

REVIEW ARTICLE

## CLINICAL SCORING SYSTEMS FOR ACUTE APPENDICITIS - CURRENT PERSPECTIVE

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### ABSTRACT

Clinical scoring systems have been used in the diagnosis of acute appendicitis and they have had varying degrees of success. The most common scoring system is the Alvarado scoring system followed by other scoring systems like the RIPASA and AIR systems. Most of the scoring systems are good at ruling out appendicitis or selecting patients who may require further imaging like ultrasound or computerized tomography. On their own most clinical scoring systems are not used to solely diagnose acute appendicitis and we have conducted this review article to look at the common scoring systems that are being used and its sensitivity and specificity.

**KEYWORDS:** Clinical scoring systems, Acute appendicitis, Alvarado score, RIPASA score, AIR score.

### INTRODUCTION

Acute appendicitis is one of the most frequent causes of acute abdominal pain and in developing countries, the diagnosis is challenging due to limitations of radiological facilities and lack of resources. There is no single test that can accurately diagnose acute appendicitis and clinical scoring systems have been introduced that use clinical history, physical examination, and laboratory tests. These scoring systems can aid in diagnosing patients who present with lower abdominal pain and reduce the complications of acute appendicitis.(1)

The world society of emergency surgeons in their guidelines in 2020 recommended the use of clinical scoring systems to diagnose low risk patients, decrease the need for imaging and negative surgical exploration. The Alvarado score was the first scoring system that was introduced, and it has been extensively studied. Further scoring systems were introduced like the RIPASA (Raja isteri Pengiran anak Saleha appendicitis) score which has shown encouraging results in the Asian population. Further scoring systems like the AIR (appendicitis inflammatory response score) and the AAS (adult appendicitis score) have been introduced and both show

favorable results. However clinical scoring systems have limited ability to diagnose acute appendicitis in the pediatric and elderly group.(2)

The Alvarado score, Appendicitis inflammatory score (AIR) and the Adult Appendicitis Score (AAS) are effective in diagnosing acute appendicitis and identifying low risk patients and decreasing the need for imaging.(3)

The aim of this review article is to assess the common clinical scoring systems and to look at its sensitivity and specificity.

### METHOD

We have conducted this review article to look at the common clinical scoring systems that are being used to diagnose acute appendicitis. A literature review was made on PubMed, the Cochrane database of clinical reviews and google scholar looking for original articles, clinical trials, observational studies, cohort studies, review articles, systemic reviews, and meta-analysis from 1995 to 2023. The following key words were used, "clinical scoring in acute appendicitis", "diagnosis of acute appendicitis", "Alvarado score", "RIPASA score" and "AIR score". All articles were in English language and

case write ups and commentaries were excluded. Articles including adults and children were included. Pregnant patients with acute appendicitis were excluded and articles in other languages were excluded.

**DISCUSSION**

**Alvarado Score and Modified Alvarado Score**

This score was derived by Alvarado in 1986 which consists of 10 points that includes clinical symptoms, signs and diagnostic test in patients who present with suspected acute appendicitis. The parameters of the score include migration of pain, anorexia, nausea, tenderness at the right lower quadrant, rebound pain, elevated temperature, leukocytosis, and shift of white cell count to the left. Each parameter accounts for one point except for leukocytosis which accounts for 2 points, and the score of 1 to 4 is associated with a probability of acute appendicitis of less than 30%, a score of 5 to 6, has a probability of 66% and a score of 7-9 has a probability of 93%. The Alvarado score was originally designed as a diagnostic score. It can be used to triage patients who present to the emergency department, with a score of less than 4 being effective to rule out acute appendicitis.(4,5)

The Alvarado score has been evaluated prospectively and the results showed that it was adequately sensitive and specific to be used as a preoperative tool to diagnosis acute appendicitis The Alvarado score helps to stratify patients into those that can be discharged, those that need further evaluation and those that need surgery. The Alvarado score can be used as a reasonable starting point for the diagnosis of acute appendicitis.(6-9)

The alvarado score is better at diagnosing acute appendicitis in male patients between the ages of 18 to 45 where it can be used to decide to either perform imaging or to proceed with surgery. A score of 4 to 6 is usually an

indication for performing imaging like ultrasound or computerized tomography.(10-14)

The Alvarado score is a good clinical score when used as an adjunct to history and clinical examination in patients with suspected acute appendicitis. A score of 5 to 6 is good at identifying patients for imaging like ultrasound, and those with a score of 3 or less can be used to rule out appendicitis, but a score of 7 is still not sensitive to diagnose acute appendicitis and proceed to appendectomy. It is also a useful diagnostic tool for junior doctors to evaluate patients who are present with suspected appendicitis. (15-19)

A systemic review was conducted to look at the validation of the Alvarado score in diagnosing patients with suspected acute appendicitis.5 studies with 2239 patients were included in this review and the conclusion was that an Alvarado score of 7 and above was a significant predictor of acute appendicitis but further clinical trials may be needed to evaluate this.(20)

The modified Alvarado score is a modified version that excludes one laboratory parameter, the shift to the left of neutrophil maturation. The score is then calculated out of nine parameters and this score performed as well as the Alvarado score. It was evaluated and found to be reliable, easy to perform,it increases the diagnostic accuracy of acute appendicitis, and reduce negative appendectomy rates.(21-24)

Both the Alvarado and modified Alvarado score are still the most popular scores that are being used to diagnose acute appendicitis, but they seem to be more effective in the western population. Both these scores are effective at ruling out acute appendicitis in low-risk patients and quantifying patients that may require further investigations.

