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The Analysis Study of Diagnostic Approaches in Acute Appendicitis: A Comprehensive Systematic Review

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ABSTRACT

Background: Diagnostic approaches for appendicitis have evolved to improve accuracy and reduce negative appendectomy rates. Laboratory markers and imaging modalities have been developed to provide supportive but non-specific information. However, challenges persist in balancing accuracy with concerns like radiation exposure and cost-effectiveness. This systematic review seeks to synthesize existing evidence on diagnostic approaches in acute appendicitis, examining their performance, limitations, and potential for standardized integration into clinical practice. **Methods:** This systematic review was conducted in accordance with the PRISMA 2020 guidelines, incorporating only full-text, peer-reviewed articles published in English from 2015 to 2025. To maintain the integrity and reliability of the sources, editorial pieces and review articles lacking a Digital Object Identifier (DOI) were excluded. A comprehensive literature search was performed using databases such as ScienceDirect, PubMed, and SAGE Publications to identify relevant studies. **Result:** An initial search of selected databases identified over 300 potentially relevant studies. After a structured three-phase screening process, only eight met the inclusion criteria for detailed review. These articles underwent rigorous critical appraisal to evaluate their relevance and quality. This ensured that the final analysis was based on strong evidence aligned with the study's objectives. **Conclusion:** The effective diagnosis and management of acute appendicitis necessitate an integrated approach involving clinical scoring systems, imaging studies, and evidence-based surgical decision-making. Imaging is crucial for confirmation and planning, while timely surgical intervention is essential. Advancements in diagnostic tools and surgical techniques can improve patient outcomes and reduce healthcare burden.

Keywords: acute appendicitis, diagnostic approaches, imaging, clinical scoring system

INTRODUCTION

Acute appendicitis remains one of the most common surgical emergencies worldwide, with an estimated lifetime risk of 7–8%.[1] Despite its prevalence, accurate diagnosis remains a clinical challenge, particularly in atypical presentations or in populations such as children, the elderly, and pregnant women.[2] Traditional diagnosis has relied heavily on clinical evaluation, including symptoms like right lower quadrant pain, nausea, and fever, combined with physical examination signs such as McBurney's point tenderness or rebound tenderness.[1,3] However, due to variability in presentation and overlap with other abdominal conditions, reliance on clinical features alone can result in misdiagnosis, delayed treatment, or unnecessary surgeries, reinforcing the need for more precise and reliable diagnostic approaches.

Over the years, diagnostic strategies have evolved to incorporate laboratory markers and imaging modalities aimed at improving accuracy and reducing negative appendectomy rates. Laboratory tests, such as elevated white blood cell count (WBC) and C-reactive protein (CRP) levels, provide supportive but non-specific information.[4] Meanwhile, imaging modalities—particularly ultrasonography, computed tomography (CT), and magnetic resonance imaging (MRI)—have become essential tools in confirming appendicitis.+5 CT, with its high sensitivity and specificity, is often considered the gold standard, particularly in adult populations, while ultrasound is favored in pediatric and pregnant patients due to its safety profile.[6] Despite these advances, challenges persist in balancing diagnostic accuracy with concerns such as radiation exposure, cost-effectiveness, and availability of imaging technologies.

Given the critical importance of early and accurate diagnosis, current research has increasingly focused on developing diagnostic algorithms, clinical scoring systems (e.g., Alvarado, RIPASA, and AIR scores), and machine learning models to guide decision-making.[7-9] These approaches aim to integrate clinical, laboratory, and imaging data to optimize diagnostic precision and minimize unnecessary surgical intervention. However, significant heterogeneity remains in

their application, validation, and comparative effectiveness across different healthcare settings and populations. This systematic review seeks to synthesize existing evidence on diagnostic approaches in acute appendicitis, examining their performance, limitations, and potential for standardized integration into clinical practice.

METHODS

Protocol

This review was systematically designed in accordance with the PRISMA 2020 framework to maintain methodological accuracy and ensure research credibility. Following these standardized procedures strengthened the study's clarity, consistency, and scientific rigor. Every step, from thorough literature collection to detailed data analysis and synthesis, was conducted with the intent to reduce bias and enhance reliability. This structured approach reinforces the credibility of the results and contributes meaningful perspectives to the existing evidence-based research.

Criteria for Eligibility

This systematic review is designed to critically examine diagnostic strategies used in the assessment of acute appendicitis by integrating findings from a broad spectrum of relevant studies. Through the identification of common patterns, emerging trends, and research gaps, the review aims to offer actionable insights that can inform and refine clinical decision-making. Its core objective is to strengthen the current knowledge base, contributing to improved diagnostic accuracy and better patient outcomes in clinical settings.

