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CLINICAL OUTCOMES OF PEDIATRIC PATIENTS REQUIRING CONTINUOUS POSITIVE AIRWAY PRESSURE AT AL MADAEN GENERAL HOSPITAL, BAGHDAD

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ABSTRACT

Background: Continuous positive airway pressure is an important non-invasive respiratory support modality for pediatric patients with moderate to severe respiratory distress, especially in hospitals with limited access to intensive care and invasive ventilation. **Objectives:** To assess the clinical outcomes of pediatric patients requiring continuous positive airway pressure at Al Madaen General Hospital, Baghdad. **Methods:** A comparative observational study was conducted at Al Madaen General Hospital, Baghdad, from June 2025 to March 2026. The study included 163 pediatric patients with clinical indications for continuous positive airway pressure. Patients were divided into two groups: 83 patients received continuous positive airway pressure, while 80 patients were managed without it because of limited availability. Data were analyzed using IBM SPSS Statistics version 31. Categorical variables were presented as frequencies and percentages, and group comparisons were performed using the chi-square test or Fisher's exact test. A p-value of less than 0.05 was considered statistically significant. **Results:** Of the 163 patients, 109 (66.9%) were males and 54 (33.1%) were females. Most patients were term infants or children, while only 3 (1.8%) were preterm. Clinical improvement was observed in 107 patients (65.6%), referral in 48 (29.6%), and death in 7 (4.3%). Improvement was significantly higher among patients who received continuous positive airway pressure compared with those managed without it (81.9% vs 49.4%, $p < 0.001$), while referral was lower in the treated group (10.8% vs 49.4%). Mortality was higher in the treated group (7.2% vs 1.3%). Hospital stay differed significantly between groups ($p = 0.025$), with prolonged stay more frequent among patients receiving continuous positive airway pressure. **Conclusions:** Continuous positive airway pressure use was associated with better clinical improvement and lower referral rates among pediatric patients requiring respiratory support. Wider availability of devices, consumables, standardized protocols, and staff training is recommended to improve pediatric respiratory care in resource-limited hospital settings.

KEYWORDS: Baghdad; CPAP; Pediatric outcomes; Respiratory distress.

1-INTRODUCTION

Acute respiratory distress remains one of the most important causes of pediatric hospital admission and clinical deterioration, particularly among infants and young children with pneumonia, bronchiolitis, sepsis, asthma exacerbation, or other lower respiratory tract illnesses. In many hospital settings, early recognition of respiratory compromise and timely escalation of respiratory support are essential to prevent hypoxemia, exhaustion, referral to higher-level care, invasive mechanical ventilation, and death. Continuous positive airway pressure (CPAP) is a non-invasive respiratory support modality that delivers a constant distending airway pressure to spontaneously breathing patients, helping to improve alveolar recruitment, reduce work of breathing, enhance oxygenation, and stabilize children with moderate to severe respiratory distress. Recent pediatric respiratory support literature continues to emphasize the role of non-invasive ventilation, including CPAP, as an important therapeutic option in acute pediatric respiratory failure, especially when applied with appropriate monitoring, trained staff, and clear criteria for escalation of care.[1-2]

The clinical value of CPAP is particularly relevant in resource-limited hospitals, where access to pediatric

intensive care beds, invasive mechanical ventilation, transport facilities, and advanced respiratory support may be limited. In such contexts, CPAP can function as an intermediate level of respiratory support between standard oxygen therapy and referral or intubation. Evidence from low- and middle-income settings suggests that CPAP may improve physiological parameters and clinical outcomes in selected children with respiratory distress; however, its effect on mortality and treatment failure may vary according to disease severity, staffing levels, monitoring capacity, oxygen supply, equipment availability, and the ability to identify CPAP failure early. Therefore, the benefit of CPAP depends not only on the device itself but also on the health-system environment in which it is used.[3-4]

