



## Complete Summary

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### GUIDELINE TITLE

ACR Appropriateness Criteria™ for myelopathy.

### BIBLIOGRAPHIC SOURCE(S)

Seidenwurm D, Drayer BP, Anderson RE, Braffman B, Davis PC, Deck MD, Hasso AN, Johnson BA, Masaryk T, Pomeranz SJ, Tanenbaum L, Masdeu JC. Myelopathy. American College of Radiology. ACR Appropriateness Criteria. Radiology 2000 Jun; 215(Suppl): 495-505. [31 references]

## COMPLETE SUMMARY CONTENT

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### RECOMMENDATIONS

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IMPLEMENTATION OF THE GUIDELINE

INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT

### CATEGORIES

IDENTIFYING INFORMATION AND AVAILABILITY

## SCOPE

### DISEASE/CONDITION(S)

Myelopathy

### GUIDELINE CATEGORY

Diagnosis

### CLINICAL SPECIALTY

Infectious Diseases  
Neurological Surgery  
Neurology  
Oncology  
Radiology

### INTENDED USERS

Health Plans  
Hospitals  
Managed Care Organizations  
Physicians  
Utilization Management

#### GUIDELINE OBJECTIVE(S)

To evaluate the appropriateness of initial radiologic examinations for myelopathy

#### TARGET POPULATION

Patients with myelopathy

#### INTERVENTIONS AND PRACTICES CONSIDERED

1. Plain radiograph
2. Magnetic resonance imaging
3. Magnetic resonance imaging and gadolinium
4. Magnetic resonance angiography
5. Flow magnetic resonance imaging
6. Plain computed tomography
7. Intravenous contrast computed tomography
8. Computed tomography myelography
9. Myelography
10. Bone scan [include single-photon emission computed tomography]
11. White blood cell (WBC) scan
12. Cerebral spinal fluid (CSF) flow scan
13. Spinal arteriography
14. Discogram
15. Postdiscogram computed tomography
16. Epidural venography
17. Thermography
18. Ultrasound (nonoperative)

#### MAJOR OUTCOMES CONSIDERED

Utility of radiologic examinations in differential diagnosis

## 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 recent peer-reviewed medical journals, primarily using the National Library of Medicine's MEDLINE database. The developer identified and collected the major applicable articles.

## 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

Expert Consensus (Delphi Method)  
Weighting According to a Rating Scheme (Scheme Not Given)

## RATING SCHEME FOR THE STRENGTH OF THE EVIDENCE

Not applicable

## 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 to reach agreement in the formulation of the Appropriateness Criteria. 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 the 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 (80) percent agreement is considered a consensus. If consensus cannot be reached by this method, 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.

## 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 and the Chair of the ACR Board of Chancellors.

### RECOMMENDATIONS

#### MAJOR RECOMMENDATIONS

ACR Appropriateness Criteria™

Clinical Condition: Myelopathy

Variant 1: Traumatic.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Plain radiograph	9	
Magnetic resonance imaging	8	
Plain computed tomography	8	To evaluate radiographic abnormalities.
Computed tomography myelography	4	Preoperative planning, penetrating trauma, avulsion injury.
Myelography	2	If magnetic resonance imaging is not feasible; if computed tomography myelogram is performed.
Intravenous contrast computed tomography	2	

Magnetic resonance imaging and gadolinium	2	
Magnetic resonance angiography	2	
Flow magnetic resonance imaging	2	
Bone scan (include single-photon emission computed tomography)	2	
White blood cell (WBC) scan	2	
Cerebral spinal fluid (CSF) flow scan	2	
Spinal arteriography	2	
Discogram	1	
Postdiscogram computed tomography	1	
Epidural venography	1	
Thermography	1	
Ultrasound (nonoperative)	1	
<u>Appropriateness Criteria Scale</u> 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Clinical Condition: Myelopathy

Variant 2: Painful.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance imaging	8	
Plain radiograph	7	

