ATTAHADI MED J. 2026;3(1):1-6
https://doi.org/10.69667/amj.26101

Original article

Clinical Profile, Management, and Outcomes of Pediatric Pneumonia Patients Admitted to the Intensive Care Unit: A Retrospective Cohort Study

Mufeeda Mansour[1]*, Yousef Assaleh[2]

[1]*Department of Pediatrics, Faculty of Medicine, University of Zawia, Zawia, Libya*
[2]*Faculty of Medicine, University of Zawia, Zawia, Libya*
Corresponding email. *Mu.Mansour@zu.edu.ly*

Keywords.
Intensive Care Units, Critical Care Unit, Pediatric Pneumonia.

ABSTRACT

Geographical and socioeconomic factors affect the incidence and outcomes of pneumonia, which is a major cause of severe illness and mortality in children globally. There is a dearth of information on the characteristics and consequences of severe pediatric pneumonia in Libya, a growing upper-middle-income nation with a healthcare system with limited resources. The purpose of this study was to describe the clinical characteristics, course of treatment, and results of pediatric pneumonia patients hospitalized to an intensive care unit (ICU) in Libya. 139 consecutive pediatric patients (age ≤18 years) hospitalized to the intensive care unit at Zawia Medical Center between January and December 2023 were the subject of a retrospective cohort study. Patients were split into two groups: those with pneumonia (n = 48) and those without (n = 91). Study variables focused on the outcomes, clinical course, and demographics. The main "severe outcomes" for the patients in this study were demand for mechanical ventilation or fatality. The cohort's median age was 24 months (IQR: 0-88). For 48 patients (34.5%), pneumonia was the main reason for admission. Patients with pneumonia exhibited a clear seasonal peak in the winter and were substantially younger than those without pneumonia (median age, 12.6 vs. 85.7 months, $p < 0.001$). The pneumonia group required more mechanical ventilation (25% vs. 6.6%, $p = 0.004$) and had a significantly higher mortality rate (20.8% vs. 6.6%, $p = 0.012$). younger age was the most significant risk factor for mortality, with an average age of 12.6 months vs. 85.7 months for mortalities and survival cases, respectively ($p = 0.012$). The presence of comorbidities (65.2% vs. 32.0%, $p = 0.02$) and a positive C-reactive protein (CRP) level> 30 mg/L were substantially linked to the pneumonia group, with worsening ($p = 0.01$). Pediatric pneumonia results in severe morbidity and high mortality and is a significant cause of ICU admission. Important risk factors for poor outcomes include younger age, elevated CRP, and underlying comorbidities. To improve patient treatment and inform national standards, these findings emphasize the need for further multicenter research, protocolized management, and improved seasonal planning.

Introduction

Pneumonia is one of the most common causes of ICU admissions and mortality across all age groups (neonates, pediatrics, and adults) [1,2], and its management is becoming increasingly challenging despite the continued developments in critical care medicine [3,4]. Indeed, multi-drug resistant (MDR) bacteria [5], difficulty in identifying the causative organism [2], and inadequate infection control protocols in ICUs [6] are what make preventing and treating this condition a particularly difficult task for critical care physicians.

Even though pneumonia is a leading infectious cause of ICU admission worldwide and for all age groups, it does show great geographical variation across different geographical and socio-economic environments. The literature shows moderate to strong evidence that climate affects the distribution and outcomes of pneumonia admissions to ICUs [7] for example, Troung et al., 2023 [8] showed that cold waves increased ICU admissions and mortality, and on the other hand, Hossain et al (2020 showed that increases in temperature are positively correlated with hospitalization period [9]. Moreover, socioeconomic settings can significantly impact the prevalence and outcomes of pneumonia in pediatric patients. The factors identified include: maternal education [10], exposure to second-hand smoking [11], and household income [12]. However, the most significant factors impacting the incidence and outcomes of pneumonia among the critically ill patients include infection control protocols and the causative organism. The impact of such factors is particularly demonstrated by the higher incidence rate and poorer outcomes of pediatric pneumonia in the critically ill patients in developing countries compared with developed countries [13].

