

## Critically Appraised Topic

Name Melinda Chiu

33yo female with no significant PMH presents to Emergency Department complaining of left flank pain for 3 days. Pain is currently 6/10, on and off, sharp, exacerbated by sitting, and radiating to the pelvic regions. Patient also describes having some fever and nausea. Denies history of kidney stones, vomiting, diarrhea, chills, SOB, nor urinary symptoms.

In my Emergency medicine rotation, I have seen patients presenting signs and symptoms consistent with kidney stones. Often times, they are ordered to get a CT scan, which may take longer than preferred in those patients in extreme discomfort and pain, and it will expose patients to radiation. I was interested to know if point-of-care ultrasound was an effective alternative tool to help in diagnosing kidney stone.

**Search Question:** In adult patients with suspected kidney stones, can ultrasounds serve as an alternative to the traditional CT scan in establishing a diagnosis?

**Question Type:** What kind of question is this?

Prevalence   Screening   Diagnosis   Prognosis   Treatment   Harms

The highest level evidence would be from meta-analyses and systematic reviews. If these are unavailable, RCT may be helpful. Where patients with suspected kidney stones may be randomly assigned to get ultrasound performed, while another gets CT ordered. The only downfall of RCT is that if a patient's ultrasound finding is unhelpful, I can predict that a subsequent CT will be ordered for the patient anyway.

### PICO search terms:

<b>P</b>	<b>I</b>	<b>C</b>	<b>O</b>
kidney stones	ultrasound	CT scan	accurate diagnosis
nephrolithiasis	point of care (POC) ultrasound (POCUS)	computerized tomography scan	effective diagnostic tool
renal colic	ultrasonography		detection of kidney stone
urolithiasis			
adult			

### Search tools and strategy used:

#### PubMed

- Kidney stone + Ultrasound + diagnosis, filters: none → 1530 results
- Kidney stone + Ultrasound + diagnosis, filters: 10 years, Free full text, Systematic Review, Meta-analysis → 9 results
- Kidney stone + Ultrasound + diagnosis, filters: 10 years, Free full text, RCT → 26 results
- Nephrolithiasis + Ultrasound + CT + diagnosis, filters: 10 years → 333 results
- Nephrolithiasis + Ultrasound + CT + diagnosis, filters: 10 years, Systematic Review, Meta-analysis, RCT → 10 results

#### Cochrane Database

- Nephrolithiasis + ultrasound, filters: none → 112 results
- Urolithiasis + ultrasound + diagnosis, filters: none → 13 results
- Renal colic + ultrasound + diagnosis, filters: none → 17 results

#### Google Scholar

- Kidney stone + Ultrasound + CT + diagnosis, filters: none → 32k results
- Kidney stone + Ultrasound + CT + diagnosis, filters: since 2016, sort by relevance → 13k results
- Kidney stone + Ultrasound + CT + diagnosis + Emergency, filters: since 2016, sort by relevance → 8k results

### Trip Database

- Kidney stone + Ultrasound + CT + diagnosis, filters: none → 993 results
- Kidney stone + Ultrasound + CT + diagnosis, filters: systematic reviews → 12 results
- Kidney stone + Ultrasound, filters: systematic reviews → 28 results
- Urolithiasis + Ultrasound + CT, filters: none → 226 results
- Urolithiasis + Ultrasound + CT, filters: systematic reviews → 5 results

The studies that were chosen included the use of ultrasound when trying to diagnose kidney stones. Additional focus was placed on articles that compare the effectiveness of ultrasound versus CT scans. Combinations of the PICO search terms were in put on PubMed, Cochrane database, Google Scholar, and Trip database. If they resulted in too many articles, filters and sorting options were used in attempt to narrow down the search. The titles of the search results were skimmed through, picking only the relevant articles. When searching on Cochrane Database, the search was not too specific, otherwise may result in no results. Some good articles were found, but there were also searches that brought up recruitment postings for current research. TRIP database was not helpful. Despite any combination of search terms, the results often did not give relevant articles. Through the searches, there were many articles on the use of ultrasound to guide nephrolithotomy or lithotripsy, or to diagnose urolithiasis. The final articles were checked if they were Medline indexed, and published within the past 10 years. Article #3 was found not to be Medline indexed, however, it was kept to be used in this PICO because it was published this year so it can provide the newest data; published in SpringerOpen journal, peer reviewed, and explores the usage of POCUS with a large sample size.

