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ORIGINAL ARTICLE

Pattern and burden of respiratory diseases in pediatric intensive care unit.

Atia Aijaz[1], Aqsa Majeed[2], Anwar-ul-Haque[3]

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ABSTRACT… Objective: To assess the pattern and burden of respiratory illnesses admitted in Pediatric Intensive Care Unit and their outcome. **Study Design:** Retrospective Cohort study. **Setting:** A closed multidisciplinary PICU with 4-S framework [system, space, stuff and staff] of a newly opened public-sector children hospital in Karachi. **Period:** January 1, 2023 to June 30, 2023. **Methods:** We retrospectively reviewed the medical records of children (1month-15yrs) with acute respiratory illnesses admitted in PICU of a newly opened public-sector children hospital during six months. Demographic data (age and gender), clinical variables (types, severity of respiratory failure, type of respiratory support and clinical outcome as alive or expired were extracted from medical records. **Results:** Total respiratory cases were 274(15.1%) during this study period. The median age was 9 months (IQR6-15) and 179(65.3%) were male. Acute bronchiolitis 160(58.4%) and pneumonia 50(18.2%) were the most common admitting diagnosis. Respiratory failure was observed in 42(15.3%) and needed positive pressure ventilation either as High Flow nasal cannula 32(11.7%) and MV 10(3.6%). Predictor of respiratory failure in this cohort was non-vaccination, malnutrition, abnormal chest X-ray and use of vasoactive drugs ($p=0.017$, $p=0.418$, $p<0.001$, $p=<0.001$). Mortality is associated with clinical severity ($p<0.001$). The case specific mortality rate was 2(0.08%). **Conclusion:** Acute bronchiolitis and Pneumonia were the leading respiratory illnesses with marginal mortality rate. Effective management strategies lead to significant improved outcome of children with respiratory diseases.

Key words: ALRTI, Burden, Critically Ill Children, PICU, Respiratory Diseases.

INTRODUCTION

Respiratory illnesses are a major cause of morbidity and mortality globally especially in infants and young children of low and middle income countries.[1] Respiratory diseases are the common reason for admission in PICU for monitoring and therapeutic interventions, ranged from 20-35%.[2,3] The pattern of respiratory illnesses may be related to geography, seasonal, socio-economic status and environmental factors. The spectrum of respiratory illness is wide and includes diseases of upper and lower airways, lung and pleura and it also classify into communicable and non-communicable diseases.[4] Epidemiological data on disease-specific like Bronchiolitis[5], Pneumonia[6], Acute Respiratory distress syndrome (ARDS)[7] were available from PICUs of both developed and developing countries in the medical literature. Acute Lower Respiratory Tract Infections (ALRTIs) in children especially under-five years of age is the most common reason for hospitalization, including admission in PICU and pediatric wards.[8,9] Many epidemiological studies demonstrated that the viruses, especially respiratory syncytial virus and influenza are the most common causes of ALRTIs in children with the discovery of Real-rime Polymerase Chain Reaction (RT-PCR).[10,11] Khuhro et al reported respiratory illnesses cause 31.3% (266) of hospital admission and ALRTIs were 55.6% (148).[12] Similarly, another recent report on respiratory illnesses from PICU of Aga Khan University Hospital, Karachi and 68.9% (192) were ALRTIs cases.[13]

Global Burden Disease (GBD) reported the incidence of respiratory illnesses especially ALRTI in resource-limited countries is almost twice of the developed countries and the mortality rate is almost 60 times higher.[14]

1. MBBS, Resident Pediatric Medicine, SICHN Hospital, Karachi, Pakistan.
2. MS, Research Associate, SICHN Hospital, Karachi, Pakistan.
3. MBBS, DABP and DABPCCM, Professor Pediatric Medicine, SICHN Hospital, Karachi, Pakistan.

Correspondence Address:
Dr. Atia Aijaz
Department of Pediatric Medicine
SICHN Hospital, Karachi, Pakistan.
atia.aijaz@gmail.com

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Better outcome is associated with the early recognition and timely appropriate interventions. Infants and young children are more susceptible than adult for acute and quick deterioration in clinical status for several anatomical and physiological reasons of respiratory system.[15] Respiratory support is pivotal in care of acute respiratory illnesses like clearing the airways and supplemental oxygen via different modes including non-invasive and invasive ventilation along with other medical therapies.[16]

There is a paucity of data on pattern and outcome of acute respiratory diseases in children from PICUs.[4,13] The objective of this study is to evaluate the clinical profile and outcome of children admitted with acute respiratory illnesses in a newly established PICU of a public sector Children hospital.