In Libya, these factors combine uniquely compared with the neighboring countries. Libya is an Upper Middle-Income Country (UMIC), but it is also a developing country with a poorly structured healthcare system with significant resource limitations and discrepancies in the allotment of financial, logistic, and human resources to different healthcare facilities [14,15]. Additionally, the absence of a unified registry for PICUs, individual publications from the different healthcare facilities around the country, is the best available alternative to providing data that can contribute to developing protocols, updating guidelines, and national healthcare policies. This study aims to characterize the clinical profile, management, and outcomes

Received*: 27-10-2025 -* ***Accepted****: 25-12-2025 -* ***Published****: 04-01-2026*

of pediatric patients with pneumonia admitted to the ICU and to identify factors associated with clinical deterioration and mortality.

Methods

This retrospective cohort study covered the period from January 2023 to December 2023, during which data from 139 consecutive patients were obtained. Information was collected from the medical records of pediatric patients hospitalized at the Pediatric Intensive Care Unit (ICU) of Zawia Medical Center. The study population included all pediatric patients aged 0 to 18 years who were admitted to the ICU during the specified study period.

The collected data included: demographic information (e.g., Sex, Age), admission details (e.g., Cause of Admission, Comorbidities), clinical and laboratory results (e.g., CRP levels, Blood Culture results), ICU course (e.g., Time to Deterioration, Respiratory Support), treatments (e.g., PLT, FFP, RBCs received), and patient outcomes (e.g., Alive/Dead) are examples of important variables. Several concepts are defined operationally for the sake of this analysis: "Clinical Deterioration Period" is defined as a documented period of deterioration, a change to a higher level of respiratory support, or death; "Severe Outcome" is a composite endpoint defined as either death or the need for mechanical ventilation; and "DAMA" refers to discharge against medical advice. A "Pneumonia Case" is a patient with "Pneumonia" listed as the primary cause of admission.

Descriptive statistics were first used. Continuous variables were examined for normality and summarized as mean (± standard deviation) or median (interquartile range), while categorical variables were displayed as frequencies and percentages. The cohort was split into two groups for comparison analysis: individuals with pneumonia and those without. Chi-square or Fisher's exact tests for categorical variables and Student's t-tests or Mann-Whitney U tests for continuous variables were used for group comparisons. Particularly within the pneumonia group, a subgroup analysis was carried out to compare survivors with non-survivors and those who needed mechanical ventilation with those who did not. In order to find independent predictors while accounting for potential confounders like age and comorbidities, univariate analysis first identified variables linked to severe outcomes. Variables with a p-value of less than 0.1 were then taken into consideration for inclusion in a multivariate logistic regression model. A p-value of less than 0.05 is considered statistically significant, and all analyses were performed using SPSS for Windows.

The local Institutional Review Board (IRB) or Ethics Committee approved this study protocol. Since the study is retrospective and makes use of previously collected, anonymized data, informed consent is anticipated to be exempt. By using serial numbers and making sure all data is saved securely, patient confidentiality was strictly upheld.

Results

A total of 139 consecutive pediatric patients who were hospitalized in the intensive care unit during the study period were examined. 54.7% (n=76) of the patients were male, and their median age was 24 months (IQR: 0-88 months). For 34.5% (n=48) of the group, pneumonia was the main reason for admission. After admission, the median time to clinical deterioration was three days (IQR: one to four days). Admissions showed a distinct temporal pattern. The number of pneumonia cases increased significantly over the winter, peaking in January and February. Admissions for other reasons, on the other hand, exhibited a different trend; they were more common in the middle of the year and stayed mostly constant with no discernible seasonal surges ($p < 0.001$) (Figure 1).

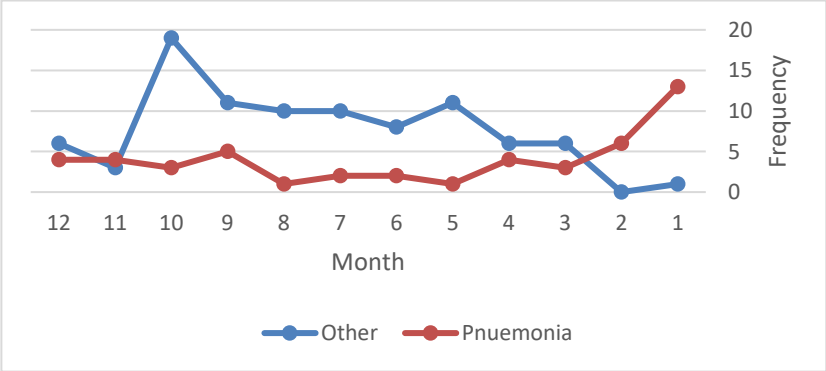

Figure 1. Monthly distribution of pneumonia versus other causes of admission, showing a clear peak in pneumonia cases during January and February, while other causes were more common mid-year

The overall mortality rate was 11.5% (n = 16), and the composite rate of severe outcomes (mortality or need for mechanical ventilation) was 13% (n = 18) (Figure 2).

