

# Diagnostic Imaging Pathways - Loin Pain (Acute Pyelonephritis)

## Population Covered By The Guidance

This pathway provides guidance for imaging adult patients with acute loin pain suspected to be due to acute pyelonephritis.

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## Quick User Guide

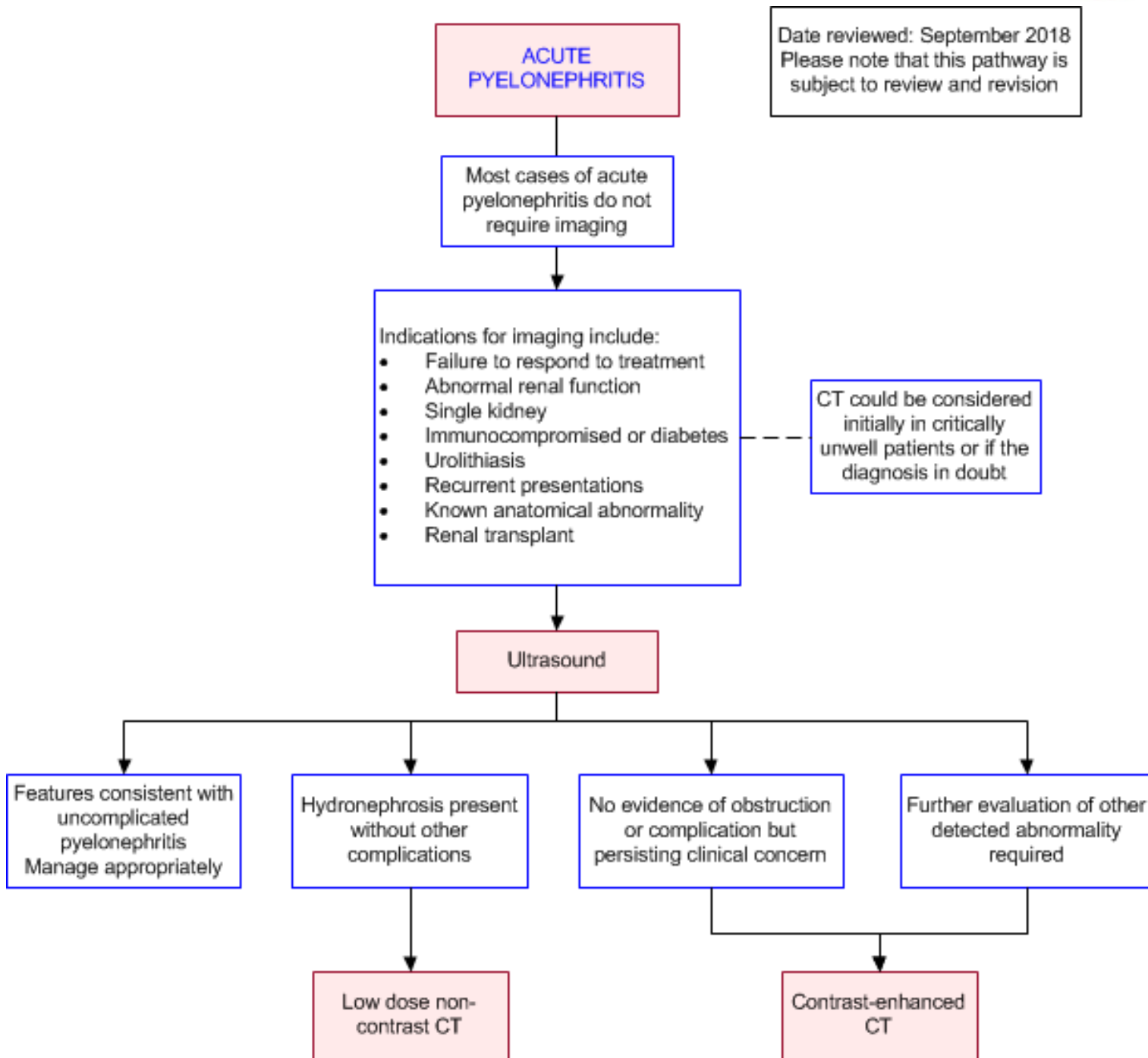
Move the mouse cursor over the **PINK** text boxes inside the flow chart to bring up a pop up box with salient points.

