Complete Summary

GUIDELINE TITLE

Acute pyelonephritis.

BIBLIOGRAPHIC SOURCE(S)

Sandler CM, Choyke PL, Bluth E, Bush WH Jr, Casalino DD, Francis IR, Jafri SZ, Kawashima A, Kronthal A, Older RA, Papanicolaou N, Ramchandani P, Rosenfield AT, Segal AJ, Tempany C, Resnick MI, Expert Panel on Urologic Imaging. Acute pyelonephritis. [online publication]. Reston (VA): American College of Radiology (ACR); 2005. 5 p. [21 references]

GUIDELINE STATUS

This is the current release of the guideline.

It updates a previous published version: American College of Radiology (ACR), Expert Panel on Urologic Imaging. Imaging in acute pyelonephritis. Reston (VA): American College of Radiology (ACR); 2001. 4 p. (ACR appropriateness criteria). [17 references]

The appropriateness criteria are reviewed annually and updated by the panels as needed, depending on introduction of new and highly significant scientific evidence.

** REGULATORY ALERT **

FDA WARNING/REGULATORY ALERT

Note from the National Guideline Clearinghouse: This guideline references a drug(s) for which important revised regulatory and/or warning information has been released.

- May 23, 2007, Gadolinium-based Contrast Agents: The addition of a boxed warning and new warnings about the risk of nephrogenic systemic fibrosis (NSF) to the full prescribing information for all gadolinium-based contrast agents (GBCAs).

COMPLETE SUMMARY CONTENT

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SCOPE

DISEASE/CONDITION(S)

Acute pyelonephritis

GUIDELINE CATEGORY

Diagnosis
Evaluation

CLINICAL SPECIALTY

Family Practice
Internal Medicine
Nephrology
Nuclear Medicine
Pediatrics
Radiology
Urology

INTENDED USERS

Health Plans
Hospitals
Managed Care Organizations
Physicians
Utilization Management

GUIDELINE OBJECTIVE(S)

To evaluate the appropriateness of radiologic examinations for imaging in acute pyelonephritis

TARGET POPULATION

Patients with acute pyelonephritis

INTERVENTIONS AND PRACTICES CONSIDERED

1. X-ray
    - Kidney, intravenous urography, intravenous pyelogram (IVP)

    - Abdomen, kidneys, ureters, bladder (KUB)
    - Bladder, voiding cystourethrography (VCUG)
    - Kidney, antegrade pyelography
2. Ultrasound (US)
    - Kidney
    - Renal with KUB
3. Computed tomography (CT)
    - Kidney with and without contrast
    - Abdomen and pelvis, with and without contrast
4. Nuclear medicine (NUC), kidney, technetium (Tc)-99m dimercaptosuccinic acid (DMSA) scan
5. Magnetic resonance imaging (MRI) kidney

MAJOR OUTCOMES CONSIDERED

Utility of radiologic examinations for imaging in acute pyelonephritis

METHODOLOGY

METHODS USED TO COLLECT/SELECT EVIDENCE

Searches of Electronic Databases

DESCRIPTION OF METHODS USED TO COLLECT/SELECT THE EVIDENCE

The guideline developer performed literature searches of peer-reviewed medical journals, and the major applicable articles were identified and collected.

NUMBER OF SOURCE DOCUMENTS

The total number of source documents identified as the result of the literature search is not known.

METHODS USED TO ASSESS THE QUALITY AND STRENGTH OF THE EVIDENCE

Weighting According to a Rating Scheme (Scheme Not Given)

RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not stated

METHODS USED TO ANALYZE THE EVIDENCE

Systematic Review with Evidence Tables

DESCRIPTION OF THE METHODS USED TO ANALYZE THE EVIDENCE

One or two topic leaders within a panel assume the responsibility of developing an evidence table for each clinical condition, based on analysis of the current

literature. These tables serve as a basis for developing a narrative specific to each clinical condition.