Received*: 27-10-2025 -* ***Accepted****: 25-12-2025 -* ***Published****: 04-01-2026*

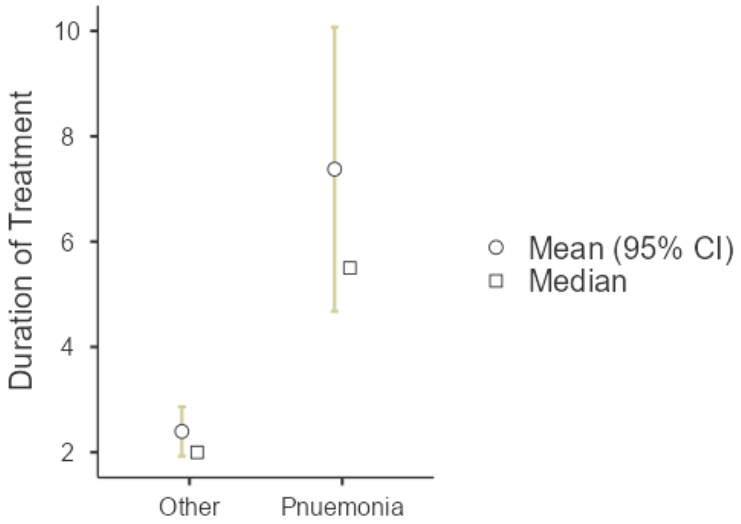

Figure 2. The duration of treatment differed between patients with pneumonia compared with those who were admitted for other causes

Patients admitted with pneumonia (n = 48) and those admitted for other reasons (n = 87) were compared. With a median age of 12.6 months as opposed to 85.7 months in the non-pneumonia group ($p < 0.001$), patients in the pneumonia group were noticeably younger (Figure 3).

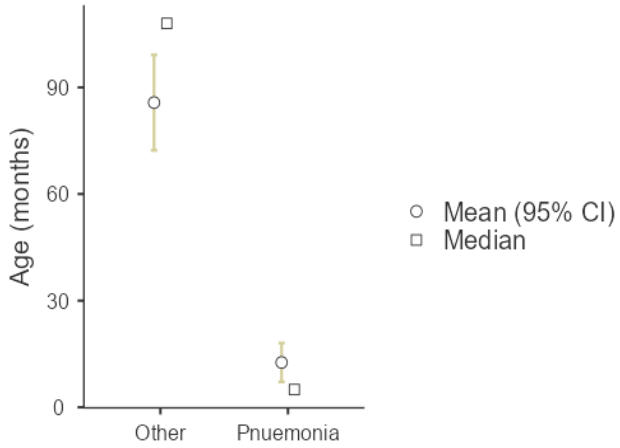

Figure 3. Difference in age distribution between the pneumonia patients and the patients admitted for other causes ($p < 0.001$)

The pneumonia group had a higher death rate (20.8% vs. 6.6%, p=0.012) and a considerably higher demand for mechanical ventilation (25% vs. 6.6%, p<0.004) (OR = 3.8, CI:1.6–13.6). The distribution of sexes and the frequency of positive blood culture results did not differ significantly between the groups (Figure 4).

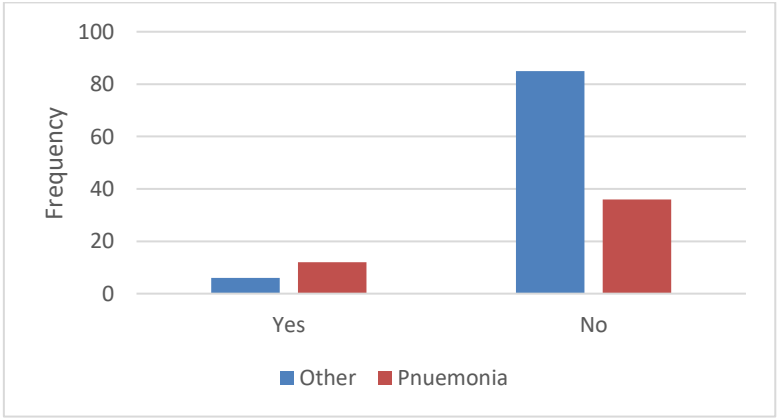

Figure 4. The need for respiratory support (CPAP, MV, or both) is compared between pneumonia patients and patients admitted for other reasons

