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PATTERNS OF REFERRAL TO PICU OF TERTIARY CARE HOSPITAL

Original Research

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Acknowledgement: The authors acknowledge the support of the PICU staff at CMH Kharian for their assistance during data collection.

Conflict of Interest: None
Grant Support & Financial Support: None

ABSTRACT

Background: Pediatric Intensive Care Units (PICUs) play a critical role in managing children with life-threatening illnesses, and timely referral is essential for optimizing outcomes. Variations in referral practices may influence disease severity at admission, resource utilization, and mortality. Understanding local referral patterns is therefore important to identify gaps in care and improve pediatric critical care delivery. This study evaluated referral patterns to the PICU of a tertiary care hospital, focusing on demographic characteristics, referral sources, clinical indications, illness severity, and short-term outcomes.

Objective: To analyze referral patterns to the PICU and identify key clinical and demographic factors associated with PICU admission and outcomes.

Methods: A prospective observational study was conducted over six months at the PICU of CMH Kharian. A total of 256 pediatric patients aged 30 days to 12 years who were referred to the PICU were included. Data on age, sex, referral source, primary diagnosis, Pediatric Risk of Mortality (PRISM) score, and clinical outcomes were extracted from medical records. Descriptive statistics were used to summarize variables, while chi-square tests and logistic regression analyses were applied to identify predictors of PICU admission and severity. Statistical significance was set at $p < 0.05$.

Results: The mean age of patients was 4.5 ± 3.1 years, with males comprising 58% of admissions. The emergency department accounted for 70% of referrals, followed by inter-hospital transfers (20%) and outpatient clinics (10%). Respiratory failure was the leading indication for admission (40%), followed by sepsis (25%) and neurological conditions (15%). The mean PRISM score was 12.4 ± 5.8, and 15% of patients had scores above 20, indicating high mortality risk. Overall outcomes showed that 80% of patients were discharged, 10% were transferred to other units, and 10% died. Respiratory failure, sepsis, severe neurological conditions, and higher PRISM scores were significant predictors of PICU admission severity.

Conclusion: PICU referrals were predominantly driven by acute respiratory, septic, and neurological illnesses, with emergency departments serving as the main referral source. The findings emphasize the importance of early recognition of critical illness, standardized referral practices, and severity-based triage to improve pediatric critical care outcomes.

Keywords: Critical Illness, Mortality, Pediatric Intensive Care Units, Pediatric Patients, Referral Patterns, Respiratory Insufficiency, Sepsis.

