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Chapter 9

Clinical Scoring Systems in the Diagnosis of Acute Appendicitis: An Update

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Abstract

Acute appendicitis remains one of the most frequent surgical emergencies worldwide, posing significant diagnostic challenges due to its variable clinical presentation. Clinical scoring systems have been developed to standardize evaluation and improve diagnostic precision. Among the most widely used are the Alvarado score, the Pediatric Appendicitis Score (PAS), the Appendicitis Inflammatory Response (AIR) score, and the Adult Appendicitis Score (AAS). These tools integrate clinical signs, symptoms, and laboratory parameters to stratify patients based on the likelihood of appendicitis. However, their diagnostic performance varies across patient populations, including pediatric, adult, elderly, and pregnant individuals. This review examines the validation and clinical utility of various scoring systems, highlighting their strengths and limitations across different patient groups. Overall, clinical scoring systems serve as valuable adjuncts rather than standalone diagnostic tools. Their utility is maximized when integrated with clinical judgment and imaging modalities. Further refinement and population-specific validation are essential to enhance diagnostic accuracy and reduce unnecessary surgeries.

Keywords: Acute Appendicitis, Clinical Scoring Systems, Diagnosis, Alvarado, RIPASA, AIR, and AIR.

Introduction

Acute appendicitis is a common general surgical emergency with a lifetime risk of 7%-8% of the population. It is commonly seen in the second and third decades of life, and it has a higher rate in male than female patients. The incidence of acute appendicitis in most Western countries is about 90-100 per 100,000 population (Bhangu, 2015). The diagnosis of acute appendicitis involves the clinical examination of the patient and the assessment of the blood investigation, and due to the subjective interpretation of this, clinical scoring systems have been developed to overcome this.

These scoring systems include both clinical and inflammatory markers, and they are used to score patients into low risk, intermediate, and high risk for acute appendicitis (Bom, 2021). These scoring systems are used to quantify patients into those who would require reassessment or imaging modalities like ultrasound or computed tomography. Numerous scoring systems are available, with the Alvarado score being the most common scoring system, and others that include the modified Alvarado. the RIPASA, AIR, and AAS (Diaz, 2025).

The World Society of Emergency Surgeons (WSES), in its 2020 guidelines for the diagnosis and treatment of acute appendicitis, has recommended the use of clinical scoring systems to exclude acute appendicitis and identify intermediate-risk patients who may require imaging modalities. They have recommended the use of the AIR and AAS scoring systems to predict acute appendicitis clinically. For pediatric patients with suspected acute appendicitis, they have not recommended the use of clinical scoring systems to make a diagnosis of acute appendicitis on its own (Di Saverio, 2020). The European Association of Emergency Surgeons(EAES) in the guidelines for the management of acute appendicitis has recommended that the clinical scoring systems be used to quantify patients into low, intermediate, and high risk for acute appendicitis, and to decide which patient will require imaging modalities (Gorter, 2016). The Swedish national guidelines for the diagnosis and management of acute appendicitis have recommended clinical scoring systems for assessing the likelihood of acute appendicitis and risk-stratifying those who would require observation or imaging modalities. They have also recommended the Appendicitis Inflammatory Response (AIR) score for both adults and pediatric patients (Salö, 2025).

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This review seeks to evaluate prevalent clinical scoring systems, focusing on their sensitivity and specificity. We will also look at the role of the clinical scoring systems in the diagnosis of acute appendicitis in pediatric, adult, and elderly patients. We have undertaken this review to examine the clinical scoring systems commonly employed in diagnosing acute appendicitis. A comprehensive literature review was conducted using PubMed, the Cochrane Database of Clinical Reviews, and Google Scholar, targeting original articles, clinical trials, observational studies, cohort studies, review articles, systematic reviews, and meta-analyses from 1985 to 2026. The search utilized the following keywords: "clinical scoring systems," "Acute Appendicitis", "diagnosis," "Alvarado, "RIPASA," AAS," and "AIR". All articles were in English, with case reports and commentaries excluded. Studies involving both adults, the elderly, and children were included. Pregnant patients were excluded.

