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AIOS v/s IMNCI IN COMMUNITY ACQUIRED PNEUMONIA

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HOW TO CITE THIS ARTICLE:

Murali B. H, Lingaraj Mulage. "AIOs v/s IMNCI in Community Acquired Pneumonia". Journal of Evolution of Medical and Dental Sciences 2014; Vol. 3, Issue 13, March 31; Page: 3260-3266, DOI: 10.14260/jemds/2014/2277

ABSTRACT: BACKGROUND AND OBJECTIVES: Community acquired pneumonia (CAP) continue to be the leading cause for morbidity and mortality of infant and young children in India. IMNCI is found to be an effective strategy for management of acute childhood respiratory illness which will be more effective in managing pneumonia when supplemented by an illness severity scoring system. In this regard use of Acute Illness Observation Score (AIOs)-an illness severity scale developed by P. L. McCarthy based on simple observation which acts as sensitive indicator of severity of illness in children. In this background the present study was undertaken to validate AIOs in predicting illness severity and clinical outcome of community acquired pneumonia. **METHODOLOGY:** This was a descriptive epidemiological study conducted on children in age group of 2-59 months, with clinical features of pneumonia as per WHO recommendations. IMNCI and Acute Illness Observation Scale (AIOs) scoring is applied on each subject to assess the severity of community acquired pneumonia. Respiratory parameters, investigations, treatment and disease course are documented and statistical analysis was done. **RESULTS:** AIOs scoring has good internal consistency and external validity. AIOs correlates well with clinical signs, abnormal X ray findings, initial SpO₂ reading, predicting and therapeutic decision taken by the physician and clinical outcomes. Comparing with IMNCI, sensitivity of AIOs in detecting illness severity in pneumonia group was very high but with a poor specificity, where as in very severe pneumonia its sensitivity was poor but had very high specificity. **CONCLUSION:** AIOs can be used as a tool to decide on therapeutic modalities and prognosticating a child with pneumonia admitted to the hospital. This study indicates the clinimetric validity of AIOs in managing childhood pneumonia and suggests its role in further enriching IMNCI strategy. **KEYWORDS:** Acute illness observation scale (AIOs), Community acquired pneumonia (CAP), Integrated Management of Neonatal and childhood illness (IMNCI).

INTRODUCTION: Pneumonia has become the most common reason parents cite for taking their children to see the general practitioner, and for attendance to the emergency department with a pediatric medical problem.¹ Recent estimates from the United Nations Children's Fund (UNICEF) show that pneumonia continues to be the number one killer of children around the world - causing 18% of all child mortality². India ranked no.1 in Global Mortality Rank in Pneumonia Deaths in Children under five.³

India being one of the countries with highest number of pneumonia deaths it is essential to optimize criteria for triage; early referral; hospitalization and commence treatment. This has been aided by the IMNCI strategy that simplifies the classification of illness severity for major acute childhood illness including pneumonia. Reports from UNICEF/WHO showed that only 1 in 5 caregivers know the danger signs of pneumonia and only about half of children sick with pneumonia receive appropriate medical care.⁴

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Hence, an illness severity scoring system based on “clinical appearance” rather than “complex symptomatology” that can quickly quantitate the severity of illness and optimize criteria for triage in a primary care setup will be helpful in effective management of pneumonia. In this regard use of AIOS- a generic illness severity scale developed by P.L. McCarthy- a three point scale for six observational factors is a validated clinical index of quantifying risk of serious bacterial infection in children 36 months or younger presenting with febrile illnesses.^{5,6}

Therefore, the primary objective of our study is to compare the acute illness observation scale (AIOS) with IMNCI in assessing severity of community acquired pneumonia and to assess the outcome of management of community acquired pneumonia by grading the severity of pneumonia.

