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Review Article

Clinical Scoring Systems in the Diagnosis of Acute Appendicitis: Narrative Review Article

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Abstract: Acute appendicitis continues to be one of the most prevalent surgical emergencies globally, presenting significant diagnostic challenges due to its diverse clinical manifestations. To standardize evaluation and enhance diagnostic accuracy, clinical scoring systems have been developed. Among the most commonly employed are the Alvarado score, the Pediatric Appendicitis Score (PAS), the Appendicitis Inflammatory Response (AIR) score, and the Adult Appendicitis Score (AAS). These instruments incorporate clinical signs, symptoms, and laboratory parameters to categorize patients based on the probability of appendicitis. Nevertheless, their diagnostic efficacy varies across different patient populations, including pediatric, adult, elderly, and pregnant cohorts. This review evaluates the validation and clinical applicability of various scoring systems, emphasizing their strengths and limitations across diverse patient groups. Overall, clinical scoring systems function as valuable adjuncts rather than standalone diagnostic tools. Their effectiveness is optimized when combined with clinical judgment and imaging techniques. Further refinement and population-specific validation are crucial to improving diagnostic precision and minimizing unnecessary surgical interventions.

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

INTRODUCTION

Acute appendicitis represents a prevalent surgical emergency, with a lifetime incidence of 7%-8% within the general population. It predominantly occurs during the second and third decades of life and exhibits a higher prevalence in male patients compared to female patients. In most Western countries, the incidence rate of acute appendicitis is approximately 90-100 per 100,000 individuals (Bhangu, 2015). The diagnostic process for acute appendicitis involves a clinical examination and the evaluation of blood tests. Given the subjective nature of these assessments, clinical scoring systems have been developed to enhance diagnostic accuracy. These systems incorporate both clinical and inflammatory markers to categorize patients into low, intermediate, and high-risk groups for acute appendicitis (Bom, 2021). Such scoring systems facilitate the identification of patients who may require further reassessment or imaging modalities, such as ultrasound or computed tomography. Among the various scoring systems available, the Alvarado score is the most widely utilized, alongside others such as the modified Alvarado, RIPASA, AIR, and AAS (Diaz, 2025).

The World Society of Emergency Surgeons (WSES), in its 2020 guidelines for diagnosing and treating acute appendicitis, advocates the use of clinical scoring systems to exclude acute appendicitis and identify intermediate-risk patients who may require imaging modalities. Specifically, they recommend the use of the Appendicitis Inflammatory Response (AIR) and Adult Appendicitis Score (AAS) systems for clinical prediction of acute appendicitis. However, for pediatric patients with suspected acute appendicitis, they do not endorse the use of clinical scoring systems as a standalone diagnostic tool (Di Saverio, 2020). Similarly, the European Association of Emergency Surgeons (EAES) guidelines for managing acute appendicitis

suggest employing clinical scoring systems to categorize patients into low, intermediate, and high-risk groups for acute appendicitis, thereby guiding the decision on which patients necessitate imaging modalities (Gorter, 2016). The Swedish national guidelines for diagnosing and managing acute appendicitis also recommend clinical scoring systems for assessing the likelihood of acute appendicitis and stratifying risk for those who may require observation or imaging modalities. They further endorse the AIR score for both adult and pediatric patients (Salö, 2025).

This review aims to assess prevalent clinical scoring systems, with a particular focus on their sensitivity and specificity. Additionally, we will examine the role of these systems in diagnosing acute appendicitis across pediatric, adult, and elderly populations. This review was undertaken to scrutinize the clinical scoring systems frequently utilized in the diagnosis of 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 employed 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 adults, the elderly, and children were included, while pregnant patients were excluded.

DISCUSSION

Clinical Scoring Systems in the Diagnosis of Acute Appendicitis in Adult Patients

The Alvarado score, developed by Alfredo Alvarado in 1986, is the most widely utilized scoring system for assessing acute appendicitis, based on a retrospective analysis of 305 patients. This scoring system incorporates parameters such as clinical history, physical examination, and laboratory investigations. The study demonstrated a sensitivity of 81% and a specificity of 74% (A., 1986). A systematic review by Kabir *et al*., on the diagnosis of acute appendicitis concluded that the Alvarado score is particularly effective in predicting acute appendicitis in male patients and should serve as a reasonable initial assessment tool for patients suspected of having acute appendicitis. However, they also noted that the Alvarado score alone is insufficient for a definitive diagnosis (Kabir, 2017). Furthermore, a systematic review conducted by Ohle *et al*., evaluated the predictive capability of the Alvarado score for acute appendicitis, incorporating a total of 42 studies. This review found that a cut-off value of 5 achieved a sensitivity of 99% in excluding acute appendicitis in adults (Ohle, 2011).