METHODS

We retrospectively reviewed the medical records of all children (age from one month to 15 years) admitted in PICU of newly opened public-sector Children Hospital Korangi, under Govt. of Sindh as "Sindh Institute of Child Health and Neonatology" (SICHN) from January 2023 to June 2023.

Sample size was calculated on WHO software for sample size determination by the formula of estimation of population proportion for one sample with specified absolute precision. The sample size was calculated from OpenEpi v3, with previous reported incidence of 20% respiratory illnesses admission in PICU.[18] At 95% confidence interval and 0.05 absolute precision, the calculated sample size was 246. If we consider drop out 10%, a sample of 260 participants will be adequate for this study. Non-probability consecutive sampling technique was used for this study. Children with respiratory complications from cardiac illnesses, neurological disorders or metabolic illnesses and children with chronic respiratory diseases were excluded. We stratified our data for severity [respiratory distress or failure] and types [upper airway, lower airway and lung tissue disease] of respiratory diseases based on Pediatric Advance Life Support (PALS) criteria.[19] All respiratory signs and symptoms were recorded as abnormal per PALS guidelines. All patients were managed by PICU team based on standard treatment protocol. The demographic data (like age, gender, weight to assess the nutritional status based on z score for weight for height from WHO anthropometric charts, vaccination status as per Expanded Programme of Immunization [EPI] of Pakistan[20], pertinent clinical variables (like severity and type of respiratory disease, significant labs and use of respiratory support like supplemental oxygen as nasal prong, High Flow Nasal Cannula [HFNC] and mechanical ventilation) and final outcome as either alive or expired were recorded on Google Forms.

Statistical analysis was conducted using SPSS V26. Data were expressed as percentages and frequencies for qualitative data and mean and standard deviation for quantitative data. The chi-squared ($\chi 2$) test or Fisher's Exact test was applied to find any associations between the categorical variables. The $p < 0.05$ was considered the level of significance. This study was approved by local Institutional review board (SICHN/Ex-002/2024).

RESULTS

Among 274 study participants, the majority were male 179(65.3%) with a median age of 9 months (IQR 6–15.3). Patients' characteristics were described in Table-I. Nearly half 120(43.8%) were malnourished, and over half 143(52.2%) were unvaccinated. Bronchiolitis was the most common diagnosis 160(58.4%), followed by pneumonia 50(18.2%), and measles 32(11.7%). Respiratory distress was prevalent in 268(97.8%) of cases, while hypoxia and chest recession were noted in approximately one-third of participants each 266(34.9%), 264(34.6%) Table-I.

Key complications included a median hemoglobin level of 9.5 g/dL (IQR 8.4–10.6) and a median white blood cell count of 11.2 × 10□/L (IQR 8–15.6). CRP was measured in 29.2% of cases, with a median value of 14.6 mg/L (IQR 5–43.6). Most chest X-rays were normal 200(73%), and only 32 (11.7%) of participants required high-flow nasal cannula (HFNC) or mechanical ventilation 10(3.6%). The median length of stay was 3 days (IQR 2–4), and the survival rate was 272(99.3%)

Table-I.

Demographic	
Gender	**n(%)**
Female	95(34.7)
Male	179(65.3)
Age (month)	
Median(IQR)	9(6-15.3)
Under Nutrition	120(43.8)
Vaccination status –UTD	131(47.8%)
Diagnosis	**n(%)**
Bronchiolitis	160(58.4)
Asthma	18(6.6)
Measles	32(11.7)
Pneumonia (other than Measles)	50(18.2)
Miscellaneous	14(5.1)
Severity	**n(%)**
Respiratory Distress	232 (84.7)
Respiratory Failure	42 (15.3)
Respiratory Support	**n(%)**
Mechanical Ventilation	10(3.6)
Nasopharyngeal	232(84.7)
High-Flow Nasal Cannula	32 (11.7)
Transfer (refer to another hospital)	8 (2.9)
Length of stay Median(IQR) (days)	3(1-18)
Mortality	2 (0.08)

Table-I. Patients' characteristics (n=274)

We evaluated associations between clinical status (respiratory distress vs. respiratory failure) and participant characteristics. The predictors of respiratory failure were un-vaccinated and malnourished child, abnormal chest X-ray, use of inotropes Table-II.

