bakım ünitesinde yapıldı. Merkezimiz ÇYBÜ'ne 01.09.2019-01.09.2021 tarihleri arasında yatırılmış olan 1 ay ile 18 yaş arası 2280 hastanın dosya kayıtları retrospektif olarak incelendi. Yaş, cinsiyet, kronik hastalık varlığı, yoğun bakım ünitesine yatırılma nedeni, yatış süresi, solunum destek cihazına bağlanma durumu ve süresi, mortalite oranları değerlendirildi.

**Bulgular:** Olguların ortalama yaşları  $5,16 \pm 5,12$  yıl ve ortalama yoğun bakım yatış süreleri  $12,47 \pm 20,16$  gündü. ÇYBÜ'ne bronşiolit, sepsis, pnomoni, travma, konjenital kalp hastalığı, status epileptikus, hematolojik hastalıklar, onkolojik hastalıklar, diabetik ketoasidoz, metabolik hastalıklar en sık yatış nedeni olarak bulundu. En fazla alta yatan hastalıklar norolojik, solunumsal, hematolojik, kardiyolojik, endokrinolojik, nefrolojik, gastrointestinal sistem (GIS) hastalıkları, onkolojik hastalıklar, Mmetabolik hastalıklar gözlemlendi. Hastaların %10.8'u kaybedildi. Ölen hastalarda alta yatan onkolojik, hematolojik hastalıklar ve immün yetmezliği olan hastalarda enfeksiyona duyarlılıklarının fazla olması, yatış süresinin ve mekanik ventilatörde kalış süresinin uzun olması sağ kalanlara göre istatistiksel olarak anlamlı derecede fazla bulundu.

**Sonuç:** Çocuk yoğun bakıma kabul edilen hasta profili her geçen gün artmaktadır. Bütün hasta gruplarında multidisipliner olarak yaklaşıtkça mortalitede önemli oranda azalma görülmüştür. Hastaların bir çoğunda alta yatan kronik bir hastalık olduğu ve bu durumun mortalite ile ilişkili olduğu gözlemlendi.

**Anahtar Kelimeler:** Çocuk yoğun bakım ünitesi, Mortalite, Solunum destek Cihazları



## INTRODUCTION

Although pediatric intensive care units (PICUs) represent a new subbranch of medical treatment, they have developed rapidly and their importance is increasing day by day. Today, patient mortality rates are decreasing rapidly thanks to the treatment of critically ill patients in PICUs. Especially with extracorporeal membrane oxygenation (ECMO), there has been a noticeable decrease in mortality rates. The vital signs of patients in intensive care units are monitored more closely, the patients are supported as necessary, and multidisciplinary treatment approaches are applied.

The first PICU was established in Sweden in 1955, which was followed by the establishment of PICUs in important centers in Europe, Australia, and North America in the 1960s (1). While the number of general pediatric service beds in hospitals in the United States decreased by 40% between 1980 and 2000, the number of pediatric intensive care beds increased by 70% (2). About half of the units in Turkey were opened between 2000 and 2004 (3). This study was designed to evaluate the diagnosis, treatment, and mortality outcomes of patients admitted to a PICU by examining the retrospective clinical and demographic characteristics of the patients hospitalized in our center over the course of 2 years.

## MATERIALS AND METHODS

This retrospective study was carried out in the 32-bed tertiary PICU of xxxxxxxxxxxx Hospital. The demographic characteristics of children aged 1 month to 18 years who were hospitalized in the PICU between September 1, 2019, and September 1, 2021, were evaluated. For this purpose, records of 2280 patients hospitalized within these 2 years were retrospectively analyzed. Age, sex, presence of chronic disease, reason for hospitalization in the intensive care unit, length of stay, status and duration of respiratory support, and mortality rates were evaluated.

This study was authorized by the Ministry of Health (Ethics Committee E2-22-1245) and local ethics committee approval was received on January 5, 2022 (Ethics Committee No: 1245).