Discussion

Clinical Scoring Systems in the diagnosis of acute appendicitis in adult patients

The Alvarado score is the most common scoring system, developed by Alfredo Alvarado in 1986, based on his retrospective analysis of 305 patients. The parameters of this score include clinical history, examination, and laboratory investigations. This study showed a sensitivity and specificity of 81% and 74%, respectively (A., 1986). A systematic review by Kabir et al on the diagnosis of acute appendicitis concluded that the Alvarado score is the best at predicting acute appendicitis in men, and it should be used as a reasonable starting point for the assessment of patients with acute appendicitis. They also stated that the Alvarado score cannot diagnose acute appendicitis on its own (Kabir, 2017). A systematic review on the ability of the Alvarado score in predicting acute appendicitis was conducted by Ohle et al. A total of 42 studies were included in this review, and a cut-off value of 5 had a sensitivity of 99% in ruling out acute appendicitis in adults (Ohle, 2011).

A systematic review and Meta-regression for the Alvarado score in diagnosing acute appendicitis was conducted by Gupta et al. A total of 17 studies with 2239 patients were included in this study, and an Alvarado score of 7 and above was associated with a higher prediction risk of appendicitis and intervention (Gupta, 2023). Another retrospective study by Ozsoy et al., who evaluated the Alvarado score in predicting acute appendicitis, also noted that a score of 7 and above was associated with a higher rate of predicting acute appendicitis (Özsoy, 2017). A systematic review and meta-analysis on the diagnostic accuracy of the Alvarado score in acute appendicitis was conducted by Kinesya et al. A total of 32 studies with 10,862 patients were included in this study, and patients with a high-risk Alvarado score showed an odds ratio of 8.21 (95% CI, 4.15-16.13), and the low-risk Alvarado score to rule out acute appendicitis had an odds ratio of 0.08;95% CI, 0.02-0.32) (Kinesya, 2022). A cross-sectional study on the diagnostic accuracy of the Alvarado score was conducted by Memon et al, and the sensitivity and specificity were 93.5% and 80.6%, respectively (Memon, 2013). A prospective study by Bouali et al on the diagnostic accuracy of the Alvarado score for acute appendicitis had a sensitivity and specificity of 94.9% and 72.7%, respectively (Bouali, 2012).

The Modified Alvarado Score involved the removal of the shift to the left in the neutrophil count, and the diagnostic accuracy in acute appendicitis was assessed by a cross-sectional study by Kanumba et al. A total of 127 patients were involved in this study, and the sensitivity and specificity of the Modified Alvarado Score were 94.1% and 90.4%, respectively (Kanumba, 2011). Another study by Jain et al. also looked at the diagnostic accuracy of the Modified Alvarado Score. A total of 100 patients were included in this study, and the sensitivity and specificity were 86.1% and 83.3%, respectively (Jain, 2018). The Modified Alvarado Score was compared with the Alvarado score by Phopphrom et al. A total of 114 patients were included in this study, and the sensitivity and specificity of the Modified Alvarado score were 98% and 100%, respectively, and the Alvarado score were 98% and 90%, respectively (Phophrom, 2005).

The Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) score was introduced with 14 clinical parameters and 1 additional parameter for a total score of 15. The RIPASA score was evaluated by Chong et al, who had conducted a retrospective study on 144 patients, and at a cut-off score of 7.5, it has a sensitivity and specificity of 97.5% and 81.8%, respectively (Chong, 2010). A prospective study was performed by Singh et al to validate the RIPASA score on 200 patients, and at a cut-off of 7.5, the sensitivity and specificity were 95.8% and 75.9%, respectively (Singh, 2018). Another study by Legesse et al on the validation of the RIPASA score has a sensitivity and specificity of 96.2% and 40.8%, respectively (Legesse, 2024). A prospective study by Zaouche et al on the diagnostic accuracy of the RIPASA score concluded that it had a moderate diagnostic accuracy (Zaouche K, 2026).

A meta-analysis of randomized controlled trials comparing the RIPASA and Alvarado scores for the diagnosis of acute appendicitis was conducted by Frountzas et al. A total of 12 studies with 2161 patients were included in this study, and the sensitivity and specificity of the RIPASA score were 94% (95% CI, 92%-95%) and 55% (95% CI, 51%-55%), respectively. The sensitivity and specificity of the Alvarado score was 69% (95% CI, 67%-71%) and 77% (95% CI, 74%-80%), respectively. This study concluded that the RIPASA score had a higher sensitivity but lower specificity in diagnosing acute appendicitis (Frountzas, 2018). A systematic review and meta-analysis comparing the RIPASA score and the Alvarado score for risk assessment for acute appendicitis was conducted by Favara et al. A total of 35 studies with 5384 patients were included in this study, and the sensitivity and specificity of the RIPASA score were 0.95 (95% CL, 0.92-0.97) and 0.71 (95% CL, 0.60-0.80). The sensitivity and specificity of the Alvarado score were 0.72 (95% CL, 0.66-0.77) and 0.77 (95% CL,0.70-0.82) (Favara, 2022).