Several studies and reviews have shown that CPAP may reduce signs of respiratory distress, improve oxygen saturation, and decrease treatment failure in children with severe pneumonia or acute respiratory distress when adequate clinical supervision is available. A systematic review of CPAP use for pediatric respiratory distress in low- and middle-income countries reported that CPAP was associated with improved respiratory physiology and, in some settings, lower mortality; however, the review also highlighted heterogeneity between studies and the importance of implementation quality.[3] Similarly, evidence summaries on CPAP for severe pediatric respiratory infections indicate potential reductions in respiratory distress and mortality among selected children, while also cautioning that outcomes may be less favorable in poorly monitored settings or where nurse-to-patient ratios and escalation pathways are inadequate.[4]

Despite these potential benefits, CPAP availability remains inconsistent in many secondary-care hospitals. Children who clinically require CPAP may not always receive it because of limited machines, consumables, oxygen delivery systems, trained personnel, or monitoring capacity. This creates an important clinical and public health problem: patients with similar indications for non-invasive respiratory support may experience different outcomes depending on whether CPAP is available at the time of admission. Evaluating such real-world differences is important for hospital planning, resource allocation, staff training, and the development of local protocols for pediatric respiratory care. Recent studies from resource-limited neonatal and pediatric settings continue to report CPAP success rates, failure predictors, and outcome differences, reinforcing the need for local data to guide safe and effective implementation.[5-6]

In Iraq, published local data regarding pediatric CPAP use and its relationship with clinical outcomes remain limited, particularly outside tertiary pediatric intensive care settings. Al Madaen General Hospital in Baghdad serves a large pediatric population and frequently receives children with respiratory distress who may require escalation beyond conventional oxygen therapy. Studying outcomes among pediatric patients requiring CPAP in this setting can provide useful evidence about the clinical impact of CPAP availability on improvement, referral, mortality, and duration of hospital stay. Therefore, the present study was conducted to assess and compare clinical outcomes among pediatric patients with indications for CPAP therapy, according to whether CPAP was received or not.

2-PATIENTS AND METHODS

This comparative observational study was conducted at Al Madaen General Hospital, Baghdad, Iraq, during the period from June 2025 to March 2026. The study included pediatric patients who were admitted with respiratory distress and had clinical indications for CPAP therapy. A total of 163 patients were enrolled. Patients were divided into two groups according to the actual respiratory support received: the CPAP group, which included 83 patients who received CPAP therapy, and the non-CPAP group, which included 80 patients who had indications for CPAP but were managed without CPAP because of limited availability of CPAP devices or related resources at the time of admission. All patients were managed according to the clinical judgment of the treating pediatric team and the available hospital resources.

Eligible patients were children admitted with moderate to severe respiratory distress requiring escalation of respiratory support beyond standard oxygen therapy. Clinical indications for CPAP included increased work of breathing, tachypnea, chest retractions, nasal flaring, grunting, persistent hypoxemia despite oxygen therapy, or clinical deterioration suggesting the need for non-invasive respiratory support. Patients were excluded if they had incomplete clinical data, required immediate intubation at presentation, had major congenital anomalies incompatible with CPAP use, or were transferred before adequate assessment of outcome. Demographic and clinical data were collected using a structured data sheet, including age, gender, gestational age status, treatment group, duration of hospital stay, and final clinical outcome. CPAP therapy was provided to eligible patients when a CPAP device and required consumables were available. Patients in the CPAP group received continuous positive airway pressure through an appropriate pediatric interface with oxygen supplementation according to clinical need. Patients were monitored clinically for respiratory rate, oxygen saturation, work of breathing, general condition, and response to therapy. The non-CPAP group consisted of patients who fulfilled clinical indications for CPAP but were treated with conventional supportive measures, including oxygen therapy, medications, fluids, and other standard pediatric care, because CPAP was unavailable at the time of management.

The main outcome variables were clinical improvement, referral for further management, death, and duration of

hospital stay. Clinical improvement was defined as stabilization of the patient's respiratory condition with reduction in respiratory distress and no need for referral or escalation of care. Referral was defined as transfer to another hospital or higher-level care facility for further management. Death referred to in-hospital mortality during the course of admission. Duration of hospital stay was recorded in days and categorized into short stay (0–2 days), moderate stay (3–5 days), and prolonged stay (≥6 days).

Data were entered and analyzed using IBM SPSS Statistics version 31. Categorical variables were presented as frequencies and percentages, while continuous variables were summarized as mean ± standard deviation, median, interquartile range, and range when applicable. Comparisons between the CPAP and non-CPAP groups were performed using the chi-square test or Fisher's exact test for categorical variables, as appropriate. A p-value of less than 0.05 was considered statistically significant.