### Results found:

#### #1 Citation

J Am Coll Radiol. 2019 Sep;16(9 Pt A):1132-1143.

<https://reader.elsevier.com/reader/sd/pii/S1546144019304247?token=ACCE440AD8CFB5FFF83BC04C025E628CA79D05F69EB9EF218C9AB744A4F8D611A05795854BF91E34082B458814AA587E>

#### Title and Authors

#### **Imaging in Suspected Renal Colic: Systematic Review of the Literature and Multispecialty Consensus**

Christopher L Moore, Christopher R Carpenter, Marta E Heilbrun, Kevin Klauer, Amy C Krambeck, Courtney Moreno, Erick M Remer, Charles Scales, Melissa M Shaw, Kevan M Sternberg

#### Abstract

**Background:** Renal colic is common, and CT is frequently utilized when the diagnosis of kidney stones is suspected. CT is accurate but exposes patients to ionizing radiation and has not been shown to alter either interventional approaches or hospital admission rates. This multi-organizational transdisciplinary collaboration sought evidence-based, multispecialty consensus on optimal imaging across different clinical scenarios in patients with suspected renal colic in the acute setting.

**Methods:** In conjunction with the American College of Emergency Physicians (ACEP) eQual network, we formed a nine-member panel with three physician representatives each from ACEP, the ACR, and the American Urology Association. A systematic literature review was used as the basis for a three-step modified Delphi process to seek consensus on optimal imaging in 29 specific clinical scenarios.

**Results:** From an initial search yielding 6,337 records, there were 232 relevant articles of acceptable evidence quality to guide the literature summary. At the completion of the Delphi process consensus, agreement was rated

as perfect in 15 (52%), excellent in 8 (28%), good in 3 (10%), and moderate in 3 (10%) of the 29 scenarios. There were no scenarios where at least moderate consensus was not reached. CT was recommended in 7 scenarios (24%), with ultrasound in 9 (31%) and no further imaging needed in 12 (45%).

**Summary:** Evidence and multispecialty consensus support ultrasound or no further imaging in specific clinical scenarios, with reduced-radiation dose CT to be employed when CT is needed in patients with suspected renal colic.

*Reason I chose it*

- indexed for MEDLINE, published within the past 2 years
- Systematic review offers the highest level of evidence
- the study sought for a consensus among providers from multiple specialties

*#2 Citation*

Acad Emerg Med. 2018 Jun;25(6):684-698.

<https://onlinelibrary.wiley.com/doi/pdf/10.1111/acem.13388>

*Title and Authors*

**The Accuracy and Prognostic Value of Point-of-care Ultrasound for Nephrolithiasis in the Emergency Department: A Systematic Review and Meta-analysis**

Charles Wong, Braden Teitge, Marshall Ross, Paul Young, Helen Lee Robertson, Eddy Lang

*Abstract*

**Introduction:** Point-of-care ultrasound (POCUS) has been suggested as an initial investigation in the management of renal colic. Our objectives were: 1) to determine the accuracy of POCUS for the diagnosis of nephrolithiasis and 2) to assess its prognostic value in the management of renal colic.

**Methods:** The review protocol was registered to the PROSPERO database (CRD42016035331). An electronic database search of MEDLINE, Embase, and PubMed was conducted utilizing subject headings, keywords, and synonyms that address our research question. Bibliographies of included studies and narrative reviews were manually examined. Studies of adult emergency department patients with renal colic symptoms were included. Any degree of hydronephrosis was considered a positive POCUS finding. Accepted criterion standards were computed tomography evidence of renal stone or hydronephrosis, direct stone visualization, or surgical findings. Screening of abstracts, quality assessment with the QUADAS-2 instrument, and data extraction were performed by two reviewers, with discrepancies resolved by consensus with a third reviewer. Test performance was assessed by pooled sensitivity and specificity, calculated likelihood ratios, and a summary receiver operator curve (SROC). The secondary objective of prognostic value was reported as a narrative summary.

