



## Study to Evaluate the Effectiveness of Acute Illness Observation Scale (AIOS) in Predicting the Severity of the Illness and Determining the Management Among Children of 2-60 Months of Age with Acute Respiratory Illness

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#### ABSTRACT

Acute Illness Observation Scale (AIOS) system developed by P.L. McCarthy a generic illness severity scoring system uses 6 easily observed parameters are shown to be a sensitive indicator of illness in children. Present study was aimed to study the effectiveness of Acute Illness Observation Scale (AIOS) in predicting the severity of the illness among children of 2-60 months of age with acute respiratory illness. Present study was Descriptive epidemiological study, conducted in children between 2-60 months with suspected acute respiratory illness. On day 1 AIOS Scoring was done and outcome was compared with the score on Day 5. A total of 50 children were enrolled, majority were from age group 13-36 months (48%) were male (62%). All children with tachypnea were admitted, where about 46% of children had respiratory rate between 40-50, while 22% of children had respiratory rate more than 60. Intercostal/subcostal retractions were also found in about 60% of cases, with grunt in 20% cases, cyanosis in 1 child, inability to drink in 18% of cases. Abnormal breath sounds like crepitation were found in 10 (20%) children, wheeze in 11 children, decreased breath sound were found in 13 children (26%). 42% of children scored abnormally ( $\geq 16$ ) at the initial presentation, while about 20% children scored between 11-15 and 38% children scored near normal ( $\leq 10$ ). Majority of children between age group 12-36 months scored abnormally ( $\geq 16$ ) at the initial presentation. Mean score at the initial presentation is 14.56. The reduction in the score between day 1 and day 5 were statistically significant among all the three scores ( $p < 0.05$ ). AIOS can be used as a tool to decide on therapeutic modalities and prognosticating a child with pneumonia admitted to the hospital by a physician.

## INTRODUCTION

Pediatric respiratory disease remains an important cause of morbidity in both the developing and the developed world. It has become the most common reason for parents taking their children to see the clinician and to the emergency department with a pediatric medical problem<sup>[1]</sup>. In India about 45 million acute respiratory illness episodes are estimated annually accounting for 6.6 million hospitalizations, which contribute to 24% national disease burden with 0.37 million deaths annually<sup>[2]</sup>. In India Pneumonia is responsible for the high morbidity and mortality amongst children <5 years. It is essential to formulate the criteria to triage, classify and treat or refer the children in developing countries. The strategy developed by IMNCI seeks to reduce the morbidity and mortality in children by improving the management of illness in family and community practices. It relies on case detection by using simple clinical assessment and research based treatment. Acute Illness Observation Scale (AIOS) system developed by P.L. McCarthy a generic illness severity scoring system uses 6 easily observed parameters are shown to be a sensitive indicator of illness in children<sup>[3,4]</sup>. Using the Acute illness observation scale can also be rationalized with the curative services of the hospital management. Present study was aimed to study the effectiveness of Acute Illness Observation Scale (AIOS) in predicting the severity of the illness among children of 2-60 months of age with acute respiratory illness.

## MATERIALS AND METHODS

Present study was Descriptive epidemiological study, conducted in department of Pediatrics, at Govt. Royapettah Hospital/ KMC, Chennai, Tamilnadu, India. Study duration was of 1 year (March 2018-February 2019). Study was approved by institutional ethical committee.

### Inclusion Criteria:

- Children between 2 months to 60 months presenting to OPD with fever, cough and difficult breathing <2 weeks with any of the signs: as Fast breathing 2 Months-12 months >50 breaths/min OR 12 Months-5 years >40 breaths/min), Chest in drawing, Stridor in calm child, Lethargy, Convulsion, Grunting, Inability to drink and parents willing to participate in present study.

### Exclusion Criteria:

- Duration of illness >2 weeks.
- Known case of Asthma.
- Any underlying cardiac diseases.
- Other conditions like IEM, Chronic Lung Disease etc.

- Neurological conditions like Developmental delay, neurodegenerative disorders.

Study was explained to participants in local language and written informed consent was taken. Children between 2 months to 60 months attending OP with suspected pneumonia, if satisfying the criteria of inclusion were enrolled as the study group and were admitted and classified according to IMNCI based on severity assessment. On day 1 AIOS Scoring was done using the 6 parameters and given scoring as 1 for normal, 3 for moderate and 5 for severe disease, with final score ranging from 6-30 depending on the severity, in a reasonably quite state by a single observer. Similarly, AIOS scoring was done and followed for respiratory parameters to determine the outcome of illness on Day 5, where the outcome will be compared with the initial score on Day 1.

