PICO Search Assignment Worksheet
PICO #8: CT vs immediate surgery in pregnant patients with suspected appendicitis - Tara Capo

Brief description of patient problem/setting (summarize the case very briefly)
Pt is a 31 YOF, G3P1001 currently 17 weeks pregnant who presented to the ED for RLQ abdominal pain for one day with associated nausea and vomiting. On exam, pt was exquisitely tender to the RLQ and umbilical area. Lactate 1.9. US tech and MRI were unavailable during this time. Per ED discussion with OBGYN, risks and benefits of CT imaging were discussed including benefits outweighing risks. Pt consented to CT, which was significant for acute appendicitis. Surgery was consulted, and pt was taken to the OR for laparoscopic appendectomy.

Search Question: Clearly state the question (including outcomes or criteria to be tracked)
In pregnant patients with high suspicion of acute appendicitis when US and MRI are unavailable, does CT imaging prior to surgery compared with immediate operative intervention reduce unnecessary appendectomies while maintaining favorable maternal and fetal outcomes?

Question Type: What kind of question is this? (boxes now checkable in Word)

☐Prevalence	☐Screening	☐Diagnosis
☐Prognosis	☐**Treatment**	☐**Harms**

Assuming that the highest level of evidence to answer your question will be meta-analysis or systematic review, what other types of study might you include if these are not available (or if there is a much more current study of another type)? Please explain your choices.
- If meta-analysis or systematic reviews are not available, I would include randomized controlled trials (RCTs), cohort studies, and large observational studies. RCTs generally provide the strongest evidence because they minimize bias and allow for direct comparison between interventions. However, they are often difficult to conduct in pregnant patients due to ethical concerns surrounding fetal radiation exposure and delaying potentially necessary surgery. Therefore, high-quality cohort studies are likely to make up much of the available evidence. Prospective cohort studies would be preferred because they follow patients forward in time and can assess outcomes such as negative appendectomy rates, appendix perforations, and maternal/fetal complications. Large observational studies can provide important information on real-world maternal and fetal outcomes associated with CT imaging and operative management.

PICO search terms:

P	**I**	**C**	**O**
Pregnant patients	CT imaging	Immediate surgery	Maternal outcomes
Pregnancy	Computed tomography	Operative intervention	Fetal outcomes
Acute appendicitis		Appendectomy	Perforation
Suspected appendicitis			Negative appendectomy
Pregnant patient with RLQ pain			

Search tools and strategy used:
Please indicate what data bases/tools you used, provide a list of the terms you searched together in each tool, and how many articles were returned using those terms and filters. Explain how you narrow your choices to the few selected articles.

Results found:

PubMed:
Pregnancy AND CT AND Appendectomy AND Maternal outcomes: 4 results
Filters: free full text, meta analysis, RCT, systematic review: 0 results

Pregnant patient AND CT AND Immediate surgery AND Fetal outcomes: 4 results
Filters: free full text, meta analysis, RCT, systematic review: 0 results

Pregnancy AND appendicitis AND computed tomography AND immediate surgery AND perforation: 1 result

Google Scholar:
CT prior to surgery in pregnant patients with suspected appendicitis: 21,300 results
Filters: since 2022, review articles, sort by relevance: 1,070

Maternal/fetal outcomes after CT during pregnancy due to appendicitis suspicion: 2,070 results
Filters: since 2026, review articles, sort by relevance: 16 results

Cochrane:
Pregnancy AND Appendicitis AND CT: 1 result
Pregnant patient AND RLQ pain AND CT: 1 result

How I chose the articles:
Because this was a highly specific clinical PICO question, identifying relevant studies was challenging. To improve the quality of the search, I applied filters to narrow the results and tried to focus on studies that directly examined the role of CT imaging in the evaluation of suspected appendicitis during pregnancy. Priority was given to articles that compared imaging-based diagnostic strategies with immediate operative management or assessed how CT findings influenced surgical decision-making and patient outcomes. I also favored more recent publications whenever possible, as advances in CT technology have significantly reduced fetal radiation exposure and improved diagnostic accuracy. As a result, newer studies were considered more reflective of current clinical practice and more applicable to answering the PICO question.