**TABLE 1- Alvarado Score**

Features	Score
Migration of Pain	1
Anorexia	1
Nausea	1
Tenderness at the Right Lower quadrant	2
Rebound Pain	1
Elevated Temperature	1
Leucocytosis	2
Shift of White Cell Count to the Left	1
Total	10

Score of 1-4 Appendicitis unlikely  
 Score of 4-6 Appendicitis Probable  
 Score of 7-10 Appendicitis Likely

**TABLE 2- Modified Alvarado Scoring System (MASS)**

Subjects	Score (Yes/No)
<b>Symptoms</b>	
Migratory Pain	1
Anorexia	1
Nausea/ Vomiting	1
<b>Sign</b>	
Rt Lower quadrant Pain	2
Rebound Tenderness	1
Elevation of Temperature	1
<b>Lab Investigation</b>	
Leucocytosis	2

Score of 1-4-Appendicitis unlikely  
 Score of 4-6-Appendicitis probable  
 Score of 7-9-Appendicitis likely

**RIPASA SCORE**

The Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) scoring system was based on 14 fixed clinical parameters which included two demographic, five clinical symptoms, five clinical signs, two investigative parameters and one additional parameter which is foreign national identity card. This score was developed and prospectively evaluated for patients with right iliac fossa pain in Brunei. This score was easy to evaluate and quickly decide on the management of patients with pain in the right iliac fossa.(25)

The RIPASA score was compared to the Alvarado score in a meta-analysis by frontzas et al, which included 2161 patients from 12 studies. This study concluded that the RIPASA score was more sensitive than the Alvarado score, but its specificity was much lower and needs further investigations to supplement the diagnosis of pain in the right iliac fossa. (26)

A systemic review and meta-analysis conducted by Favara et al, also confirmed that the RIPASA score was more sensitive at detecting cases with suspected

appendicitis, but its specificity was much lower when compared to the Alvarado score.(27)

Further prospective observational studies comparing the RIPASA score to other scorings systems showed that it was more sensitive and has a better diagnostic accuracy than other scores like the modified Alvarado score and Alvarado score. The RIPASA was also comparable with the appendicitis inflammatory response (AIR) score in diagnosing patients with acute appendicitis.(28–35)

The RIPASA score was prospectively compared with the Alvarado, Lintula, and AIR score, and it was found to be more sensitive in diagnosing cases of suspected appendicitis. Comparison of the RIPASA score with the Eskelinen, Ohhmann and Alvarado score showed that the RIPASA score was highly specific and useful in the diagnosis of acute appendicitis .(36–39)

The conclusion from these studies is that the RIPASA score is more effective in diagnosing acute appendicitis in the Asian population and is a valuable tool in the diagnosis of acute appendicitis, but further validation may be needed in prospective studies.

**TABLE 3- RIPASA Score**

Parameter		Score
Sex	Male	1.0
	Female	0.5
Age	< 39.9 years	1.0
	>40.0 years	0.5
RIF Pain		0.5
Migration of ROQ Pain		0.5
Anorexia		1.0
Nausea and Vomiting		1.0
Duration of Symptoms	<48 hours	1.0
	> 48 hours	0.5
RIF Tenderness		1.0
RIF Guarding		2.0
Rebound Tenderness		1.0
Rovsing Sign		2.0
Fever		1.0
Raised WBC		1.0
Negative Urinalysis		1.0
Foreign NRIC		1.0

Total Score of Less Than 5-Appendicitis Unlikely

Total Score Of 5-7 -Low Probability of Appendicitis

Total Score Of 7.5-11.5 -Probability of Appendicitis Is High.

Total Score of 12-Appendicitis Highly Likely

**TABLE 4-**

Study	Study Type	Sensitivity (Alvarado Score)	Specificity (Alvarado Score)	Positive Predictive Value (Alvarado Score)	Negative Predictive Value (Alvarado Score)	Sensitivity (Ripasa Score)	Specificity (Ripasa Score)	Positive Predictive Value (Ripasa Score)	Negative Predictive Value (Ripasa Score)
Frontaz Et Al	Meta-Analysis	69%	77%	N/A	N/A	94%	55%	N/A	N/A
Erdew Et Al	Retrospective Study	82%	75%	88%	66%	100%	28%	75%	100%
Zeb Et Al	Prospective Study	88.4%	63.6%	96.4%	33.3%	96.7%	72.7%	97.5%	66.7%
Heiranizadeh Et Al	Cross-Sectional Study	67.1%	72.2%	91.7%	32.5%	86.6%	66.7%	92.2%	52.2%
Dezfuli Et Al	Prospective Study	53.9%	70.1%	70.6%	53.3%	93.4%	45.6%	69.6%	83.8%
Chong CF Et Al	Prospective Study	68.3%	87.9%	86.2%	71.4%	98.2%	81.3%	85.3%	97.3%