METHODS USED TO FORMULATE THE RECOMMENDATIONS

Expert Consensus (Delphi)

DESCRIPTION OF METHODS USED TO FORMULATE THE RECOMMENDATIONS

Since data available from existing scientific studies are usually insufficient for meta-analysis, broad-based consensus techniques are needed for reaching agreement in the formulation of the appropriateness criteria. The American College of Radiology (ACR) Appropriateness Criteria panels use a modified Delphi technique to arrive at consensus. Serial surveys are conducted by distributing questionnaires to consolidate expert opinions within each panel. These questionnaires are distributed to the participants along with the evidence table and narrative as developed by the topic leader(s). Questionnaires are completed by participants in their own professional setting without influence of the other members. Voting is conducted using a scoring system from 1-9, indicating the least to the most appropriate imaging examination or therapeutic procedure. The survey results are collected, tabulated in anonymous fashion, and redistributed after each round. A maximum of three rounds is conducted and opinions are unified to the highest degree possible. Eighty percent agreement is considered a consensus. This modified Delphi technique enables individual, unbiased expression, is economical, easy to understand, and relatively simple to conduct.

If consensus cannot be reached by the Delphi technique, the panel is convened and group consensus techniques are utilized. The strengths and weaknesses of each test or procedure are discussed and consensus reached whenever possible. If "No consensus" appears in the rating column, reasons for this decision are added to the comment sections.

RATING SCHEME FOR THE STRENGTH OF THE RECOMMENDATIONS

Not applicable

COST ANALYSIS

A formal cost analysis was not performed and published cost analyses were not reviewed.

METHOD OF GUIDELINE VALIDATION

Internal Peer Review

DESCRIPTION OF METHOD OF GUIDELINE VALIDATION

Criteria developed by the Expert Panels are reviewed by the American College of Radiology (ACR) Committee on Appropriateness Criteria.

RECOMMENDATIONS

MAJOR RECOMMENDATIONS

ACR Appropriateness Criteria®

Clinical Condition: Acute Pyelonephritis

Variant 1: Uncomplicated patient.

Radiologic Exam Procedure	Appropriateness Rating	Comments
X-ray, kidney, intravenous urography, IVP	3	Studies show that imaging adds little to management if the patient responds to therapy within 72 hours.
X-ray, abdomen, KUB	2	See above.
X-ray, bladder, voiding cystourethrography (VCUG)	2	See above.
US, kidney	2	See above.
CT, kidney, with and without contrast	2	See above.
CT, kidney, without contrast	2	See above.
NUC, kidney, Tc-99m DMSA	2	See above.
MRI, kidney	1	See above.
X-ray, kidney, antegrade pyelography	1	See above.
Appropriateness Criteria Scale **1 2 3 4 5 6 7 8 9** **1 = Least appropriate 9 = Most appropriate**		

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 2: Diabetes, immunocompromised.

Radiologic Exam Procedure	Appropriateness Rating	Comments

Radiologic Exam Procedure	Appropriateness Rating	Comments
CT, abdomen and pelvis, with and without contrast	8	Parenchymal and excretory phase.
US, renal, with KUB	6	Somewhat less sensitive than CT but used preferentially if there is compromised renal function. KUB to evaluate stones or air.
X-ray, kidney, intravenous urography, IVP	4	Normal renal function
MRI, kidney	4	For patients who cannot receive iodinated contrast.
NUC, kidney, Tc-99m DMSA	3	Cannot differentiate renal parenchymal disease from perinephric process.
X-ray, bladder, voiding cystourethrography (VCUG)	2	Not part of initial evaluation.
X-ray, abdomen, KUB	2	Insufficient information by itself to guide therapy.
X-ray, kidney, antegrade pyelography	1	Not an initial study.
Appropriateness Criteria Scale **1 2 3 4 5 6 7 8 9** **1 = Least appropriate 9 = Most appropriate**		

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Variant 3: Complicated, other (e.g., history of stones, prior renal surgery, etc.).

Radiologic Exam Procedure	Appropriateness Rating	Comments
CT, abdomen and pelvis, with and without contrast	8	Parenchymal and excretory phase.
X-ray, kidney, intravenous urography, IVP	6	

Radiologic Exam Procedure	Appropriateness Rating	Comments
US, renal, with KUB	6	May be used as an alternative study to above.
MRI, kidney	4	
X-ray, bladder, voiding cystourethrography (VCUG)	3	Not part of initial evaluation but may be used subsequently to demonstrate clinically suspected reflux.
NUC, kidney, Tc-99m DMSA	3	Cannot differentiate renal parenchymal disease from perinephric process.
X-ray, abdomen, KUB	2	Insufficient information by itself to guide therapy.
X-ray, kidney, antegrade pyelography	1	Not an initial study.
Appropriateness Criteria Scale **1 2 3 4 5 6 7 8 9** **1 = Least appropriate 9 = Most appropriate**		

Note: Abbreviations used in the tables are listed at the end of the "Major Recommendations" field.