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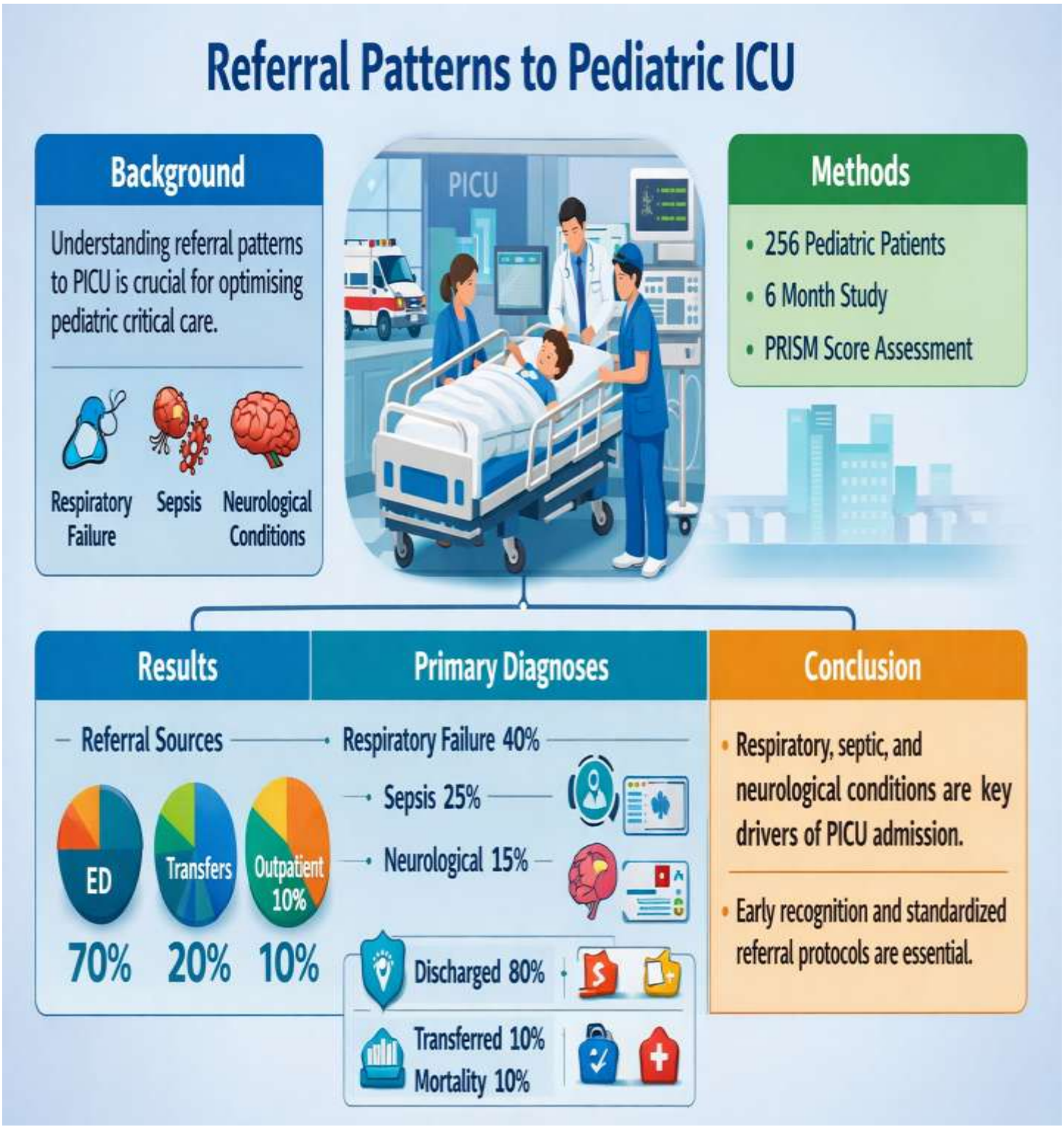

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INTRODUCTION

Pediatric Intensive Care Units (PICUs) represent a cornerstone of tertiary healthcare, delivering advanced, life-saving care to children with severe and complex illnesses. Timely and appropriate referral to a PICU is widely recognized as a critical determinant of clinical outcomes, efficient resource utilization, and overall health system performance (1). Despite their importance, referral pathways to PICUs remain variable and, in many settings, insufficiently structured, creating potential delays or mismatches between patient needs and available critical care services (2). As pediatric morbidity patterns evolve and survival of children with complex conditions improves, the demand for PICU services continues to increase, intensifying pressure on already limited critical care capacity (3,4). Referral decisions to PICUs are inherently complex and are shaped by multiple interrelated factors. Clinical considerations such as illness severity, presence of comorbidities, need for mechanical ventilation or invasive monitoring, and anticipated disease trajectory play a central role in determining referral urgency (5). However, substantial variability in referral practices has been documented across institutions and regions, often reflecting differences in physician training, clinical experience, risk perception, and local protocols (6). Inconsistent decision-making may result in delayed referrals for critically ill children or, conversely, unnecessary admissions that strain PICU resources without clear clinical benefit. Beyond clinical judgment, system-level and contextual factors further influence referral patterns. Geographic distance from tertiary centers, availability of transport services, and disparities in healthcare access can significantly affect whether and when children are referred for intensive care (7).

