

# Evaluation of Diagnostic Accuracy of Alvarado, Appendicitis Inflammatory Response and Adult Appendicitis Scoring System in Diagnosing Acute Appendicitis: A Prospective Cohort Study

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## ABSTRACT

**Introduction:** Appendicitis is one of the most common surgical emergencies, but its clinical diagnosis is still a big challenge for surgeons to decrease the negative appendectomy rate.

**Aim:** To validate and compare alvarado, Appendicitis Inflammatory Response (AIR) score and adult appendicitis scoring system in diagnosing acute appendicitis.

**Materials and Methods:** A prospective cohort study was conducted in the Department of General Surgery, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi, India, from December 2020 to May 2022 on 100 patients who were clinically suspected of acute appendicitis. All three scores {AIR, Adult Appendicitis Score (AAS), Alvarado} were calculated. Diagnostic tests were used to calculate sensitivity, specificity, Negative Predictive Value (NPV) and Positive Predictive Value (PPV). DeLong test were used to compare the area under the curve of three scores with each other for

predicting acute appendicitis and the final result was compared with the histopathological report. The data was presented as numbers and percentage and the p-value <0.05 was considered statistically significant.

**Results:** The mean age of study subjects was 30.28±10.9 years. It was found that the AIR score had more sensitivity (92.55%), followed by the AAS (84.04%) score and Alvarado (60.64%) score for diagnosing acute appendicitis but the specificity of the Alvarado score was highest (100%), followed by AAS (83.33%) and AIR (66.67%) score. AIR score had more NPV (36.40%) as compared to AAS (25%) and Alvarado score (14%). The diagnostic accuracy of AIR (91%) was higher than AAS and Alvarado's score 84% and 63%, respectively.

**Conclusion:** Appendicitis Inflammatory Response (AIR) score and AAS can be used over Alvarado score for better diagnosis of acute appendicitis in emergency patients and to reduce the rate of negative appendectomy.

**Keywords:** Appendix, Negative appendectomy, Right iliac fossa

## INTRODUCTION

Acute Appendicitis (AA) is one of the most common surgical emergencies in the world, with 7-12% of the general population being affected at some point in their life [1]. Its incidence is 1.5-1.9 per 1000 in the general population and men are around 1.4 times more likely than woman to experience it [2]. It is associated with high morbidity and occasional mortality related to the failure to make an early diagnosis. Although the diagnosis of appendicitis is clinical, the varied presentations create an environment of confusion in the diagnosis and subsequent management of the condition. Only 20-33% of cases present typical findings [3]. The treatment of choice remains surgical in both complicated and uncomplicated patients. Hence, overdiagnosis can lead to an increase in unnecessary surgeries, resultant morbidity and drainage of resources in a resource-improvised setting [4]. Recent studies have shown the negative appendectomy rate as high as 17.2% [5]. Chae MS et al., conducted a study in 2017 in which the negative appendectomy rate was 20.8% [6]. Sammalkorpi HE et al., studied histologically confirmed reduced negative appendectomy rate from 18.2-8.7% [7]. Statistics show that one out of five appendicitis is misdiagnosed [5]. On the other hand, underdiagnosing appendicitis, especially in particular groups like women in the reproductive age group and the elderly can have severe complications, including perforation. An effective scoring system can be an excellent guiding tool for deciding on managing patients with acute appendicitis [8].

In emergency cases, the concept of scoring along with the clinical examination can increase the accuracy of diagnosis [8]. Alvarado score is the most extensively used and studied scoring system [9]. Still, its sensitivity and specificity are suitable only for ruling out cases of appendicitis but not so for making decisions on patients requiring surgery [9-12]. In patients with suspected AA, clinical scores alone appear sensitive enough to select low-risk patients and reduce the need for imaging and negative surgical exploration (such diagnostic laparoscopy [13].