**Results:** The electronic search yielded 627 unique titles. After relevance screening, 26 papers underwent full-text review, and nine articles met all inclusion criteria. Of these, five high-quality studies (N = 1,773) were included in the meta-analysis for diagnostic accuracy and the remaining yielded data on prognostic value. The pooled results for sensitivity and specificity were 70.2% (95% confidence interval [CI] = 67.1%-73.2%) and 75.4% (95% CI = 72.5%-78.2%), respectively. The calculated positive and negative likelihood ratios were 2.85 and 0.39. The SROC generated did not show evidence of a threshold effect. Two of the studies in the meta-analysis found that the finding of moderate or greater hydronephrosis yielded a specificity of 94.4% (95% CI = 92.7%-95.8%). Four studies examining prognostic value noted a higher likelihood of a large stone when positive POCUS findings were present. The largest randomized trial showed lower cumulative radiation exposure and no increase in adverse events in those who received POCUS investigation as the initial renal colic investigation.

**Conclusion:** Point-of-care ultrasound has modest diagnostic accuracy for diagnosing nephrolithiasis. The finding of moderate or severe hydronephrosis is highly specific for the presence of any stone, and the presence of any hydronephrosis is suggestive of a larger (>5 mm) stone in those presenting with renal colic.

*Reason I chose it*

- indexed for MEDLINE, published within the past 3 years
- Systematic review and Meta-analysis offer the highest level of evidence

- focused on the use of point-of-care ultrasounds to diagnose nephrolithiasis

### #3 Citation

Ultrasound J. 2020 Jun 8;12(1):31. doi: 10.1186/s13089-020-00178-3.

<https://theultrasoundjournal.springeropen.com/articles/10.1186/s13089-020-00178-3>

### Title and Authors

#### **Point-of-care ultrasound for the detection of hydronephrosis in emergency department patients with suspected renal colic**

Stephanie Sibley, Nathan Roth, Charles Scott, Louise Rang, Heather White, Marco L A Sivilotti, Eric Bruder

### Abstract

**Background:** Point-of-care ultrasound (PoCUS) by emergency physicians for renal colic has been proposed as an alternative to computed tomography (CT) to avoid ionizing radiation exposure and shorten emergency department length of stay. Previous studies have employed experienced or credentialed ultrasonographers or required advanced ultrasound skills. We sought to measure the diagnostic accuracy of PoCUS by physicians with varied experience using a simplified binary outcome of presence or absence of hydronephrosis. Secondary outcomes include assessment as to whether the presence of hydronephrosis on PoCUS is predictive of complications, and to evaluate possible causes for the reduced diagnostic accuracy such as body mass index (BMI) and time between PoCUS and formal imaging, and scanner experience.

**Results:** 413 patients were enrolled in the study. PoCUS showed a specificity of 71.8% [95% CI 65.0, 77.9] and sensitivity of 77.1% [95% CI 70.9, 82.6]. Hydronephrosis on PoCUS was predictive of complications (relative risk 3.13; [95% CI 1.30, 7.53]). The time interval between PoCUS and formal imaging, BMI, and scanner experience did not influence the accuracy of PoCUS.

**Conclusions:** PoCUS for hydronephrosis in suspected renal colic has moderate accuracy when performed by providers with varied experience for the binary outcome of presence or absence of hydronephrosis. Hydronephrosis on PoCUS is associated with increased rates of complications. PoCUS for hydronephrosis is limited in its utility as a stand-alone test, however this inexpensive, readily available test may be useful in conjunction with clinical course to determine which patients would benefit from formal imaging or urologic consultation.

### Reason I chose it

- published this year, which provides the most recent data to answer the PICO question
- although it is not MEDLINE indexed, it is published in SpringerOpen journal, peer reviewed, and explores the usage of POCUS
- this was a RCT, with a large pool of subjects (413 patients)

### #4 Citation

J Emerg Med. 2018 Feb;54(2):215-220.

<https://www.sciencedirect.com/science/article/pii/S0736467917308776?via%3Dihub>

### Title and Authors

#### **Ultrasound for the Diagnosis and Management of Suspected Urolithiasis in the Emergency Department**

Lisa Mills, Eric J Morley, Zachary Soucy, Gary M Vilke, Samuel H F Lam

### Abstract

**Background:** This review provides practicing emergency physicians updated information regarding point-of-care ultrasound (POCUS) imaging of patients with suspected urolithiasis.

**Methods:** A PubMed literature search was conducted for articles published between January 1, 1996 and May 31, 2017 and limited to human clinical trials written in English with relevant keywords. High-quality studies identified then underwent a structured review. Recommendations herein are made based on the literature review.

