

# **Clinical Decision Support (CDS) Content and Health Level 7 (HL7)- compliant Knowledge Artifacts (KNARTs)**

## **Neurosurgery: Radiculopathy (Cervical) Clinical Content White Paper**

**Department of Veterans Affairs (VA)**



**Knowledge Based Systems (KBS)  
Office of Informatics and Information Governance (OIIG)  
Clinical Decision Support (CDS)**

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# Clinical Decision Support (CDS) Content and Health Level 7 (HL7)-compliant Knowledge Artifacts (KNARTs): Neurosurgery: Radiculopathy (Cervical) Clinical Content White Paper

by Department of Veterans Affairs (VA)

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**Table 1. Relevant KNART Information**

KNART Name	Associated CLIN
Radiculopathy (Cervical) - Order Set	CLIN0004AB
Radiculopathy (Cervical) - Documentation Template	CLIN0005AC
Radiculopathy (Cervical) – Composite/Consult Request	N/A

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# Introduction

The VA is committed to improving the ability of clinicians to provide care for patients while increasing quality, safety, and efficiency. Recognizing the importance of standardizing clinical knowledge in support of this goal, VA is implementing the HL7 Knowledge Artifact Specification for a wide range of VA clinical use cases. Knowledge Artifacts, referred to as KNARTs, enable the structuring and encoding of clinical knowledge so the knowledge can be integrated with electronic health records to enable clinical decision support.

The purpose of this Clinical Content White Paper is to capture the clinical context and intent of KNART use cases in sufficient detail to provide the KNART authoring team with the clinical source material to construct the corresponding knowledge artifacts using the HL7 Knowledge Artifact Specification. This paper has been developed using material from a variety of sources: VA artifacts, clinical practice guidelines, evidence in the body of medical literature, and clinical expertise. After reviewing these sources, the material has been synthesized and harmonized under the guidance of VA subject matter experts to reflect clinical intent for this use case.

Unless otherwise noted, items within this white paper (e.g., documentation template fields, orderable items, etc.) are chosen to reflect the clinical intent at the time of creation. To provide an exhaustive list of all possible items and their variations is beyond the scope of this work.

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# Conventions Used

Conventions used within the knowledge artifact descriptions include:

- <obtain>: Indicates a prompt to obtain the information listed
  - If possible, the requested information should be obtained from the underlying system(s). Otherwise, prompting the user for information may be required.
  - The technical and clinical notes associated with a section should be consulted for specific constraints on the information (e.g., time-frame, patient interview, etc.).
  - Default values: unless otherwise noted, <obtain> indicates to obtain the one most recent observation. It is recognized that this default time-frame value may be altered by future implementations
- [...]: Square brackets enclose explanatory text that indicates some action on the part of the user, or general guidance to the clinical or technical teams. Examples include, but are not limited to:
  - [Begin...], [End...]: Indicates the start and end of specific areas to clearly delineate them for technical purposes.
  - [Activate...]: Initiates another knowledge artifact or knowledge artifact section.
  - [Section Prompt: ...]: If this section is applicable, then the following prompt should be displayed to the user.
  - [Section Selection Behavior: ...]: Indicates technical constraints or considerations for the selection of items within the section.
  - [Attach: ...]: Indicates the specified item should be attached to the documentation template if available.
  - [Link: ...]: Indicates that, rather than attaching, a link to the item should be included in the documentation template.
  - [Clinical Comments: ...]: Indicates clinical rationale or guidance.
  - [Technical Note: ...]: Indicates technical considerations or notes.
  - [If...]: Indicates the beginning of a conditional section.
  - [Else, ...]: Indicates the beginning of the alternative branch of a conditional section.
  - [Else if...] Indicates the end of a conditional section.
- Check boxes: Indicates items that should be selected based upon the section selection behavior.