- Pulse oxy meter reading of each patient was recorded.
- Vital signs including respiratory rate were collected and documented.
- At the time of admission, complete blood count, Chest X ray was done within 24 hrs.
- Interpretation of Chest X Ray was done by a radiologist who was blinded about the study.
- Treatment was decided according to the initial AIOS score at presentation, where children with score >16 were started on IV antibiotics and nasal oxygen and intravenous fluid depending on the respiratory distress. Rest of the children were treated according to the IMNCI protocol.
- The children were followed up until discharge from the hospital.

Data was collected and compiled using Microsoft Excel, analysed using SPSS 23.0 version. Frequency, percentage, means and standard deviations (SD) was calculated for the continuous variables, while ratios and proportions were calculated for the categorical variables. Difference of proportions between qualitative variables were tested using chi-square test or Fisher exact test as applicable. P value <0.5 was considered as statistically significant.

## RESULTS AND DISCUSSIONS

A total of 50 children were enrolled in the study, age ranging from 2 months to 60 months. Children in the age group 13-36 months were more affected (48%). Male (62%) incidence was higher than the females (38%). Male: female ratio was 1.63:1. While considering the nutritional status, majority of children were between 3rd and 15th percentile (32%), while children below 3rd percentile were 14% and children above 97th percentile according to WHO were 4%.

**Table 1: General Characteristics**

Characteristics	No. of subjects	Percentage
Age group (in years)		
2-12 months	18	36
13-36 months	24	48
37-60 months	8	16
Gender		
Male	31	62%
Female	19	38%

Children who presented to outpatient department with complaints of fever, cough and breathlessness were enrolled into the study. Among the danger signs, majority of the children had lethargy (40%), while inability to drink (18%) and grunt (20%) were least common. None of the children had convulsions.

**Table 2: Danger Signs**

Danger signs	No. of subjects	Percentage
Lethargy	20	40
Inability to drink	9	18
Grunt	10	20
Convulsion	0	0

All children with tachypnea were admitted, where about 46% of children had respiratory rate between 40-50, while 22% of children had respiratory rate >60. Intercostal/subcostal retractions were also found in about 60% of cases, with grunt in 20% cases, cyanosis in 1 child, inability to drink in 18% of cases. Abnormal breath sounds like crepitations were found in 10 (20%) children, wheeze in 11 children, decreased breath sound were found in 13 children (26%).

**Table 3: Respiratory Parameters**

Respiratory Signs	Total	%
Respiratory Rate		
40-50	23	46
51-60	16	32
>60	11	22
Subcostal / Intercostal Recession	30	60
Decreased breath sound	13	26
Wheeze	11	22
Grunt	10	20
Crepitations	10	20
Inability to drink	9	18
Bronchial Breathing	8	16
Increased Vocal Resonance	8	16
Cyanosis	1	2
Abnormal Capillary refill time	1	2
Convulsion	0	0

Pulse oximetry reading was done on the children at admission, day 2 and day 5. Children with spO<sub>2</sub> <85, was found to have cyanosis and only 1 child had cyanosis with saturation 83% and 68% children were having saturation between 86-92% and remaining 30% were having saturation >92%. Chest X ray was done in all subjects at the time of admission. Normal findings were seen in about 40% children, abnormal in 30 children, where infiltrates found in 22 children (56%) and consolidation was seen in 16% of children. Leukocytosis was seen in 17 children (34%), where the

total count >11000 was considered leukocytes.

**Table 4: Clinical Examination and Investigations**

Characteristics	No. of subjects	Percentage
SpO <sub>2</sub>		
<85	1	2
86-92	34	68
>92	15	30
CXR Finding		
Normal	20	40%
Infiltrates	22	44%
Consolidation	8	16%
INVESTIGATIONS		
Leucocytosis	17	34

According to IMNCI classification, of the total 50 children, 20% of them (10), had fever, cough, tachypnea and was diagnosed pneumonia, while the remaining 80% (40) had distress along with retractions or grunt or lethargy and was diagnosed as Severe Pneumonia.