To ensure methodological integrity, the study employed stringent inclusion and exclusion criteria. Only peer-reviewed research articles published in English between 2015 and 2025 were considered, with each source verified through a Digital Object Identifier (DOI) to confirm authenticity. Editorials, literature reviews, and duplicate studies were excluded to maintain a focused analysis on

original, high-quality research. This careful selection process adds to the reliability and validity of the review's conclusions.

Utilizing a structured and evidence-driven approach, the review's findings are firmly rooted in comprehensive empirical analysis. The goal is to support the enhancement of current diagnostic protocols for acute appendicitis, particularly in pediatric care, by providing evidence that promotes improved accuracy and clinical efficiency. Ultimately, this review contributes to the advancement of best practices in the diagnosis and management of this common yet complex condition.

Search Strategy

A thorough and methodical search strategy was implemented to identify relevant studies for this review, using targeted keywords such as "diagnostic," "approaches," and "acute appendicitis." To capture a broad and representative range of peer-reviewed literature, the search was carried out across three prominent academic databases: PubMed, SAGE Publications, and ScienceDirect. This approach ensured access to diverse, high-quality sources, enhancing the depth and breadth of the evidence base. By applying a well-structured and academically rigorous search process, the review reinforces the credibility of its findings and enables a more comprehensive assessment of diagnostic practices in pediatric emergency care.

Table 1. Search Strategy

Database	**Search Strategy**	***Hits***
Pubmed	*("diagnostic" AND "approaches" AND "acute appendicitis")*	58
Science Direct	*("diagnostic approaches" AND "acute appendicitis")*	250
Sagepub	*("diagnostic approaches" AND "acute appendicitis")*	10

Data retrieval

The authors conducted a careful and systematic screening of all retrieved studies, beginning with an evaluation of titles and abstracts to determine their

relevance to the research objectives. Only those that clearly met the established inclusion criteria and aligned with the focus of the review were selected for full-text assessment. This deliberate approach enabled the identification of recurring themes and notable trends, ensuring the synthesis remained focused and directly addressed the core research question. Through a transparent selection process, the review integrated only high-quality evidence to support its findings.

To maintain uniformity and enhance the comparability of the data, only full-text articles written in English were considered. A strict screening protocol was applied to confirm that each study satisfied the eligibility criteria and directly contributed to the aims of the review. Studies falling short of these standards were excluded, resulting in a refined collection of relevant and credible sources. This meticulous filtering helped minimize bias and increased the validity of the conclusions drawn.

Further evaluation included a detailed analysis of each study's characteristics, such as authorship, publication year, geographic context, and research design. This comprehensive assessment ensured that only methodologically sound and contextually appropriate research was included in the final synthesis. By applying this thorough and organized framework, the review strengthened the reliability of its findings and offered well-grounded insights into diagnostic strategies for acute appendicitis in clinical practice.

Quality Assessment and Data Synthesis

The authors implemented a thorough and systematic screening process, initially reviewing study titles and abstracts to identify research that met established criteria for relevance and methodological soundness. Only studies that closely aligned with the review’s objectives and exhibited strong scientific quality were chosen for full-text analysis. This focused selection approach ensured the inclusion of only the most relevant and high-quality studies, thereby enriching the review’s overall depth and significance. By concentrating on credible and contextually appropriate sources, the authors enhanced the precision, coherence, and analytical strength of the review, further bolstering its validity and academic integrity.