Results found: Identify at least 4 articles (or other appropriate reputable sources) that answer your specific question with the highest available level of evidence (you will probably need to look at more than 4 articles to get the 4 most focused and highest-level articles to address your question). Please make sure that they are Medline indexed. Selected articles should ideally be published within the last 5 to 10 years to ensure the evidence reflects current clinical standards. If an article older than 10 years is selected, you must provide a specific clinical justification as to why it remains the superior choice or a landmark study over more recent data. In addition to providing the hyperlinks, the PDFs of the full-length articles must also be attached in Brightspace.

Please post the citation and abstract for each article (to include the journal and authors' names and date) and say why you chose it. Please also note what kind of article it is (e.g. meta-analysis, cohort study, or independent blind comparison with the gold standard of diagnosis, etc.).
At the bottom of each abstract, please comment on what your key points are from this article (including any points or concepts included in the article, but not present in the abstract – i.e. make the concepts understandable to the reader). Please note that if the evidence is not in the abstract, you must clearly summarize the evidence in your posting. Similarly, if the abstract is not present, you will need to summarize the article to highlight the key points. That means writing about 1-2 paragraphs about the article

(1) **Citation:** Shetty, M. K., & Garrett, N. M. (2010). *Abdominal computed tomography during pregnancy for suspected appendicitis: A 5-year experience at a maternity hospital*. Journal of Clinical Imaging Science, 34(1), 21–25. https://www.sciencedirect.com/science/article/pii/S0887217109000821

Type of article: Retrospective cohort study

Abstract:
The objective of this article is to evaluate the role of computed tomography (CT) in a pregnant patient with right lower quadrant pain in whom there was a clinical suspicion of acute appendicitis. During a 5-year period the clinical records of all pregnant women who underwent imaging examination for clinically suspected appendicitis were reviewed. The imaging findings were correlated with patient management and final outcome. Thirty-nine pregnant patients were referred for imaging, of which 35 underwent initial evaluation with sonography, 23 of these women underwent a computed tomographic examination, and an additional 4 patients were directly imaged with CT without earlier sonographic assessment. Surgery confirmed appendicitis in all 5 patients who were operated on on the basis of findings of appendicitis on a CT scan. Two patients underwent surgery based on an alternate diagnosis suggested preoperatively (tubal torsion = 1, ovarian torsion = 1). All patients with negative findings at CT had an uneventful clinical course. In those patients who were evaluated only with ultrasound, a diagnosis of appendicitis was missed in 5 patients. The sensitivity of CT in the diagnosis of appendicitis in our study group was 100%, compared with a sensitivity of 46.1% for ultrasound. CT provides an accurate diagnosis in patients suspected to have acute appendicitis and is of value in avoiding false negative exploratory laparatomy with its consequent risk of maternal and fetal mortality and morbidity. Although sonography is the preferred initial imaging modality as its lack of ionizing radiation, CT is more accurate in providing a timely diagnosis and its use is justified to reduce maternal mortality and mortality in patients with appendicitis.

Key points:
- CT demonstrated 100% sensitivity for diagnosing acute appendicitis in the pregnant patients included in the study, compared with 46.1% sensitivity for US
- All patients with negative CT findings had an uneventful clinical course, suggesting that CT was effective in ruling out appendicitis and avoiding unnecessary surgery
- In the US-only group, appendicitis was missed in several patients, demonstrating the limitations of US when evaluating pregnant patients with suspected appendicitis
- The authors concluded that CT can reduce unnecessary exploratory surgery and may help prevent maternal and fetal morbidity associated with delayed or missed diagnosis of appendicitis

I chose this article because it directly addresses my PICO question by evaluating the role of CT in pregnant patients with suspected appendicitis. The study specifically compares the diagnostic performance of CT with US and demonstrates how CT findings influence surgical decision-making. Additionally, it examines clinically relevant outcomes such as diagnostic accuracy, missed appendicitis, avoidance of unnecessary surgery, and maternal-fetal safety considerations. Although it is a retrospective cohort study published in 2010, it remains highly relevant because it provides direct evidence regarding whether CT before surgery can reduce negative appendectomies while maintaining favorable maternal and fetal outcomes.

(2) **Citation:** Fatum, M., Rojansky, N., & Lavy, Y. (2011). Acute appendicitis during pregnancy: Diagnostic and therapeutic dilemma. International Journal of Gynecology & Obstetrics, 115(1), 3–8. https://pubmed.ncbi.nlm.nih.gov/21784406/

Type of article: Narrative review article

Abstract:

Background: In pregnant women, a high negative appendectomy (NA) rate often is reported; however, the outcome of pregnancy after a NA is not well studied.