**Table 5: Diagnosis According to IMNCI**

Diagnosis	No. of subjects	Percentage
Pneumonia	10	20%
Severe pneumonia/	40	80%

During their course of management, (2%) 1 child was so severely affected that the child needed mechanical ventilation for respiratory failure and 1 child (2%) needed inotropic support for shock management. Nasal Oxygen was administered for 66% (33/50) of cases in view of severe respiratory distress. Majority of children, about (32/50) 64% of them required maintenance intravenous fluids because of respiratory distress and/or dehydration and/or refusal of feeds. Parenteral antibiotics were administered in majority(82%) of patients while remaining were treated with oral antimicrobial (18%). During the hospital stay 1 child (2%) developed complication in the form of shock. About 60% of children had hospital stay between 6-14 days, with range 5-12 and mean duration of stay was 6.78 days and all were discharged after treatment. No deaths were encountered during the course of the illness.

**Table 6: Treatment Required for the Subjects**

Treatment Done	No. of subjects	Percentage
Antibiotics		
Oral	9	18%
Intravenous	41	82%
Nasal O <sub>2</sub>	33	66%
Intravenous Fluids	32	64%
Nebulisation	12	24%
Mechanical Ventilation	1	2%
Complication	1	2%

Acute illness observation scale (AIOS) is a generic illness severity scale developed by P.L. McCarthy. AIOS is a 3 point scale for six ordinal variables and total score range from 6-30. In our study, about 42% of children scored abnormally ( $\geq 16$ ) at the initial presentation, while about 20% children scored between 11-15 and 38% children scored near normal

(≤10). Majority of children between age group 12-36 months scored abnormally (≥16) at the initial presentation. Mean score at the initial presentation is 14.56.

**Table 7: AIOS Score at Admission**

	AIOS SCORE On day 1					
	≤10		11-15		≥16	
	N	%	N	%	N	%
2-12 years	18	6 (31.6 %)	4	40	8	38.1%
12-36 years	24	9 (47.4 %)	4	40	11	52.4%
>36 years	8	4 (21.1 %)	2	20	2	9.5%
Total	19		10		21	

X2 value=1.36 , df=4. P value >0.05 not significant

In the individual item analysis of AIOS, 94% and 78% of affected children scored normally for variables-color and-hydration status respectively. In contrast majority of children showed worst score in the variable -response to social overtures. At the initial presentation, of the 50 children, 19 of them showed normal score for quality of cry, while 62% of children (31) showed abnormal score 3/5. In view of response to parent stimulation, where abnormal score was seen 76% (38) of children. 66% children scored abnormal for state variation, while majority of children had normal score in variables like colour and hydration. But almost majority of children (49) 98% showed worst score for social over tunes.

**Table 8: Individual Variable Analysis**

Items	Normal Score (=1)	Abnormal SCORE (=3or5)
Quality of cry	19 (38%)	31 (62%)
Response to parent stimulation	12 (24%)	38 (76%)
State variation	17 (34%)	33 (66%)
Colour	47 (94%)	3 (6%)
Hydration	39 (78%)	11 (22%)
Response to social overtones	1 (2%)	49 (98%)

When comparing the respiratory morbidities of the children with the scores during their initial presentation, children scoring >10, had marked significance with lethargy (p<0.05,11.4) and grunt (11.45, p<0.05), while inability to drink and convulsion, does not show much significance(p>0.05). Higher scores thus found to be significantly correlating with clinical features of Pneumonia. When comparing with the physical signs and the AIOS, children who scored >16 had significant correlation(p<0.05,12.4) with decreased breath sounds and with crepitations, where almost all children who scored above 16, were having decreased breath sounds either due to consolidation or infiltrates. 38.1% of children with AIOS >16, had increased vocal resonance (p<0.05, 13.1) and bronchial breath sounds(p<0.05, 13.4), which were statistically significant. On relation of AIOS to the pulse oximetry readings in children, severe hypozeugma was seen in 1 child (4.8%) with saturation <85, while about 68% of children had saturation between 85-92, (p<0.05, 14.4)

showing significance and scored higher values in AIOS (>15), whereas 30% of children scored normal AIOS with saturation >92. Complete blood count and blood culture was done in all subjects at the admission and those children with AIOS >16, showed significant statistical correlation for leukocytes (p<0.05, 7.98). 78.9% of children with normal X ray had scored AIOS <10, while children 52.4% children with infiltrates had scored >16 and those with consolidation had major significance with all of them scoring AIOS >16 with (p<0.05, 20.4). The reduction in the score between day 1 and day 5 were statistically significant among all the three scores (p<0.05). There was no worsening of the score in any of the children during the hospital stay. Complications were absent in those children who scored ≤10, while complication were seen in a child those who scored ≥16, in the form of shock. All the cases were discharged at the end of the treatment, after assessing the decreased severity of the disease, where 50 cases were discharged and none of the death had occurred in any of the AIOS groups, with a mean hospital stay of 6.78 days with range 5 -12 days.