Information obtained from the data was analyzed using the SPSS 17.0 software program. Categorical data were expressed as percentages. Medians and interquartile ranges were used for quantitative data. Differences between categorical variables were evaluated with chi-square tests and differences between continuous variables were evaluated with non-parametric tests (Mann-Whitney U). Values of  $p < 0.05$  were considered to be statistically significant.

## RESULTS

Over the course of 2 years, 2280 patients were hospitalized in the PICU. While 60% of the patients were hospitalized directly in the PICU, 20% of them were transferred to the PICU with a sudden worsening of their general condition while they

were hospitalized in the pediatric ward. The rate of patients admitted to the PICU for postoperative patient care was 20% and 20% of the patients admitted to the PICU had been referred by ambulance. While 2% came to the hospital by air ambulance, 18% came by land ambulance. Fifteen percent of the patients admitted to the PICU were the children of immigrants. While 52% of the patients were male, 48% were female. Furthermore, 22% of the patients were between 1 month and 1 year old, 36% were 1 year to 5 years old, 10% were 6 years to 10 years old, and 32% were 11 years to 18 years old. The demographic data of the patients hospitalized in the PICU are given in Table 1.

**Table 1.** Demographic data of patients hospitalized in the pediatric intensive care unit (PICU)

Demographic data, n=2280	n (%) or mean±SD	p
Age (years) of all patients	5.16±5.12	
Average age of patients discharged from PICU	9.23±8.15	0.160
Average age of patients who died in PICU	3.45±7.60	
Sex		
Male	1186 (52%)	0.630
Female	1094 (48%)	
Hospitalization rates by age		
1 month to 1 year	502 (22%)	
1 year to 5 years	820 (36%)	
6 years to 10 years	228 (10%)	
11 years to 18 years	730 (32%)	
Mean length of stay of all patients	12.47±20.16	
Total length of stay of patients discharged from PICU	7.6±12.16	0.001
Total length of stay of patients who died in PICU	23±15.82	
Duration of mechanical ventilation for all patients	9±15.04	
Duration of mechanical ventilation for patients discharged from PICU	3±4.13	0.001
Duration of mechanical ventilation for patients who died in PICU	17.25±24.82	
High-flow nasal cannula	752 (33%)	
NIV/CPAP/BiPAP	798 (35%)	
Tracheostomy	116 (5.1%)	
Use of inotropes	807 (35.4%)	
Extracorporeal membrane oxygenation	13 (0.6%)	
Bed occupancy rate	2166 (95%)	
Mortality rate	246 (10.8%)	
Sequelae rate	109 (4.8%)	
Immigrant children	250 (11%)	
Use of central venous catheter	729 (32%)	

NIV/CPAP/BiPAP: Non-invasive positive airway pressure/continuous positive airway pressure/bi-level continuous positive airway pressure

The mean age of the patients was 5.16±5.12 years (range: 1 month to 18 years). The mean length of stay of all patients admitted to the PICU was found to be 12.47±20.16 days (range: 1-280). Bed occupancy rate was 95% for these 2 years in the unit. The main reasons for hospitalization in the PICU were as follows: infections, 28% (12% bronchiolitis, 10% sepsis, 4% pneumonia, 2% other causes of infection); trauma, 14%; congenital heart disease, 12%; status epilepticus, 12%;

hematological diseases, 10%; oncological diseases, 7%; diabetic ketoacidosis, 3%; and metabolic diseases, 2%. The most common reasons for hospitalization are given in Table 2. The rate of underlying disease of all patients hospitalized in the PICU was 66%. The most common underlying diseases were neurological diseases at 17%, respiratory diseases at 14%, hematological diseases at 13%, cardiological diseases at 11%, endocrinological diseases at 8%, nephrological diseases at 8%, gastrointestinal system (GIS) diseases at 7%, oncological diseases such as solid organ cancers at 7%, and metabolic diseases at 5% (**Table 2**). Nearly one-fourth (24%) of the patients were treated with mechanical ventilation during their hospitalization. The mean duration of mechanical ventilation was  $9 \pm 15.04$  days (range: 1-280) for all patients hospitalized in the PICU. While 87% of the patients were subsequently transferred to pediatric clinics, 2.2% were referred to other centers, 10.8% of the patients died, and 4.8% recovered with sequelae.