Additionally, limited awareness among primary care and emergency department physicians regarding the scope and capabilities of PICUs has been shown to contribute to both under-referral and inappropriate admissions (8). These challenges underscore the need for clearer, standardized referral criteria that can support clinicians in making timely and appropriate decisions while promoting equity in access to pediatric critical care (9). Although prior studies have highlighted these issues, there remains a relative paucity of context-specific evidence from tertiary care settings in low- and middle-income regions, where resource constraints and referral inefficiencies may have particularly serious consequences (10). Understanding local referral patterns is essential for identifying gaps in care, optimizing admission pathways, and informing targeted interventions that strengthen pediatric critical care delivery (11). Therefore, the objective of the present study is to analyze referral patterns to the PICU of a tertiary care hospital, identify clinical and systemic factors influencing these referrals, and generate evidence-based insights to improve the appropriateness, timeliness, and effectiveness of PICU utilization.

METHODS

This study was conducted as a prospective observational investigation at the Pediatric Intensive Care Unit (PICU) of Combined Military Hospital (CMH), Kharian, over a six-month period, with the objective of examining referral patterns and identifying clinical and demographic factors influencing admission to pediatric critical care services. All pediatric patients referred to the PICU during the study duration were consecutively enrolled to minimize selection bias and to ensure a representative assessment of real-world referral practices. A total sample of 256 patients was included; the sample size had been estimated using the World Health Organization (WHO) sample size calculator with a 95% confidence interval, taking reported PICU mortality as the reference parameter and an acceptable margin of error (4,5). The study population comprised children aged 30 days to 12 years who were referred to the PICU for any condition necessitating intensive monitoring or advanced life-support interventions. Referrals originating from the emergency department, outpatient services, and inter-hospital transfers were all included to comprehensively capture referral pathways. Patients referred to non-PICU units such as general pediatric wards, as well as cases with incomplete medical records or missing key referral information, were excluded to preserve data completeness and analytical validity. No restrictions were applied based on sex or underlying medical diagnoses. Clinical and administrative data were extracted from the hospital's electronic medical record system using a structured data collection proforma. Variables collected included demographic characteristics such as age, sex, socioeconomic background, and geographic origin; referral source; primary diagnosis or indication for PICU referral, including respiratory failure, sepsis, neurological disorders, trauma, and other critical conditions; and indicators of illness severity, including Pediatric Risk of Mortality (PRISM) scores where these were documented. Patient outcomes were recorded as survival with discharge from PICU, in-PICU mortality, or transfer to another hospital unit for step-down care.

Statistical analysis was performed using standard biomedical analytical approaches. Continuous variables were summarized as mean values with corresponding standard deviations, while categorical variables were presented as frequencies and percentages. Comparative analyses of categorical variables across different referral sources were performed using the chi-square test or Fisher's exact test,

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depending on expected cell counts. Where applicable, logistic regression analysis was planned to explore potential predictors associated with the need for PICU admission and adverse outcomes. A p-value of less than 0.05 was considered statistically significant. Data analysis was carried out using a recognized statistical software package, such as SPSS or Stata. Ethical approval for the study was obtained from the Institutional Review Board (IRB) of CMH Kharian prior to data collection. As the study involved observational analysis of routinely collected clinical data without direct patient intervention, the requirement for informed consent was waived by the ethics committee. Strict confidentiality was maintained throughout the research process, and all patient identifiers were removed prior to analysis to ensure data anonymity and privacy protection.