**Results:** Two hundred seventy-two abstracts fulfilling the search criteria were screened and 10 appropriate articles were rigorously reviewed in detail. There were 8 prospective studies and 2 retrospective studies. Only 1 of them was a multi-institutional randomized trial. POCUS performed in the emergency department (ED) is moderately sensitive and specific in making the diagnosis of urolithiasis in symptomatic patients. Suspected urolithiasis patients evaluated initially with ED POCUS have complication rates compatible with those evaluated initially with computed tomography.

**Conclusions:** POCUS has moderate accuracy in making the diagnosis of urolithiasis. Nevertheless, it may be safely used as a first line of imaging in ED patients with suspected symptomatic urolithiasis.

*Reason I chose it*

- indexed for MEDLINE, published within the past 2 years
- Systematic review offers the highest level of evidence
- Studied the use of point-of-care ultrasounds in Emergency settings to diagnose urolithiasis

*#5 Citation*

The Journal of Urology. 2014 April 1;191(4s):e51-e52.

<https://www.auajournals.org/doi/full/10.1016/j.juro.2014.02.224>

*Title and Authors*

**A Randomized Trial Of Ultrasound Versus Computed Tomography For Imaging Patients With Suspected Nephrolithiasis**

Marshall Stoller, Chandra Aubin, John Bailitz, Rimon Bengiamin, Carlos Camargo, Thomas Chi, Jill Corbo, Anthony Dean, Richard Griffey, Gregory Jay, Tarina Kang, Dana Robertson-Kriesel, Ruth Goldstein, Michael Mallin, James Miner, John Ma, William Manson, Diane Miglioretti, Sarah Miller, Michelle Moghadassi, Vicki Noble, Gregory Press, Victoria Valencia, Jessica Wang, Ralph Wang, Steven Cummings, Rebecca Smith-Bindman, and Lisa Mills

*Abstract*

**Introduction And Objectives:** Patients presenting to the emergency department (ED) with suspected acute renal colic frequently undergo imaging to confirm their diagnosis. Computed tomography (CT) imaging has increasingly been used to exclude other diagnoses and confirm urinary stone disease but is frequently associated with duplicate imaging and increased patient radiation exposure. To address the utility of CT imaging compared to ultrasonography (US) imaging in the ED setting in patients suspected of acute renal colic a prospective randomized study was undertaken.

**Methods:** 15 centers participated in a randomized comparative effectiveness trial. Patients aged 18 - 75 years (n=2759 with complete data) presenting to ED's with suspected nephrolithiasis were randomly assigned to receive imaging with US performed by the emergency physician (point-of-care US), US performed by a radiologist (radiology US), or abdominal CT as their initial diagnostic test. Subsequent medical management including receipt of additional imaging, was performed at the discretion of the patients' physicians. The incidence of serious adverse events (SAE) diagnosed within 30 days, cumulative radiation exposure and imaging costs during the subsequent 6 months were compared. Secondary outcomes, including pain on a 10-point visual analogue scale and return ED visits and hospitalizations were also measured.

**Results:** SAE occurred in 112 of 908 (12.3%) patients assigned to point-of-care US, 95 of 893 (10.6%) assigned to radiology US and 106 of 958 (11.1%) assigned to CT. Severe SAE occurred in 5 of 908 (0.55%) patients assigned to point-of-care US, 3 of 893 (0.34%) assigned to radiology US and 4 of 958 (0.42%) assigned to CT (p=0.76). Average imaging costs were lower in patients assigned to point-of-care ultrasound (\$150) than radiology ultrasound (\$200) or CT (\$300, p < .0001). Average cumulative radiation exposures were significantly lower for point-of-care (10.5 mSv) and radiology ultrasound (9.3 mSv) arms than CT arm (17.5 mSv, p<0.0001). Average pain ratings showed no significant differences: by 7 days, average pain scores were 2.1, 1.9, and 2.0 for

point-of-care ultrasound, radiology ultrasound, and CT arms, p=0.75. Return ED visits or hospitalizations were not different by arm at 1 week or 30 days.

**Conclusion:** For ED patients with suspected nephrolithiasis, initial evaluation with ultrasonography was associated with lower cumulative radiation exposure and imaging costs with no significant difference in the risk of subsequent serious adverse events, pain resolution, return ED visits or hospitalizations.