**Table 2.** Diagnoses of patients admitted to the pediatric intensive care unit (PICU)

	n	%
Diagnoses of admitted patients, n=2280		
Infections	638	28
Bronchiolitis	272	12
Sepsis	228	10
Pneumonia	92	4
Other infection causes	46	2
Trauma	319	14
Congenital heart disease	273	12
Seizures	273	12
Hematological diseases	228	10
Oncological diseases	160	7
Diabetic ketoacidosis	68	3
Metabolic diseases	46	2
Intoxication	46	2
Gastrointestinal system (GIS) diseases	46	2
Kidney diseases	46	2
Other*	137	6
Total	2280	100
Underlying diseases, n=1485 (66% of total patients)		
Neurological	253	17
Respiratory	207	14
Hematological	194	13
Cardiological	163	11
Endocrinological	119	8
Nephrological	119	8
GIS diseases	104	7
Oncological diseases such as solid organ cancers	104	7
Metabolic diseases	74	5
Other**	148	10
Total	1485	100

\*: Hypertension, bronchial asthma attack, urticaria, primary immunodeficiency, endocrinological emergencies, choking, \*\*: Infectious diseases, immunological diseases, hereditary diseases

The mean age of the patients transferred from the PICU to pediatric clinics or discharged from the PICU was  $9.23 \pm 8.15$  years (range: 1 month to 18 years), and 8% of the patients

who left the PICU had been treated by mechanical ventilation during their hospitalization in the PICU. The total length of hospital stay was calculated as  $7.6 \pm 12.16$  days (median: 1-280). When only patients who were discharged from the PICU were considered, the duration of mechanical ventilation was  $3 \pm 4.13$  days (range: 1-55 days) (Table 1).

The mean age of the patients who died in the PICU was found to be  $3.45 \pm 7.60$  years (range: 1 month to 18 years). Their total hospitalization duration was calculated as  $23 \pm 15.82$  days (range: 1-280). It was determined that 100% of the deceased patients had been treated by mechanical ventilation (Table 1). The duration of mechanical ventilation among deceased patients was  $17.25 \pm 24.82$  days (median: 1-280). In the PICU, approximately 41% of the patients were found to have died due to underlying leukemia, lymphoma, or solid organ cancers, while 22% died due to heart diseases.

Length of hospital stay and duration of mechanical ventilation among deceased patients were statistically significantly longer compared to those of surviving patients ( $p < 0.05$ ). The rate of mortality in cases of hemato-oncological diseases was also statistically significant ( $p < 0.05$ ).

One-third (33%) of the patients were treated by high-flow nasal cannula (HFNC) and 35% received non-invasive positive airway pressure (NIV) treatment. Furthermore, 5.1% of the patients who were intubated for an extended period had tracheostomy. Single or multiple inotropic therapy was administered to 35.4% of the patients hospitalized in the PICU. Eleven patients underwent ECMO (4.8%) (Table 1).

## DISCUSSION

In recent years, PICUs have developed rapidly in Turkey as well as in the world. This has resulted in a significant reduction in mortality with swift and appropriate interventions for many children. The variety of patients admitted to PICUs has increased with each passing day. Mortality has also significantly decreased thanks to the use of extracorporeal therapies in PICUs. This study was conducted to examine the clinical and demographic characteristics of patients hospitalized in a PICU over the course of 2 years and the respiratory support treatments that they received.