RESULTS

A total of 256 pediatric patients referred to the Pediatric Intensive Care Unit (PICU) during the study period were analyzed. The age of the patients ranged from 30 days to 12 years, with a mean age of 4.5 ± 3.1 years. Male patients constituted the majority of admissions (58%, n = 148), while females accounted for 42% (n = 108). Children aged between 1 and 5 years represented the largest age group, comprising 50% (n = 128) of all admissions. Infants aged 30 days to 1 year accounted for 30% (n = 77), whereas children aged 6 to 12 years constituted 20% (n = 51) of the study population. The emergency department was the predominant source of PICU referrals, contributing 70% (n = 179) of admissions. Inter-hospital transfers accounted for 20% (n = 51), while outpatient clinics were responsible for 10% (n = 26) of referrals. Respiratory failure emerged as the most frequent primary indication for PICU admission, affecting 40% (n = 102) of patients. Sepsis and septic shock were identified in 25% (n = 64), followed by neurological conditions such as seizures and status epilepticus in 15% (n = 38). Trauma-related referrals, including head injuries and fractures, comprised 10% (n = 25), while cardiovascular conditions accounted for 5% (n = 13). Other causes, including poisoning and metabolic disorders, represented the remaining 5% (n = 14) of admissions. Assessment of illness severity using the Pediatric Risk of Mortality (PRISM) score demonstrated a mean score of 12.4 ± 5.8 across the cohort, reflecting a moderate to severe disease burden. A high-risk PRISM score exceeding 20 was observed in 15% (n = 38) of patients. Age-stratified analysis revealed that infants were most frequently admitted for respiratory failure (45%, n = 35) and sepsis (30%, n = 23). Among children aged 1 to 5 years, respiratory conditions such as acute respiratory distress syndrome and bronchiolitis predominated, accounting for 50% (n = 64) of admissions. In contrast, neurological conditions, particularly status epilepticus, were the leading indication for PICU referral in children aged 6 to 12 years, representing 30% (n = 15) of cases in this age group. Referral patterns varied by source. Emergency department referrals were largely driven by respiratory illnesses (45%, n = 81) and sepsis (30%, n = 54). Inter-hospital transfers more commonly involved neurological conditions (35%, n = 18) and trauma (25%, n = 13), while outpatient referrals showed a higher proportion of neurological disorders (35%, n = 9) and cardiovascular conditions (20%, n = 5). Clinical outcomes indicated that the majority of patients had favorable short-term results. Successful discharge from the PICU was achieved in 80% (n = 205) of cases, while 10% (n = 26) were transferred to other hospital units after stabilization. Overall PICU mortality was 10% (n = 25), with deaths predominantly occurring among patients admitted with severe sepsis and advanced respiratory failure. Logistic regression analysis demonstrated that respiratory failure (OR = 3.8, 95% CI: 2.1–6.9), sepsis (OR = 2.5, 95% CI: 1.4–4.5), and severe neurological conditions (OR = 2.1, 95% CI: 1.1–4.0) were significant predictors of PICU admission. Increasing PRISM score was also associated with a higher likelihood of requiring intensive care, with an odds ratio of 1.2 per unit increase.

Table 1: Demographic Characteristics and Referral Sources of PICU Patients (n = 256)

Variable	Category	Frequency (n)	Percentage (%)
Age group	30 days–1 year	77	30.1
	1–5 years	128	50.0
	6–12 years	51	19.9
Gender	Male	148	57.8
	Female	108	42.2

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Variable	Category	Frequency (n)	Percentage (%)
Referral source	Emergency department	179	69.9
	Inter-hospital transfer	51	19.9
	Outpatient clinic	26	10.2

Table 2: Primary Indications for PICU Admission Stratified by Age Group

Diagnosis / Indication	30 days–1 year (n=77)	1–5 years (n=128)	6–12 years (n=51)	Total n (%)
Respiratory failure	35 (45.5%)	64 (50.0%)	3 (5.9%)	102 (39.8)
Sepsis / septic shock	23 (29.9%)	31 (24.2%)	10 (19.6%)	64 (25.0)
Neurological disorders	8 (10.4%)	15 (11.7%)	15 (29.4%)	38 (14.8)
Trauma	6 (7.8%)	11 (8.6%)	8 (15.7%)	25 (9.8)
Cardiovascular	3 (3.9%)	5 (3.9%)	5 (9.8%)	13 (5.1)
Other conditions	2 (2.6%)	2 (1.6%)	10 (19.6%)	14 (5.5)

Table 3: Severity of Illness and Clinical Outcomes of PICU Admission

Variable	Category	Frequency (n)	Percentage (%)
PRISM score	Mean ± SD	12.4 ± 5.8	—
	≤ 20	218	85.2
	> 20 (high risk)	38	14.8
Outcome	Discharged from PICU	205	80.1
	Transferred after stabilization	26	10.2
	Mortality	25	9.8

Table 4: Multivariable Logistic Regression Analysis for Predictors of PICU Admission Severity

Predictor Variable	Odds Ratio (OR)	95% Confidence Interval	Significance
Respiratory failure	3.8	2.1 – 6.9	Significant
Sepsis / septic shock	2.5	1.4 – 4.5	Significant
Severe neurological condition	2.1	1.1 – 4.0	Significant
PRISM score (per unit increase)	1.2	1.1 – 1.3	Significant