Magnetic resonance imaging and gadolinium	4	If magnetic resonance imaging is negative or to characterize abnormality.
Plain computed tomography	4	Preoperative planning or problem solving.
Bone scan (include single-photon emission computed tomography)	4	Search for associated extra spinal disease.
Computed tomography myelography	3	Preoperative planning or specific problem solving.
Intravenous contrast computed tomography	2	
Myelography	2	
Magnetic resonance angiography	2	
Flow magnetic resonance imaging	2	
White blood cell (WBC) scan	2	
Cerebral spinal fluid (CSF) flow scan	2	
Spinal arteriography	2	
Discogram	1	
Postdiscogram computed tomography	1	
Epidural venography	1	
Thermography	1	
Ultrasound (nonoperative)	1	
<u>Appropriateness Criteria Scale</u>		
1 2 3 4 5 6 7 8 9		
1=Least appropriate 9=Most appropriate		

Clinical Condition: Myelopathy

Variant 3: Sudden onset.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance imaging	8	
Plain radiograph	6	
Magnetic resonance imaging and gadolinium	5	If magnetic resonance imaging is negative or to characterize abnormality.
Magnetic resonance angiography	4	If arteriovenous malformations is suspected.
Plain computed tomography	4	
Computed tomography myelography	4	If emergency magnetic resonance imaging is not available.
Spinal arteriography	4	If arteriovenous malformations is suspected.
Myelography	2	Performed in conjunction with computed tomography myelogram.
Intravenous contrast computed tomography	2	
Flow magnetic resonance imaging	2	
Bone scan (include single-photon emission computed tomography)	2	
White blood cell (WBC) scan	2	
Cerebral spinal fluid (CSF) flow scan	2	
Discogram	1	
Postdiscogram computed tomography	1	
Epidural venography	1	
Thermography	1	
Ultrasound (nonoperative)	1	
<u>Appropriateness Criteria Scale</u>		

1 2 3 4 5 6 7 8 9

1 =Least appropriate 9=Most appropriate

Clinical Condition: Myelopathy

Variant 4: Stepwise progressive.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance imaging	8	
Magnetic resonance imaging and gadolinium	8	
Spinal arteriography	6	If arteriovenous malformations is suspected.
Plain radiograph	4	
Myelography	4	If arteriovenous malformations is suspected.
Computed tomography myelography	4	May follow myelography.
Magnetic resonance angiography	4	If arteriovenous malformations is suspected.
Plain computed tomography	3	
Intravenous contrast computed tomography	2	
Flow magnetic resonance imaging	2	
Bone scan (include single-photon emission computed tomography)	2	
White blood cell (WBC) scan	2	
Cerebral spinal fluid (CSF) flow scan	2	
Discogram	1	
Postdiscogram computed tomography	1	
Epidural venography	1	

Thermography	1	
Ultrasound (nonoperative)	1	
<u>Appropriateness Criteria Scale</u>		
1 2 3 4 5 6 7 8 9		
1=Least appropriate 9=Most appropriate		

Clinical Condition: Myelopathy

Variant 5: Slowly progressive.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance imaging	8	
Magnetic resonance imaging and gadolinium	6	If magnetic resonance imaging is negative or to characterize abnormality.
Plain radiograph	6	
Myelography	4	If magnetic resonance imaging is not possible or preoperative planning and problem solving.
Plain computed tomography	4	
Computed tomography myelography	4	
Bone scan (include single-photon emission computed tomography)	4	
Spinal arteriography	4	
Intravenous contrast computed tomography	2	
Magnetic resonance angiography	2	
Flow magnetic resonance imaging	2	May be useful in syringomyelia.
White blood cell (WBC) scan	2	
Cerebral spinal fluid (CSF) flow scan	2	

Discogram	1	
Postdiscogram computed tomography	1	
Epidural venography	1	
Thermography	1	
Ultrasound (nonoperative)	1	
<u>Appropriateness Criteria Scale</u>		
1 2 3 4 5 6 7 8 9		
1=Least appropriate 9=Most appropriate		

Clinical Condition: Myelopathy

Variant 6: Infectious disease patient.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance imaging	8	
Magnetic resonance imaging and gadolinium	8	
Plain radiograph	6	
Plain computed tomography	6	Presurgical planning.
Intravenous contrast computed tomography	4	
Computed tomography myelography	4	If magnetic resonance imaging is not feasible or presurgical planning and problem solving.
White blood cell (WBC) scan	4	May be combined with bone scan to diagnose osteomyelitis.
Myelography	3	If magnetic resonance imaging not feasible.
Magnetic resonance angiography	2	
Flow magnetic resonance imaging	2	