Gupta *et al*., conducted a systematic review and meta-regression to evaluate the efficacy of the Alvarado score in diagnosing acute appendicitis. This study incorporated 17 studies with a total of 2,239 patients, revealing that an Alvarado score of 7 or higher was significantly associated with an increased risk of appendicitis and the need for intervention (Gupta, 2023). Similarly, a retrospective study by Ozsoy *et al*., assessed the predictive capability of the Alvarado score for acute appendicitis, corroborating that a score of 7 or above was linked to a higher predictive rate of the condition. (Özsoy, 2017). Furthermore, Kinesya *et al*., performed a systematic review and meta-analysis on the diagnostic accuracy of the Alvarado score in acute appendicitis, including 32 studies with 10,862 patients. Their findings indicated that patients with a high-risk Alvarado score had an odds ratio of 8.21 (95% CI, 4.15-16.13), while a low-risk score for ruling out acute appendicitis had an odds ratio of 0.08 (95% CI, 0.02-0.32) (Kinesya, 2022). Additionally, Memon *et al*., conducted a cross-sectional study on the diagnostic accuracy of the Alvarado score, reporting a sensitivity of 93.5% and a specificity of 80.6%(Memon, 2013). In a prospective study by Bouali *et al*., the diagnostic accuracy of the Alvarado score for acute appendicitis was evaluated, yielding a sensitivity of 94.9% and a specificity of 72.7% (Bouali, 2012).

The Modified Alvarado Score, which excludes the left shift in neutrophil count, was evaluated for its diagnostic accuracy in acute appendicitis through a cross-sectional study conducted by Kanumba *et al*., This study involved 127 patients, revealing a sensitivity and specificity of 94.1% and 90.4%, respectively (Kanumba, 2011). Similarly, Jain *et al*., investigated the diagnostic accuracy of the Modified Alvarado Score in a study comprising 100 patients, reporting a sensitivity of 86.1% and a specificity of 83.3% (Jain, 2018). Furthermore, Phopphrom *et al*., compared the Modified Alvarado Score with the original Alvarado Score in a study including 114 patients. The Modified Alvarado Score demonstrated a sensitivity and specificity of 98% and 100%, respectively, while the Alvarado Score showed a sensitivity of 98% and a specificity of 90% (Phophrom, 2005).

The Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) score comprises 14 clinical parameters and an additional parameter, culminating in a total score of 15. Chong *et al*., conducted a retrospective study involving 144 patients to evaluate the RIPASA score, determining that at a cut-off score of 7.5, the sensitivity and specificity were 97.5% and 81.8%, respectively (Chong, 2010). Singh *et al*., performed a prospective study to validate the RIPASA score on a cohort of 200 patients, finding that at the same cut-off, the sensitivity and specificity were 95.8% and 75.9%, respectively (Singh, 2018). Another validation study by Legesse *et al*., reported a sensitivity and specificity of 96.2% and 40.8%, respectively (Legesse, 2024). Furthermore, a prospective study by Zaouche *et al*., assessing the diagnostic accuracy of the RIPASA score concluded that it demonstrated moderate diagnostic accuracy (Zaouche K, 2026).

A meta-analysis of randomized controlled trials conducted by Frountzas *et al*., compared the RIPASA and Alvarado scores for diagnosing acute appendicitis. This study incorporated 12 studies with a total of 2161 patients. The sensitivity and specificity of the RIPASA score were found to be 94% (95% CI, 92%-95%) and 55% (95% CI, 51%-55%), respectively. In contrast, the Alvarado score demonstrated a sensitivity of 69% (95% CI, 67%-71%) and a specificity of 77% (95% CI, 74%-80%). The study concluded that the RIPASA score exhibited higher sensitivity but lower specificity in diagnosing acute appendicitis (Frountzas, 2018). Additionally, a systematic review and meta-analysis by Favara *et al*., compared the RIPASA and Alvarado scores for risk assessment of acute appendicitis. This analysis comprised 35 studies involving a total of 5,384 patients. The sensitivity and specificity of the RIPASA score were reported as 0.95 (95% CL, 0.92-0.97) and 0.71 (95% CL, 0.60-0.80), respectively. The Alvarado score showed a sensitivity of 0.72 (95% CL, 0.66-0.77) and a specificity of 0.77 (95% CL, 0.70-0.82) (Favara, 2022).