Inflammatory disease involving the urinary tract is among the most common infectious disorders affecting humankind. In most adults, the infection is confined to the lower urinary tract (LUT), the diagnosis is established by clinical or laboratory studies, and imaging studies are not required. When the kidney itself is involved or when there is difficulty in differentiating LUT infection from renal parenchymal involvement, imaging studies are often requested both for diagnosis and to plan management. Conditions that are thought to predispose a patient with LUT infection to renal involvement include vesicoureteral reflux, altered bladder function, congenital urinary tract anomalies, and the presence of renal calculi.

Pathologically, inflammatory disease of the kidney generally occurs as the result of ascending infection from the LUT (whether or not radiologically demonstrated vesicoureteral reflux is present) by gram-negative enteric pathogens (usually *Escherichia coli*) and is known as acute pyelonephritis. This name accurately reflects the underlying pathologic condition present (i.e., infection involving both the renal parenchyma and the renal pelvis). In the majority of patients, uncomplicated pyelonephritis is readily diagnosed clinically and responds quickly to treatment with appropriate antibiotics. If the treatment is started late, the patient is immunocompromised, or, for other poorly understood reasons, small microabscesses that form during the acute phase of pyelonephritis may coalesce to form an acute renal abscess. If such an abscess then ruptures into the perinephric space, a perirenal abscess is formed. If the infection is confined to an obstructed collecting system, the infection is referred to as pyelonephrosis. Patients with underlying diabetes are of particular concern. Not only are they

more vulnerable to the development of a complication from acute pyelonephritis, but it is also more difficult to establish the diagnosis on clinical grounds in diabetics, since as many as 50% will not have the typical flank tenderness that helps to differentiate pyelonephritis from LUT infection in an otherwise healthy patient.

Prior to the advent of cross-sectional imaging, radiologic studies performed in patients with uncomplicated pyelonephritis were normal in most cases. In the early 1970s, however, a subgroup of patients was identified with acute pyelonephritis, commonly with underlying diabetes, who did not respond quickly to therapy and in whom urography showed anatomic and severe functional abnormalities. In order to differentiate such patients from those with garden-variety pyelonephritis, a new term, acute bacterial nephritis, was coined. With the advent of cross-sectional imaging, a whole new lexicon of terminology evolved to describe various degrees of parenchymal involvement with pyelonephritis. The Society of Uroradiology has recommended that all patients with renal infection be referred to as having acute pyelonephritis, with only the additional modifiers unilateral or bilateral, focal or diffuse, focal swelling or no focal swelling, and renal enlargement or no enlargement used to describe the extent of the process.

Traditionally, excretory urography (IVP) has been the primary diagnostic modality for imaging patients with renal infection. The rationale for performing urography is not to diagnose acute pyelonephritis but to look for an underlying anatomic abnormality (i.e., anomaly) that may have predisposed the patient to the infection; to search for a process such as a calculus, papillary necrosis, or obstruction that may prevent a rapid therapeutic response; or to diagnose a complication of the infection such as a renal or perinephric abscess. As such, many urologists routinely order an excretory urogram in all patients with clinical pyelonephritis within the first 24 hours after initiation of therapy. More recently, CT urography has been increasingly used in place of IVP.

There is now reasonably good evidence that routine urography does not alter the clinical care in 90% of patients with pyelonephritis. This same study showed, however, that if investigation was confined to those patients who did not become afebrile after 72 hours of appropriate antibiotics therapy, the number of patients with urographic findings of immediate clinical significance rose to 36%. The authors also found a five-fold increase in yield from routine urography in patients with underlying diabetes or those infected with a pathogen other than ampicillin-sensitive *Escherichia coli*. Other authors confirmed the validity of the 72-hour period in a study of the utility of CT in patients with pyelonephritis; in this series, 95% of patients with uncomplicated pyelonephritis became afebrile within 48 hours of appropriate antibiotic therapy, and nearly 100% did so within 72 hours.