6 OBSERVATION ITEMS AND THEIR SCALES (PLEASE CHECK BOXES THAT DESCRIBE YOUR CHILD'S APPEARANCE AND BEHAVIOR)			
OBSERVATION ITEM	NORMAL	MODERATE IMPAIRMENT	SEVERE IMPAIRMENT
1. QUALITY OF CRY	STRONG WITH NORMAL TONE ☐ OR CONTENT AND NOT CRYING ☐	WHIMPERING ☐ OR SOBBING ☐	WEAK ☐ OR MOANING ☐ OR HIGH PITCHED ☐
2. REACTION TO PARENT STIMULATION (Effect on crying when held, patted on back, jiggled on lap, or carried)	CRIES BRIEFLY, THEN STOPS ☐ OR CONTENT AND NOT CRYING ☐	CRIES OFF AND ON ☐	CONTINUAL CRY ☐ OR HARDLY RESPONDS ☐
3. STATE VARIATION (Going from awake to asleep or asleep to awake)	IF AWAKE, THEN STAYS AWAKE ☐ OR IF ASLEEP AND STIMULATED, THEN WAKES UP QUICKLY ☐	EYES CLOSE BRIEFLY, THEN AWAKENS ☐ OR AWAKENS WITH PROLONGED STIMULATION ☐	WILL NOT ROUSE ☐ OR FALLS TO SLEEP ☐
4. COLOR	PINK ☐	PALE HANDS, FEET ☐ OR ACROCYANOSIS (BLUE HANDS AND FEET) ☐	PALE ☐ OR BLUE ☐ OR ASHEN (GRAY) ☐ OR MOTTLED ☐
5. HYDRATION (Moisture in skin, eyes, mouth)	SKIN NORMAL AND EYES, MOUTH MOIST ☐	SKIN, EYES NORMAL AND MOUTH SLIGHTLY DRY ☐	SKIN DOUGHY OR TENTED AND EYES MAY BE SUNKEN AND DRY EYES AND MOUTH ☐
6. RESPONSE TO SOCIAL OVERTURES (Being held, kissed, hugged, touched, talked to, comforted)	SMILES ☐ OR ALERTS ☐ (2 months or less)	BRIEF SMILE ☐ OR ALERTS BRIEFLY ☐ (2 months or less)	NO SMILE, FACE ANXIOUS ☐ OR DULL, EXPRESSIONLESS ☐ OR NO ALERTING ☐ (2 months or less)

Table 1: Acute Illness Observation Scale⁷: Composition and Score Description

SCORE INTERPRETATION: Each item scored as Normal =1, Moderate impairment =3, Severe impairment =5.

MATERIALS AND METHODS: This is a Descriptive epidemiology study conducted in K.I.M.S Bangalore during January 2012 to June 2013. Children between 2 months to 59 months presenting with fever with tachypnea (as defined by WHO criteria) and/or cough and/or difficult breathing were

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included in study. Children who were known asthmatics/wheezers and/or duration of illness >2wks were excluded from the study.

Children between 2 months –59 months satisfying the inclusion criteria were enrolled into the study and admitted after getting informed consent from the parents/guardians. IMNCI and Acute Illness Observation Scale (AIOS) scoring is applied on each subject on to assess the severity of community acquired pneumonia (CAP). Respiratory parameters and Vital signs were recorded and chest X-ray, complete blood count, blood culture, and will be done with in 24 hrs. of admission. Chest X ray was interpreted by a radiologist who was blinded about the study based on WHO guidelines for interpretation of X rays⁸ in pediatric pneumonia.

Treatment, investigations and disease course were documented. Clinimetric evaluation of AIOS included item analysis, reliability measurement (internal consistency reliability) and validity (construct and predictive) testing. Descriptive and inferential statistical analysis has been carried out in the present study. Following statistical methods are applied in our present study: Chi-Square Test, Fisher Exact Test, Diagnostic statistics, Diagnostic values based on Area under curve, Kappa Statistic for agreement and statistical analysis of data is done using SPSS 16 software.

RESULTS: Total of 109 children who met with inclusion criteria were enrolled in to the study and results are presented as follows:

1. GENERAL CHARACTERISTICS: The age in the study group ranged from 2months to 59 months (mean, 16.28 months; SD±12.96); and infants (2-12 months) (52.3%) being most affected with Males: Female ratio 1.65:1. All the children presented with complaints of fever (4.39 ± 2.26 days) and cough (4.37 ± 2.21) while history of rapid and difficult breathing (1.77 ± 0.91 days) was obtained in 98% of cases. Regarding danger symptoms, majority had lethargy (32.1%) while convulsion (4.6%) and grunt (2.8%) was least common. Vital signs like respiratory rate had a mean of 57.88/min (SD±11.39) while temperature and heart rate had a mean of 100.81° F and 133.08 beats/min respectively. Regarding other respiratory morbidity signs majority had a respiratory rate between 51-60 (41.3%) and inter costal retraction were present in 58.7% and subcostal retractions was mild-moderate in 45.9% and severe in 30.3%. Percentage of children with grunting (10.1%) and cyanosis (2.8%) was very less, like wise was those with abnormal capillary refill time (11.9%).

Under investigations Pulse oxymetre recording at the time of admission was recorded; a reading below 85%, which is associated with central cyanosis, was observed in 9.2% (10/109) and reading >92% was seen in 53.2% (58/109) and the remaining being in between. The chest X-ray (CXR) was done and Normal CXR finding were present in 36.7% (40/109) and remaining 63.3% (69/109) had significant abnormalities. Among the X-ray abnormalities End- point consolidation was seen in 35.8% while other Non-end point infiltrates was seen in 27.5% (30/109).