Heiranizadeh *et al*., conducted a prospective cross-sectional study to compare the RIPASA and Alvarado scores. This study included a total of 100 patients, revealing that the RIPASA score demonstrated a sensitivity of 86.6% and a specificity of 66.7%, whereas the Alvarado score exhibited a sensitivity of 67.1% and a specificity of 77.2% (Heiranizadeh, 2023). Similarly, Karimi *et al*., prospectively evaluated the RIPASA and Alvarado scores in diagnosing acute appendicitis. Their findings indicated that the RIPASA score had a sensitivity of 93.1% and a specificity of 91.6%, while the Alvarado score showed a sensitivity of 78.4% and a specificity of 100% (Karami, 2017).

The Appendicitis Inflammatory Response (AIR) score is a clinical scoring system that incorporates two clinical symptoms, two clinical signs, and two laboratory investigations. This scoring system has been validated for diagnosing acute appendicitis, with a score of 7 or higher indicating a likelihood of acute appendicitis, whereas a score of 5 or lower can effectively rule it out (de Castro, 2012; Deboni, 2022; Gupta V. G., 2022). A systematic review and meta-analysis conducted by Andersson *et al*., evaluated the diagnostic value of the AIR score. This study included 26 studies with a total of 15,699 patients, revealing an area under the receiver operating characteristic (ROC) curve of 0.86 (95% CI, 0.83-0.88) for the AIR score, compared to 0.79 (95% CI, 0.76-0.81) for the Alvarado score. The findings demonstrated that the AIR score possesses superior diagnostic capability for acute appendicitis (Andersson, 2025).

The Adult Appendicitis Score (AAS) is a diagnostic tool for adults with suspected appendicitis, incorporating two clinical symptoms, two clinical signs, and inflammatory markers, including leukocyte count, neutrophil proportion, and C-reactive protein (CRP) levels. An AAS score of 11 or higher is associated with a sensitivity of 90% and a specificity of 60% for diagnosing acute appendicitis. A prospective study involving 829 patients with suspected appendicitis reported an area under the ROC curve of 0.882 (95% CI, 0.85-0.90), indicating that this score is both rapid and accurate in diagnosing acute appendicitis in adults (Sammalkorpi H. E., 2017; Sammalkorpi H. E., 2014). Ghali *et al*., conducted a retrospective study comparing the Adult Appendicitis Score (AAS) with the Alvarado Score, involving a total of 1303 cases. In this study, an AAS score exceeding 11 was associated with a sensitivity of 88.9% and a specificity of 33.6%, along with a diagnostic accuracy of 86.9% (Ghali, 2023).

Kandabas *et al*., evaluated the diagnostic efficacy of the modified Alvarado score, the RIPASA score, AIR, and AAS in patients with suspected acute appendicitis. The study encompassed 238 patients, revealing that the AAS demonstrated the highest sensitivity at 81.8%, whereas the AIR exhibited the highest specificity at 77.3% (Kandabas, 2026). Similarly, Shemes *et al*., conducted a prospective study to compare the diagnostic capabilities of the AAS, AIR, RIPASA, and Alvarado scores for acute appendicitis. In this investigation, the AAS demonstrated superior discriminatory power with an area under the curve (AUC) of 0.988, followed by the AIR at 0.920 and the RIPASA at 0.825. Furthermore, the AAS score achieved the highest specificity, recorded at 100% (Shemes, 2026).