Clicking on the **PINK** text box will bring up the full text.

The relative radiation level (RRL) of each imaging investigation is displayed in the pop up box.

SYMBOL	RRL	EFFECTIVE DOSE RANGE
	None	0
	Minimal	< 1 millisieverts
	Low	1-5 mSv
	Medium	5-10 mSv
	High	>10 mSv

## Pathway Diagram



## Image Gallery

*Note: These images open in a new page*

### Acute Pyelonephritis

Image 1 (Computed Tomography): Contrast enhanced CT in the cortical phase shows wedge shaped low attenuation lesion in an enlarged right kidney.



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## Teaching Points

- Imaging in uncomplicated acute pyelonephritis is usually not indicated
- The role of imaging is:
  - To assess for complications or obstruction
  - To assess for underlying predisposing abnormalities
  - Investigate for alternative diagnoses if diagnosis is in doubt
- Ultrasound is commonly the initial imaging modality of choice in suspected acute pyelonephritis because it avoids ionising radiation and IV contrast, but it is less sensitive for complications
- CT is an alternative more sensitive investigation in suspected acute pyelonephritis

## Acute Pyelonephritis

- Acute pyelonephritis is due to bacterial or fungal infection that causes tubulo-interstitial inflammation of the renal parenchyma [1](#)
- The diagnosis is suggested by the typical features of urinary frequency/dysuria, flank tenderness and high grade fever accompanied by typical laboratory and microbiological findings [2](#)
- The majority of cases of pyelonephritis are diagnosed clinically, with appropriate confirmatory evidence from laboratory and microbiological tests, [3](#) although urine cultures may be negative in as many as 30-76% [4,5](#)
- Imaging is not required for diagnosis in uncomplicated pyelonephritis

### Imaging Indications in Acute Pyelonephritis

- Routine imaging is not advocated in uncomplicated acute pyelonephritis (90% of cases). [1](#) However it can be challenging to identify which patients will require intervention without performing imaging studies [4](#)
  - Studies have found structural abnormalities to be more frequent in patients who were febrile and/or haemodynamically unstable, [4](#) or have prolonged fever >72h, [6](#) however in other studies, patients with and without abscesses and structural abnormalities could not be clinically differentiated [5,7,8](#)
  - For this reason, some guidelines suggest all patients should undergo imaging with ultrasound [9](#)
- The role of imaging is to assess for complications or obstruction, underlying predisposing abnormalities

### Some features increase the likelihood of relevant abnormalities on imaging:

- Failure to respond to treatment
  - Initial treatment with suitable antibiotics for 72h is usually appropriate [1,9-12](#)
- Abnormal renal function [8](#)
- Urolithiasis [6,13](#)
- Immunocompromised patients or diabetes mellitus [6,13](#)
  - Poorly controlled diabetes increases the risk of emphysematous pyelonephritis, which requires surgical intervention and can be challenging to detect on ultrasound [14](#)
- Patients with known anatomical abnormalities [13](#)

### Other indications for imaging include:

- Recurrent presentations
- Single kidney or transplanted kidney
- If obstruction of the collecting system is suspected, investigation is required to prevent destruction of the renal parenchyma and irreversible loss of renal function
- When the diagnosis is in doubt