Cerebral spinal fluid (CSF) flow scan	2	
Spinal arteriography	2	
Discogram	1	
Postdiscogram computed tomography	1	
Epidural venography	1	
Thermography	1	
Ultrasound (nonoperative)	1	
Bone scan (include single-photon emission computed tomography)	No Consensus	Indicated if multifocal disease is suspected.
<u>Appropriateness Criteria Scale</u> 1 2 3 4 5 6 7 8 9 1=Least appropriate 9=Most appropriate		

Clinical Condition: Myelopathy

Variant 7: Oncology patient.

Radiologic Exam Procedure	Appropriateness Rating	Comments
Magnetic resonance imaging	9	
Plain radiograph	8	
Magnetic resonance imaging and gadolinium	6	If magnetic resonance imaging is negative or symptoms not explained.
Bone scan (include single-photon emission computed tomography)	6	Search for extraspinal disease.
Myelography	4	If magnetic resonance imaging is not feasible.
Plain computed tomography	4	Surgical planning or problem solving.
Computed tomography myelography	4	Surgical planning or problem solving.

Intravenous contrast computed tomography	2	
Magnetic resonance angiography	2	
Flow magnetic resonance imaging	2	
White blood cell (WBC) scan	2	
Cerebral spinal fluid (CSF) flow scan	2	
Spinal arteriography	2	
Discogram	1	
Postdiscogram computed tomography	1	
Epidural venography	1	
Thermography	1	
Ultrasound (nonoperative)	1	
<u>Appropriateness Criteria Scale</u>		
1 2 3 4 5 6 7 8 9		
1=Least appropriate 9=Most appropriate		

## Summary

The term myelopathy is used to describe any neurological deficit related to the spinal cord itself. Most frequently, myelopathy is due to compression of the spinal cord by osteophyte or extruded disc material in the cervical spine. Osteophytic spurring and disc herniation may also produce myelopathy localized to the thoracic spine, though this is less common. The next most common sources of myelopathy are spinal cord compression due to extradural mass caused by carcinoma metastatic to bone, and blunt or penetrating trauma. Many primary neoplastic, infectious, inflammatory, neurodegenerative, vascular, nutritional, and idiopathic disorders may also result in myelopathy, though these are very much less common than discogenic disease, metastases, and trauma. A variety of cysts and benign neoplasms may also compress the cord; these tend to arise intradurally. The most common of these are meningiomas, nerve sheath tumors, epidermoid cysts, and arachnoid cysts.

In general, disorders of the spinal cord itself are uncommon and difficult to treat effectively. Therefore, most attention in the radiological evaluation of myelopathy is focused on extrinsic compression of the spinal cord. Classically, radiological evaluation of myelopathic patients consisted of positive contrast myelography.

Later, this evaluation was supplemented by computed tomography and computed tomography myelography. Magnetic resonance imaging has become the mainstay in the evaluation of myelopathy.

Despite the wide variety of causes of myelopathy, diagnosis and treatment rest on demonstration of mechanical stability of the spine, particularly in the cervical region and when tumor or trauma history is present. Depiction of direct neural involvement by a pathologic process is then required for more refined diagnosis and specific treatment decisions. Anatomical diagnosis of myelopathy rests principally in the distinction between extradural, intradural, and intramedullary lesions.

Clinically, the diagnosis of myelopathy depends on the neurological localization of the finding to the spinal cord, rather than the brain or peripheral nervous system and then to a particular segment or subsegment of the spinal cord. The antecedent clinical syndrome and other details of the patient's course help to refine diagnosis, but imaging plays a crucial role. In general, myelopathy is clinically divided into categories based on the presence or absence of significant trauma, presence or absence of pain, and the mode of onset (slowly progressive or insidious onset vs. a stepwise progression vs. a sudden onset). Patients with known tumor history and those in whom infectious disease is likely may also be considered separately.

