

## Emergency department's diagnosis of acute appendicitis the efficiency of ultrasonography: A systematic review

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### Abstract

Computed tomography is increasingly often used to examine patients with appendicitis. However, due to rising concerns about the long-term cancer risk linked with computed tomography-induced ionizing radiation, its routine usage is being reevaluated. Point-of-care ultrasound is a quick, useful, noninvasive, and reasonably priced diagnostic technique used in the emergency room to detect trauma, severe abdominal pain and discomfort, chest pain, and dyspnea. And The purpose of this systematic review study is to determine how well ultrasonography diagnoses acute appendicitis in emergency rooms. The biological literature for our systematic review study was gathered from a variety of sources, including Google Scholar, Ovid MEDLINE, and PubMed. We included studies on diagnosing appendicitis in emergency rooms. After reviewing the abstracts and full texts of the included papers, the relevant information was retrieved. 391 items in total were retrieved by the database search after duplication and filtering were done. Six studies were added for analysis after meeting the study's inclusion criteria. Ultrasound sensitivity ranged from a minimum of 0.44 to a maximum of 0.99. However, the mean overall sensitivity and specificity were 0.80 and 0.81, respectively, with the least specificity recorded being 0.63 and the greatest being 0.96.

**Keywords:** Acute appendicitis; Emergency department; Diagnosis

### 1. Introduction

Surgery must be performed right away if you have acute appendicitis, a dangerous appendix infection (1). Ultrasound has a sensitivity of 75% to 90% and a specificity of 86% to 95% for diagnosing acute appendicitis (2). Although the diagnostic accuracy reported in these early research varies, other investigations have examined the reliability of ultrasonography for the diagnosis of acute appendicitis (3).

Computed tomography is increasingly often used to examine patients with appendicitis (4). However, increasing concern about the long-term cancer risk linked to computed tomography-induced ionizing radiation is reevaluating its widespread usage (5). Computed tomography is becoming more and more common as a supplementary diagnostic technique when using ultrasound as the primary imaging modality to confirm or rule out the diagnosis of juvenile appendicitis (6). For children with appendicitis, researchers have recently noted a trend in big U.S. pediatric hospitals toward a higher reliance on ultrasonography and a decreasing use of computed tomography (7).

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In order to diagnose trauma, severe stomach pain and discomfort, dyspnea, and chest pain, the emergency department employs point-of-care ultrasonography as a quick, useful, noninvasive, and reasonably priced diagnostic tool (8). Due to time restrictions and context, ultrasound's diagnostic efficacy in the emergency department may vary (9). The purpose of this systematic review study is to determine if ultrasonography is a useful diagnostic tool for acute appendicitis in emergency rooms.

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## 2. Methods

We thoroughly reviewed the literature on the use of bedside sonography to detect acute appendicitis in emergency rooms. This study was carried out in accordance with the guidelines for a systematic review.

The Google Scholar databases, PubMed, Ovid MEDLINE, an online database of biomedical articles, and a number of databases with systematic reviews and other supporting data were the sources of the biomedical literature used in this investigation. The following keywords were used to search the database: "ultrasound," "sonography," "ultrasonography," "US," "appendix," "appendicitis," "emergency," "Emergency room," and "ED." There were no restrictions on the title or abstract's use of dates or keyword combinations. However, only English-language articles were included in the search. Two researchers worked independently on each phase of this study.

It was decided that research on the diagnosis of appendicitis in ERs should be included in this inquiry. The titles and abstracts of extracted articles were read, and the full texts of potentially relevant publications were reviewed. The inclusion criteria were the availability of information on diagnostic factors such as sensitivity and specificity and the use of bedside ultrasonography as a method for diagnosing acute appendicitis in the emergency room. Acute appendicitis was diagnosed by surgical pathology if the ultrasound results were positive, and clinical follow-up if the results were negative. The papers that would be included in this study were selected by two or more scientists, and any discrepancies were resolved by discussion.

After reviewing the abstracts, the relevant material was retrieved and the full texts of the included papers were updated. The retrieved data comprised the name and year of publication of the author, the design of the study, the characteristics of the patients, the goal of the study, the results, and the main conclusions. Before being imported into a pre-made table, the retrieved data was modified in an Excel spreadsheet.

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## 3. Results and discussion

We included 6 articles (10–15) in this review 5 prospective (10,11,13–15) and one retrospective study (12). The goal of Becker BA et al., 2022 (10), was to evaluate the accuracy of point-of-care ultrasound (POCUS) in diagnosing appendicitis in a general emergency department population by using emergency doctors with different levels of ultrasound competence. This study examines adult patients with appendicitis who visited the emergency department between July 2014 and February 2020. There are 256 patients in the sample. POCUS may be performed with a moderate degree of accuracy for acute appendicitis by emergency doctors with considerable ultrasound expertise, according to the findings. However, it lacks the sensitivity and specificity to be employed as a definitive diagnosis in an undifferentiated ED population. The overall ultrasonography sensitivity and specificity were 63% (95% CI = 56% - 70%) and 85% (95% CI = 74% - 92%), respectively.

Children between the ages of 2 and 18 who come to a pediatric emergency room with complaints of abdominal discomfort were included in Doniger SJ et al.'s 2018 study. The research comprised 40 patients. The ultrasound's sensitivity and specificity were determined to be 93.8% (95% CI 69.7% to 98.9%) and 87.5% (95% CI, 67.6% to 97.2%), respectively. In pediatric patients with a clinical suspicion of acute appendicitis, a tiered approach that incorporates POCUS is dependable and may lessen the requirement for CT scans (11).