In India, Childhood pneumonia represents one of the most common and infective illnesses and it is an importance cause of preventable mortality in children, especially in children under 5 years. In order to overcome this global problem, WHO brought a strategy for effective case management that had marked impact on mortality of under 5 children due to pneumonia in developing countries, like India. Age is an important predictor of morbidity and mortality in pediatric pneumonias. In the present study, conducted between the age group of 2 months to 60 months, majority (48%) were in the age group between 13-36 months. Whereas in studies done by Reddaiah<sup>[5]</sup> and Sehgal<sup>[6]</sup> (52.2%), on prediction of mortality and morbidity factors in under 5 children with ARI, majority of children with pneumonia were in the age group of <1 year with prevalence 63.2% and 52.2% respectively. Regarding sex distribution, in our study it was observed that male (62%) incidence was higher than the females (38%). Male: female ratio was 1.63:1. The study conducted by Sehgal<sup>[6]</sup> had the same incidence of higher male to female ratio, with males constituting 58.25% of the total study population. In our study, we included all children who presented with fever, cough and breathlessness, but tachypnea (100%) and chest retractions (60%) were the important signs for making a clinical diagnosis of pneumonia. Palafox<sup>[7]</sup> found that tachypnoea (as defined by WHO) had a 74% sensitivity and 67% specificity for radiologically defined pneumonia. Among the total no. of children admitted for the study, 20% were diagnosed as Pneumonia and remaining 80% as severe pneumonia according to IMNCI. On applying the AIOS score on the patients,

**Table 9: Symptoms Correlation with the AIOS**

Symptoms	No. of subjects	AIOS						Chi square, P value
		10		11-15		>16		
		N	%	N	%	N	%	
Breathlessness	50	19	100	10	100	21	100	-
Lethargy								
Yes	20	5	26.3	1	10	14	66.7	11.45., <0.05*
No	30	14	73.7	9	90	7	33.3	
Grunt								
Yes	10	1	5.3	0		9	42.9	11.45., <0.05*
No	40	18	94.7	10	10	12	57.1	
Inability to drink								
Yes	9	1	5.2	3	30	5	23	2.3 >0.05
No	41	18	94.8	7	10	16	76.1	
Convulsion								
No	50	19	100	10	100	21	100	
Tachypneic	50	19	100	10	100	21	100	-
Total		19		10		21		

**Table 10: AIOS Correlation with Signs**

Signs	No. of subjects	AIOS						Chi square, P value
		10		11-15		>16		
		N	%	N	%	N	%	
Cyanosis								1.4 df=2 >0.05
Yes	1	0		0		1	4.8	
CRT								
<3 Sec	49	19	100	10	100	20	95.2	1.4 df=2, >0.05
>3 sec	1	0		0		1	4.8	
Decreased Breath Sound								
Yes	13	0		0		13	100	;<0.05*
No	37	19	100	10	100	8	66.7	
Wheeze								
Yes	11	5	26.3	2	20	4	19	0.83, >0.05
No	39	14	73.7	8	80	17	81	
Crepitations								
Yes	10	0		1	10	9	42.9	12.4, <0.05*
No	40	19	100	9	90	12	57.1	
Bronchial Breathing								
Yes	8	0	0	0		8	38.1	(<0.05*), 13.4,
Vocal Resonance								
Increased	8	0	0	0	0	8	38.1	(<0.05*), 13.1

**Table 11: AIOS and Its Correlation with Pulse Oximetry**

	No. of subjects	AIOS						Chi square, P value
		10		11-15		>16		
		N	%	N	%	N	%	
SpO2								
<85	1	0		0		1	4.8	14.4
85-92	34	8	42.1	7	70	19	90.5	<0.05*
>92	15	11	57.9	3	30	1	4.8	
Leucocytosis								
YES	17	2	10.5	4	40	11	52.4	7.98 df=2 <0.05*
NO	33	17	89.5	6	60	10	47.6	
XRAY								
Normal	20	15	78.9	3	30	2	9.5	20.4
Infiltrates	22	4	21.1	7	70	11	52.4	<0.05*
Consolidation	8	0	0	0	0	8	100	