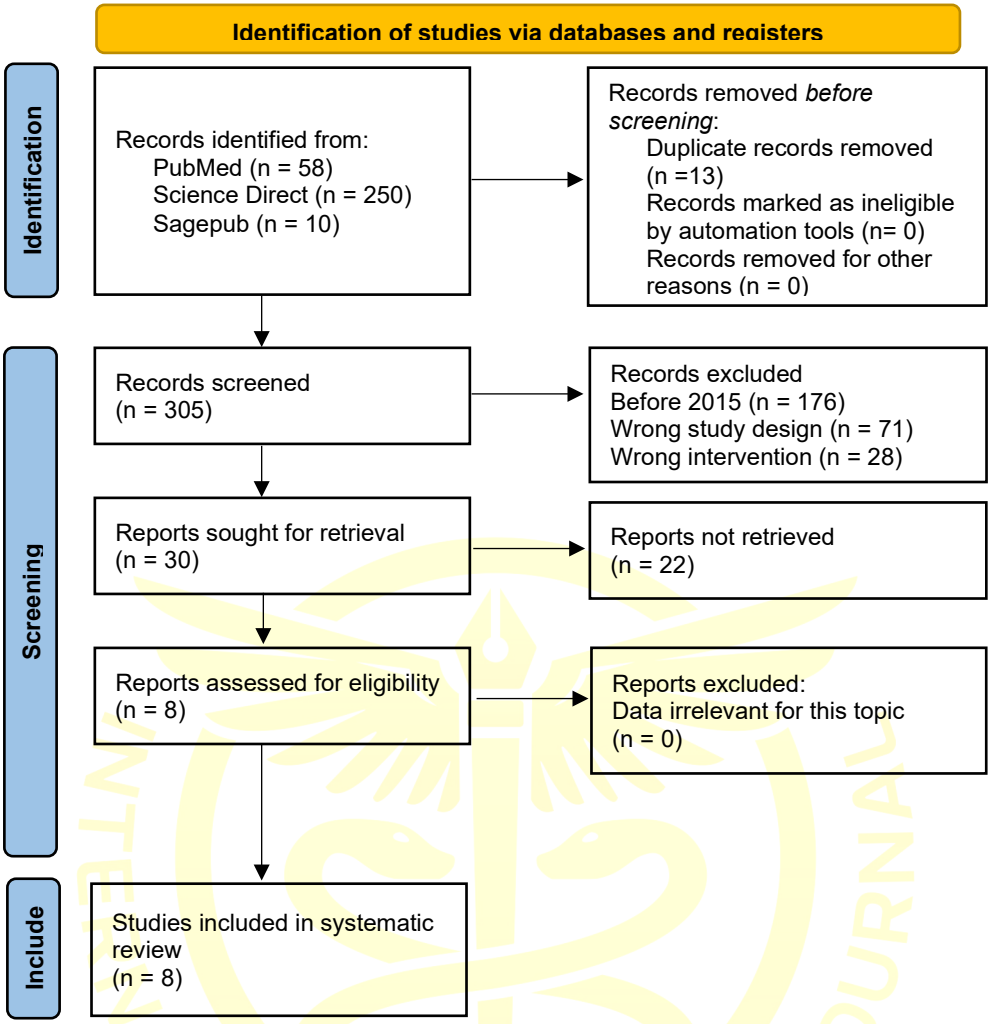

Figure 1. Article search flow chart

Table 2. Critical appraisal of Study

Parameters	(Alubaidi et al., 2016)	(Gorter et al., 2016)	(Lipsett et al., 2017)	(Alvarado. A, 2018)	(Synder et al., 2018)	(Reismann et al., 2019)	(Di Saverio et al., 2020)	(Dogan et al., 2024)
1. Bias related to temporal precedence								
Is it clear in the study what is the "cause" and what is the "effect" (ie, there is no confusion about which variable comes first)?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
2. Bias related to selection and allocation								
Was there a control group?	No	No	No	No	No	No	No	No
3. Bias related to confounding factors								
Were participants included in any comparisons similar?	Yes	No	No	No	No	Yes	No	Yes
4. Bias related to administration of intervention/exposure								
Were the participants included in any comparisons receiving similar treatment/care, other than the exposure or intervention of interest?	Yes.	No.	No.	No.	No.	Yes.	No.	Yes.
5. Bias related to assessment, detection, and measurement of the outcome								
Were there multiple measurements of the outcome, both pre and post the intervention/exposure?	No	No	No	No	No	No	No	No
Were the outcomes of participants included in any comparisons measured in the same way?	No	No	No	No	No	No	No	No
Were outcomes measured in a reliable way?	Yes	No	No	No	No	Yes	No	Yes
6. Bias related to participant retention								
Was follow-up complete and, if not, were differences between groups in terms of their follow-up adequately described and analyzed?	Yes	No	No	No	No	No	No	No
7. Statistical conclusion validity								
Was appropriate statistical analysis used?	Yes	No	No	No	No	Yes	No	Yes

RESULT

The study commenced with a methodical search across reputable academic databases such as ScienceDirect, PubMed, and SAGE Publications to gather literature pertinent to the review's objectives. A thorough three-step screening process was employed to narrow down the initial results, resulting in the selection of eight studies that met the established inclusion criteria. These studies were then subjected to an in-depth analysis, enabling the identification and evaluation of key themes and significant findings. To facilitate clarity and comparison, the synthesized results are organized and presented in Table 3, providing a structured summary that enhances the interpretability of the reviewed literature.