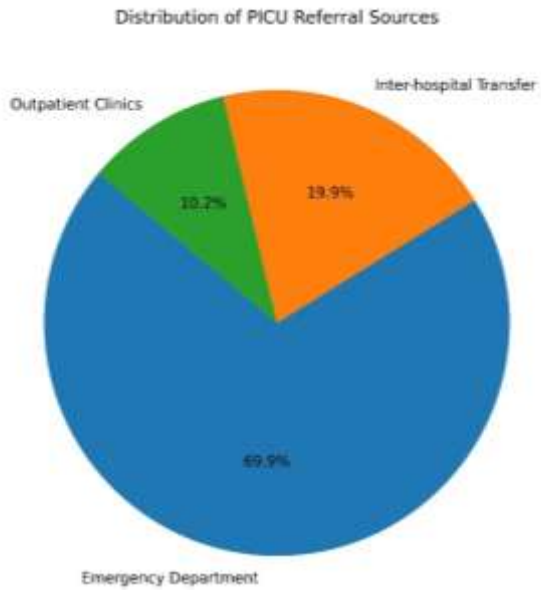

Figure 2 Distribution of PICU Referral Sources

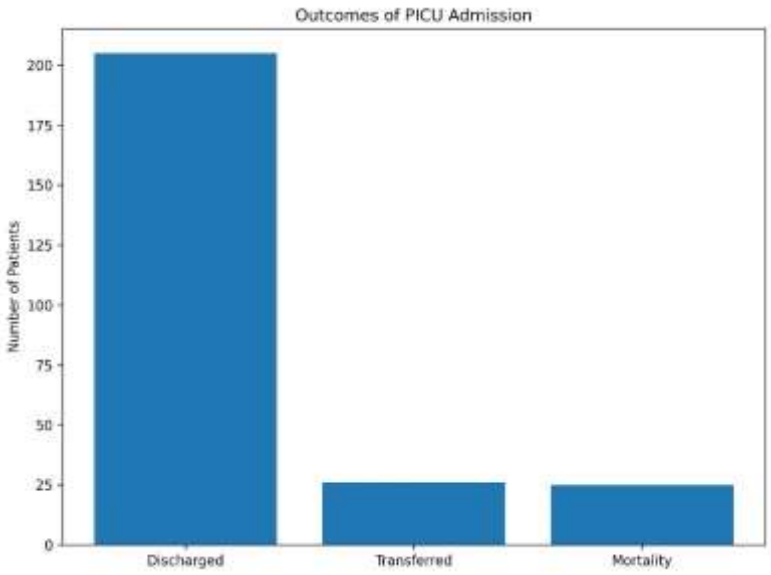

Figure 2 Outcomes of PICU Admission

DISCUSSION

The present study provided a comprehensive overview of referral patterns to the Pediatric Intensive Care Unit (PICU) in a tertiary care hospital and highlighted key clinical and system-level factors influencing pediatric critical care utilization. The findings demonstrated that respiratory failure was the leading indication for PICU referral, followed by sepsis and neurological conditions, reflecting a pattern consistently reported across pediatric critical care literature (12,13). This predominance of respiratory illness underscores the ongoing burden of acute respiratory diseases in children and reinforces the central role of PICUs in providing advanced respiratory support, particularly during periods of increased viral circulation and seasonal surges in pediatric admissions (14). The observed referral trends aligned closely with previous reports indicating that emergency departments serve as the primary gateway to PICU admissions, largely due to the acute nature of presentations such as respiratory distress and septic shock (15). Inter-hospital transfers, although fewer in number, were more frequently associated with neurological conditions and trauma, suggesting that peripheral facilities may lack specialized neurocritical care services and advanced imaging or monitoring capabilities. This pattern highlights the importance of strengthening referral networks and transport systems to ensure timely escalation of care for critically ill children requiring tertiary-level interventions (16). A notable aspect of the findings was the association between illness severity, as reflected by higher Pediatric Risk of Mortality (PRISM) scores, and the need for intensive care admission. This relationship is consistent with prior evidence demonstrating that validated severity scoring systems are useful for risk stratification and outcome prediction in pediatric critical care settings (17). However, delays between initial patient identification and PICU referral, although not quantitatively assessed in this study, emerged as an important contextual concern when interpreting outcomes. Existing literature has consistently shown that delayed transfers to intensive care are associated with increased morbidity and mortality, particularly in time-sensitive conditions such as sepsis and multi-organ dysfunction (18). These findings emphasize the need for early recognition of clinical deterioration and prompt activation of PICU referral pathways.

