International Journal for Multidisciplinary Research (IJFMR)
E-ISSN: 2582-2160 ● Website: www.ijfmr.com ● Email: editor@ijfmr.com

Utilize the Acute Illness Observation Scale by Associating the Score with Radiological Findings and Oxygen Saturation Findings in Community-Acquired Pneumonia

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Abstract

Community Acquired Pneumonia (CAP) remains a significant burden impacting morbidity and mortality in infants and children. Scales are available to evaluate the severity and outcomes, thereby influencing illness prognosis. This study evaluated the effectiveness of the Acute Illness Observation Scale (AIOS) in predicting the severity and outcomes of community-acquired pneumonia.

Introduction

Community-acquired pneumonia (CAP) is a lung infection caused by several bacteria obtained from the community. It results in inflammation of lung tissue. The clinical presentation typically includes fever and respiratory symptoms, including cough and tachypnoea; however, symptoms may lack specificity in young children.

Pneumonia is the primary infectious cause of mortality worldwide in children under five years of age, responsible for around 920,000 fatalities annually. Long-term illness and death are most likely to happen to babies who were born prematurely or with low birth weight, people whose immune systems aren't working well, and people who already have other health problems, like malnutrition or congenital heart disease. [2] Addressing pneumonia and decreasing the Under-Five Mortality Rate (U5MR) attributable to it does not necessitate significant technological advancements; rather, it involves identifying the children most at risk and implementing effective interventions to bridge the gap.[3]

Simple protocols, like Integrated Management of Neonatal and Childhood Illness (IMNCI), can help doctors diagnose and treat community-acquired pneumonia in primary care settings and referral hospitals, which greatly lowers the death rate among children.[4] The IMNCI method will work better for treating pneumonia if combined with a disease severity rating system that can quickly figure out how serious the illness is at all stages, from the start to the end of recovery. The Acute Illness Observation Scale (AIOS) is a general illness severity scale based on clinical presentation rather than detailed symptomatology. It helps improve triage criteria, make early referrals, figure out who needs to go to the hospital and start therapeutic interventions in poor countries. AIOS is a validated clinical index utilizing a three-point scale for six ordinal variables, with a total score range of 6 to 30, initially introduced by McCarthyPL.[5] AIOS focuses on six readily observable variables that collectively serve as a sensitive indicator of serious illness in children. The occurrence of severe bacterial infections is at 2-3% when a febrile child scores 10 or less and over 90% when the AIOS score is 16 or more.

A lot of research has shown that AIOS can help find serious illnesses in kids with fever. However, not as much research has been done on how AIOS can be used to find community-acquired pneumonia, especially in India. The study aimed to evaluate this scale's effectiveness in analyzing CAP's severity and outcomes.

Materials & Methods

This was an observational study conducted in the Department of Paediatrics, AVMCH. The study was approved by the Institutional Ethical Committee. Children between 2 months to 60 months presenting with fever, cough< 2 weeks with the following symptoms like fast breathing, chest in drawing, Stridor in calm child, Lethargy, Grunting, Inability to drink were included for the study.

Children with a duration of illness of more than 2 weeks, previously diagnosed asthma, underlying cardiac disease, and other conditions like IEM and chronic lung disease, Children with neurological conditions like developmental delay and neurodegenerative disorders were excluded from the study.

Procedure

Children aged 2 to 60 months coming to the outpatient department with suspected pneumonia, if satisfying the inclusion criteria were enrolled into the study group after obtaining informed consent. Those children would either be admitted or given treatment as outpatients based on Acute illness severity score as evaluated by IMNCI classification. AIOS scoring was done on each subject from day 1, 2, and 5 by two persons simultaneously in a reasonably quiet state.

Respiratory parameters, vital signs and pulse oximeter readings of each patient in data collection form were documented. Chest x-ray, complete blood count and blood culture were performed within 24 hours of admission. A chest x-ray was interpreted by a radiologist who was blinded to the study based on WHO guidelines for the interpretation of X-rays in pediatric pneumonia. Treatment, investigations, and the disease course are documented as per the data collection form.