The sensitivity and specificity of the Alvarado and RIPASA score

**Appendicitis Inflammatory Response (AIR) Score and Adult Appendicitis Score (AAS)**

The Appendicitis Inflammatory Response (AIR) score consists of 12 points, of which 6 points are clinical in nature and 6 points are laboratory markers. A score of less than 3 is of low probability, score of 4 to 8 is medium probability, and 9 to 12 is of high probability of appendicitis. This score was prospectively evaluated and found to be sensitive in diagnosing complicated appendicitis and it performs well in both sexes.(40–42)

The Appendicitis Inflammatory Score (AIR) score was evaluated in a cross-sectional and prospective studies and found to have a good sensitivity and is reliable in the diagnosis of patients with symptoms of suspected appendicitis.(43–46)

The Adult Appendicitis Score is a scoring system that considers two clinical symptoms, 2 clinical signs and 2 laboratory tests. The scores are divided into low risk (<10), intermediate risk (11-15) and high risk (>16) for acute appendicitis. This scoring system was prospectively evaluated and found to be effective in selecting patients that would require imaging in suspected appendicitis and hence reduce negative appendectomy rates. The higher score is associated with a worse intraoperative picture in cases of acute appendicitis.(47–49)

Both these scoring systems are currently the best performing scores, and they decrease the negative Appendectomy rate and reduce the need for hospital admissions and imaging studies as recommended by the world society of emergency surgeons. Further studies may be needed to evaluate their efficacy.

**TABLE 5- AIR Score**

Diagnosis	Score
Vomit	1
Pain in RIF	1
Abdominal Defense	
Low	1
Mild	2
Severe	3
Temperature > 38,5 C	1
70-80 %	1
>85 %	2
Leukocytes	
> 20.0-24.9 *10 <sup>9</sup> /l	1
>15.0 * 10 <sup>9</sup> /l	2
CRP	
10-49 g/l	1
> 50 g/l	2

*AIR: Sum 0-4= low probability; sum 5-8= mild probability; sum 9-12= high probability; RIF= Right Iliac Fossa; CRP= C-Reactive protein*

**TABLE 6- AAS Score**

Diagnosis	Score
Vomiting	1
Pain in RIF	1
Abdominal Défense	
Low	1
Mild	2
Severe	3
Temperature > 38.5 C	1
Segmented Neutrophils	

70-84 %	1
> 85 %	2
Leukocytes (*10 <sup>9</sup> /L)	
10.0-14.9	1
>15.0	2
CRP (g/L)	
10-49	1
>50	2
Total	12

*Score of less than 10-low probability of appendicitis, score of 11-15 intermediate probability of appendicitis, score of more than 15 high probability of appendicitis*

### OTHER SCORING SYSTEMS

The Ohmann score is another scoring system that uses clinical examination and laboratory investigation to score patients with suspected appendicitis. It does not diagnose acute appendicitis on its own but will require additional investigations like imaging to confirm the diagnosis. When the ohmann score was compared to the Alvarado score, it was found to be useful as a guide to rule out acute appendicitis. (50,51)

Other scoring systems like the lintula score, The Eskelinen score which also uses symptoms and clinical examination to quantify patients at risk of acute appendicitis and it is effective in the diagnosis of acute appendicitis.(52,53)

There are other clinical scoring systems, but none are as popular as the Alvarado, RIPASA, AIR and AAS scoring systems. In the pediatric patients presenting with suspected acute appendicitis, the pediatric appendicitis score is better at diagnosing patients with suspected appendicitis when compared to the Alvarado score, but it will require further imaging to diagnose acute appendicitis.(54,55)

### CONCLUSION

The conclusion from these studies is that all these scoring are good at ruling out acute appendicitis, but they cannot be used on its own to diagnose acute appendicitis. Further examination and investigations like imaging with ultrasound or computerized tomography may be required to diagnose acute appendicitis. These scoring systems are useful as a starting point to work up patients who present with symptoms of acute appendicitis and they are valuable for junior doctors and registrars to establish patients that will require either follow up or further investigations. The limitations of these studies were that

they were predominantly retrospective in nature, hence further randomized, prospective studies may be required to look at its efficacy.

These scoring systems are relevant in our region as they help to triage patients that will require admission for acute appendicitis.

### Conflict of interest

There is no conflict of interest related to this article.

### Abbreviations

RIPASA-Raja Isteri Pengiran Anak Saleha Appendicitis, AIR-Appendicitis Inflammatory Response, AAS-Adult Appendicitis Score.

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