Table 3. The literature included in this study

Author	Origin	Method	Sample	Result
Alubaidi et al.[10] (2016)	United Kingdom	Retrospective Study	124 participants	Acute appendicitis is a common clinical condition characterized by right iliac fossa tenderness, anorexia, nausea, migratory abdominal pain, tachycardia, and pyrexia. The simple triad of anorexia, right iliac fossa tenderness, and migratory abdominal pain is a reliable diagnostic tool for acute appendicitis, with a specificity of 84.2% and sensitivity of 45.7%. If the triad is negative, imaging and diagnostic laparoscopy should be considered.
Gorter et al.[11] (2016)	Netherlands	Review	-	The EAES consensus meeting resulted in recommendations for the diagnosis and management of acute appendicitis, supported by the European surgical

				community, providing guidance to surgeons and residents dealing with patients with this condition.
Lipsett et al.[12] (2017)	USA	Review	-	Appendicitis imaging has been reduced due to radiation concerns, favoring ultrasound over computed tomography. Risk stratification involves clinical signs, white blood cell count, and ultrasound for evaluation and management. Magnetic resonance imaging is promising but costly. Nonoperative management is being explored in children with confirmed appendicitis.
Alvarado, A.[13] (2018)	Colombia	Review	-	Acute appendicitis requires an accurate diagnosis within 24 hours of symptoms onset, relying on the physician's experience and common sense to prevent serious complications like gangrene and appendix perforation, ensuring timely treatment.
Synder et al.[14] (2018)	USA	Review	-	Acute appendicitis is a common cause of abdominal pain in adults and children, with a lifetime risk of 8.6% in males and 6.7% in females. The Alvarado score helps diagnose the condition, with positive signs like psoas, obturator, and Rovsing being reliable indicators.
Reismann et al.[15] (2019)	Germany	Cross Sectional	590 participants	The study analyzed 590 patients with appendicitis using machine learning

				and AI algorithms. The biomarker signatures showed 90% specificity and 67% accuracy for appendicitis diagnosis, with 51% sensitivity and 33% specificity for complicated inflammation.
Di Saverio et al.[16] (2020)	United Kingdom	Review	-	Acute appendicitis is a common cause of abdominal pain, with diagnosis and management controversies. The World Society of Emergency Surgery (WSES) organized a consensus conference in 2015 to develop evidence-based guidelines. Updated guidelines include clinical scores, imaging, surgery indications, non-operative management, antibiotics, laparoscopy, and surgical techniques.
Dogan et al.[17] (2024)	Turkey	Cross Sectional	266 participants	Successfully using deep learning, the success rate for diagnosing radiologically suspicious cases was 83.3%, indicating that successful results can be achieved even in cases where appendix diameter has not significantly increased.

DISCUSSION

Accurate and timely diagnosis of acute appendicitis remains a critical component of emergency abdominal care, particularly given the condition's rapid progression and potential for life-threatening complications if not promptly managed. Over the decades, diagnostic strategies have evolved to incorporate clinical scoring systems, laboratory findings, and advanced imaging techniques, all of which aim to enhance diagnostic precision and reduce unnecessary surgical interventions. This systematic review examined the current evidence surrounding diagnostic criteria, supporting examinations, surgical indications, and operative techniques in acute appendicitis, highlighting key advancements and remaining challenges in clinical practice.

Diagnostic Criteria for Acute Appendicitis: Alvarado vs. RIPASA Scores

Clinical scoring systems play a pivotal role in the early identification of acute appendicitis, particularly in resource-limited settings where advanced imaging may not be readily available. Among the most frequently utilized scoring models are the Alvarado Score and the Raja Isteri Pengiran Anak Saleha Appendicitis (RIPASA) Score.[7,9] The Alvarado Score, established in 1986, combines symptoms (e.g., right lower quadrant pain, anorexia, nausea), signs (e.g., rebound tenderness, fever), and laboratory markers (e.g., leukocytosis, neutrophilia) to generate a cumulative score out of 10. A score of 7 or more typically suggests a high likelihood of appendicitis and supports the decision to operate.[7,18] However, the Alvarado Score has shown limited sensitivity in non-Western populations and among pediatric and female patients, where the clinical presentation can be atypical.

In response to these limitations, the RIPASA Score was developed in 2010 in Brunei Darussalam to improve diagnostic accuracy in Asian populations. This model includes additional parameters such as age, gender, duration of symptoms, and specific clinical signs, generating a total score of 16.5.[19] Studies consistently report that the RIPASA Score demonstrates higher sensitivity, specificity, and

overall diagnostic accuracy compared to the Alvarado Score, particularly in Southeast Asian and Middle Eastern cohorts.[20,21] Despite its enhanced performance, the RIPASA Score is underutilized in Western countries, indicating a need for broader validation and clinical integration across different healthcare settings. Ultimately, both scoring systems offer significant clinical value and should be used in conjunction with other diagnostic tools to guide timely and effective management.