Data was collected and compiled by Microsoft Excel with SPSS 23.0 version. Frequency, Percentage, Means, and Standard deviation (SD) were calculated. The chi-square test was used to find the proportions of categorical variables. P value <0.05 is found significant.

Results

A total of 190 children were enrolled in the study age ranging from 2 months to 60 months. There were 115 females and 75 males. 56 female children of 2-12 months age, 34 children of 12-36 age group, and 25 children of age group >36 months are observed in the study. In males, 40 children fall under 2-12 months of age; 25 children below 12-36 months, and 10 children who fit to > 36 months of age have participated. Overall there were 96 toddlers in the 2-12 months age group; 59 children in the 12-36 months and 35 children in the> 36 months type.

Table 1: Showing Respiratory Morbidity distribution on Day 1

Sign		Male	Female	Total	Percentage
Respiratory rate/min	40-50	30	59	**89**	**46%**
	51-60	25	43	**68**	**35%**
	>60	20	13	**33**	**17%**
Intercoastal retraction		57	38	**95**	**50%**

Subcoastal retraction	Mild-moderate Severe	45 30	79 36	**124** **66**	**65%** **34%**
Grunt		21	32	**53**	**27%**
Cyanosis		5	8	**13**	**7%**
Lethargy		28	52	**80**	**42%**
Convulsion		4	7	**11**	**6%**
Inability to drink		15	27	**42**	**22%**
Abnormal capillary refill time (>2 sec)		10	12	**22**	**11%**
Decreased breath sounds		10	20	**30**	**15%**
Bronchial breathing		6	5	**11**	**6%**
Crepitations		70	98	**168**	**88%**
Wheeze		14	20	**34**	**17%**
Vocal resonance	Decreased Increased	9 11	15 13	**24** **24**	**12%** **12%**

Respiratory morbidity distribution on day 1 is as follows

Fever and cough were seen in almost all the children; Tachypnoea is noted in 98% of cases; Concerning dangerous symptoms; 42% had lethargy; 7% had cyanosis; 27% of children had grunting; 6% had convulsion; 22% were unable to drink; Respiratory rate > 60 was denoted in 17% of study participants; Mild to moderate retraction was seen in 65% of children and severe retraction was seen in 34% of children.

Table 2: Respiratory Morbidity Distribution on Day 5

Sign		Male	Female	Total	Percentage
Respiratory rate/min	40-50 51-60 >60	29 27 19	59 43 13	**88** **67** **35**	**46%** **34%** **18%**
Intercoastal retraction		45	30	**75**	**39%**
Sub coastal retraction	Mild- moderate Severe	63 12	86 29	**149** **41**	**78%** **21%**
Grunt		19	18	**37**	**19%**
Cyanosis		5	8	**13**	**7%**
Lethargy		15	48	**63**	**33%**
Convulsion		3	7	**10**	**6%**
Inability to drink		13	25	**38**	**20%**
Abnormal capillary refill time (>2 sec)		3	13	**22**	**11%**
Decreased breath sounds		10	20	**30**	**15%**
Bronchial breathing		5	6	**11**	**6%**

Crepitations		70	98	**168**	**88%**
Wheeze		12	22	**34**	**17%**
Vocal resonance	Decreased	9	15	**24**	**12%**
	Increased	11	13	**24**	**12%**

Respiratory morbidity distribution on day 5 is as follows

Tachypnoea is noted in 98% of cases . Intercoastal recession was 39%; Subcoastal recession was 78%; Grunt was seen in 19% of cases; Lethargy in 33%; Convulsion in 6%; Inability to drink in 20% of incumbents; Abnormal capillary refill time in 11%; Bronchial breathing in 6%; Crepitations in 88% and Wheeze in 17% of children.