Clinical Scoring Systems in the Diagnosis of Acute Appendicitis in Children

Van Amstel *et al*., conducted an assessment of the role of clinical scoring systems in diagnosing acute appendicitis in children. Through a literature review, they identified seven clinical scoring systems: the Ohmann, Alvarado, modified Alvarado, Pediatric Appendicitis Score (PAS), Christian Score, Lintula Score, and Fenyo score. These systems can be utilized to evaluate acute appendicitis in children; however, none is capable of independently diagnosing the condition (van Amstel, 2019). Similarly, Macco *et al*., evaluated these clinical scoring systems in the context of diagnosing acute appendicitis in children. Their study encompassed 747 children with suspected appendicitis, employing the Alvarado score, AIR score, and PAS. The area under the receiver operating characteristic (ROC) curve was 0.90 for the AIR score, 0.87 for the Alvarado score, and 0.82 for the PAS, indicating that the AIR score demonstrated the highest discriminative ability for diagnosing acute appendicitis in children (Macco, 2016). Furthermore, Rentea *et al*., assessed the Alvarado score and PAS in evaluating suspected cases of acute appendicitis in children. Large validation studies reported sensitivities and specificities in the 70s and 80s, leading to the conclusion that while these scores may assist in

diagnosing acute appendicitis, they cannot be solely relied upon for diagnosis (Rentea, 2017).

The Pediatric Appendicitis Score (PAS) was validated through a retrospective study conducted by Salahuddin *et al*., This study included a total of 104 children, and a score of 4 or higher was associated with a sensitivity of 96.8% and a specificity of 80% (Salahuddin, 2022). Iftikhar *et al*., compared the Alvarado score with the Pediatric Appendicitis Score in a prospective study involving 180 patients. At a cut-off of 7, the Pediatric Appendicitis Score demonstrated a sensitivity of 93.8% and a specificity of 70%, whereas the Alvarado score exhibited a sensitivity of 85.5% and a specificity of 70% (Iftikhar, 2021). Kulik *et al.*, conducted a systematic review of clinical prediction rules for acute appendicitis, incorporating 12 studies with a total of 4201 patients. The review found that both the Pediatric Appendicitis Score (PAS) and the Alvarado Score were well validated, yet neither could be solely relied upon for diagnosing acute appendicitis in children (Kulik, 2013). Ebell *et al*., conducted a systematic review to determine the most clinically useful cut-off for the Alvarado and Pediatric Appendicitis Score (PAS). This review included 26 studies and concluded that for children with a pretest probability of acute appendicitis of 60% or less, an Alvarado score of 4 or lower can effectively rule out acute appendicitis (Ebell, 2014).

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

Clinical scoring systems such as the Alvarado, Modified Alvarado, and RIPASA scores have been employed in elderly patients; however, none have been validated specifically for this demographic. The majority of studies have been retrospective, utilizing the Alvarado and Modified Alvarado scores for elderly patients with suspected acute appendicitis, where a score of 5 or above typically results in a diagnosis of acute appendicitis (Lapsa, 2021). Dominguez-Torres *et al*., conducted a systematic review on the diagnostic efficacy of the Alvarado score in cases of acute appendicitis among the elderly. This review included four studies encompassing a total of 480 patients. The area under the ROC curve ranged from 0.7999 to 0.969, indicating that the diagnostic capability of the Alvarado score in identifying acute appendicitis in the elderly is limited. (Domínguez-Torres, 2024).

Rivas *et al*., conducted a retrospective observational study to evaluate the diagnostic efficacy of clinical scoring systems in identifying acute appendicitis among elderly patients. The study encompassed a total of 41 participants. The Alvarado score demonstrated an area under the curve (AUC) of 0.538, while the Appendicitis Inflammatory Response (AIR) score and the Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) score exhibited AUCs of 0.488 and 0.541, respectively. The findings of this study indicate that these clinical scoring systems possess limited diagnostic capability for acute appendicitis in the elderly population (Curiel Rivas, *et al*., 2025). In alignment with these findings, the World Society of Emergency Surgeons (WSES) guidelines for diagnosing and treating acute appendicitis in the elderly advise against the exclusive reliance on clinical scoring systems for diagnosis. Instead, they recommend utilizing these systems to exclude acute appendicitis in patients with a low probability score (Fugazzola, 2020).

Table I

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

Clinical scoring systems play a significant role in stratifying the risk of patients suspected of having acute appendicitis. The Alvarado, Appendicitis Inflammatory Response (AIR), Adult Appendicitis Score (AAS), and Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) scores are commonly employed in such cases. These systems are primarily utilized in emergency departments to exclude appendicitis in patients with low scores and to determine the necessity for imaging modalities such as ultrasound or computed tomography. It is important to note that these scoring systems should not be used as standalone diagnostic tools for acute appendicitis, and their applicability is limited in pediatric and elderly populations.

Conflict of Interest: There is no conflict of interest.

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