Supporting Examinations for Acute Appendicitis

Laboratory and imaging investigations are essential adjuncts to clinical scoring systems, providing objective data that support or refute the diagnosis of acute appendicitis. Common laboratory markers such as elevated white blood cell (WBC) count, neutrophilia, and increased C-reactive protein (CRP) levels are typically observed in patients with appendicitis.[4] However, while helpful, these markers lack specificity and may be elevated in various other intra-abdominal or systemic inflammatory conditions.

Imaging has become indispensable in the diagnostic algorithm, with ultrasound (US) often being the first-line modality, especially in children and pregnant women due to its safety and absence of radiation. Ultrasound is highly specific but less sensitive, particularly in obese patients or when bowel gas obscures the appendix.[22] In contrast, computed tomography (CT) remains the gold standard in adult patients due to its high sensitivity (94–98%) and specificity (up to 97%). CT scans can accurately detect appendiceal inflammation, perforation, and abscesses, facilitating appropriate surgical planning.[5,23] Magnetic Resonance Imaging (MRI) has also emerged as a reliable, radiation-free alternative, particularly valuable in pregnant patients, with diagnostic accuracy comparable to CT.[24] Integrating imaging results with clinical scores enhances overall diagnostic certainty, reducing negative appendectomy rates and associated complications.

Surgical Indications in Acute Appendicitis

The decision to proceed with surgery in cases of suspected acute appendicitis depends on a combination of clinical judgment, scoring systems, laboratory and imaging findings, and patient-specific factors. The classic indication for surgery is a confirmed or strongly suspected diagnosis of appendicitis, particularly when symptoms are severe or progressive. In patients with confirmed uncomplicated appendicitis, immediate appendectomy is the standard of care to prevent perforation and peritonitis.[25] However, recent studies have explored non-operative management using antibiotics in selected cases of uncomplicated appendicitis, with varying degrees of success. While non-surgical approaches may reduce immediate morbidity, concerns remain regarding recurrence, diagnostic uncertainty, and long-term outcomes.[26]

In contrast, complicated appendicitis—characterized by perforation, abscess formation, or generalized peritonitis—requires urgent surgical intervention. Delaying treatment in these cases significantly increases the risk of morbidity and mortality. Clear surgical indications include persistent right lower quadrant pain, signs of sepsis, peritoneal irritation, and radiological evidence of a gangrenous or perforated appendix.[27] In some patients with localized abscesses, interval appendectomy following initial percutaneous drainage and antibiotic therapy may be considered.[28] Therefore, individualized assessment is crucial to balance the risks and benefits of immediate versus delayed or conservative management.

Types of Surgical Intervention for Acute Appendicitis

Two primary surgical techniques are employed in the treatment of acute appendicitis: open appendectomy (OA) and laparoscopic appendectomy (LA). Open appendectomy, traditionally performed through a right lower quadrant incision (McBurney's point), remains effective and is still widely used, particularly in settings with limited access to minimally invasive equipment or expertise.[29] However, laparoscopic surgery has become the preferred approach in many high-resource settings due to its numerous advantages, including smaller incisions, reduced postoperative pain, shorter hospital stays, quicker return to normal activities, and lower wound infection rates.[30]

Laparoscopy also provides enhanced visualization of the abdominal cavity, allowing for better identification of atypical or complicated cases. In some instances, it can also serve a diagnostic purpose, especially when the clinical picture is unclear.[29,30] That said, in cases of severe inflammation, extensive adhesions, or diffuse peritonitis, surgeons may opt for open surgery based on clinical judgment and patient stability.

Emerging surgical techniques such as single-incision laparoscopic surgery (SILS) and natural orifice transluminal endoscopic surgery (NOTES) are being explored to further reduce invasiveness.[31,32] While these approaches show promise in selected patient groups, their widespread use is currently limited by technical challenges and the need for further evidence regarding safety and efficacy.

CONCLUSION

In conclusion, the effective diagnosis and management of acute appendicitis require an integrated approach that combines clinical scoring systems, laboratory findings, imaging studies, and evidence-based surgical decision-making. While the Alvarado and RIPASA Scores provide valuable diagnostic guidance, imaging remains essential for confirmation and planning. Timely surgical intervention remains the cornerstone of treatment, with laparoscopic appendectomy now favored in many settings due to its clinical advantages. Ongoing advancements in both diagnostic tools and surgical techniques hold the potential to further improve patient outcomes and reduce the healthcare burden associated with this common surgical emergency.

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