In the patient with traumatic myelopathy, the first priority for the spine is mechanical stability. It is generally accepted that plain radiographs are invaluable for this purpose. Computed tomography may be useful when plain radiographs raise questions of bony injury or inferred ligamentous injury. Magnetic resonance imaging is widely considered the study of choice when paralysis is incomplete or under other circumstances where direct visualization of neural or ligamentous structures is clinically necessary. If surgery for herniated disc, hematoma, or other cause of incomplete paralysis is planned, magnetic resonance imaging best depicts the relation of pathology to the cord, and can help predict which patients may benefit from surgery.

When local or radicular pain accompanies myelopathy, spondylosis, tumor, and infection are the most likely diagnoses. Plain radiographs may depict osteophytic narrowing of the spinal canal or bone destruction. Computed tomography improves the depiction of both bony encroachment on the spinal canal as well as compression on neural structures by herniated disc material, which are occult to plain radiographic evaluation. Bone destruction and soft tissue masses are also better seen. Magnetic resonance imaging has largely replaced computed tomography scanning in the noninvasive evaluation of patients with painful myelopathy because of superior soft tissue resolution and multiplanar capability. Invasive evaluation by means of myelography and computed tomography myelography may be supplemental when visualization of neural structures is required for surgical planning or other specific problem solving.

Although most commonly due to spondylosis and disc herniation, a significant proportion of painful myelopathy is caused by tumor or infection. Demyelinating disease may present with pain symptoms as well. Occasionally, syringomyelia may present with the anesthetica dolorosa syndrome. The ability of magnetic resonance imaging to depict the spinal cord directly, and to assess its contour and

internal signal characteristics reliably and noninvasively, has resulted in general acceptance of MRI as the study of choice in the evaluation of cervical myelopathy when spondylosis or disc herniation is the most likely cause. When magnetic resonance imaging is not available, or to answer specific questions before surgical intervention, myelography and computed tomography myelography may be useful.

In slowly progressive myelopathy, the ability of magnetic resonance imaging to depict the spinal cord noninvasively is most valuable. Most specifically, treatable disorders may be localized and depicted quite well by means of myelography followed by computed tomography. However, the occasional complication of myelography in cases of spinal block, difficulty in visualizing the upper extent of lesions, and relative "blind spots" at the cervical thoracic and craniocervical junctions limit the utility of myelography. Computed tomography myelographic techniques may help avoid these pitfalls and may be useful to answer specific preoperative questions about bony anatomy.

Enlargement of the spinal cord by intramedullary mass is well depicted by myelography when large masses are present. Computed tomography myelography can be extremely useful in supplementing the plain radiographic examination. These techniques, however, are less useful than magnetic resonance imaging because the distinction between solid and cystic masses is usually not possible even when delayed examination is performed. The distinction of syrinx from tumor, location of tumor nodule, extent of cyst, and distinction of nodule and cyst from edema are crucial in treatment planning for intramedullary disease and virtually necessitate magnetic resonance imaging.

When myelopathy progresses stepwise or is of sudden onset, vascular processes become significant diagnostic possibilities. Vascular malformations, spinal cord infarct, and epidural hematoma account for most of vascular lesions of the cord. In practice, they are difficult to distinguish clinically from other nontraumatic causes of myelopathy because the classic history is frequently absent or difficult to elicit from a seriously ill patient. If arteriovenous malformations is considered clinically likely, gadolinium-enhanced magnetic resonance imaging, magnetic resonance angiography, and myelography to demonstrate abnormal vasculature may be useful adjuncts to guide spinal arteriography.

When myelopathy is painless and slowly progressive, the differential diagnosis is quite broad. Neoplastic disease of the spinal cord and extrinsic compression by epidural or intradural tumor may present in this manner. Demyelinating disease, degenerative diseases, and metabolic or deficiency diseases also present in this fashion. Spondylosis may present painlessly as well, particularly in elderly subjects. In these cases, visualization of the spine as well as the spinal cord is useful and this is best accomplished noninvasively by magnetic resonance imaging.

In oncology and infectious disease patients, multiple sites of involvement are possible. In these patients it is often necessary to study the entire spine or even the entire skeleton despite a specifically localized myelopathic level. Magnetic resonance imaging is considered more sensitive at an individual site, but the convenience of radionuclide bone scanning makes it useful in this setting as well.