Madasi V concluded that the Alvarado score was surpassed in validity and reliability by the newly designed AIR score [14]. Karki OB and Hazra NK found that AIR scoring performed well and was more accurate than the Alvarado scoring system, with high specificity and high NPV preventing negative appendectomies [15]. Pogorelic Z et al., found that the AIR score can detect acute appendicitis with a high level of sensitivity and specificity. The results of this study have also demonstrated the high significance of the AIR score in differentiating between perforated and non perforated appendicitis, which can have a major impact on treatment choices [16].

All the existing scoring system has been crafted for the western population. Therefore, studies are needed to validate the scoring system of the Indian population. Hence, the present study was conducted with the aim to assess the predictive accuracy of Alvarado, AIR and AAS scoring systems in diagnosis of acute appendicitis.

## MATERIALS AND METHODS

This prospective cohort study was conducted in the Department of General Surgery, Vardhman Mahavir Medical College and Safdarjung Hospital, New Delhi, India, from December 2020 to May 2022. The ethical clearance from the Institutional Ethics Committee. (IEC/VMMC/SJH/Thesis/2020-11/CC-140).

**Inclusion criteria:** All clinically suspected patients of acute appendicitis in the Emergency Department between the age of 18 to 60 years were included in the study.

**Exclusion criteria:** Pregnant women, patients who were not fit for surgery, patients with appendicular perforation or abscess, appendicular mass and patients who were not willing for surgery were excluded from the study.

**Sample size calculation:** The study of Sammakorpi HE et al., observed that the sensitivity and specificity of AAS was 49% and 93.3%, respectively [7]. The study of Madasi V observed that the sensitivity and specificity of the Alvarado score was 87.3% and 52.4%, respectively and of AIR score was 95.7% and 90.5%, respectively [14]. Taking these values as a reference, the minimum required sample size with desired precision of 15%, 80% power of study, and 5% level of significance is 86 patients. To reduce the margin of error, the total sample size taken was 100.

### Study Procedure

All patients were scored using AAS, Alvarado and AIR scoring system [13,17-19]. Alvarado is a 10 points scoring system introduced in 1986, it is based on pain migration to Right Iliac Fossa (RIF), anorexia, nausea and vomiting, RIF tenderness, rebound tenderness, fever, raised White Blood Cells (WBC), shift of WBC to left. AIR score includes vomiting, pain in Right Lower Quadrant (RLQ), abdominal guarding, raised temperature, WBC, serum CRP and segmented neutrophils. The new diagnostic scoring system known as AAS evaluates pain in RLQ, abdominal guarding, WBC, neutrophils proportion and CRP levels. The operative decision was made and the patient underwent an emergency appendectomy. Resected appendix specimen was sent for a histopathology examination. A postoperative histopathological report was collected and compared with the preoperative diagnosis. The calculated score was considered positive if it showed the probability of appendicitis and a comparison was made with the gold standard histopathological diagnosis. Based on the data collected, sensitivity and specificity were calculated for each scoring system separately and the receiver operator curve was plotted for further analysis.

## STATISTICAL ANALYSIS

The presentation of the categorical variables was done in the form of numbers and percentages (%). On the other hand, the qualitative data were presented as the means±Standard Deviation (SD) and as median with 25<sup>th</sup> and 75<sup>th</sup> percentiles (interquartile range). Receiver operating characteristic curve was used to find cut-off point of the total Alvarado score, total AIR and total AAS for predicting appendicitis. For statistical significance, p-value <0.05 was considered statistically significant.

## RESULTS

The mean age of study subjects was 30.28±10.9 years [Table/Fig-1]. Out of 100 patients, 96 (96%) were males and 4 (4%) were females. In the present study, while calculating the Alvarado component, anorexia was the most common symptom (99%), followed by nausea (88%) and pain migration (32%) [Table/Fig-2]. For the AIR scoring system, pain in Right Iliac Fossa (RIF) was present in all the patients (100%), followed by vomiting (94%), fever (88%) and mild abdominal guarding (61%) [Table/Fig-3].