There is almost universal agreement that precontrast and postcontrast CT is the imaging study of choice to diagnose patients with atypical pyelonephritis or to look for a potential complication of the infection such as a renal or perinephric abscess or a renal emphysema. In most of the studies comparing CT with US, much of the superiority of CT lay in its ability to detect parenchymal abnormalities in patients with pyelonephritis that are generally missed by US but do not alter the patient´s therapy. One study, however, reported that US missed 6 of 10 intrarenal and 1 of 5 perinephric abscesses subsequently diagnosed by CT. In only three of these cases, however, were the results verified by surgery. The

proponents of US are quick to point out its advantages; namely, low risk, relatively low expense, lack of ionizing radiation, and, most importantly, the fact that it does not require the use of contrast material. Recent technical advances in US such as tissue harmonic imaging and the use of US contrast agents have been shown to increase the sensitivity of US to subtle parenchymal abnormalities in pyelonephritis, but further work in this area is needed before definite recommendations can be made. Conventional gray-scale US has been considered the method of choice to diagnose pyelonephrosis (i.e., low-level echoes within the collecting system), but CT can also suggest this diagnosis. The most specific test to diagnose pyelonephrosis, however, is needle aspiration of the collecting system, which is generally performed as a prelude to percutaneous nephrostomy.

Recently there has been increased interest in the diagnosis of acute pyelonephritis utilizing technetium 99m DMSA renal scintigraphy, particularly in children. Recent studies have shown this technique to be much more sensitive for the detection of pyelonephritis than US. Recently, Power Doppler ultrasonography has shown sensitivities and specificities approaching 90% in children with acute pyelonephritis. This is important in children since differentiating LUT infection from pyelonephritis is more difficult in the pediatric population and since it is the young who are more vulnerable to permanent renal damage from renal inflammatory disease. One recent study, however, suggests that these benefits do not extend to adults.

Various other imaging studies are of value in selected patients. MRI is felt to be useful in patients in whom the use of iodinated contrast material must be avoided, (i.e., those with azotemia or contrast sensitivity), but case-controlled studies documenting its efficacy have yet to be published. Recently, gadolinium enhanced inversion recovery MRI has been shown to be only slightly less sensitive and specific than DMSA scintigraphy for acute pyelonephritis in children. One potential disadvantage of MRI is its inability to detect smaller calculi. Retrograde pyelography is of value in patients with severe infection and obstruction that cannot be demonstrated noninvasively. Antegrade pyelography can be used as an alternative to the retrograde study. Voiding cystourethrography is used to demonstrate vesicoureteral reflux but is generally only routinely performed in children.

Otherwise healthy patients with uncomplicated pyelonephritis probably need no radiologic work-up if they respond to antibiotic therapy within 72 hours. If there is no response to therapy, urography is probably the most cost-effective starting point for evaluation. Diabetics or other immunocompromised patients should probably be evaluated with precontrast and postcontrast CT within 24 hours of diagnosis. Ultrasound should be reserved for patients in whom pyelonephrosis is suspected and those patients for whom exposure to contrast or radiation is hazardous. All other adult patients (i.e., males and patients with a history of stones or other urologic conditions, prior urologic surgery, repeated episodes of pyelonephritis, etc.) probably deserve early evaluation with urography.

Anticipated Exceptions

The first line study in pregnant patients should be ultrasonography. Patients with azotemia, pregnancy, suspected vesicoureteral reflux, or an accelerated clinical course (i.e., sepsis) may all need more aggressive evaluation.

Abbreviations

- CT, computed tomography
- IVP, intravenous pyelogram
- KUB, kidneys, ureters, bladder
- MRI, magnetic resonance image
- NUC, nuclear medicine
- Tc, technetium; DMSA, dimercaptosuccinic acid
- US, ultrasound
- VCUG, voiding cystourethrography

CLINICAL ALGORITHM(S)

Algorithms were not developed from criteria guidelines.

EVIDENCE SUPPORTING THE RECOMMENDATIONS

TYPE OF EVIDENCE SUPPORTING THE RECOMMENDATIONS

The recommendations are based on analysis of the current literature and expert panel consensus.

BENEFITS/HARMS OF IMPLEMENTING THE GUIDELINE RECOMMENDATIONS

POTENTIAL BENEFITS

Selection of appropriate radiologic imaging procedures for evaluation of patients with acute pyelonephritis

Subgroups Most Likely to Benefit

- Immunocompromised patients
- Diabetic patients
- Technetium (Tc) 99m dimercaptosuccinic acid (DMSA) renal scintigraphy is particularly beneficial in children
- Patients in whom the use of iodinated contrast material must be avoided
- Patients with severe infection and obstruction

POTENTIAL HARMS

- The ability to detect parenchymal abnormalities in patients with pyelonephritis is generally missed by ultrasound (US).
- One potential disadvantage of magnetic resonance (MR) is its inability to detect smaller calculi.