Variables	Clinical Status		P-Value
	Respiratory Distress n%	Respiratory Failure n%	
Gender			
Female	82(35.3)	13(31)	0.582ţ
Male	150(64.7)	29(69)	
Age Cat (Month)			
<24	187(80.6)	34(81)	1.000 ţ
≥24	45(19.4)	8(19)	
Malnutrition	104(44.8)	16(38.1)	0.418ţ
Unvaccinated	114(49.1)	29(69)[b]	0.017 *ţ
Abnormal Chest X-ray	41(17.7)	21(50)[b]	<0.001**‡
Inotropes	2(0.9)	8(19)[b]	<0.001**‡
Mortality	0	2(4.8)[b]	0.023*‡

** P<0.001,* P<0.05, ţ Pearson Chi-Square, ‡ Fisher's Exact

Table-II. Association of clinical status with other characteristics of participants

Acute bronchial asthma and acute bronchiolitis are common over 2 years of age and under 2 years of age respectively as shown in Figure-1.

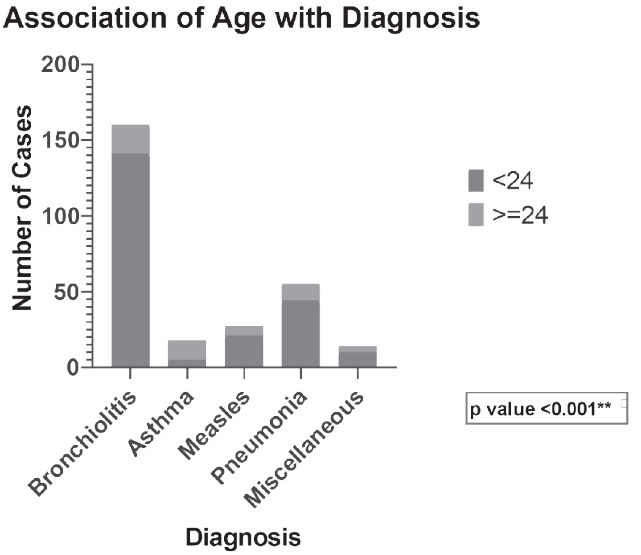

Figure 1. Association of age with diagnosis. (P<0.001, ţ Pearson Chi-Square)**

DISCUSSION

Acute and chronic respiratory diseases are very common in both children and adult from mild illness to severe life-threating leading to more than one billion deaths annually worldwide[21, 22]. The pattern and burden of respiratory illnesses vary from area to another area for a variety of factors. Respiratory diseases cause high morbidity and mortality in infant and children less than five-year-old in low-middle income countries.[23] LRTIs are the leading cause of deaths in children under the age of five years especially from low sociodemographic index countries, estimating about 70 deaths per 100,000 populations.[24] Several published pediatric clinical reports from Pakistan have reported LRTIs like pneumonia are the leading cause of death in infants and children under-five of age.[25,26]

However, there is very low reported mortality from acute respiratory illnesses in PICUs of developed countries.[27] For the management of acute respiratory infections required timely recognition of severity of illness and quick implementation of appropriate simple therapy like oxygen supplementation and positive pressure ventilation for hypoxemia and respiratory failure as well

as fluid therapy and vigilant use of vasoactive drugs for treatment of associated shock. All these supplies and stuffs are available. However, their uses are limited due to lack of knowledge and skills among healthcare staffs. There is a great need of education and training in a timely recognition and appropriate management of respiratory distress and failure to improve the outcome of such illnesses because the incidence is still rising.

We observed very good survival rate from acute respiratory illnesses from a newly opening PICU of a public-sector children hospital. Effective management strategies significantly improve the chances of survival. It can be a major reason for improved outcome. It is a well-known that there is a lack of structured designed intensive care unit, trained and adequate number of healthcare staff, access to medications, supplies and equipment. We have implemented a well-known preparedness tool "4-S frameworks" [composed of system, space, staff, and stuff] for initiating a new project to provide a standard quality of care.[17] Establishing a new PICU is a complex process with an optimal design can help reduce medical errors, improve patient outcomes, reduce the length of stay and reduce costs. The growth of PICUs in LMICs including Pakistan is significant. There are only few units in the whole country fulfills the 4S criteria.[28]

The strength of this study is the implementation of structured and organized work showed a big difference. This study also emphasized that availability and implementation of timely appropriate, low-cost and basic intensive care treatment significantly reduces respiratory-related mortality. Our study has had several limitations, including retrospective, single center and small sample size, although the cohort was adequately characterized for clinical research implications. There was no microbiological assay of respiratory specimen due to non-availability at that time. There were other limitations like only limited number of respiratory diseases.

CONCLUSION

Most of children admitted with ALRTIs in PICU and low-cost, timely intervention significantly improved the outcome. A prospective, multi-center with large sample size is needed.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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AUTHORSHIP AND CONTRIBUTION DECLARATION	
1	**Atia Aijaz:** Data collection, manuscript writing.
2	**Aqsa Majeed:** Data collection, analysis.
3	**Anwar-ul-Haque:** Concept, study design, manuscript editing.