A total of 100% of patients had pain in the right lower quadrant. Pain relocation was seen in 60% of patients. Mild abdominal

guarding was elicited in 72% of patients, while moderate and severe abdominal guarding was present in 28% of patients [Table/Fig-4].

Age (years)	Frequency	Percentage
18-20	20	20%
21-30	43	43%
31-40	23	23%
41-50	9	9%
51-60	5	5%
Mean±SD	30.28±10.9	
Range	18-60	

[Table/Fig-1]: Distribution of age (years) of study subjects.

Alvarado score components	Frequency	Percentage
Pain migration	32	32%
Anorexia	99	99%
Nausea	88	88%
Right iliac fossa tenderness	100	100%
Rebound tenderness	34	34%
Fever (>37.5°C)	81	81%

[Table/Fig-2]: Distribution of Alvarado score components of study subjects.

Appendicitis Inflammatory Response (AIR) components	Frequency	Percentage
Vomiting	94	94%
Pain in right iliac fossa	100	100%
Temperature (>38.5°C)	88	88%
<b>Abdominal guarding</b>		
Low	11	11%
Mild	61	61%
Severe	28	28%
<b>Segmented neutrophils</b>		
70-84%	62	62%
≥85%	38	38%
<b>Leucocyte (x10<sup>9</sup>/L) (n=88)</b>		
>10-14.9	22	25%
≥15	66	75%
<b>C-reactive protein (g/L)</b>		
10-49	23	23%
≥50	77	77%

[Table/Fig-3]: Distribution of appendicitis inflammatory response components of study subjects.

Adult Appendicitis score components	Frequency	Percentage
Pain in right lower quadrant	100	100%
Pain relocation	60	60%
<b>RLQ tenderness</b>		
Males in age group of 16-49 years and females	92	92%
All other patients	8	8%
<b>Abdominal guarding</b>		
Mild	72	72%
Moderate or severe	28	28%
<b>Leucocyte (x10<sup>9</sup>/L)</b>		
≥7.2 to <10.9	13	13%
≥10.9 to <14	25	25%
≥14	62	62%
<b>Proportion of neutrophils (%)</b>		
≥62 to <75	42	42%
≥75 to <83	31	31%
≥83	27	27%

CRP (mg/L), symptoms <24 hours (n=94)		
≥4 to <11	17	18.09%
≥11 to <25	11	11.7%
≥25 to <83	66	70.21%
CRP (mg/L), symptoms >24 hours		
12 to 53	6	6.38%

**[Table/Fig-4]:** Distribution of Adult Appendicitis Score (AAS) components among study subjects.  
RLQ: Right lower quadrant; CRP: C-reactive protein

In the present study, 94 out of 100 patients diagnosed with acute appendicitis without perforation presented within 24 hours of onset symptoms. And in 66 (70.21%) patients, the C-reactive Protein (CRP) level was elevated. Six patients presented to the emergency after 24 hours, and their CRP level was lower than those who presented early [Table/Fig-4].

For Alvarado's score, most patients scored >7 i.e., 57, out of which none patients had a negative appendectomy. Forty-three patients were having ≤7 and out of which the negative appendectomy was found in six patients [Table/Fig-5].

Total Alvarado score	No appendicitis (n=6)	Appendicitis present (n=94)
≤7 (Low probability), n (%)	6 (13.95%)	37 (86.05%)
>7 (High probability), n (%)	0 (0%)	57 (100%)
Mean±SD	5.83±0.98	7.84±1.23
Range	5-7	5-10

**[Table/Fig-5]:** Association of total Alvarado score of study subjects.

Appendicitis Inflammatory Response score categorised 89 out of 100 cases as high risk, out of which only 2 (2.25%) patients had a negative appendectomy. Eleven patients were in the low-risk category, and the negative appendectomy was found in 4 patients (36.36%) [Table/Fig-6].