Methods: Among 1,696 consecutive patients (728 men and 968 women) who underwent an appendectomy at our institution (1996-2005), 87 pregnant women were identified. Postoperative surgical and obstetric outcomes were analyzed based on the final pathologic report of the appendix (normal appendix, inflamed, or perforated).

Results: The NA rate was significantly higher in pregnant women compared with nonpregnant women (36% vs 14%; P < .05). The fetal demise rate was similar between the NA group and the inflamed group (3% vs 2%; P = NS), and highest (14%) in the perforated group, although this difference did not reach statistical significance (P = .3). Wound infections were most frequent in the perforated group (P < .05).

Conclusions: NA during pregnancy is not free of risk to the fetus. We recommend careful assessment to avoid unnecessary exploration when appendicitis is suspected in pregnant women.

Key points:
- Prompt diagnosis of appendicitis in pregnancy is essential because delayed treatment increases the risk of appendix perforation, maternal complications, fetal loss, and preterm labor
- US is recommended as the initial imaging modality because it avoids radiation exposure. However, its sensitivity decreases as pregnancy progresses due to the enlarging uterus. When US is inconclusive, MRI is preferred, while CT may be considered when other imaging modalities are unavailable
- Authors emphasize that concern about fetal radiation exposure should not prevent appropriate diagnostic evaluation when appendicitis is strongly suspected.
    - Delayed diagnosis and perforation are associated with worse maternal and fetal outcomes then the relatively low radiation exposure from modern CT

I chose this article because it supports the rationale for obtaining CT imaging when US and MRI are unavailable, rather than proceeding directly to surgery in a pregnant patient with suspected appendicitis. It discusses the balance between radiation exposure and the risks of unnecessary appendectomy or delayed diagnosis, which directly relates to my PICO question about whether CT can reduce unnecessary operations while maintaining favorable maternal and fetal outcomes. The only downside of the study is that because it is a review article, it would generally be considered lower evidence than a systematic review or meta-analysis.

(3) **Citation**: Aggenbach, L., Zeeman, G. G., Cantineau, A. E. P., Gordijn, S. J., & Hofker, H. S. (2015). Impact of appendicitis during pregnancy: No delay in accurate diagnosis and treatment. International Journal of Surgery, 15, 84–89. https://doi.org/10.1016/j.ijsu.2015.01.025

Type of article: Retrospective cohort study

Abstract:
Background: Acute appendicitis during pregnancy may be associated with serious maternal and/or fetal complications. To date, the optimal clinical approach to the management of pregnant women suspected of having acute appendicitis is subject to debate. The purpose of this retrospective study was to provide recommendations for prospective clinical management of pregnant patients with suspected appendicitis.

Method: Case records of all pregnant patients suspected of having appendicitis whom underwent appendectomy at our hospital between 1990 and 2010 were reviewed.

Results: Appendicitis was histologically veri ed in fteen of twenty-one pregnant women, of whom six were diagnosed with perforated appendicitis. Maternal morbidity was seen in two cases. Premature delivery occurred in two out of six cases with perforated appendicitis cases and two out of six cases following a negative appendectomy. Perinatal mortality did not occur.

Conclusion: Both (perforated) appendicitis and negative appendectomy during pregnancy are associated with a high risk of premature delivery. Clinical presentation and imaging remains vital in deciding whether surgical intervention is indicated. We recommend to cautiously weigh the risks of delay until correct diagnosis with associated increased risk of appendiceal perforation and the risk of unnecessary surgical intervention. Based upon current literature, we recommend clinicians to consider an MRI following an inconclusive or negative abdominal ultrasound aiming to improve diagnostic accuracy to reduce the rate of negative appendectomies. Accurate and prompt diagnosis of acute appendicitis should be strived for to avoid unnecessary exploration and to aim for timely surgical intervention in pregnant women suspected of having appendicitis.

Key points:
- Ultrasonography has a high rate of non-visualization of the appendix.
- (Perforated) appendicitis is known to be associated with a high rate of maternal and fetal morbidity and mortality.
- Prematurity was seen following a negative appendectomy (33%) and perforated appendicitis (33%).
- A rapid and accurate diagnosis of appendicitis is particularly critical in pregnant patients.
- We recommend clinicians to consider an MRI to improve diagnostic accuracy to reduce the rate of negative appendectomies.