QUALIFYING STATEMENTS

QUALIFYING STATEMENTS

An American College of Radiology (ACR) Committee on Appropriateness Criteria and its expert panels have developed criteria for determining appropriate imaging examinations for diagnosis and treatment of specified medical condition(s). These criteria are intended to guide radiologists, radiation oncologists, and referring physicians in making decisions regarding radiologic imaging and treatment. Generally, the complexity and severity of a patient's clinical condition should dictate the selection of appropriate imaging procedures or treatments. Only those exams generally used for evaluation of the patient's condition are ranked. Other imaging studies necessary to evaluate other co-existent diseases or other medical consequences of this condition are not considered in this document. The availability of equipment or personnel may influence the selection of appropriate imaging procedures or treatments. Imaging techniques classified as investigational by the U.S. Food and Drug Administration (FDA) have not been considered in developing these criteria; however, study of new equipment and applications should be encouraged. The ultimate decision regarding the appropriateness of any specific radiologic examination or treatment must be made by the referring physician and radiologist in light of all the circumstances presented in an individual examination.

IMPLEMENTATION OF THE GUIDELINE

DESCRIPTION OF IMPLEMENTATION STRATEGY

An implementation strategy was not provided.

IMPLEMENTATION TOOLS

Personal Digital Assistant (PDA) Downloads

For information about availability, see the "Availability of Companion Documents" and "Patient Resources" fields below.

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

IOM CARE NEED

Getting Better

IOM DOMAIN

Effectiveness

IDENTIFYING INFORMATION AND AVAILABILITY

BIBLIOGRAPHIC SOURCE(S)

Sandler CM, Choyke PL, Bluth E, Bush WH Jr, Casalino DD, Francis IR, Jafri SZ, Kawashima A, Kronthal A, Older RA, Papanicolaou N, Ramchandani P, Rosenfield AT, Segal AJ, Tempany C, Resnick MI, Expert Panel on Urologic Imaging. Acute

pyelonephritis. [online publication]. Reston (VA): American College of Radiology (ACR); 2005. 5 p. [21 references]

ADAPTATION

Not applicable: The guideline was not adapted from another source.

DATE RELEASED

1995 (revised 2005)

GUIDELINE DEVELOPER(S)

American College of Radiology - Medical Specialty Society

SOURCE(S) OF FUNDING

The American College of Radiology (ACR) provided the funding and the resources for these ACR Appropriateness Criteria®.

GUIDELINE COMMITTEE

Committee on Appropriateness Criteria, Expert Panel on Urologic Imaging

COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Panel Members: Carl M. Sandler, MD (*Principal Author*); Peter L. Choyke, MD; Edward Bluth, MD; William H. Bush, Jr, MD; David D. Casalino, MD; Isaac R. Francis, MD; S. Zafar H. Jafri, MD; Akira Kawashima, MD, PhD; Alan Kronthal, MD; Robert A. Older, MD; Nicholas Papanicolaou, MD; Parvati Ramchandani, MD; Arthur T. Rosenfield, MD; Arthur J. Segal, MD; Clare Tempany, MD; Martin I. Resnick, MD

FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

GUIDELINE STATUS

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GUIDELINE AVAILABILITY

Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.

ACR Appropriateness Criteria® *Anytime*, *Anywhere*™ (PDA application). Available from the ACR Web site.

Print copies: Available from the American College of Radiology, 1891 Preston White Drive, Reston, VA 20191. Telephone: (703) 648-8900.

AVAILABILITY OF COMPANION DOCUMENTS

The following is available:

- ACR Appropriateness Criteria®. Background and development. Reston (VA): American College of Radiology; 2 p. Electronic copies: Available in Portable Document Format (PDF) from the American College of Radiology (ACR) Web site.

PATIENT RESOURCES

None available

NGC STATUS

This summary was completed by ECRI on May 6, 2001. The information was verified by the guideline developer as of June 29, 2001. This summary was updated by ECRI on September 7, 2004. The updated information was verified by the guideline developer on October 8, 2004. This summary was updated by ECRI on February 6, 2006. This summary was updated by ECRI Institute on May 17, 2007 following the U.S. Food and Drug Administration (FDA) advisory on Gadolinium-based contrast agents. This summary was updated by ECRI Institute on June 20, 2007 following the U.S. Food and Drug Administration (FDA) advisory on gadolinium-based contrast agents.

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