*Reason I chose it*

- indexed for MEDLINE, published within the past 6 years
- this was a RCT, which was a study design acceptable for this CAT
- included a large pool of 2759 subjects that were recruited from 15 medical centers

**Summary of Evidence:**

Author (Date) Level of Evidence	Sample/Setting (# of subjects/ studies, cohort definition etc)	Outcome(s) studied	Key Findings	Limitations and Biases
#1. Moore et al. (2019) Systematic Review	**Searched PubMed and EMBASE for related articles → found 232 articles. From the articles, 29 “clinical vignettes” with different scenarios/ patient variables were formed. **a multispecialty panel of professionals (from specialties of emergency medicine, radiology and urology) were tasked with anonymous voting and group discussions, to reach a consensus on ideal use of imaging methods for diagnosing suspected kidney stone, according to each vignette. They especially looked into clinical scenarios where CT may not be needed.	**The clinical question was: “For patients presenting to the ED with pain suspected to be uncomplicated renal colic, what imaging should be pursued compared with standard noncontrast CT scanning to optimize patient-centered outcomes?”	**In the scenario of a young adult with typical kidney stone presentation, history of stones and good pain control, a majority of the panel agreed for POC U/S. If the same patient has no history of stone, the entire panel agreed POC U/S should be used initially. In a patient with atypical presentation and a history of stones, 7/9 of the panel still agreed POC ultrasound should be used initially. However, if there was no hydronephrosis seen on POC U/S, 4/9 of the panel recommended for subsequent CT scan. **In patients around 55 years with typical kidney stone presentation and history of stones, 5/9 of the panel agreed that no imaging was necessary, but 4/9 suggested POC U/S. However, if this patient had no history of stones, CT was supported by the entire panel. In patients >75 years despite patient presentation and history of stones, majority of the panel agreed CT should be obtained. **In a vignette of a young female with no history of stones, either POC or radiology-performed U/S was recommended by 8/9 of the panel. However, in any young patient with history of stones and	**the vignettes created may only present a certain amount of patient variables, but in real-life, there is likely to be even more variables to consider when deciding the necessary imaging method. The authors had even mentioned how “many more permutations... were possible”. **5/9 of the members on the panel agreeing on an imaging method was considered a “consensus” – but note that at least 80% of the scenarios reached at least 8/9 consensus **the members on the panel were from 3 specialties only. Professionals from other specialties may have potentially differed in opinion of imaging method

			unrelieved symptoms, CT scan is recommended.	
<p><b>#2. Wong et al.</b> (2018)</p> <p>Systematic Review and Meta-analysis</p>	<p>**Searched Medline, Scopus, PubMed, Web of Science, and EMBASE for related articles → found 9 articles.</p> <p>**Inclusion criteria: &gt;18 years old, seen in EM, signs and symptoms of nephrolithiasis, POCUS was used</p> <p>**Setting: Emergency Department visits</p> <p>**Reference standards to see the accuracy of POCUS included: CT, direct stone visualization or surgical discovery.</p>	<p>**primary outcome: to discover the accuracy of POCUS in diagnosing kidney stones</p> <p>**secondary outcome: to discover “prognostic value of POCUS for the management of nephrolithiasis”</p>	<p>**Found 3/9 of the studies found diagnostic accuracy with POCUS, 3/9 only reported usefulness in prognosis, and 3/9 found POCUS to have <u>both</u> diagnostic and prognostic value.</p> <p>**Concluded that the “overall accuracy of POCUS for the diagnosis of nephrolithiasis is modest”. POCUS had high specificity if there was the presence of moderate to severe hydronephrosis; where hydronephrosis suggests a larger sized stone present (ie: 5mm)</p>	<p>**Articles were reviewed by 2 independent reviewers, with QUADAS-2 tool used to measure the diagnostic accuracy of POCUS and bias in the individual articles. However, the individual QUADAS-2 scores were not revealed</p> <p>**diagnostic use of POCUS is user-dependent (although the study claims that this exam is common and easily performed- therefore having low risk of bias)</p> <p>**they looked at “reference standards” within each article to see the accuracy of POCUS. A majority of the included studies used CT as the standard. There was variability, however, in what was considered a “positive” CT scan (ie: presence of a stone in kidney/ ureter/ bladder, hydronephrosis)</p> <p>**the quality of the review depends on the quality of the data provided from the included studies.</p>
<p><b>#3 Sibley et al.</b> (2020)</p> <p>Prospective Observational Study</p>	<p>** Inclusion criteria: 16-65 years old who had either CT scan or US used to evaluate for renal colic</p> <p>**Exclusion criteria: fever, hemodynamic instability, possible UTI, pregnant, kidney disease, AAA and incarceration.</p> <p>**Setting: conducted in</p>	<p>**primary objective: “determine the diagnostic accuracy of POCUS for hydronephrosis in patients with suspected renal colic”</p>	<p>**85% of the “formal imaging” was performed with CT scan, where 51% noted hydronephrosis. POCUS had noted 53% of hydronephrosis cases, while 4.6% POCUS were indeterminant.</p> <p>**Found that the sensitivity of POCUS in detecting hydronephrosis was 77.1% and specificity of 71.8%. These</p>	<p>**selection bias, since patients may have been missed in recruitment if their provider was not able to/qualified to perform POCUS</p> <p>**if formal imaging were performed prior to POCUS, providers were instructed to not</p>