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# Chapter 1. Radiculopathy (Cervical)

## 1. Clinical Context

The Neurosurgery Radiculopathy (Cervical) KNART set is intended for referring providers (Primary Care, Pain Clinic, Anesthesiologist, Physical Therapist and sometimes Emergency Department Physicians) performing an initial workup for adult outpatients with symptoms prior to requesting a Neurosurgery Consultation. Diagnostic and treatment modalities include Magnetic Resonance Imaging (MRI), Computed Tomography (CT) Myelogram, medication, physical therapy, acupuncture, steroid injections and pain clinic visits. The provider should also consider both a mental health evaluation and a substance abuse evaluation (alcohol, smoking, opioids/narcotics) where appropriate. The clinical context for this consultation includes only routine, non-urgent referrals to neurosurgery.

**Table 1.1. Clinical Context Domains**

Target User	Provider in Primary Care, Emergency Medicine, Anesthesiology, Pain Clinic, Physical Therapy
Patient	Adult outpatient being referred to Neurosurgery for Radiculopathy (Cervical)
Priority	Routine/Non-urgent
Specialty	Primary Care
Location	Outpatient

## 2. Knowledge Artifacts

This section describes the CDS knowledge artifacts that are specific to Neurosurgery Radiculopathy (Cervical) and is intended for users caring for adult patients who may require a Neurosurgery referral for surgery. Target clinical users include Primary Care physicians, Emergency Department physicians, Physical Therapist, Pain Clinic or Anesthesiologists. Patient cohort includes adult outpatients being referred to Neurosurgery.

The intent of these artifacts is to ensure a minimum workup is initiated prior to a Neurosurgery Consultation. Specific constraints for these artifacts are that:

- They apply to adult outpatients being considered for Neurosurgery referral.
- All imaging studies and treatment modalities are documented and appropriate results are accessible for Neurosurgery consultation.

There are three knowledge artifacts that define this clinical use case. These artifacts are the Consult Request, the Documentation Template and the Order Set and are described in detail in the following sections.

- Consult Request
  - This is a high-level, encompassing artifact.
  - It relies upon the documentation template and order set artifacts.
- Documentation Template
  - This is a template used to document the information provided by the referring provider.
  - It includes logic for appropriate display of documentation sections.
- Order Set
  - This is the set of orderable items associated with the consult request.

- It includes logic for appropriate display of the order set.

---

# Chapter 2. Composite

[Begin Composite.]

## 1. Knowledge Narrative

[See Clinical Context in Chapter 1.]

Cervical radiculopathy is a common problem that exerts a significant impact on functional impairment, chronic pain, disability, absenteeism, and other parameters that negatively affect quality of life. Referring physicians, most commonly primary care physicians and mid-level providers, often respond to the frustration of a patient with cervical radiculopathy by ordering advanced imaging tests and prematurely referring patients to subspecialists before exhausting the full array of conservative treatment modalities that are within their scope of practice. Implementation of an evidence-based approach consistent with the recommendations of authoritative professional societies, such as the American Association of Neurological Surgeons and the Congress of Neurological Surgeons, can optimize resource allocation and facilitate use of appropriate treatment modalities based on clinical presentation.

## 2. Consult and Referrals

[Begin Consul and Referrals.]

[Technical Note: The following list provides the basic components of the consult request. This is the high-level, encompassing artifact, and must be combined with the documentation template and order set to form a fully functional knowledge artifact. The information for the consult request can be obtained as part of the composite or within the corresponding order set component in the consult section. If obtained within the composite, this information should pre-populate the respective order set component.]

[Section Prompt: To request a neurosurgery consult for evaluation of cervical radiculopathy, please provide the following information.]

- Reason for Consult: Evaluate patient with cervical radiculopathy for surgery
- Consult Specialty: Neurosurgery
- Priority: Routine
- <obtain> Referring Physician
- <obtain> Referring Physician Contact Information

[Activate Documentation Template.]

[End Consult and Referrals.]

[End Composite.]

---

# Chapter 3. Documentation Template

[Begin Documentation Template.]

## 1. Knowledge Narrative

[See Clinical Context in Chapter 1.]

[Section Prompt: This documentation template should be completed by the provider requesting neurosurgical evaluation for a patient with cervical radiculopathy.]