In developed countries, PICU beds constitute 10% of the total hospital beds (4). The total number of beds in Ankara City Hospital is 3633. The number of beds in the children's hospital is 555. The ratio of the number of beds in the PICU to the total number of beds is 6% (32/555). When other studies conducted in Turkey are examined, it is seen that the length of stay in PICUs varies between 2 and 5.3 days (5,6). In various studies conducted outside of Turkey, it was reported that the length of stay in the PICU varied between 4.5 and 8.1 days (7). In the present study, the duration of hospitalization was  $12.47 \pm 20.16$  days for all patients hospitalized in the PICU. The reason why hospital stay was longer in the present study compared to others is that Ankara City Hospital is a referral hospital, and patients with high mortality risk have to be hospitalized without indication, similarly to patients in the

terminal stage. It was thought that this situation was also due to the presence of all branches of medicine in Ankara City Hospital, the follow-up of many chronically ill patients in the relevant departments, the need for intensive care during the treatment of patients with underlying chronic diseases, and the fact that since this is a referral hospital, patients requiring long-term intensive care treatment are admitted to the PICU.

The reasons for and rates of hospitalization of patients in PICUs vary in different studies. In the studies conducted by Arias et al. and Khilnani et al., it was suggested that the most important reasons for hospitalization in PICUs were related to respiratory system disorders, while some studies showed that congenital heart disease was the leading cause of hospitalization (8,9). In the present study, respiratory system diseases ranked first among the reasons for hospitalization.

Different mortality rates were stated in various studies conducted in PICUs. Mortality in PICUs generally varies between 3% and 7% worldwide (10,11). In the present study, the mortality rate in the PICU was 10.8%, and 14% of the patients who died did so within the first 48 hours. In a developing country like Turkey, the fact that the mortality rate in the PICU is over 10% is considered an indicator of the fact that intensive care is applied for patients with no prognosis or indications (12). In a study by Tutanç et al., it was reported that there was a negative correlation between age and length of stay in the PICU, that treatment by mechanical ventilation statistically significantly prolonged the length of stay, and that treatment by mechanical ventilation also increased the probability of mortality by 30% (13). In the present study, the increase in length of stay due to mechanical ventilation is seen to be a reason for the high mortality rate. In univariate analyses, similar to the findings in the literature, longer duration of mechanical ventilation and longer hospitalization duration of deceased patients were found to be statistically significant ( $p=0.001$ ).

Since this hospital is both a referral and pandemic hospital, it serves all of Turkey and also neighboring countries. Therefore, the mortality rate is higher than that in the referring hospitals due to admission of patients with poor general condition and critical diseases. In this evaluation, it was observed that very different patient groups were treated in the PICU, most of the patients had an underlying chronic disease, and the duration of mechanical ventilation was related to mortality. Long-term complications develop as the hospital stay is prolonged. There are studies showing that the use of inotropic or vasoactive drugs also increases the risk of mortality. The use of these drugs is generally associated with disease severity and mortality (14,15). In the present study, the rate of inotrope use was 35% among all patients. Use of central venous catheters (CVCs) and mechanical ventilation are associated with high mortality and complication rates (16,17). In the present study, the rate of patients with CVCs was 32%, and 24% of the total patients were intubated and treated with mechanical ventilation. In Ankara City Hospital,

the use of NIV or HFNC is preferred to the use of mechanical ventilators as much as possible. The NIV application rate was 35% and the HFNC application rate was 33% in the present study. Two previous studies showed that the use of NIV significantly reduced mortality (18,19).

## CONCLUSION

In the present study, it was seen that the main factors affecting mortality and longer hospitalization in the PICU were mechanical ventilation and the presence of chronic diseases. The fact that children with surgical problems are not followed in PICUs and that terminal patients with no prognosis are transferred to intensive care show that the indications for admission to PICUs should be reconsidered. Necessary studies should be carried out in order to develop treatment services in PICUs and make plans in this regard.

## ETHICAL DECLARATIONS

**Ethics Committee Approval:** This study was authorized by the Ministry of Health (Ethics Committee E2-22-1245) and local ethics committee approval was received on January 5, 2022 (Ethics Committee No: 1245).

**Informed Consent:** Because the study was designed retrospectively, no written informed consent form was obtained from patients.

**Referee Evaluation Process:** Externally peer-reviewed.

**Conflict of Interest Statement:** The authors have no conflicts of interest to declare.

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