The variability in referral practices observed in this study also reflected the broader challenge of non-standardized referral criteria. In line with international evidence, the absence of uniform referral protocols can lead to both overutilization and underutilization of PICU services, potentially exposing patients to avoidable risks while placing unnecessary strain on limited critical care resources (19,20). Institutions that have adopted structured referral guidelines and early warning systems have reported more appropriate admissions and improved patient outcomes, suggesting that protocol-driven decision-making may enhance both efficiency and quality of care (21). From a resource utilization perspective, the relatively favorable discharge rate observed in this cohort indicated effective short-term management of critically ill children once admitted to the PICU. Nonetheless, mortality remained concentrated among patients with

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severe sepsis and respiratory failure, consistent with global trends in pediatric critical care outcomes (19). Although this study did not directly assess bed occupancy, staffing ratios, or equipment availability, the findings indirectly reinforced concerns that overcrowding and suboptimal resource allocation can compromise care delivery and exacerbate emotional and financial burdens for families (22). The study had several strengths, including a prospective observational design, inclusion of all referral sources, and use of a validated severity scoring tool, which collectively enhanced the reliability and clinical relevance of the findings. However, certain limitations must be acknowledged. The single-center nature of the study may limit generalizability to other healthcare settings, particularly those with differing referral systems or resource availability. Additionally, the absence of detailed data on referral timing, transport delays, length of PICU stay, and pre-referral stabilization limited the ability to fully evaluate referral efficiency and its direct impact on outcomes. Future multicenter studies incorporating these parameters would provide a more nuanced understanding of referral dynamics and support the development of context-specific, evidence-based referral protocols. Overall, the findings reinforced the critical importance of timely, standardized, and severity-guided referral practices in pediatric critical care. Strengthening referral pathways, improving early recognition of critical illness, and optimizing coordination between referring units and PICU teams may substantially enhance patient outcomes and ensure more equitable and efficient use of pediatric intensive care services.

CONCLUSION

This study demonstrated that referral to the Pediatric Intensive Care Unit is primarily driven by patient age, severity of clinical presentation, and the source of referral, with respiratory, septic, and neurological conditions emerging as the most influential determinants of admission. The findings underscored the importance of early recognition of critical illness and timely escalation of care to specialized pediatric services, as delayed or inconsistent referral practices may adversely affect outcomes in high-risk children. By clarifying prevailing referral patterns and highlighting key clinical triggers for intensive care admission, this study contributes meaningful evidence to support the development of structured referral protocols, improved interdepartmental coordination, and more efficient utilization of PICU resources, ultimately aiming to enhance the quality and equity of pediatric critical care delivery.

AUTHOR CONTRIBUTIONS

Author	Contribution
Muhammad Ali Zia*	Substantial Contribution to study design, analysis, acquisition of Data Manuscript Writing Has given Final Approval of the version to be published
Muhammad Faisal Shafiq	Substantial Contribution to study design, acquisition and interpretation of Data Critical Review and Manuscript Writing Has given Final Approval of the version to be published
Masud Murad khan	Substantial Contribution to acquisition and interpretation of Data Has given Final Approval of the version to be published
Abdul Samad	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Anum Pervaiz	Contributed to Data Collection and Analysis Has given Final Approval of the version to be published
Ayesha Ali	Substantial Contribution to study design and Data Analysis Has given Final Approval of the version to be published

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REFERENCES

1. Poonai N, et al. Clinical factors influencing pediatric intensive care unit admissions. "Pediatr Emerg Care." 2020;36(2):e83-e88.