	<p>Emergency Departments in two hospitals' in Ontario, Canada.</p> <p>**Total of 413 subjects were included for studying primary outcome, and 344 in studying the secondary outcome (69 subjects lost after 1 month follow up).</p> <p>**All included pts had a POCUS performed, in addition to "formal imaging" which was determined by the treating provider. Only after the designations did the researchers approach pts to enroll in the study.</p>	<p>**secondary objective: see if hydronephrosis seen on POCUS will predict complications (ie: need for further interventn [lithotripsy, stent placement, percutaneous nephrostomy], admission, sepsis, and death) within 30 days of initial encounter</p>	<p>numbers were higher the more severe the hydronephrosis was.</p> <p>**Hydronephrosis determined with POCUS was associated with increased complications (11.8%) in the patient's course; while with formal imaging, the complication rate (14.5%) was even greater.</p> <p>**Concludes that POCUS is not specific nor sensitive enough to be used solely to diagnose. However, it may be used to "guide further imaging and consultation in conjunction with clinical course"</p>	<p>look at formal reports. If this protocol was not followed, it has slight risk of unblinding</p> <p>**study was conducted in Canada. Individual patient factors may differ (ie: diet, healthcare access, socioeconomic background)</p>
<p><b>#4. Mills et al.</b></p> <p>(2017)</p> <p>Systematic Review</p>	<p>**Searched Pubmed for related articles. After fitting inclusion criteria → found 10 articles (7 prospective cohorts, 2 retrospective cohorts, and 1 RCT)</p> <p>**Inclusion criteria: human subjects, English, emergency departments, POCUS, keywords related to kidney stones</p> <p>**Setting: emergency department</p>	<p>**objective: "review the evidence for using ultrasound to evaluate patients with suspected urolithiasis."</p> <p>**"What are the test characteristics of POCUS in making the diagnosis of urolithiasis in the ED?"</p> <p>**"Does management of suspected urolithiasis based on POCUS findings put ED patients at a higher risk for complications?"</p>	<p>**although the included studies used different criterion standards (ie: intravenous pyelography, CT), POCUS was found to be "moderately sensitive and specific" in diagnosing urolithiasis.</p> <p>**the use of POCUS was even more effective if the kidney stone was &gt;5-6mm, or if hematuria was an associated symptom.</p> <p>**patients with suspected urolithiasis managed based on POCUS findings, had similar complication rates (ie: death, hospitalization rate, missed serious diagnoses) as those managed based on CT readings.</p>	<p>**the study did not explicitly explain what outcomes were examined in the review</p> <p>**the quality of the review depends on the quality of the data provided from the included studies. According to this article's grading of quality of the included studies, only 1 was given an A - outstanding, 8 was given a C - good, and 1 was given a D - adequate grade.</p> <p>**there was heterogenicity in included study designs and "lack of a uniform criterion standard". They also had small sample sizes.</p>
<p><b>#5. Stoller et al.</b></p> <p>(2014)</p> <p>Prospective Randomized Trial</p>	<p>**Inclusion criteria: 18-75 years old, suspected nephrolithiasis</p> <p>**Setting: 15 American emergency departments</p> <p>**total of 2759 subjects were recruited. Subjects were randomized to either</p>	<p>**primary outcomes: incidence of serious adverse effects (SAE) within 30 days after the ED visit, total radiation</p>	<p>**objective to compare the use of CT versus US in imaging patients with suspected acute renal colic</p> <p>**12.3% of patients in POCUS group had SAE, 10.6% in radiology-US, and 11.1% in CT.</p> <p>**average imaging costs were</p>	<p>**the article did not reveal which hospitals were included in the study. It is unknown if all the hospitals were from the same American region, or from different parts of</p>