Total Appendicitis Inflammatory Response (AIR)	No appendicitis (n=6)	Appendicitis present (n=94)
5-8 (Mild probability), n (%)	4 (36.36%)	7 (63.64%)
9-12 (High probability), n (%)	2 (2.25%)	87 (97.75%)
Mean±SD	7.5±1.76	9.82±1.52
Range	6-10	5-12

**[Table/Fig-6]:** Association of total Appendicitis Inflammatory Response (AIR) among study subjects.

Adult Appendicitis Score categorises the patients into three categories low, intermediate, and high risk. 70 patients came in high risk, out of which only 1 (1.43%) patient underwent a negative appendectomy. Twenty one patients came under intermediate risk out of which 19 (90.48%) patients' histopathological examination came as acute appendicitis. In the low-risk group, the negative appendectomy rate was high. Out of 9 patients 3 (33.33%) had a negative appendectomy [Table/Fig-7].

Total Adult Appendicitis Score (AAS)	No appendicitis (n=6)	Appendicitis present (n=94)
≤10 (Low risk), n (%)	3 (33.33%)	6 (66.67%)
11-15 (Intermediate risk), n (%)	2 (9.52%)	19 (90.48%)
>16 (Low risk)	1 (1.43%)	69 (98.57%)
Mean±SD	11.83±4.02	16.33±2.63
Median (25 <sup>th</sup> -75 <sup>th</sup> percentile)	10 (9-13.25)	16 (15-18)

**[Table/Fig-7]:** Association of total Adult Appendicitis Score (AAS) among study subjects.

It was found that the AIR score had more sensitivity (92.55%), followed by the AAS (84.04%) score and Alvarado (60.64%) score but the specificity of the Alvarado score was more (100%), which was 83.33% for AAS and 66.67% for AIR score [Table/Fig-8].

Variables	Total Alvarado score	Total Appendicitis Inflammatory Response (AIR)	Total Adult Appendicitis Score (AAS)
Area under the ROC curve (AUC)	0.892	0.833	0.808
Standard error	0.0525	0.0897	0.139
95% CI	0.814-0.945	0.746-0.9	0.717-0.88
p-value	<0.0001*	0.0002*	0.0266*
Cut-off	>7	>8	>14
Sensitivity (95% CI)	60.64% (50.0-70.6%)	92.55% (85.3-97.0%)	84.04% (75.0-90.8%)
Specificity (95% CI)	100% (54.1-100.0%)	66.67% (22.3-95.7%)	83.33% (35.9-99.6%)
PPV (95% CI)	100% (93.7-100.0%)	97.8% (92.1-99.7%)	98.7% (93.2-100.0%)
NPV (95% CI)	14% (5.3-27.9%)	36.4% (10.9-69.2%)	25% (8.7-49.1%)
Diagnostic accuracy	63%	91%	84%

**[Table/Fig-8]:** Receiver operating characteristic curve of Total Alvarado score, Total Appendicitis Inflammatory Response (AIR) and Total Adult Appendicitis Score (AAS) for predicting appendicitis.  
CI: Confidence interval; PPV: Positive predictive value; NPV: Negative predictive value

## DISCUSSION

In this study, 100 patients were included with the age of the study population ranging from 18-60 years. A total of 43% of patients were between 21-30 years. Madasi V conducted a study in which the maximum number of patients were in the age group of 20-40 years 60.90% [14]. Another study by Viniol A et al., concluded that acute appendicitis is peak in age from 10-30 years [20]. The incidence of acute appendicitis is more in the younger age group, might be due to the larger amount of lymphoid tissue in young patients.