## Ultrasound

- In the adult, hydronephrosis or pyonephrosis is usually due to acute or chronic obstruction secondary to calculus, tumour, stricture or congenital anomaly with super-imposed infection
- Ultrasound is sensitive in the detection of pelvi-calyceal dilation. When pyonephrosis is present, echoes and septations secondary to gas forming bacteria or debris may be seen [15](#)
  - Compared to CT, ultrasound is 78-85% sensitive for hydronephrosis; the sensitivity is higher with larger stones [16,17](#)
- However, ultrasound is significantly less sensitive than CT for demonstrating parenchymal change [4,18](#) and abscesses, including gas-forming infections [19](#)
- Further imaging may be required prior to/or following decompression via a percutaneous nephrostomy or retrograde ureteric stent placement, in order to establish the cause of obstruction. In this case a CT may be warranted
- The main advantage of ultrasound is that it avoids ionising radiation, which is especially important as pyelonephritis occurs frequently in younger women
- Disadvantages:
  - Less sensitive than CT
  - Operator dependent

## Computed Tomography (CT)

- Contrast-enhanced CT is the most accurate modality for identifying pyelonephritis and its complications
- Several studies have shown that ultrasonography may miss subtle changes of acute pyelonephritis or underestimate its severity, [4,10,19](#) therefore, if persistent clinical suspicion remains following an unremarkable ultrasound, CT is indicated
- Some guidelines recommend CT as the initial investigation of choice [12](#)
- The un-enhanced CT scan can detect calculi, gas formation, haemorrhage, parenchymal calcifications, obstruction, renal enlargement and inflammatory masses. In many cases however, the kidney will appear normal and contrast enhanced scans should be performed
- Contrast enhanced scans enables different phases of excretion to be studied. Typical features of acute pyelonephritis or its complications (e.g. renal abscess, emphysematous pyelonephritis) are readily appreciated
- The main disadvantage of contrast-enhanced CT is the significant radiation exposure

## Low Dose Non-Contrast CT

- Sensitivity of 93-97% and specificity of 86-97% for urolithiasis compared to standard dose CT [20,21](#)
- However, contrast-enhanced CT has higher sensitivity for parenchymal changes in acute pyelonephritis

## References

References are graded from Level I to V according to the Oxford Centre for Evidence-Based Medicine, Levels of Evidence. [Download the document](#)