A prospective cross-sectional study comparing the RIPASA and Alvarado scores was conducted by Heiranizadeh et al. A total of 100 patients were included in this study, and the sensitivity and specificity of the RIPASA score were 86.6% and 66.7%, while the sensitivity of the Alvarado score was 67.1% and 77.2%, respectively (Heiranizadeh, 2023). Karimi et al also prospectively assessed the RIPASA score and the Alvarado score in diagnosing acute appendicitis, and the sensitivity and specificity of the RIPASA score were 93.1% and 91.6%, while the sensitivity and specificity of the Alvarado score were 78.4% and 100%, respectively (Karami, 2017).

The Appendicitis Inflammatory Response (AIR) score is a clinical scoring system that utilizes 2 clinical symptoms, 2 clinical signs, and 2 laboratory investigations. This scoring system was validated for the diagnosis of acute appendicitis, with a score of 7 and above being associated with a probability of acute appendicitis, while a score of 5 and below can rule out acute appendicitis (de Castro, 2012; Deboni, 2022; Gupta V. G., 2022). A systematic review and meta-analysis of the diagnostic value of the AIR score was conducted by Andersson et al. A total of 26 studies with 15,699 patients were included in this study, and the area under the receiver operator curve (ROC) was 0.86(95% CI, 0.83-0.88) while the ROC for the Alvarado score was 0.79(95% CI, 0.76-0.81). This study showed that the AIR score had a better diagnostic ability for acute appendicitis (Andersson, 2025).

The Adult Appendicitis Score (AAS) is a scoring system for adults with suspected appendicitis, which includes two clinical symptoms,

two clinical signs, and inflammatory markers, including the leukocyte count, proportion of neutrophils, and C-reactive protein (CRP) levels. The AAS score of 11 and above was associated with a sensitivity and specificity of 90% and 60%, respectively, for diagnosing acute appendicitis. A prospective study on 829 patients with suspected appendicitis found that the area under the ROC was 0.882 (95%CI, 0.85-0.90), and it showed that this score was fast and accurate in diagnosing acute appendicitis in adults (Sammalkorpi H. E., 2017; Sammalkorpi H. E., 2014). The Adult Appendicitis Score(AAS) was compared with the Alvarado Score by Ghali et al. A total of 1303 cases were involved in this retrospective study, and the AAS score of more than 11 was associated with a sensitivity and specificity of 88.9% and 33.6%, respectively, while it had a diagnostic accuracy of 86.9% (Ghali, 2023).

The diagnostic value of the modified Alvarado score, the RIPASA score, AIR, and AAS for patients with suspected acute appendicitis was assessed by Kandabas et al. A total of 238 patients were included in this study, and the AAS had the highest sensitivity at 81.8%, while the AIR had the highest specificity at 77.3% (Kandabas, 2026). Shemes et al also conducted a prospective study to compare the AAS, AIR, RIPASA, and Alvarado scores in their ability to diagnose acute appendicitis. In this study, the AAS had the highest discriminatory ability with an area under the curve (AUC) of 0.988, followed by the AIR with 0.920 and the RIPASA with 0. 825. The AAS score also had the best specificity, 100% (Shemes, 2026).

Clinical Scoring Systems in the Diagnosis of Acute Appendicitis in Children

The role of using clinical scoring systems to diagnose acute appendicitis in children was assessed by Van Amstel et al. They had identified seven clinical scoring systems that could diagnose acute appendicitis following a literature review, and they include the Ohmann, Alvarado, modified Alvarado, Pediatric Appendicitis Score, Christian Score, Lintula Score, and the Fenyo score, which could be used to evaluate acute appendicitis in children, but none could diagnose acute appendicitis on its own (van Amstel, 2019). Macco et al also evaluated the clinical scoring systems in diagnosing acute appendicitis in children. This study included 747 children with suspected appendicitis, and the Alvarado score, AIR score, and the PAS were used. The area under the ROC for the AIR score was 0.90, the Alvarado score was 0.87, and the PAS was 0.82, respectively. The AIR score had the best discriminating ability for diagnosing acute appendicitis in children (Macco, 2016). Rentea et al also evaluated the Alvarado score and the Pediatric Appendicitis Score (PAS) in evaluating suspected cases of acute appendicitis in children, and large validation studies found the sensitivity and specificity in the 70s and 80s, and they concluded that these scores may aid in the diagnosis of acute appendicitis, but cannot be used on their own to diagnose acute appendicitis (Rentea, 2017).