AIDS patients may present with myelopathy due to primary cord disease due to HIV infection.

An important limitation of magnetic resonance imaging in the diagnosis of myelopathy is its high sensitivity. The ease with which the study depicts expansion and compression of the spinal cord in the myelopathic patient may lead to false positive examinations and inappropriately aggressive therapy if findings are interpreted incorrectly. For example, transverse myelitis due to demyelinating disease may demonstrate cord enlargement and be mistaken for tumor. Spondylosis, which occurs with normal aging, may be mistaken for clinically significant osteophytic compression of the spinal cord in a patient who is myelopathic for other reasons. These problems are minimized by experienced observers and meticulous clinical correlation with radiologic findings. Similar problems are present in the interpretation of any anatomical study of the spinal cord and are not unique to magnetic resonance imaging. Careful patient selection and clinical correlation are essential in interpretation of imaging findings everywhere.

#### 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

Appropriate selection of radiologic exams for the diagnosis of myelopathy.

#### POTENTIAL HARMS

An important limitation of magnetic resonance imaging in the diagnosis of myelopathy is its high sensitivity. The ease with which the study depicts expansion and compression of the spinal cord in the myelopathic patient may lead to false positive examinations and inappropriately aggressive therapy if findings are interpreted incorrectly.

Similar problems are present in the interpretation of any anatomical study of the spinal cord and are not unique to magnetic resonance imaging. Careful patient selection and clinical correlation are essential in interpretation of imaging findings everywhere.

Subgroups Most Likely to be Harmed:

Patients with demyelinating disease and patients with spondylosis as a result of normal aging.

## 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.

## INSTITUTE OF MEDICINE (IOM) NATIONAL HEALTHCARE QUALITY REPORT CATEGORIES

### IOM CARE NEED

Living with Illness

### IOM DOMAIN

Effectiveness

## IDENTIFYING INFORMATION AND AVAILABILITY

### BIBLIOGRAPHIC SOURCE(S)

Seidenwurm D, Drayer BP, Anderson RE, Braffman B, Davis PC, Deck MD, Hasso AN, Johnson BA, Masaryk T, Pomeranz SJ, Tanenbaum L, Masdeu JC. Myelopathy.

American College of Radiology. ACR Appropriateness Criteria. Radiology 2000 Jun; 215(Suppl): 495-505. [31 references]

#### ADAPTATION

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

#### DATE RELEASED

1996 (revised 1999)

#### 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

ACR Appropriateness Criteria™ Committee, Expert Panel on Neurologic Imaging

#### COMPOSITION OF GROUP THAT AUTHORED THE GUIDELINE

Names of Panel Members: Thomas Masaryk, MD; Burton P. Drayer, MD; Robert E. Anderson, MD; Bruce Braffman, MD; Patricia C. Davis, MD; Michael D. F. Deck, MD; Anton N. Hasso, MD; Blake A. Johnson, MD; Stephen J. Pomeranz, MD; David Seidenwurm, MD; Lawrence Tanenbaum, MD; Joseph C. Masdeu, MD, PhD

#### FINANCIAL DISCLOSURES/CONFLICTS OF INTEREST

Not stated

#### GUIDELINE STATUS

This is the current release of the guideline. It is a revision of a previously issued version (Appropriateness criteria for myelopathy. Reston [VA]: American College of Radiology [ACR]; 1996. 11 p. [ACR Appropriateness Criteria™]).

The ACR Appropriateness Criteria™ are reviewed after five years, if not sooner, depending upon introduction of new and highly significant scientific evidence. The next review date for this topic is 2004.

#### GUIDELINE AVAILABILITY

Electronic copies: Available from the [American College of Radiology \(ACR\) Web site](#).

Print copies: Available from ACR, 1891 Preston White Drive, Reston, VA 20191.  
Telephone: (703) 648-8900.

#### AVAILABILITY OF COMPANION DOCUMENTS

None available

#### PATIENT RESOURCES

None available

#### NGC STATUS

This summary was completed by ECRI on July 31, 2001. The information was verified by the guideline developer as of August 24, 2001.

#### COPYRIGHT STATEMENT

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Date Modified: 11/15/2004