**Table 12: AIOS on Day 1 and Day 5**

SCORE	DAY 1		DAY 5	
≤10	19	38%	49	98%
11-15	10	20%	1	2%
≥16	21	42%	0	0

**Table 13: AIOS vs Complications**

Complications	AIOS						Chi square, P value
	10		11-15		>16		
Present	1	0	0	1	4.8	1.4	>0.05
Absent	49	19	10	20	100		

about 21 (42%) children scored >16, while 19 (38%) of them scored below 10 and the remaining scored between 11-15. In the individual item analysis of AIOS, 94% and 78% of affected children scored normally for variables-color and-hydration status respectively. In contrast majority of children showed worst score in the variable-response to social overtures. In the study conducted by Paul L McCarty<sup>[4]</sup>, discriminate function analysis revealed that these six items when used together had a specificity of 88% and sensitivity of 77% for serious illness. Another study conducted by Lingaraj<sup>[8]</sup> on AIOS, showed that 88.9% and 80% of children scored normal for color and hydration, which was consistent in our study. In our study, the other parameters which were significant was grunt (20%), crepitations (20%), lethargy, were observed in children who scored >16 at the time of admission. Also, the study conducted by Bharti<sup>[9]</sup> on the Role of AIOS on managing severe pneumonia showed the percentage of children with grunt(55.5%), retractions (55.5%), tachypnea was significantly higher in those children who scored >16 at the time of admission. In our study, severe hypoxemia was seen in 4.8% (1/50) with saturation <85, while majority (68% )of children had saturation between 85-92 and scored higher values in AIOS ( 11-15), whereas 30% of children scored normal AIOS with saturation >92. In a prospective study from Zambia, conducted by Smyth<sup>[10]</sup> on clinical predictors of hypoxemia in pneumonia, severity and risk of death from pneumonia was significantly high ( $p<0.05$ ) when hypoxaemia (spo2 <92) was present. In our study, the abnormal radiological changes were seen in about 60% (30) children, majority (73%) of which was in the form of infiltrates(22/50). While (52.4%) of children with infiltrates had scored >16 and those with consolidation had major significance with all of them scoring AIOS >16 with ( $p<0.05$ , 20.4). In a study conducted by Murali<sup>[8]</sup> showed that about 53.2% of children had abnormal X ray findings with score >16. This shows the significance of X ray abnormalities were more when the score was high. On the view of deciding initial therapeutic modalities, about 66% of children were in need of nasal O2 due to respiratory distress, of which (18/33) 54.4% were having AIOS score >16 and in case of intravenous fluids, among 32, 18 of them (56.2%) who needed IV fluids were having AIOS score >16. Regarding the initiation of antibiotics, 9 of the children were started on oral antibiotics and they had score <10, while 23 children of 41 who had IV antibiotics, were having score >16, which had significant correlation ( $p<0.05$ ). According to the study conducted by Bharti<sup>[9]</sup> their study showed that 83.3% of children who had score >16, were started on parenteral antibiotics and had significant correlation with the AIOS score. On predicting the occurrence of

complications, shock and mechanical ventilator was needed in 1 child, whose AIOS score was >16 at the time of admission and did not have much significance( $p>0.05$ ). On day 1, 38% of patients were in the score < 10, while on day 5, 98% of patients were in the score below 10. 42% of patients were scoring >16 on day 1, while none of the patients scored >16 on day 5. The reduction in the score between day 1 and day 5 were statistically significant among all the three scores ( $p<0.05$ ) and also correlates significantly among the respiratory parameters. Hence the AIOS score correlates well on determining the clinical outcome. We observed that, AIOS scoring has good consistency in predicting severe pneumonia in children. The observed variables of AIOS had significant correlation and was an independent predictor of severity including hypoxemia, distress in pneumonia. AIOS correlates well with abnormal X ray findings and other investigations and therapeutic decision taken by the physician. AIOS had good correlation with initial SpO2 reading. AIOS predict and correlate well with clinical outcome in community acquired pneumonia. Limitations of present study were considerably low sample size. The feasibility and reproducibility of AIOS in elucidating its determining sensitivity may be low in case of less qualified workers.

## CONCLUSION

IMNCI can be used as a tool to triage and early referral of children with community acquired pneumonia in the fields by peripheral health care workers. AIOS can be used as a tool to decide on therapeutic modalities and prognosticating a child with pneumonia admitted to the hospital by a physician. In hospital curative services can be rationed with AIOS, where children with pneumonia can be treated with oral antibiotics alone if the AIOS score is less. And finally in resource poor setting, when a radiological facility is not available, AIOS can be used to predict the outcome of Pneumonia.

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