1. Kawashima A, LeRoy AJ. **Radiologic evaluation of patients with renal infections.** Infect Dis Clin North Am. 2003;17(2):433-56. (Review article). [View the reference](#)
2. Stunell H, Buckley O, Feeney J, Geoghegan T, Browne RF, Torreggiani WC. **Imaging of acute pyelonephritis in the adult.** Eur Radiol. 2007;17(7):1820-8. (Review article). [View the reference](#)
3. Johnson JR, Russo TA. **Acute pyelonephritis in adults.** N Engl J Med. 2018;378(1):48-59. (Review article). [View the reference](#)
4. Kim Y, Seo M-R, Kim S-J, Kim J, Wie S-H, Cho YK, et al. **Usefulness of blood cultures and radiologic imaging studies in the management of patients with community-acquired acute pyelonephritis.** Infect Chemother. 2017;49(1):22-30. (Level III evidence). [View the reference](#)
5. Piccoli GB, Consiglio V, Deagostini MC, Serra M, Biolcati M, Ragni F, et al. **Piccoli GB, Consiglio V, Deagostini MC, Serra M, Biolcati M, Ragni F, et al.** BMC Nephrol. 2011;12:68-. (Level III evidence). [View the reference](#)
6. Wang IK, Chang FR, Yang BY, Lin CL, Huang CC. **The use of ultrasonography in evaluating adults with febrile urinary tract infection.** Ren Fail. 2003;25(6):981-7. (Level III evidence). [View the reference](#)
7. Rollino C, Beltrame G, Ferro M, Quattrocchio G, Sandrone M, Quarello F. **Acute pyelonephritis in adults: a case series of 223 patients.** Nephrol Dial Transplant. 2012;27(9):3488-93. (Level III evidence). [View the reference](#)
8. van Nieuwkoop C, Hoppe BP, Bonten TN, Van't Wout JW, Aarts NJ, Mertens BJ, et al. **Predicting the need for radiologic imaging in adults with febrile urinary tract infection.** Clin Infect Dis. 2010;51(11):1266-72. (Level III evidence). [View the reference](#)
9. Bonkat G, Pickard R, Bartoletti R, Cai T, Bruyère F, Geerlings SE, et al. **EAU Guidelines for urological infections.** The Netherlands. 2018. (Guideline). [View the reference](#)
10. Soulen MC, Fishman EK, Goldman SM, Gatewood OM. **Bacterial renal infection: role of CT.** Radiology. 1989;171(3):703-7. (Level IV evidence) [View the reference](#)
11. Colgan R, Williams M, Johnson JR. **Diagnosis and treatment of acute pyelonephritis in women.** Am Fam Physician. 2011;84(5):519-26. (Review article). [View the reference](#)
12. Nikolaidis P, Dogra VS, Goldfarb S, Gore JL, Harvin HJ, Heilbrun ME, et al. **American College of Radiology. ACR appropriateness criteria. Acute pyelonephritis.** 2018. (Guideline). [View the reference](#)
13. Sorensen SM, Schonheyder HC, Nielsen H. **The role of imaging of the urinary tract in patients with urosepsis.** Int J Infect Dis. 2013;17(5):e299-303. (Level III evidence). [View the reference](#)
14. Lu YC, Chiang BJ, Pong YH, Chen CH, Pu YS, Hsueh PR, et al. **Emphysematous pyelonephritis: clinical characteristics and prognostic factors.** Int J Urol. 2014;21(3):277-82. (Level II-III evidence). [View the reference](#)
15. Vourganti S, Agarwal PK, Bodner DR, Dogra VS. **Ultrasonographic evaluation of renal infections.** Radiol Clin North Am. 2006;44(6):763-75. (Review article). [View the reference](#)
16. Riddell J, Case A, Wopat R, Beckham S, Lucas M, McClung CD, et al. **Sensitivity of emergency bedside ultrasound to detect hydronephrosis in patients with computed tomography-proven stones.** West J Emerg Med. 2014;15(1):96-100. (Level II-III evidence). [View the reference](#)
17. Leo MM, Langlois BK, Pare JR, Mitchell P, Linden J, Nelson KP, et al. **Ultrasound vs. computed tomography for severity of hydronephrosis and its importance in renal colic.** West J Emerg Med. 2017;18(4):559-68. (Level II-III evidence). [View the reference](#)
18. Yoo JM, Koh JS, Han CH, Lee SL, Ha US, Kang SH, et al. **Diagnosing acute pyelonephritis with CT, (99m)Tc-DMSA SPECT, and Doppler ultrasound: a comparative study.** Korean J Urol.



- 2010;51(4):260-5. (Level II-III evidence). [View the reference](#)
19. Stojadinovic M, Micic S, Milovanovic D. **Ultrasonographic and computed tomography findings in renal suppurations: performance indicators and risks for diagnostic failure.** Urol Int. 2008;80(4):389-97. (Level III evidence). [View the reference](#)
20. Koteswar P, Kakkar C, Sripathi S, Parakh A, Shrivastav R. **Low dose MDCT with tube current modulation: role in detection of urolithiasis and patient effective dose reduction.** J Clin Diagn Res. 2016;10(5):TC01-TC5. (Level II evidence). [View the reference](#)
21. Tack D, Sourtzis S, Delpierre I, de Maertelaer V, Gevenois PA. **Low-dose unenhanced multidetector CT of patients with suspected renal colic.** AJR Am J Roentgenol. 2003;180(2):305-11. (Level II-III evidence). [View the reference](#)

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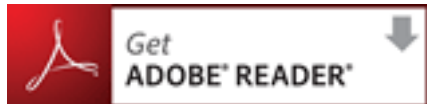
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