***Received**: 27-10-2025 - **Accepted**: 25-12-2025 - **Published**: 04-01-2026*

A univariate analysis was conducted within the pneumonia sub-cohort (n=48) to determine the factors linked to the severe outcome composite endpoint. Compared to patients who did not have a catastrophic result, and were more likely to have a comorbidity (65.2% vs. 32.0%, p=0.02). Compared to patients treated for other reasons, those admitted with pneumonia were much more likely to have an elevated CRP level (Odds Ratio [OR] = 16.50, 95% Confidence Interval [CI]: 6.23 to 43.73) (Table 1). Pneumonia patients had a significantly higher mortality rate compared with cases with other admissions. With a 20.8% mortality among the cases with pneumonia and only 6.6% among patients with other causes (p =0.012, OR: 3.2 CI). Mortality was significantly associated with age, with the average age of the patients who died 12.6 months vs. 85.7 months for the patients who survived (p < 0.001).

Table 0-1. Comparison of Pneumonia vs. Non-Pneumonia Patients

Characteristic	Pneumonia (n=48)	Non-Pneumonia (n=91)	p-value
Age (months) (mean)	12.6	85.7	<0.001
Sex (Male), n (%)	26 (54.2%)	55 (60.4%)	0.48
Severe Outcome, n (%)	23 (47.9%)	17 (18.7%)	<0.001
Positive CRP (> 30 mg/L)	75%	6.8%	<0.001

Discussion

With an emphasis on pneumonia, this retrospective cohort study offers a thorough examination of the clinical characteristics, treatment, and results of children patients admitted to a Libyan intensive care unit. In comparison to other causes of ICU admission, our findings demonstrate the substantial burden of pediatric pneumonia, characterizing it as a disease primarily affecting very young children and associated with a significantly higher risk of severe outcomes, including mechanical ventilation and death. The severity of pneumonia in our cohort is the study's most notable finding. Over one-third (34.5%) of all pediatric ICU patients had pneumonia as their primary admission diagnosis, highlighting pneumonia's position as a major cause of severe disease in children in this area. More alarmingly, compared to children admitted for other causes, children with pneumonia had a four-fold higher fatality rate (20.8% vs. 6.6%) and were almost four times more likely to need mechanical ventilation (25% vs. 6.6%). This is consistent with evidence from around the world showing pneumonia to be a significant cause of pediatric death, especially in underdeveloped countries [16]. However, compared to many studies from high-income nations, our study's mortality rate is noticeably higher, which probably reflects the particular difficulties Libya's healthcare system faces, such as resource constraints and disparities in healthcare allocation, as previously mentioned.[14].

With a median age of only 12.6 months, our data showed that pediatric pneumonia patients in our intensive care unit were noticeably younger. This is in line with the accepted epidemiological profile of pneumonia, which shows that young children and newborns are particularly susceptible because of their smaller airways and underdeveloped immune systems [17,18]. For this high-risk age range in the Libyan setting, this demographic profile emphasizes the vital significance of maternal education, immunization programs, and focused public health initiatives [19].

Finding variables linked to poor outcomes, particularly in the pneumonia group, was one of our study's main goals. The existence of a comorbidity and a high CRP level at the time of clinical deterioration were found to be two significant predictors of the severe outcome composite endpoint (death or mechanical ventilation) in our univariate analysis. Given that underlying medical problems such as congenital heart disease, malnutrition, or chronic lung illness are known to impair a child's capacity to fight off serious infection, the correlation with comorbidities is anticipated [20]. The substantial correlation between pneumonia and high CRP supports the use of CRP as a useful biomarker for systemic inflammation and disease severity in juvenile pneumonia [21]. The use of CRP as a helpful biomarker for systemic inflammation and disease severity in pediatric pneumonia is supported by the strong association between pneumonia and elevated CRP [22]. Additionally, our research revealed a strong seasonal pattern in pneumonia admissions, peaking in the winter months of January and February. This result is in line with international research showing how climate variables, including cold waves, affect the frequency and intensity of respiratory diseases.[23]. This seasonal pattern indicates a need for increased readiness throughout the winter, which has significant implications for staffing and resource planning in the PICU.