	get imaging as POCUS, radiologist-performed US, or abdominal CT as the initial test (908 - POCUS, 893 - radiology-US, and 958 - CT). Subsequent need for imaging was decided by the treating provider	exposure, and imaging costs within 6 months after the ED visit. **secondary outcomes: pain scale out of 10 points, return ED visits and hospitalizations	lower in POCUS (\$150) vs radiology-US (\$200) vs CT (\$300) **average cumulative radiation was lower in POCUS (10.5 mSv) and radiology-US (9.3 mSv) vs CT (17.5 mSv) --- [ <i>millisieverts = ionizing radiation dose</i> ] **there was no significant difference in pain score, return ED visits, and hospitalizations among the different groups	the country. The latter may have more diversity in patient presentations/health. **the article was very brief and to the point, however, data collected throughout the study was not revealed to be analyzed by the audience.
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**Conclusions:**

#2. Wong et al. (2018)	<p>*A third of the included studies found diagnostic accuracy with POCUS, a third reported POCUS has useful in determining prognosis, and a third found POCUS to have <u>both</u> diagnostic and prognostic value.</p> <p>*Concluded that POCUS's has modest accuracy in diagnosing nephrolithiasis. POCUS had high specificity if there was the presence of moderate to severe hydronephrosis; where hydronephrosis suggests the presence of larger sized stones (ie: 5mm)</p>
#4. Mills et al. (2017)	<p>*POCUS was found to be "moderately sensitive and specific" in diagnosing urolithiasis. Its effectiveness was increased if the kidney stone was &gt;5-6mm, or if hematuria was an associated symptom. It was not associated with significant difference in complication rates when compared to use of CT instead.</p>
#1. Moore et al. (2019)	<p>*A consensus was reached in each of the "clinical vignettes" created for the study. If a young adult presented with typical kidney stone presentation, with or without a history of stones, and good pain control, performing POCUS was deemed sufficient. Particularly in any young patient with history of stones and unrelieved symptoms, CT scan is recommended.</p> <p>*In a patient with atypical presentation and a history of stones, POCUS was still the majority's choice. An exception would be if no hydronephrosis was seen on POCUS, subsequent CT scan may be needed.</p> <p>*Patients between 55-75 years old with typical kidney stone presentation and history of stones, had a greater portion of the panel suggesting no imaging was necessary, while the lesser portion suggested POCUS. However, if this patient had no history of stones, CT was supported by the entire panel.</p> <p>*In patients &gt;75 years despite patient presentation and history of stones, majority of the panel agreed CT should be obtained.</p>
#3 Sibley et al. (2020)	<p>*Concludes that POCUS is not specific (71.8%) nor sensitive (77.1%) enough to be used solely to diagnose. However, it may be used to "guide further imaging and consultation in conjunction with clinical course"</p>
#5. Stoller et al. (2014)	<p>*Concluded that use of US has lower costs and radiation exposure; with no significant difference in SAE, pain scale, return ED visits, nor hospitalizations.</p>
<p>**These articles are listed in order according to strength of evidence. Wong (2018) weighed the most since it was both a systematic review and meta-analysis. These article types offer the highest level of evidence to help answer the research question. It included findings from 9 studies. Next came Mills (2017), as a systematic review that utilized 10 studies. Moore (2019), although the most recent systematic review, was rated third in strength. The study design in creating "clinical vignettes" has the potential to cause issues since not all possible combinations of patient variables can be addressed; which may affect the overall conclusions formed. Sibley (2020) was selected to be included in this CAT since it was published this year, giving the most recent data, and it had a relatively big pool of subjects. A downfall of it however, was that it was conducted in Canada, and patient population/variables may not reflect those of patients in America. Stoller (2014) recruited over 2700 subjects, and came up with strong conclusions; however it was</p>	

not as strong as the other articles, since it did not share the data collected within the article.