The Pediatric Appendicitis Score (PAS) was validated by a retrospective study by Salahuddin et al. A total of 104 children were included in this study, and a score of 4 or more was associated with a sensitivity and specificity of 96.8% and 80%, respectively (Salahuddin, 2022). The Alvarado score was compared with the Pediatric Appendicitis Score by Iftikhar et al. In this prospective study, a total of 180 patients were included. At a cut-off of 7, the Pediatric Appendicitis Score had a sensitivity and specificity of 93.8% and 70%, respectively, while the Alvarado score had a sensitivity and specificity of 85.5% and 70%, respectively (Iftikhar, 2021). A systematic review of the clinical prediction rules for acute appendicitis was conducted by Kulik et al. A total of 12 studies with 4201 patients were included in this study, and the Pediatric Appendicitis Score (PAS) and the Alvarado Score were well validated, but they could not be used on their own to diagnose acute appendicitis in children (Kulik, 2013). A systematic review on the most clinically useful cut-off for the Alvarado and Pediatric Appendicitis Score(PAS) was conducted by Ebell et al. A total of 26 studies were included in this study, and for children with a pretest probability of acute appendicitis of 60% or less, an Alvarado score of 4 or less can rule out acute appendicitis (Ebell, 2014).

Clinical Scoring Systems in the Diagnosis of Acute Appendicitis in the Elderly

Clinical scoring systems like Alvarado, Modified Alvarado, and RIPASA score have been used in elderly patients, but none have been validated for use in these patients. While most studies have been retrospective studies that have utilized the Alvarado and Modified Alvarado score for elderly patients with suspected acute appendicitis, a score of 5 or above will lead to a diagnosis of acute appendicitis (Lapsa, 2021). A systematic review was conducted on the diagnostic ability of the Alvarado score in acute appendicitis in the elderly by Dominguez-Torres et al. A total of 4 studies with 480 patients were included in this study. The area under the ROC was 0.7999 to 0.969, and the diagnostic ability of the Alvarado score in diagnosing acute appendicitis in the elderly was limited (Domínguez-Torres, 2024).

Rivas et al conducted a retrospective observational study on the diagnostic ability of the clinical scoring systems to diagnose acute appendicitis in the elderly. A total of 41 patients were included in this study, and the Alvarado score had an area under the curve of 0.538. The AIR had a score of 0.488, and the RIPASA had a score of 0.541. This study concluded that the clinical scoring systems had limited ability to diagnose acute appendicitis in the elderly (Curiel Rivas, et al., 2025). The World Society of Emergency Surgeons (WSES), in their guidelines for the diagnosis and treatment of acute appendicitis in the elderly, has recommended that the clinical scoring systems not be used solely to diagnose acute appendicitis in the elderly and the have recommended the use of the clinical scoring systems to rule out acute appendicitis in the elderly in those with a low probability score (Fugazzola, 2020).

Table 1: Comparative sensitivity and specificity of different clinical scoring systems in the diagnosis of acute appendicitis

Scoring System	Sensitivity (%)	Specificity (%)	References
Alvarado Score	80%-88%	57%-81%	Gupta et al. (2023)
Modified Alvarado Score	80%-88%	60%-75%	Hanna et al. (2024)
Appendicitis Inflammatory Response (AIR) score	85%-95%	70%-98%	Andersson et al. (2025)
RIPASA score	81%-96%	53%-94%	Karimi et al. (2017)
Pediatric Appendicitis Score (PAS)	87%-97%	31%-80%	Salahudin et al. (2022)

The table shows the sensitivity and specificity of the various clinical scoring systems in acute appendicitis

Conclusion

The clinical scoring systems have a role to play in risk-stratifying those patients who are at risk for acute appendicitis. The Alvarado, AIR, AAS, and RIPASA scores are the common scoring systems that are utilized in patients with suspected acute appendicitis. Their main use is in the emergency department to rule out appendicitis in patients with low scores and to decide those who would require imaging modalities like ultrasound or computerized tomography. These scoring systems should not be used to diagnose acute appendicitis on their own, and they have limited usage in the pediatric and elderly populations.

Declaration

Conflict of interest: There is no conflict of interest.

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