All the children obtained pulse oximetry readings from day 1 to day 5, and the recordings of days 1 and 5 were denoted below. 14 cases had Spo_2 below 85% on day 1; 12 cases on day 5; 71 study group had Spo_2 85-92% on day 1; and 56 on day 5; 105 had >92% Spo_2 on day 1; 122 on day 5.

Of the present subjects, 45% had normal Chest X-ray findings, and 54% had significant abnormalities. Endpoint consolidation was noted in 40% of cases and 60% had non-end point infiltration.

On the day of admission,

- Spo2 reading of <92% at admission period, predicted abnormal chest x-ray was seen in 84 out of 105; normal chest x-ray in 29 out of 85 patients.
- 106 had Spo2> 92% at admission period and predicted abnormal chest x-ray was seen in 50 and normal chest x-ray was seen in 56.

Table 3: Correlating Spo2 with Chest X-ray

Chest X-Ray	>92 (n=105)	85-91(n=71)	<85(n=14)	P value
Normal	56	19	10	0.001*
Abnormal	50	48	36	

There was a significant association between Spo2 and Chest X-ray

Table 4: Showing AIOS score in study participants on day 1

Age	<10(%)	11-15(%)	>16(%)
2-12 months	57 (56%)	34(32%)	5(4%)
12-36 months	21(12%)	20(11%)	18(10%)
>36 months	17(5%)	13(5%)	5(2%)

Table 5: Depicting AIOS score of included children on day 5

Age	<10(%)	11-15(%)	>16(%)
2-12 months	55 (52%)	37(35%)	5(5%)
12-36 months	19(11%)	25(15%)	15(9%)
>36 months	15(5%)	18(6%)	2(0.7%)

Table 6: Showing the correlation between AIOS scores with Chest X-Ray

Chest X-Ray	<10	11-15	>16	P value
Normal	32	28	25	<0.05
Abnormal	65	33	7	

There was a strong correlation between AIOS scores with chest X-ray

Table 7: Correlation between AIOS with Spo2

Spo2 reading (%)	<10	11-15	>16	P value
<85	6	5	3	0.001
85-92	25	32	14	
>92	45	48	12	

Pearson correlation test is used to find the significance between AIOS score with Spo2.

Discussion

Childhood pneumonia is recognized as the most significant infectious disease in several underdeveloped and developing countries. [6] Community-acquired pneumonia (CAP) represents a notable public health issue. When combined with influenza, it ranks as the eighth-leading cause of mortality in the United States and the primary infectious cause of death in developed nations. The location of care has a big effect on costs, and the right location is thought to improve outcomes. For this reason, a precise assessment of severity in CAP is thought to be very important. Community-acquired pneumonia (CAP) research has always had trouble because it's hard to tell how bad pneumonia is and predict it. Despite this, severe CAP (SCAP) is still a major clinical and public health problem. [7]

The diagnosis of pneumonia cannot rely on a single component of the history or physical examination; rather, it necessitates the consideration of multiple symptoms. Adults presenting with an acute cough exhibit a 5% probability of progressing to pneumonia.[8] The lack of any significant vital sign abnormalities (blood pressure, heart rate, and breathing rate) reduces the expected probability of pneumonia to 1%. A chest radiograph is indicated for patients exhibiting abnormal vital signs, specifically a temperature exceeding 100°F, a heart rate surpassing 100 bpm, or a respiration rate above 20 bpm. Imaging should be obtained to examine anomalies such as crackles or diminished breath sounds in a patient who does not have asthma.

In comparison to AIOS, which is considered a highly sensitive measure for assessing the severity of pneumonia, traditional history-taking and physical examinations exhibit low sensitivity.[9]

A study by McCarthy PL et al. in 1982 looked at whether comprehensive observational assessment improves the diagnostic method for severe illness in febrile children. This method includes getting a medical history and doing a physical exam. The study evaluated children under 24 months exhibiting fever symptoms to determine the sensitivity of the combined examination. [10-13]

This study showed improved sensitivity and correlation when integrating AIOS scoring with patient history and physical examination.