In their 2019 study, Shahbazipar M. et al. sought to determine how well US results identified AA, a diagnosis made by EM and radiology registrars in the emergency room. After being trained in an emergency setting, EM residents may use this approach on patients suspected of having AA with the same level of precision as radiologists (12).

The mean age of the 108 people analyzed in Karimi E. et al. (2017) was  $23.9 \pm 7.4$  years, with 61% of them being men. In 37 (34%) of the patients, appendicitis was diagnosed. The findings showed that although a radiologist's diagnostic accuracy in diagnosing appendicitis (89%) is not exceptional, it is somewhat better than an emergency physician's (80%) (13).

According to Gungor F. et al. (2017), the study sample consisted of patients over the age of 18 who had stomach discomfort and had an AA diagnostic evaluation. Being pregnant, having unstable vital signs, and not providing informed permission were among the exclusion criteria for the study. A total of 264 patients were included in the final analysis. POCUS has a substantial impact on the clinical assessment of EM and good sensitivity and specificity when utilized in the ED to identify AA. The US has a sensitivity of 0.92 (95% CI 0.87 to 0.95), and a specificity of 0.95 (0.89 to 0.98) (14).

Patients suspected of having appendicitis were chosen for the Ünlüer EE et al. (2016) study based on their Alvarado and modified (m) Alvarado scores, which had values of 2 for Alvarado and 3 for mAlvarado scores. When used with rating systems, EM's US is only marginally helpful in diagnosing appendicitis (15).

Emergency physicians find it difficult to diagnose acute appendicitis since the diagnosis based on clinical examination alone has a sensitivity of 39% to 74% and a specificity of 57% to 84% (16). The most common imaging method for diagnosing acute appendicitis is computed tomography. Computed tomography has demonstrated a high sensitivity of 91% to 98.5% and a specificity of 90% to 98% in the diagnosis of acute appendicitis (17). However, time is of the essence in a busy emergency department, and a speedy resolution is crucial; hence, computed tomography may not be performed effectively.

Perforation is the primary cause of patient morbidity and death when appendicitis is not diagnosed promptly (18). The safe and cost-effective use of ultrasonography in the diagnosis of appendicitis carries no risk of radiation exposure (19). Numerous studies have shown that bedside ultrasonography is useful in identifying acute appendicitis in the emergency department. Since most emergency departments already have ultrasound equipment, bedside ultrasound in the ED is speedy, non-invasive, and secure. Several studies have shown that ultrasound has a good sensitivity, specificity, and accuracy in the differential diagnosis of acute appendicitis (20,21). However, in a busy emergency department or acute care institution, things may be different if the medical staff person administering the therapy is not a radiologist. In contrast to a normal appendix, which is normally packed with air, an inflamed appendix may be easier to observe with ultrasonography. Accuracy may also vary depending on the examiner because learning an ultrasonic method might be more difficult than learning other techniques.

Numerous meta-analyses have been conducted to assess the effectiveness of ultrasonography in diagnosing acute appendicitis. Terasawa et al. found that computed tomography was more accurate than ultrasonography in their examination for the diagnosis of acute appendicitis, with ultrasonography's sensitivity and specificity being 86% and 81%, respectively (21). Furthermore, after examining a Korean study, Yu et al. found that their study's sensitivity and specificity for diagnosing acute appendicitis were, respectively, 86.7% and 90.0% (22). Field et al. conducted a meta-analysis of 21 studies on the use of ultrasonography to detect acute appendicitis. The results of their investigation showed that POCUS had a 91% (95% CI = 83%-96%) sensitivity and a 97% (95% CI = 91%-99%) specificity for diagnosing appendicitis (34). The combined sensitivity and specificity of POCUS for the diagnosis of acute appendicitis were 84% (95% CI: 72%-92%) and 91% (95% CI: 85%), according to Lee et al.'s meta-analysis of 17 trials. The sensitivity, specificity, and accuracy of ultrasonography in identifying pediatric acute appendicitis were also shown to be significantly higher (95%; 95% CI, 75%-99%; and 95%; 95% CI, 85%-98%) (23).

Formal ultrasonography in the radiology section usually shows high accuracy in diagnosing appendicitis, with reported accuracy rates of above 85%. The outcomes of an ultrasound performed by a physician who lacks the necessary skills might be uncertain. POCUS is performed directly by qualified specialists and has proven to be as accurate as traditional radiologist-conducted ultrasonography in several studies, leading to increased dependability (20–23). Ultimately, both POCUS and formal ultrasonography in the radiology department have benefits and drawbacks, and depending on the situation, either one may be used. If the emergency room has a stand-alone radiography facility, there could be a way to compensate for POCUS's shortcomings and address the problem of delays.

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#### 4. Conclusion

This systematic review of research on the use of ultrasound to diagnose acute appendicitis in the emergency room found that ultrasound had high overall sensitivity and specificity in diagnosing acute appendicitis, despite the fact that numerous studies suggested the need of more precise methods. Furthermore, further testing is necessary to reach a definitive diagnosis when the POCUS result is positive.

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## Compliance with ethical standards

### *Disclosure of conflict of interest*

No conflict of interest to be disclosed.

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