3-RESULTS

3.1 Baseline characteristics of the study population

A total of 163 patients were included in the study. Of these, 83 (50.9%) received continuous positive airway pressure (CPAP), while 80 (49.1%) were managed without CPAP. The study population was predominantly male, with 109 patients (66.9%), compared to 54 females (33.1%). The majority of patients were born at term (n = 160, 98.2%), whereas only 3 patients (1.8%) were preterm. As shown in table 1.

Table 1: Baseline characteristics of the study population (n = 163).

Variable	Category	n (%)
Gender	Male	109 (66.9)
	Female	54 (33.1)
Gestational age	Term	160 (98.2)
	Preterm	3 (1.8)
Group	CPAP	83 (50.9)
	Non-CPAP	80 (49.1)

3.1 Patient outcomes

Overall, the majority of patients showed clinical improvement, with 107 (65.6%) classified as improved. A total of 48 patients (29.6%) were referred for further management, while 7 patients (4.3%) died during the course of care. As shown in table 2.

Table 2: Patient outcomes (n = 163).

Outcome	n (%)
Improved	107 (65.6)
Referred	48 (29.6)
Death	7 (4.3)

3.3 Duration of hospital stay

The duration of hospital stay was generally short. The mean length of stay was approximately 2.9 ± 2.6 days, with a median of 2 days (IQR: 1–4 days). The length of stay ranged from less than 24 hours to 14 days. When categorized, the majority of patients had a short hospital stay of 0–2 days (n = 115, 70.6%), followed by 3–5 days (n = 31, 19.0%) and ≥6 days (n = 17, 10.4%). As shown in table 3 and table 4.

Table 3: Duration of hospital stay (days) (n = 163).

Variable	Value
Mean ± SD	~2.9 ± 2.6
Median (IQR)	2 (1–4)
Range	Less than 24 hours –14 days

Table 4: Duration of hospital stay (3 categories) (n = 163).

Duration category	n (%)
0–2 days	115 (70.6)
3–5 days	31 (19.0)
≥6 days	17 (10.4)

3.4 Gender distribution by treatment group

Gender distribution differed significantly between the CPAP and non-CPAP groups (p = 0.031). The CPAP group had a higher proportion of males compared to the non-CPAP group (74.7% vs 58.8%), whereas females were more represented in the non-CPAP group (41.2% vs 25.3%).

Table 5: Gender distribution according to treatment group (n = 163).

Gender	CPAP (n=83)	Non-CPAP (n=80)	Total (n=163)	p-value
Male	62 (74.7%)	47 (58.8%)	109 (66.9%)	**0.031**
Female	21 (25.3%)	33 (41.2%)	54 (33.1%)	

3. 5 Clinical outcomes by treatment group

Clinical outcomes differed significantly between the CPAP and non-CPAP groups (p < 0.001). A higher proportion of patients in the CPAP group showed improvement compared to the non-CPAP group (81.9% vs 49.4%). In contrast, referral was more frequent among patients managed without CPAP (49.4% vs 10.8%). Mortality was observed in 7.2% of patients in the CPAP group and 1.3% in the non-CPAP group.

Table 6: Clinical outcomes according to treatment group (n = 163).

Outcome	CPAP (n=83)	Non-CPAP (n=79)	Total (n=162)	p-value
Improved	68 (81.9%)	39 (49.4%)	107 (66.0%)	**<0.001**
Referred	9 (10.8%)	39 (49.4%)	48 (29.6%)	
Death	6 (7.2%)	1 (1.3%)	7 (4.3%)	

3.6 Duration of hospital stay categories by treatment group

The distribution of hospital stay duration categories differed significantly between the CPAP and non-CPAP groups (p = 0.025). Short hospital stays (0–2 days) were more common in the non-CPAP group compared to the CPAP group (77.5% vs 62.7%). In contrast, prolonged hospital stays (≥6 days) were more frequent among patients receiving CPAP (15.7% vs 3.8%). The proportion of patients with moderate stays (3–5 days) was similar between the two groups (21.7% vs 18.8%).