Among other investigations, leukocytosis was seen in 48.6% (53/109), and a positive blood culture in 4.6% of cases and 46.8% of children had moderate anemia as classified by WHO. During their management 6.4% (7/109) of children were so severely affected that they needed mechanical ventilation for respiratory failure or shock management and 4.6% (5/109) needed inotropic support for shock management. Oxygen was administered for 50.5% (55/109) of cases in view of severe respiratory distress or cyanosis.

Majority of children required maintenance intravenous fluids because of respiratory distress and/or dehydration and/or refusal of feeds. Parenteral antibiotics were administered in majority of patients while remaining were treated with oral antimicrobials. During the hospital stay

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9.2% (10/109) developed complications either in the form of shock, empyema. The mean duration of hospital stay ($\pm$ SD) was 6.37 ($\pm$ 3.56) days.

2. AIOS AND ITS CLINIMETRICS: In our study population 44.95% of children with community acquired pneumonia scored abnormally (AIOS >10) at initial evaluation. Mean score for AIOS 12.19(SD $\pm$ 4.64) clearly signifies the seriousness of all children enrolled in the study. In the individual item analysis of AIOS, 88.9% and 80.7% of affected children scored normally for the variables “color” and “hydration status” respectively. In contrast majority of children showed worst score in the variable “response to social overtures”.

Scales were assessed for their inter item correlation and overall Cronbach's α . Cronbach's α for AIOS was 0.91(an alpha of 0.70 is the minimum desirable level) indicating the homogeneity of scale variable in assessing illness severity in our study sample. For construct validity total score on AIOS showed good correlation (Pearson) with selected clinical characteristics' at admission like grade of fever ($p<0.001$), heart rate ($p<0.001$), respiratory rate ($p<0.001$). Relating children's score against their radiologic finding to assess the concurrent validity, 77.5% children with normal CXR had AIOS of ≤ 10 whereas 42.0% had normal scores in the group of abnormal CXR finding($P<0.001$).

Respiratory morbidity of affected children were also stratified by their illness severity scores at presentation. Univariate analysis of AIOS with respiratory morbidities and AIOS correlation with initial SpO₂ reading and abnormal CXR is depicted in Table 2. Majority of children were found to have moderate anemia and blood culture was positive in 80% in children scoring AIOS ≥ 16 which was moderately significant.

		AIOS DAY 1						TOTAL	χ ² TEST, P VALUE
		≤10		11-15		≥16			
		N	%	N	%	N	%		
Respiratory rate/mt	40-50	25	89.3	3	10.7	0	-	28	<0.001**
	51-60	21	46.6	12	26.6	12	26.7	45	
	>60	14	38.9	7	19.4	15	41.7	36	
Retraction type									
Intercostal recession		22	34.4	16	25.0	26	40.6	64	<0.001**
Subcostal recession	Mild-moderate	34	68.0	12	24.0	4	8.0	50	<0.001**
	severe	1	3.03	9	27.3	23	69.7	33	
Grunt		0	-	1	9.1	10	90.9	11	<0.001**
Cyanosis		0	-	0	-	3	100	3	0.021*
Lethargy		1	2.9	9	25.8	25	71.5	35	<0.001**
CRT >2sec		0	-	2	15.4	11	84.6	13	<0.001**
Bronchial breathing		2	20.0	2	20.0	6	60.0	10	0.014*
Crepitation's		48	49.5	22	22.7	27	27.9	97	0.003**
SpO2	<85	0	-	3	30.0	7	70.0	10	<0.001**
	85-92	13	31.7	12	29.3	16	39.0	41	
	>92	47	81.0	7	12.1	4	7.0	58	
CXR	Abnormal	29	42.0	17	24.6	23	33.3	69	<0.001**
CXR type [†]	End-point	16	41.0	7	18	16	41.0	39	
	Non-end point	13	43.4	10	33.3	7	23.3	30	
TABLE 2: UNIVARIATE ANALYSIS OF AIOS WITH RESPIRATORY MORBIDITY									

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†WHO guidelines for interpretation of chest radiographs in pneumonia.⁸ End-point consolidation: a dense opacity that may be a fluffy consolidation of a portion or whole of a lobe or of the entire lung, often containing air bronchograms and sometimes associated with pleural effusion. Non-end-point infiltrate: linear and patchy densities (interstitial infiltrates) featuring peribronchial thickening and multiple areas of atelectasis. It also includes minor patchy infiltrates that are not of sufficient magnitude to constitute primary end-point consolidation, and small areas of atelectasis that in children can be difficult to distinguish from consolidation.

