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# Clinical Profiles and Outcomes of Children Admitted to the Pediatric Intensive Care Unit from the Emergency Department

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## ABSTRACT

The aim of this study was to describe clinical profiles and outcomes of children admitted directly from the Emergency Room (ER) to the Pediatric Intensive Care Unit (PICU) of academic hospital. The medical records of all children (1 month to 16 years) admitted in PICU from ER, from January 2011 to December 2012 were reviewed. Of the 26,774 patients seen in the ER during the study period, 468 (1.7%) were admitted to the PICU which constituted about 41.5% (468/1127) of all the total PICU admissions. Sixty three percent (n=294) were under-five; males were 60.9% (285), 82.3% (385) were in medical category. Neurological and respiratory illnesses were the most common groups (> 50% of all ER admissions). Multi-organ dysfunction syndrome and co-morbidity were present in 25.2% (n=118) and 23.5% (n=110) respectively. The mean length of stay was  $5 \pm 3.7$  hours. The case-fatality rate was 20.3% (n=95) as compared to the overall PICU mortality rate of 11.9% (n=135).

**Key Words:** Pediatric intensive care unit (PICU). Emergency room (ER). Children. Outcome.

Pediatric emergency medicine and pediatric critical care medicine are well-established and mature disciplines in developed countries. As such they have shown positive impacts on clinical outcomes, having a pivotal role in the care of acutely ill or injured children. Both disciplines are involved in caring for similar diseases, such as respiratory failure, shock, acute neurological emergencies, trauma, poisoning, and so on. Early involvement of the pediatric intensive care team in the emergency department and coordination of teams along with multiple subspecialties leads to better clinical outcomes.<sup>1</sup> In the last two decades, there has been an increase in the number of critically ill patients visiting the emergency room, changing the landscape of healthcare delivery in the modern era.<sup>2</sup> A few reports have described various sources of admission in pediatric intensive care units.<sup>3,4</sup> The objective of this study was to determine the frequency, clinical profile and outcome of critically ill or injured children presenting to the pediatric emergency room (ER) and then requiring admission to the pediatric intensive care unit (PICU).

This was a cross-sectional, observational cohort study of all critically ill or injured children presenting to the pediatric ER and then admitted to the PICU of the Aga Khan University Hospital (AKUH) from January 2011 to December 2012. Whenever a critically ill or injured child presented to the ER, initial evaluation and management

was initiated by the ER team and then the PICU team was immediately consulted for smooth transition and continuity of care. After stabilization, the patients were moved to the PICU directly or after surgical intervention, if required, in the operation theater. If there was no bed available in the PICU, transfer to another facility via an ambulance would be arranged by ER. The demographic data (age, gender), clinical variables (admitting diagnosis, PRISM III Score, co-morbidity, length of ER stay, ICU therapies like mechanical ventilation, use of inotropes, renal supportive care, length of stay and outcome data (alive/expired) were collected. This study was approved by the Ethical Review Committee of the institution (2597-Ped-ERC-13). All data were entered and analyzed into Statistical Package of Social Sciences (SPSS) version 17. Categorical values were expressed as means with standard deviation and continuous variables were expressed as median with inter quartile ranges. Characteristics of patients were compared using chi-square analysis for categorical variables and the t-test for continuous variables. Logistic regression analyses were performed to identify risk factors for mortality in children admitted in PICU from ER.

During the study period, 26,774 cases were seen in ER. Only 468 (1.74%) patients were admitted in PICU which constituted about 41.5% (468/1127) of all PICU admissions. The majority of patients (63%) were under five of age and 60.9% (n=285) were males. The mean PRISM score III was  $6.8 \pm 4.2$ . The mean length of stay in ER before admission in the PICU was  $5 \pm 3.71$  hours. 22% (n=102) of patients waited for more than 6 hours in the ER before arrival to PICU.

Table I described the general characteristics of the cohort. With regard to type of illness, medical category

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was 82.3% (n=385) and surgical illness was 17.7% (n=83). The common medical systemic illness involved the neurological illness 28.0% (n=131), followed by respiratory system 24.4% (n=114), sepsis 13.7% (n=64) and cardiovascular illness 10.9% (n=51). The common surgical illnesses were neurosurgical 48.1% (n=40), trauma-related 21.6% (n=18) and other surgical critical illnesses 30.3% (n=25). The neurosurgical disorders were severe traumatic brain injury, intracranial bleed and acute hydrocephalus requiring neurosurgical interventions. Twenty-four percent (n=110) had comorbidities, which were neurological 31.8% (n=35), hematologic/oncological disorders 17.3% (n=19) and cardiovascular disorders. Most patients 64.1% (n=300) required invasive mechanical ventilation for respiratory support, 34.8% (n=163) needed continuous infusion of inotropes and vasoactive agents for hemodynamic support and 6.6% (n=31) received renal supportive care. The combined use of cardiorespiratory support was in 29.5% (n=138). Only 30.6% (n=143) required ICU care for close monitoring. The multiorgan dysfunction syndrome was present in 25.2% (n=118) on admission. The case-fatality rate was 20.3% (n=95). For the same study period, the overall mortality in the PICU was 12% (n=135/1127). Multivariate stepwise logistic regression analysis revealed that high PRISM-III score and presence of multiorgan dysfunctions were predictors of mortality in children admitted in PICU from ER. Age, ER duration, type of primary system involved, and length of stay showed no association with risk of mortality as shown in Table II.