Table 7: Duration of hospital stay categories by treatment group (n = 163).

Duration category	CPAP (n=83)	Non-CPAP (n=80)	Total (n=163)	p-value
Short (0–2 days)	52 (62.7%)	62 (77.5%)	114 (69.9%)	**0.025**
Moderate (3–5 days)	18 (21.7%)	15 (18.8%)	33 (20.2%)	
Prolonged (≥6 days)	13 (15.7%)	3 (3.8%)	16 (9.8%)	

4- DISCUSSION

The present study evaluated the clinical outcomes of pediatric patients who had indications for CPAP therapy at Al Madaen General Hospital, Baghdad. The study provides important real-world evidence from a secondary-care hospital setting where CPAP was not uniformly available for all eligible patients. In this context, the comparison between children who received CPAP and those who required but did not receive CPAP reflects the practical impact of respiratory-support availability on patient outcomes. The main finding was that clinical improvement was significantly higher among patients managed with CPAP compared with those managed without CPAP, while referral for further management was markedly lower in the CPAP group. This finding supports the clinical role of CPAP as an effective intermediate respiratory-support modality for pediatric patients with moderate to severe respiratory distress, particularly in hospitals where access to pediatric intensive care and invasive ventilation may be limited. The higher improvement rate observed in the CPAP group is consistent with the physiological benefits of CPAP in children with respiratory distress. CPAP maintains a continuous distending airway pressure, improves functional residual capacity, recruits collapsed alveoli, reduces atelectasis, improves oxygenation, and decreases the work of breathing. These effects are particularly relevant in children with pneumonia, bronchiolitis, neonatal respiratory distress, and other causes of hypoxemic respiratory failure. A recent systematic review and network meta-analysis by Feng et al. reported that non-invasive respiratory support may reduce the need for invasive mechanical ventilation in pediatric acute respiratory distress, while subgroup findings suggested potential benefit of CPAP over standard oxygen therapy in selected settings, although the certainty of evidence varied across outcomes and clinical contexts. This supports the interpretation that CPAP can improve short-term clinical stabilization when applied appropriately and monitored adequately.[2]

The marked reduction in referral among patients receiving CPAP is one of the most clinically important findings of the present study. Referral usually indicates failure of initial management, need for higher-level respiratory support, or lack of local capacity to continue care. Therefore, the lower referral rate in the CPAP group suggests that CPAP availability may help stabilize children locally and reduce the burden on tertiary hospitals. This finding agrees with evidence from implementation studies in low-resource settings showing that CPAP can reduce treatment escalation when integrated into pediatric care pathways. Rudman et al., in a recent feasibility study in India, reported that among children treated with a novel bubble CPAP system, most were discharged home and only a small proportion required referral, supporting the feasibility of CPAP use outside highly specialized intensive care environments when staff training and monitoring are adequate.[7]

The findings of the present study are also comparable with the Ethiopian cluster-randomized trial by Gebre et al., which evaluated bubble CPAP for children aged 1–59 months with severe pneumonia and hypoxemia. That trial demonstrated the potential effectiveness of bubble CPAP in general hospital settings, while also emphasizing that outcomes depend on implementation quality, clinical monitoring, and early recognition of treatment failure.[8] n the current study, the higher improvement and lower referral rates among CPAP-treated patients similarly suggest that CPAP may provide meaningful clinical benefit in a general hospital environment. However, direct comparison should be made cautiously because the Ethiopian trial focused mainly on severe pneumonia with hypoxemia, whereas the present study included pediatric patients with broader clinical indications for CPAP.