Research has demonstrated that the compromised general status, involving various observation variables of AIOS, is a significant and independent predictor of serious illness. [14-16]

The current study was conducted at AVMCH, Pondicherry, to evaluate the effectiveness of AIOS in predicting pneumonia and to examine the correlation between AIOS, radiological findings, and SpO2

levels. In our analysis of approximately 115 representative cases, 61% were female, while 39%, or 75 cases, were male.

Children aged 2-12 months comprised 96 cases (50%), those aged 12-36 months accounted for 59 cases (31%), while kids over 36 months represented a smaller group with 35 cases (18%). The observations align with the findings of Murali and Mulage, Anoop et al., and Reddy et al., indicating that infants are at an increased risk of developing community-acquired pneumonia. [17-19]

In terms of respiratory morbidity, lethargy was observed in 60 subjects, grunting in 53, inability to drink in 42, and convulsions and bronchial breathing in 11 each. The symptoms exhibited were nearly identical on the first day of admission and the fifth day.

Mild to moderate retraction was observed in 65% of study subjects, while severe retraction was identified in 34% of individuals. SpO2 showed improvements from day 1 to day 5 in several instances. The aforementioned observations were documented in the study conducted by Cevey-Macherel M et al. The AIOS scoring system was examined by Bhavaneet Bharathu et al. to assess its effect on severe childhood pneumonia in children aged 2 to 59 months. [20]

Akash Bang et al. and Rajesh VT et al. utilized this score to identify bacteremia in children under 36 months with fever. [21,22]

Walker et al. looked at how well the AIOS score and IMCI could predict pneumonia in kids ages 2 to 59 months by comparing their sensitivity and specificity. [23] When trying to guess how someone with pneumonia will do, things like their vital signs, age, underlying conditions, the amount of pneumonia they have, and what the x-rays show are likely to play a role. However, the degree of radiologic involvement has not been quantified on chest X-rays, complicating their inclusion as prognostic predictors. [24,25] Recently, chest radiography has emerged as the preferred imaging modality for assessing patients with suspected pneumonia due to its minimal radiation exposure, cost-effectiveness, and broad availability. In clinical practice, x-rays are used to confirm the diagnosis of pneumonia, see how bad and widespread the condition is, find complications like empyema, check how well treatment is working, and look into possible other or alternative diagnoses. [26]

The current findings indicate a significant correlation between AIOS and radiological abnormalities. This approach can inform decisions regarding X-ray assessments and mitigate unnecessary radiation exposure in pediatric pneumonia cases.

X-ray findings indicated endpoint infiltration in 60% of subjects. Abnormal radiological findings were prevalent in cases with AIOS scores exceeding 16 during acute respiratory infections. A significant correlation was identified with $P<0.05$.

Because scores are subjective, the Karl-Pearson correlation was used to look at how different observers scored. The results showed a strong positive correlation. According to the results, there is a link between the AIOS score and both the first pulse oximeter reading and the choice to give extra oxygen. Thus, it serves as a tool for assessing the necessity of administering oxygen to patients in resource-limited settings. In this observation, 18 children exhibited hemoglobin levels below 7, while 129 had hemoglobin levels ranging from 7 to 9. Nine and thirty-two children were between levels ten and eleven, followed by eleven infants with hemoglobin levels exceeding eleven. The findings align with the reports of Reddy et al., which indicated that moderate anemia was observed in children with pneumonia.

The study's strengths include the duration of hospital stay, the requirement for oxygen support, and the necessity for ICU admission, all of which demonstrate a strong correlation with AIOS scores. The study

has limitations; while AIOS can screen clinical outcomes in children with pneumonia, it is not superior to IMNCI in specific aspects.

Conclusion

AIOS scoring has high external validity, good internal consistency, and great interobserver agreement among two observers. AIOS scores can predict aberrant X-ray results and the severity of respiratory infections in children aged 2 to 60 months. AIOS can be used as a tool for selecting therapeutic options and forecasting a child with pneumonia admitted to the hospital by a physician.

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