3. Comparison of AIOS with IMNCI in illness severity assessment and clinical outcome in pneumonia.

Comparing AIOS with IMNCI in assessing illness severity of pneumonia and clinical outcome in terms of persistent distress on day 5, complication like shock and empyema and duration of hospital stay was found to be statistically significant which was comparable with IMNCI ($P < 0.001$)

IMNCI CLASS		TOTAL	AIOS ON DAY 1						P VALUE
			≤10(n=60)		11-15(n=22)		≥16(n=27)		
			N	%	N	%	N	%	
Pneumonia		40	39	97.5	1	2.5	0	-	<0.001**
Severe pneumonia		45	21	46.7	16	35.5	8	17.7	
Very severe pneumonia		24	0	-	5	20.8	19	79.2	
OUTCOME									
Persistent distress on Day 5	Present	17	1	1.7	4	18.2	12	44.4	<0.001**
Complications	Present	10	0	0	3	13.6	7	25.9	<0.001**
Duration of hospital stay	≤5	69	49	81.6	13	50.1	7	25.9	<0.001**
	6-14	32	11	18.4	8	36.4	13	48.1	
	>14	8	-	-	1	4.5	7	25.9	
TABLE 3: COMPARISON OF AIOS WITH IMNCI IN ILLNESS SEVERITY ASSESSMENT AND CLINICAL OUTCOME									

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The Diagnostic Statistics of Comparison of IMNCI Class with AIOS is depicted in Fig: 1.

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DISCUSSION: The most important decision in the management of CAP is accurate assessment of severity of illness at presentation and an assessment of likely prognosis. This has been aided by the IMNCI strategy which will be more effective in managing pneumonia when supplemented by an illness severity scoring system delivered in the context to primary care setting that can quickly quantify the severity of illness at all stages from onset to recovery. The present study was done with this view in mind.

In our present study the internal consistency and external validity of AIOS scoring system is very high which shows AIOS system to be significant and independent predictor of serious illnesses thus helpful in assessing severity of illness by primary caregiver based on clinical appearance rather than complex symptomatology of IMNCI algorithm.

This study has brought out the fact that AIOS scoring has a good correlation with initial pulse oxymeter reading and chest X-ray abnormalities and thus helps in decision regarding supplementation of oxygen and preventing unnecessary exposure to harmful radiations in a child with pneumonia. Validating the AIOS score in illness severity assessment in pneumonia, it was found that the scoring is having good sensitivity but with a poor specificity in “pneumonia” group and in “very severe pneumonia” group it had a good specificity but a poor sensitivity. In “severe pneumonia” group it had a poor sensitivity and good specificity in diagnosing pneumonia compared to IMNCI.

Regarding clinical outcome persistence of respiratory distress on day 5, maximum numbers of complications and maximum duration of hospital stay were present in those with AIOS score ≥ 16 and in very severe group in IMNCI which were statistically significant.

Thus AIOS scoring can be used to rationalize in-hospital services and on educating mother it can boost the skill in identifying severity of illness.

Though AIOS can predict clinical outcome in children with pneumonia it is not superior to IMNCI in same regards. AIOS scoring is usually done by a skilled physician familiar with behavior of a child in varying degrees of illness severity in the hospital setting where as IMNCI classification of pneumonia is done by peripheral health workers in the field setting. So AIOS scoring can be used by the treating physician in deciding on therapeutic modalities and prognosticating a child admitted to the hospital with pneumonia.

With respect to aims of the current study, some methodological issues need to be addressed. Being a subjective score inter-observer variation in scoring and assessing the correlation of AIOS with the etiology of pneumonia needs to be addressed. Other areas requiring further work include determining feasibility and reproducibility of AIOS by less qualified workers in primary health care.

CONCLUSION:

- AIOS scoring has good internal consistency and external validity.
- AIOS scoring cannot be used as a sensitive tool to classify illness severity in pneumonia.
- IMNCI remains the more sensitive tool in illness severity classification in pneumonia.
- AIOS correlates well with abnormal X ray findings and therapeutic decision taken by the physician.
- AIOS has good correlation with initial SpO₂ reading.
- Both IMNCI and AIOS predict clinical outcome similarly in community acquired pneumonia.
- 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.

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- 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.

SUMMARY: The features of respiratory distress are no doubt, any clinician's first intentions in a child with pneumonia, yet discerning the overall sickness in an objective manner by a simple clinical index like AIOS with its six observation variables may behave the treating clinician or primary care giver closer to the finality of the disease severity; and further optimize IMNCI strategy for community management of childhood acute lower respiratory tract infections.

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Date of Submission: 20/02/2014.
Date of Peer Review: 21/02/2014.
Date of Acceptance: 06/03/2014.
Date of Publishing: 25/03/2014.