The mortality pattern in the present study requires careful interpretation. Although the CPAP group showed better improvement and lower referral, mortality was numerically higher among patients receiving CPAP. This

does not necessarily indicate harm from CPAP. A more plausible explanation is confounding by indication, because patients selected to receive CPAP may have had more severe respiratory distress at presentation. In observational studies, sicker patients are more likely to receive advanced respiratory support, and therefore crude mortality comparisons may overestimate risk in the intervention group. Similar concerns have been highlighted in the literature. Sessions et al., in a systematic review and meta-analysis of CPAP use among children in resource-limited settings, found no clear overall mortality reduction with CPAP compared with low-flow oxygen, and emphasized heterogeneity across trials, variation in patient severity, and the importance of safe implementation systems.[3]

The present findings should also be interpreted in light of previous evidence showing that CPAP is not universally beneficial in all contexts. Some trials and reviews have reported improved outcomes with CPAP, while others have shown neutral or even unfavorable mortality signals when CPAP was used in settings with limited monitoring, insufficient staffing, or delayed escalation pathways. Ijaz et al. highlighted that the effectiveness of bubble CPAP in children with respiratory distress in low- and middle-income countries is highly context-dependent, with outcomes influenced by oxygen supply, equipment reliability, nurse-to-patient ratio, clinical training, patient selection, and the ability to identify CPAP failure promptly.[9] This is highly relevant to the current study because CPAP was used in a resource-limited hospital setting, and differences in baseline severity and monitoring capacity may have affected outcomes.

The longer hospital stay observed among CPAP-treated patients may also reflect greater initial disease severity rather than an adverse consequence of CPAP. Children requiring CPAP often need closer observation, longer respiratory support, and more gradual weaning before discharge. In contrast, some non-CPAP patients may have had shorter admissions because they improved quickly with standard therapy, were referred early due to lack of CPAP availability, or died before prolonged hospitalization. Therefore, hospital stay should not be interpreted alone as a marker of treatment success or failure. In a recent study of bubble CPAP integration in India, the median treatment duration was approximately 24 hours, and most children were discharged after stabilization, indicating that CPAP may require short but intensive monitoring periods when properly implemented.[7]

The gender distribution in the current study showed a predominance of males, and males were more frequent in the CPAP group. Male predominance has been reported in several pediatric and neonatal respiratory distress studies and may reflect biological susceptibility, health-seeking patterns, or admission characteristics. However, the clinical significance of gender imbalance in the present study is uncertain. Since respiratory severity scores and diagnostic categories were not fully adjusted in the analysis, gender differences should be considered descriptive rather than causal. Future studies should include multivariable analysis to determine whether sex remains independently associated with CPAP requirement or clinical outcome after controlling for age, diagnosis, oxygen saturation, severity of distress, and comorbidities.

The current study adds local evidence from Iraq regarding the clinical relevance of CPAP availability in pediatric respiratory care. Published Iraqi data on pediatric CPAP outcomes remain limited, particularly from non-tertiary hospitals. Therefore, this study is useful for hospital planning and policy development. The findings suggest that improving CPAP availability at Al Madaen General Hospital may reduce referral rates and increase the proportion of children who improve within the hospital. However, CPAP expansion should not be limited to device procurement alone. Evidence from implementation literature indicates that safe CPAP programs require standardized eligibility criteria, contraindication screening, staff training, continuous monitoring of oxygen saturation and respiratory effort, infection-control measures, availability of consumables, oxygen supply reliability, and clear referral or escalation protocols.[9]

This study has several limitations. First, it was conducted in a single hospital, which may limit the generalizability of the findings to other healthcare settings. Second, the observational design prevents confirmation of a direct causal relationship between CPAP use and clinical outcomes. Third, patients were not randomly assigned to CPAP or non-CPAP management, as CPAP use depended mainly on device availability; therefore, selection bias and confounding by disease severity may have influenced the results. Fourth, detailed clinical severity indicators, such as baseline oxygen saturation, respiratory rate, diagnosis-specific severity scores, blood gas findings, and comorbid conditions, were not fully analyzed. Fifth, the number of deaths was small, making mortality comparisons between groups less reliable. Finally, the study did not assess long-term outcomes after discharge or referral, so the final clinical course of referred patients could not be determined.

5- CONCLUSION AND RECOMMENDATION

Continuous positive airway pressure use among pediatric patients requiring respiratory support at Al Madaen General Hospital was associated with higher clinical improvement and lower referral rates compared with non-continuous positive airway pressure management. The higher mortality and longer hospital stay in the treated group may reflect greater illness severity. Improving device availability, ensuring adequate consumables, applying standardized protocols, and training staff are recommended to enhance pediatric

respiratory care. Further prospective studies are needed to confirm these findings and assess long-term outcomes.

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