I chose this article because it is a retrospective cohort study that examines the impact of accurate diagnosis and timely treatment of appendicitis during pregnancy, which directly relates to my PICO question. The study highlights the limitations of US, the risks associated with delayed diagnosis, and the importance of additional imaging in reducing unnecessary surgery while maintaining favorable maternal and fetal outcomes. Although it does not directly compare CT with immediate surgery, it provides supporting evidence for the role of imaging in improving diagnostic accuracy and guiding management decisions.

(4) **Citation**: Costescu, S., Costescu, D., Mihu, D., & Mihu, C. M. (2026). Appendectomy during pregnancy and the risk of preterm birth: A systematic review and meta-analysis. Journal of Clinical Medicine, 15(2), 819. https://doi.org/10.3390/jcm15020819

Type of article: Systematic review and meta analysis

Abstract
Background and Objectives: Appendectomy is the most frequent non-obstetric emergency operation in pregnancy, yet its relationship with preterm birth (PTB) remains uncertain. We systematically reviewed studies assessing PTB after appendectomy during pregnancy, focusing on surgical approach and histopathology.

Methods: Following a PRISMA-guided protocol, we searched PubMed, Scopus, and Web of Science to 1 October 2025 for studies reporting gestational-age outcomes after appendectomy in pregnancy. Eligible designs were cohort or case–control studies and case series ≥ 5 pregnancies. Data on technique, timing, pathology, and PTB were extracted and synthesized narratively; meta-analysis was not performed because of heterogeneity.

Results: Six studies including over one thousand pregnancies with appendectomy and over one million

comparators were identified. In the largest registry study, appendectomy was associated with increased PTB risk (adjusted hazard ratio [aHR] 1.73, 95% CI 1.42–2.09), with a stronger association for planned than spontaneous PTB. A matched cohort reported PTB in 11.9% of operated women versus 5.4% of controls and a higher PTB rate after negative appendectomy (20.5% vs. 9.2% with inflamed appendices). In a single-center series, PTB occurred in 24.4% after open but 0% after laparoscopic appendectomy. Across studies, crude PTB rates after appendectomy ranged from 4.5% to 24.4%. Three of five studies reporting effect estimates found significantly elevated PTB risk, whereas two smaller cohorts showed null or imprecise associations.

Conclusions: Current evidence suggests that appendectomy in pregnancy is associated with increased PTB risk, particularly after negative or late-gestation open procedures, supporting careful diagnostic work-up, preference for laparoscopy when feasible, and close obstetric follow-up.

Keywords: appendectomy; pregnancy; preterm birth; laparoscopy; obstetric surgical procedures

Key points:
- Appendectomy during pregnancy is associated with an increased risk of preterm birth
- Delayed diagnosis leading to perforation significantly increased the risk of adverse fetal outcomes, including preterm birth and fetal loss
- Authors emphasize that early identification and management of appendicitis may reduce complications associated with perforation
- The review supports the use of appropriate diagnostic imaging to improve diagnostic accuracy

I chose this article because it provides high-level evidence through a systematic review and meta-analysis examining maternal and fetal outcomes associated with appendicitis and appendectomy during pregnancy. My PICO question focuses on whether CT imaging prior to surgery can reduce unnecessary appendectomies while maintaining favorable maternal and fetal outcomes. This article is relevant because it although it does not examine directly CT vs immediate surgery, it demonstrates the potential risks associated with appendectomy during pregnancy. The findings highlight the importance of accurate diagnosis before surgery, supporting the rationale for obtaining diagnostic imaging such as CT when MRI and US are unavailable.

What is the clinical "bottom line" derived from these articles in answer to your question?
The evidence from the 4 articles suggests that in pregnant patients with suspected acute appendicitis, CT imaging prior to surgery can improve diagnostic accuracy and reduce unnecessary appendectomies when US and MRI are unavailable. The article from Shetty and Garrett found that CT had a sensitivity of 100% for diagnosing appendicitis compared to 46% for US, and all patients with negative CT findings had an uneventful clinical course, suggesting that CT can safely rule out appendicitis and avoid unnecessary surgery. Additionally, multiple studies demonstrated that both negative appendectomy and perforated appendicitis are associated with adverse maternal and fetal outcomes, including preterm birth and fetal loss. Therefore, when US and MRI are unavailable, the benefits of obtaining CT imaging generally outweigh the relatively low fetal radiation exposure because CT can help reduce negative appendectomies, prevent delays in diagnosis, and support favorable maternal and fetal outcomes through timely and appropriate surgical management.