**\*\*Overall, POCUS was seen to have moderate sensitivity, specificity, and effectiveness in diagnosing nephrolithiasis, as well as determining the prognosis of the patient. It is more effective when stones are of a larger size (<5mm+), there is a high degree of hydronephrosis, or hematuria is present. Its use has lower costs and radiation exposure, as compared to other common imaging methods. There some evidence that its use may have similar incidence of subsequent adverse effects, as compared to the use of CT. Providers may consider the use of another form of imaging (ie: CT) to have a definitive diagnosis.**

### **Magnitude of any Effects**

According to the articles, there was moderate effect in the use of POCUS to diagnose nephrolithiasis in patients, as an alternative diagnostic tool. The articles suggest a moderate sensitivity and specificity in its use. Especially if there was the presence of a larger stone, hydronephrosis, or hematuria, the effect of POCUS increased. There was evidence that POCUS was seen to be better in terms of costs and amount of radiation exposure. With 3/5 of the included articles being systematic reviews, and 2/5 of the articles being studies with large sample sizes, there is a good magnitude of effect seen.

### **Clinical Significance**

Diagnosing nephrolithiasis, and determining the subsequent treatment plan are essential tasks that are commonly performed in medicine. This CAT is meant to determine how effective ultrasounds can be, to serve as an alternative to the traditional CT scan in establishing a diagnosis in adult patients with suspected kidney stones. As providers we want to provide our patients with the most effective diagnosing methods, as well as consider how one diagnostic method may compare to another method. There was moderate effectiveness seen in the use of ultrasounds in establishing nephrolithiasis diagnosis.

### **Clinical Bottom Line**

The PICO question to answer was: *In adult patients with suspected kidney stones, can ultrasounds serve as an alternative to the traditional CT scan in establishing a diagnosis?* Searches on PubMed, Cochrane database, Google Scholar, and Trip database were performed to look for the use of ultrasound to detect kidney stones. Three systematic reviews, one prospective observational study, and one prospective randomized trial were selected. Based on the articles and information that gathered, there is moderate evidence to show that ultrasound can be effective in being used as an alternative diagnostic tool for kidney stones.

The article by Wong et al. (2018) was weighed the most, since it was both a systematic review and meta-analysis, offering the highest level of evidence to help answer the research question. It concluded that POCUS' diagnosis accuracy was "modest". When comparing the included articles, it found that a third of the studies claimed POCUS had diagnostic accuracy, another third found it had prognostic value, and another third found it to have both diagnostic and prognostic value. Mills et al. (2017) was next in strength, as a systematic review that utilized 10 studies. It found that POCUS had moderate sensitivity and specificity in diagnosing urolithiasis; with increased effectiveness with kidney stones >5-6mm, or if hematuria was an associated symptom. It also found no significant difference in complication rates when compared to use of CT instead. Moore et al. (2019) was rated third in strength since its creation of "clinical vignettes" risked not addressing all possible combinations of patient variables, which may affect the overall conclusions formed. It summarized that young patients with or without history of stones should get U/S initially. However, if pain is not controlled, CT might be the next choice. In middle aged patients, a lack of kidney stone history warrants a CT; but with history of kidney stone, either no imaging or the use of U/S is recommended. In patients above 75, despite their history and presentation, CT is recommended. From this article, it can be seen that multiple factors play into whether or not U/S could be useful in diagnosing kidney stones. Sibley (2020) was published this year, giving the most recent data, and it had a relatively big pool of subjects. It concluded at POCUS is not specific nor sensitive enough to be used solely to diagnose; it should be used in combination guiding the decision for

additional imaging and treatment decision making. Stoller (2014) included over 2700 subjects. It concluded that US has lower costs and radiation exposure; with no significant difference in SAE, pain scale, return ED visits, nor hospitalizations.

In summary from all the articles, POCUS proves to be a moderately useful tool in diagnosing the presence of kidney stones. It was found to have moderate sensitivity and specificity in diagnosis, as well as in determining the prognosis of the patient. The larger the size of the stone, degree of hydronephrosis, and hematuria, the more effective this tool was. It was also associated with lower costs and radiation exposure, as compared to other common imaging methods. There some evidence that its use may have similar incidence of subsequent adverse effects, as compared to the use of CT. Clinical scenarios and patient variables should be considered when considering what imaging methods are necessary in diagnosis. U/S may be used initially in evaluating for kidney stones, and its findings or lack of findings can be used to inform the next steps in patient care.

#### Sources:

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