In the present study, all the patients presented with pain in the right iliac fossa (100%) followed by anorexia (99%) and vomiting (94%). On clinical examination, right iliac fossa tenderness was found in all patients, followed by fever (88%) and abdominal guarding. In 2017, a study conducted by Gopalam PR and Konidala MVSS anorexia was found in most (94%) of the patients, followed by vomiting and nausea, RLQ pain, rebound soreness and abdominal guarding in 78%, 72%, 71% and 70% of cases, respectively [21]. In another study conducted by Von-Mühlen B et al., 95.3% patients came to the Emergency Department with pain in right iliac fossa, vomiting was reported in 51.7% and the temperature was raised in 27.9% [18]. Presenting symptoms might be variable because of previous treatment taken by the patient before presenting to the tertiary care hospital, and clinical findings may vary accordingly.

Receiver Operating Curve (ROC) had a discriminating ability to predict appendicitis. The discriminatory power of the total Alvarado score {Area Under the Curve (AUC) 0.892}, comprehensive AIR (AUC 0.833) and total AAS (AUC 0.808) but in contrast to the present study, the study conducted by Macco S et al., reported an area under the ROC of 0.90 for AIR score and 0.87 for Alvarado score and AAS score was not included in their study [22].

It was found that the AIR score had more sensitivity (92.55%), followed by the AAS (84.04%) score and Alvarado (60.64%) score but the specificity of the Alvarado score was more (100%), which was 83.33% for AAS and 66.67% for AIR score. In a study conducted by Madasi V sensitivity of AIR score was 95.7% which was comparable to the current study, but the specificity of the AIR score, sensitivity, and specificity of the Alvarado score were not comparable to the present study [14].

In the present study, AIR score had more NPV (36.40%) than the other scores AAS (25%) and Alvarado scores (14%). Alvarado's score had more PPV (100%) than AAS (98.7%) and AIR (97.8%). In study conducted by Madasi V PPV and NPV for Alvarado score was 96% and 23%, PPV of AIR score was 99.2% which were

comparable to the present study, but in contrast to the present study NPV for AIR score was 61.3% [14].

In the present study the diagnostic accuracy of AIR (91%) was more than AAS (85%) and Alvarado's score (63%). In a study conducted by Madasi V diagnostic accuracy of AIR score was 95% which was comparable to the present study but the diagnostic accuracy of Alvarado score was 85% which was different from the present study. This might be due to the less number of the study population in more time period in our study compare to the Madasi V study. There is always a trade-off between sensitivity and specificity (any increase in sensitivity will be accompanied by a decrease in specificity) so we choose that variable as best in which combination of sensitivity and specificity gives the maximum predictive value i.e., maximum diagnostic accuracy so overall total AIR was a better predictor of uncomplicated acute appendicitis.

### Limitation(s)

This study was conducted in a single tertiary care centre with a study population of 100 which was not sufficient to conclude. A multicentric study with large study population will be required to conclude AIR is a better predictor of uncomplicated acute appendicitis compared to AAS and Alvarado score.

### CONCLUSION(S)

Appendicitis Inflammatory Response can be used for better diagnosis of uncomplicated acute appendicitis in a tertiary health center as compared to AAS and Alvarado scores to decrease a negative appendectomy rate.