Pneumonia accounted for the largest proportion of deaths in the cohort. Of the 16 total deaths, 10 (62.5%) occurred among patients with pneumonia. Among the 48 pneumonia admissions, 10 patients died, corresponding to a mortality rate of 20.8%. Thus, pneumonia was both the most common admission diagnosis and the leading cause of mortality in the cohort. This is a very common finding reported in the literature across multiple settings[24]. The average age of patients with pneumonia (12.6 months) was significantly lower than that of patients admitted for other causes (85.7 months), and the average age at

Received: 27-10-2025 - **Accepted**: 25-12-2025 - **Published**: 04-01-2026

mortality was also much lower than that of surviving patients. Age is a known risk factor for pneumonia and pneumonia-related mortality, especially among infants[25,26], which is attributed to their immature immune system, MDR nature of pneumonia, and restrictions in antibiotic doses for younger children[27]. This study has a number of limitations that need to be acknowledged. First off, the results can't be applied to other PICUs in Libya or other regions due to the retrospective and single-center design. The statistical ability to find additional possible risk factors in the multivariate analysis may have been constrained by the very small sample size, especially within the pneumonia subgroup (n=48). Second, inconsistent data documentation might have resulted from the dependence on medical records. Most importantly, the study failed to identify the causal bacteria in the majority of pneumonia patients, which is a significant knowledge gap but a frequent problem in clinical practice. For the purpose of directing empirical antibiotic therapy and infection control procedures, it is crucial to comprehend the local prevalence of bacterial and viral pathogens, particularly multidrug-resistant (MDR) species.

Conclusion

This study demonstrates that, in comparison to other diseases, pediatric pneumonia is a common and serious illness in our intensive care unit (ICU), accounting for a disproportionately high rate of mortality and the need for mechanical ventilation. The condition mostly affects infants and young children, and the existence of underlying comorbidities and an increased inflammatory response, as shown by raised CRP values, greatly impairs clinical outcomes. A crucial chance for preemptive resource planning is presented by the obvious seasonal surge in winter admissions. The results herein highlight the critical need for standardized, evidence-based management guidelines for severe pediatric pneumonia. Future initiatives must concentrate on strengthening the PICU's winter readiness, putting strict infection control procedures in place, and giving high-risk populations priority. Prospective multi-center investigations are crucial to filling in the highlighted knowledge gaps, especially with regard to causing microorganisms and antibiotic resistance. In order to improve the quality of care and clinical outcomes for critically sick children with pneumonia, specific national guidelines will be developed based on this research.

Conflict of interest. Nil

References

1. Morris AC. Management of pneumonia in intensive care. J Emerg Crit Care Med. 2018 Dec;2:101. Available from: http://jeccm.amegroups.com/article/view/4830/html
2. De Pascale G, Bello G, Tumbarello M, Antonelli M. Severe pneumonia in intensive care: cause, diagnosis, treatment and management. Curr Opin Pulm Med. 2012 May;18(3):213-21.
3. Chastre J, Luyt CE. Controversies and Evolving Concepts in Hospital-Acquired Pneumonia. Semin Respir Crit Care Med. 2017 Jun;38(3):235-6.
4. Klompas M. Prevention of Intensive Care Unit-Acquired Pneumonia. Semin Respir Crit Care Med. 2019 Aug;40(4):548-57.
5. Beck AF, Florin TA, Campanella S, Shah SS. Geographic Variation in Hospitalization for Lower Respiratory Tract Infections Across One County. JAMA Pediatr. 2015 Sep 1;169(9):846.
6. Hieu Troung H, Tekin A, Rovati L, Dong Y, Kashani K. 285: The Characteristics and Outcomes of ICU Admissions During Cold and Heat Waves from 2018 to 2022. Crit Care Med. 2023 Jan;52(1 Suppl):S117.
7. Hossain MZ, Tong S, AlFazal Khan M, Hu W. Impact of climate variability on length of stay in hospital for childhood pneumonia in rural Bangladesh. Public Health. 2020 Jun;183:69-75.
8. Azab SF, Sherief LM, Saleh SH, Elsaeed WF, Elshafie MA, Abdelsalam SM. Impact of the socioeconomic status on the severity and outcome of community-acquired pneumonia among Egyptian children: a cohort study. Infect Dis Poverty. 2014 Apr 17;3:14.
9. Uzgelir AR, Ünal A, Kaçak S, Gökşen ES, Tolunay O. The effect of secondhand smoke exposure on treatment outcomes in children hospitalized for community-acquired pneumonia. Turk J Tob Control. 2025 Sep 4;5(2):47-54.
10. Thörn LK, Minamisava R, Nouer SS, Ribeiro LH, Andrade AL. Pneumonia and poverty: a prospective population-based study among children in Brazil. BMC Infect Dis. 2011 Jun 29;11:180.
11. Berezin EN, Solórzano F. Gram-negative infections in pediatric and neonatal intensive care units of Latin America. J Infect Dev Ctries. 2014 Aug 13;8(8):942-53.
12. The creation of theoretical frameworks to establish sustainable adoption of e-health in Libya. HNSJ. 2023 Jul 1;4(7).
13. Benamer HT, Bredan A, Bakoush O. The Libyan doctors' brain drain: an exploratory study. BMC Res Notes. 2009 Nov 23;2:242.
14. McAllister DA, Liu L, Shi T, Chu Y, Reed C, Burrows J, et al. Global, regional, and national estimates of pneumonia morbidity and mortality in children younger than 5 years between 2000 and 2015: a systematic analysis. Lancet Glob Health. 2019 Jan;7(1):e47-e57.
15. Lambert L, Culley FJ. Innate Immunity to Respiratory Infection in Early Life. Front Immunol. 2017 Nov 14;8:1570.