The concepts of both ER and PICU are relatively new and data regarding the status of PICU in various parts of Pakistan are limited.<sup>5</sup> The changing landscape as modern healthcare evolves reveals an increased need of critical care service and units. In a modern healthcare system the PICU is an essential and integral component of children's hospitals and is a reflection of quality of the country's pediatric medical care.<sup>6</sup> The pediatric intensive care services have shown the positive effects on child survival from potentially life threatening illness.<sup>7</sup> A PICU has multiple sources of admission like operating room, ER, wards, or transfers from other hospitals. Admissions in PICU from the ER varied from 20% to 68% in few pediatric reports.<sup>4,8</sup> Forty-one percent of patients were in a closed, multi-disciplinary PICU from ER in this cohort. Most children (62.5%) admitted in our PICU from ER were under-five. Eighty-two percent of patients belonged to the medical category. The major spectrums of medical illnesses were acute neurological illnesses and respiratory illnesses. Odefola *et al.* reported that over 70% of patients admitted in PICU from ER were with medical diagnoses.<sup>4</sup> A local survey showed that most of PICU admissions are due to medical causes.<sup>9</sup>

The mortality rate of children admitted in PICU from ER was 20%. The mortality rate in PICUs of developing

countries varied considerably. There was no association of mortality with young age and prolong ER stay as shown by others.<sup>3,10</sup> The major strength of this study is that it is the first report from developing country like Pakistan despite several limitations.

**Table I:** Characteristics of critically ill patients admitted from emergency department.

Characteristics	(n=468)
Age	
< 1 year	132 (28.2%)
1 - 5 years	161 (34.4%)
6 - 15 years	175 (37.4%)
Gender	
Males	285 (60.9%)
Emergency department time spent (hours) means	5±3.71
< 5.9 hours	360 (76.9%)
≥ 6 hours	102 (21.8%)
PRISM scoring (mean ±SD)	6.8 (± 0.383)
Category	
Medical	385 (82.3%)
Surgical	83 (17.7%)
Primary system involved	
CNS	131 (28.0%)
CVS	51 (10.9%)
Respiratory	114 (24.4%)
Sepsis	64 (13.7%)
Hematology/oncology	29 (6.2%)
Trauma	17 (3.6%)
GIT	21 (4.5%)
Miscellaneous	41 (8.8%)
Comorbidities	110 (23.5%)
MODS	118 (25.2%)
MV	300 (64.1%)
Vasoactive drugs	163 (34.8%)
Renal support	31 (6.6%)
LOS (days) Median (IQR)	7.0 (4-12)
< 7 days	257 (54.9%)
≥ 7 days	211 (45.1%)
Outcome	
Discharged	373 (79.7%)
Expired	95 (20.3%)

CNS = Central Nervous System; CVS = Cardiovascular System; GIT = Gastrointestinal tract; MODS = Multi-organ dysfunction syndrome; MV = Mechanical ventilation; LOS = length of stay

**Table II:** Multi-variate analysis of critically ill patients admitted in emergency department discharged and expired.

Characteristics	p-value	Odd Ratio (CI <95%)
Emergency department time spent > 6 hours	0.394	0.650 (0.242-1.749)
PRISM-III score (>10)	<0.001	1.223 (1.107-1.351)
Underlying system involved		
CNS	0.580	1.306 (0.507-3.369)
CVS	0.728	0.837 (0.307-2.283)
Sepsis	0.386	1.526 (0.586-3.973)
Miscellaneous	0.767	1.062 (0.715-1.577)
MODS	<0.001	0.136 (0.059-0.311)
MV	<0.001	0.089 (0.028-0.287)
Vasoactive drugs	0.003	0.288 (0.126-0.658)
Renal support	0.580	1.357 (0.460-4.004)
LOS (days) mean ±SD	0.164	0.932 (0.845-1.029)
< 7 days	0.209	0.477 (0.150-1.513)

SNS = Central Nervous System; CVS = Cardiovascular System; MODS = Multi-organ dysfunction syndrome; MV = Mechanical ventilation; LOS = Length of stay.

A large number of children were admitted in PICU from ER in this cohort. Most of the patients were under-five, with predominantly medical issues, with a major burden of neurological and respiratory illnesses.

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