### REFERENCES

- [1] Chalazonitis AN, Tzovara I, Sammouti E, Ptohis N, Sotiropoulou E, Protopappa E. CT in appendicitis. *Diagn Interv Radiol*. 2008;14(1):19-25.
- [2] Cuschieri A. *Essential surgical practice*. 3<sup>rd</sup> ed. Oxford: Butterworth-Heinemann. 1995.
- [3] Mohamed A, Bhat N. Acute appendicitis dilemma of diagnosis and management. *The Internet J Surg*. 2009;23(2):34-41.
- [4] Flum DR, Koepsell T. The clinical and economic correlates of misdiagnosed appendicitis. *Nationwide analysis*. *Arch Surg*. 2002;137(7):799-804.
- [5] Joshi MK, Joshi R, Alam SE, Agarwal S, Kumar S. Negative appendectomy: An audit of resident-performed surgery. How can its incidence be minimized? *Indian J Surg*. 2015;77(3):913-17.
- [6] Chae MS, Hong CK, Ha YR, Chae MK, Kim YS, Shin TY, et al. Can clinical scoring systems improve the diagnostic accuracy in patients with suspected adult appendicitis and equivocal preoperative computed tomography findings? *Clin Exp Emerg Med*. 2017;4(4):214-21.
- [7] Sammalkorpi HE, Mentula P, Savolainen H, Leppäniemi A. The introduction of adult appendicitis score reduced negative appendectomy rate. *Scand J Surg*. 2017;106(3):196-201.
- [8] Brigand C, Steinmetz JP, Rohr S. The usefulness of scores in the diagnosis of appendicitis. *J Chir (Paris)*. 2009;146(1):02-07.
- [9] Ohle R, O'Reilly F, O'Brien KK, Fahey T, Dimitrov BD. The Alvarado score for predicting acute appendicitis: A systematic review. *BMC Med*. 2011;9(1):139-40.
- [10] Chong CF, Thien A, Mackie AJ, Tin AS, Tripathi S, Ahmad MA, et al. Comparison of RIPASA and Alvarado scores for the diagnosis of acute appendicitis. *Singapore Med J*. 2011;52(5):340-45.
- [11] Walczak DA, Pawelczak D, Żóltaszek A, Jaguścik R, Falek W, Czerwińska M, et al. The value of scoring systems for the diagnosis of acute appendicitis. *Pol Przegl Chir*. 2015;87(2):65-70.
- [12] Nanjundiah N, Mohammed A, Shanbhag V, Ashfaque K, Priya SA. A comparative study of RIPASA score and ALVARADO score in the diagnosis of acute appendicitis. *J Clin Diagn Res*. 2014;8(11):NC03-NC05.
- [13] Di Saverio S, Podda M, De Simone B, Ceresoli M, Augustin G, Gori A, et al. Diagnosis and treatment of acute appendicitis: 2020 update of the WSES Jerusalem guidelines. *World J Emerg Surg*. 2020;15(1):27-28.
- [14] Madasi V. Comparison of predictive validity of alvarado score and Appendicitis Inflammatory Response (AIR) Score, a hospital based observational study. *Int J Sur Trauma and Orthopedics*. 2016;2(3):30-36.
- [15] Karki OB, Hazra NK. Evaluation of the appendicitis inflammatory response score against Alvarado score in diagnosis of acute appendicitis. *Kathmandu Univ Med J*. 2019;5(3):68-72.
- [16] Pogorelic Z, Mihanovic J, Nincevic S, Luksic B, Elezovic Baloevic S, Polasek O, et al. Validity of appendicitis inflammatory response score in distinguishing perforated from non-perforated appendicitis in children. *Pediatr Emerg Care*. 2021;8(1):09-18.
- [17] Andersson M, Andersson RE. The appendicitis inflammatory response score: A tool for the diagnosis of acute appendicitis that outperforms the Alvarado score. *World J Surg*. 2008;31(1):37-42.
- [18] Von-Mühlen B, Franzone O, Beduschi MG, Krueel N, Lupselo D. AIR score assessment for acute appendicitis. *Arq Bras Cir Dig*. 2015;28(3):171-73.
- [19] Alvarado A. A practical score for the early diagnosis of acute appendicitis. *Ann Emerg Med*. 1986;15(5):557-64.
- [20] Viniol A, Keuncke C, Biroga T, Stadje R, Dornieden K, Bosner S, et al. Studies of the symptom abdominal pain-a systematic review and meta-analysis. *Fam Pract*. 2014;31(1):517-29.
- [21] Gopalam PR, Konidala MVSS. Comparison of acute inflammatory score and Alvarado score in diagnosis of acute appendicitis at a tertiary care hospital. *Int Surg J*. 2017;4(1):4034-38.
- [22] Macco S, Vroenenraets BC, de Castro SM. Evaluation of scoring systems in predicting acute appendicitis in children. *Surgery*. 2016;160(6):1599-604.

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