Received: *27-10-2025* - ***Accepted***: *25-12-2025* - ***Published***: *04-01-2026*

16. Watelet JB, El Shazly A, Collet S, Doyen A. Chronic inflammation of upper airways in children: basic principles. B-ENT. 2012;8 Suppl 19:29-40.
17. Ibrahim HK, El Borgy MD, Mohammed HO. Knowledge, attitude, and practices of pregnant women towards antenatal care in primary healthcare centers in Benghazi, Libya. J Egypt Public Health Assoc. 2014 Dec;89(3):119-26.
18. Williams N, Radia T, Harman K, Agrawal P, Cook J, Gupta A. COVID-19 Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection in children and adolescents: a systematic review of critically unwell children and the association with underlying comorbidities. Eur J Pediatr. 2021 Mar;180(3):689-697.
19. Fernandes CD, Arriaga MB, Costa MCM, Costa MCM, Costa MHM, Vinhaes CL, et al. Host Inflammatory Biomarkers of Disease Severity in Pediatric Community-Acquired Pneumonia: A Systematic Review and Meta-analysis. Open Forum Infect Dis. 2019 Dec;6(12):ofz520.
20. Ruiz-González A, Utrillo L, Bielsa S, Falguera M, Porcel JM. The Diagnostic Value of Serum C-Reactive Protein for Identifying Pneumonia in Hospitalized Patients with Acute Respiratory Symptoms. J Biomark. 2016;2016:2198745.
21. Lane MA, Walawender M, Brownsword EA, Pu S, Saikawa E, Kraft CS, et al. The impact of cold weather on respiratory morbidity at Emory Healthcare in Atlanta. Sci Total Environ. 2022 Mar 10;813:152612.
22. Meliyanti A, Rusmawatiningtyas D, Makrufardi F, Arguni E. Factors associated with mortality in pediatric pneumonia patients supported with mechanical ventilation in developing country. Heliyon. 2021 May;7(5):e07063.
23. Wilkes C, Bava M, Graham HR, Duke T, ARI Review group. What are the risk factors for death among children with pneumonia in low- and middle-income countries? A systematic review. J Glob Health. 2023 Feb 24;13:05003.
24. Goyal JP, Kumar P, Mukherjee A, Das RR, Bhat JI, Ratageri V, et al. Risk Factors for the Development of Pneumonia and Severe Pneumonia in Children. Indian Pediatr. 2021 Nov 15;58(11):1036-1039.
25. Louw J, McCaul M, English R, Nyasulu PS, Davies J, Fourie C, et al. Factors Contributing to Delays to Accessing Appendectomy in Low- and Middle-Income Countries: A Scoping Review. World J Surg. 2023 Dec;47(12):3060-3069

Received*: 27-10-2025 -* ***Accepted****: 25-12-2025 -* ***Published****: 04-01-2026*