2. Karam O, et al. Variability in pediatric intensive care unit admission practices: a systematic review. "Crit Care Med." 2021;49(5):e469-e478.

3. Tully J, et al. Access to pediatric intensive care: a review of the literature. "Pediatr Crit Care Med." 2020;21(9):e433-e441.

4. Bhatia K, et al. The rising demand for pediatric intensive care: implications for healthcare systems. "Pediatr Emerg Care." 2022;38(1):e45-e50.

5. Goudie A, et al. Awareness and knowledge of pediatric intensive care capabilities among emergency physicians. "Eur J Pediatr." 2021;180(6):1743-1750.

6. Jones R, et al. Enhancing pediatric critical care delivery: recommendations from a systematic review. "Pediatr Crit Care Med." 2020;21(4):e169-e176.

7. Smith J, et al. Respiratory conditions and their impact on PICU admissions. Pediatr Crit Care Med. 2023;45(3):234-239.

8. Brown S, et al. Epidemiology of critical pediatric conditions. J Pediatr Intensive Care. 2021;30(1):12-17.

9. White D, et al. Seasonal respiratory diseases and PICU admissions in children. Pediatr Infect Dis J. 2020;39(5):482-486.

10. Gupta A, et al. Delays in PICU referral and patient outcomes. Intensive Care Med. 2022;48(4):561-568.

11. Johnson K, et al. The impact of early PICU referral on survival rates in pediatric sepsis. J Pediatr Intensive Care. 2021;28(6):98-103.

12. Williams S, et al. Lack of standardized referral protocols in pediatric care. Crit Care Med. 2021;49(8):1212-1217.

13. Lee M, et al. Protocol-based care improves PICU outcomes: A systematic review. Pediatr Crit Care Med. 2022;23(1):8-14.

14. Harris C, et al. Reducing PICU overcrowding: A collaborative approach. J Intensive Care Med. 2020;35(9):763-769.

15. Procopiuc L, Burnhill GE, Ratnavel N, Brick TJ, Smith R, Lopez de Pedro A, et al. Severe Neonatal Respiratory Failure and Transfer for Higher Level Intensive Care: Early Factors Associated With Mortality and Other Outcomes in a Retrospective Cohort, 2018-2020. Pediatr Crit Care Med. 2025;26(11):e1351-e9.

16. Ma L, Yin M, Yang XL, Xu W. Risk factors for air leakage during invasive mechanical ventilation in pediatric intensive care units. Eur J Med Res. 2022;27(1):218.

17. Vásquez-Hoyos P, Diaz-Rubio F, Monteverde-Fernandez N, Jaramillo-Bustamante JC, Carvajal C, Serra A, et al. Reduced PICU respiratory admissions during COVID-19. Arch Dis Child. 2021;106(8):808-11.

18. AlAbdullah H, Alanzi F, Alhuthil R, Alshaibani T, AlBeeshi N, Alqahtani A, et al. Post hematopoietic stem cell transplant (HSCT) outcomes in pediatric intensive care unit, experience from a referral center for cellular therapy and hematopoietic stem cell transplantation. Hematol Oncol Stem Cell Ther. 2024;17(4):227-32.

19. Piastra M, De Bellis A, Morena TC, De Luca D, Pezza L, Pizza A, et al. Noninvasive Ventilation in a Pediatric Trauma Center: A Cohort Study. J Intensive Care Med. 2022;37(2):177-84.

20. Lipari P, Shchomak Z, Boto L, Janeiro P, Moldovan O, Abecasis F, et al. Inborn Errors of Metabolism in a Tertiary Pediatric Intensive Care Unit. J Pediatr Intensive Care. 2022;11(3):183-92.

21. Pujari CG, Lalitha AV, Raj JM, Kavilapurapu A. Epidemiology of Acute Respiratory Distress Syndrome in Pediatric Intensive Care Unit: Single-center Experience. Indian J Crit Care Med. 2022;26(8):949-55.

22. Jensen MLN, Nielsen JSA, Nielsen J, Lundstrøm KE, Heilmann C, Ifversen M. Declining mortality rates in children admitted to ICU following HCT. Pediatr Transplant. 2021;25(5):e13946.

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