## 2. Chief Complaint

[Begin Chief Complaint section.]

[Section Prompt: Chief Complaint.]

[Section Selection Behavior: Select at least one.]

- ☐ Pain
- ☐ Numbness
- ☐ Weakness
- ☐ Other <obtain>

[Section Prompt: Location of symptoms.]

[Section Selection Behavior: Select at least one.]

- ☐ Neck
- ☐ Left Arm
- ☐ Right Arm
- ☐ Other <obtain> Location

[Section Prompt: If pain is not a chief complaint, then skip to Duration of Symptoms.]

[Section Prompt: Please provide details regarding the character of the pain (e.g., burning, shooting, aching, electric, jabbing, etc.).]

<obtain> Details

[Section Prompt: Duration of Symptoms]

[Section Selection Behavior: Select only one.]

- ☐ Less than 2 weeks
- ☐ Greater than or equal to 2 weeks and less than or equal to 3 months
- ☐ Greater than 3 months

[End Chief Complaint section.]

### 3. Prior Conservative Therapies

[Begin Prior Conservative Therapies section.]

[Section Prompt: Which conservative therapies have been tried?]

**Medications.** [Subsection Prompt: Medications.]

[Section Selection Behavior: Select any. Optional.]

[Technical Note: Details for this subsection include: name of medication, dose, date started, and date ended.]

- ☐ Nonsteroidal anti-inflammatory drug (NSAIDs) <obtain> Details
- ☐ Opioids <obtain> Details
- ☐ Antiepileptics <obtain> Details
- ☐ Tricyclic antidepressants <obtain> Details
- ☐ Other <obtain> Details
- ☐ None

**Other Therapies.** [Subsection Prompt: Other Therapies.]

[Section Selection Behavior: Select any. Optional.]

[Technical Note: Details for this subsection include: therapy summary, date started, date ended, number of times and outcome.]

- ☐ Occupational Therapy <obtain> Details
- ☐ Cervical traction <obtain> Details
- ☐ Acupuncture <obtain> Details
- ☐ Spinal Manipulation <obtain> Details
- ☐ Cognitive behavioral therapy <obtain> Details
- ☐ Pain clinic <obtain> Details
- ☐ Selective nerve root blocks <obtain> Details
- ☐ Epidural steroid injections <obtain> Details
- ☐ Other <obtain> Details

[End Prior Conservative Therapies section.]

### 4. Medical History

[Begin Medical History section.]

[Section Prompt: Applicable Medical History.]

[Section Selection Behavior: Select any. Optional.]

[Technical Note: Details for this section include: summary, consult date, consult results, current status.]

- ☐ Chronic pain <obtain> Details
- ☐ Posttraumatic stress disorder <obtain> Details
- ☐ Anxiety <obtain> Details
- ☐ Depression <obtain> Details
- ☐ Other mental conditions <obtain> Details
- ☐ Oncological conditions <obtain> Details
- ☐ Obesity <obtain> Body Mass Index (BMI)
- ☐ Cardiovascular conditions <obtain> Details

[Technical Note: Provide link to full medical history.]

[End Medical History section.]

## 5. Surgical History

[Begin Surgical History section.]

[Section Prompt: Applicable Surgical History.]

[Section Selection Behavior: Select any. Optional.]

[Technical Note: Details for this section include: surgical summary and surgery date.]

- ☐ Spinal surgery <obtain> Details
- ☐ Other prior surgeries <obtain> Details

[Technical Note: Provide link to full surgical history.]

[End Surgical History section.]

## 6. Social History

[Begin Social History section]

[Section Prompt: Social History.]

[Section Selection Behavior: Select any. Optional.]

[Technical Note: Details for this section include: summary, current status, applicable dates.]

- ☐ Alcohol use/abuse <obtain> Details
- ☐ Rehabilitation or detoxification <obtain> Details
- ☐ Current or former tobacco user <obtain> Details <obtain> Pack years

[Technical Note: Provide link to Tobacco Assessment and Cessation Counseling KNART]

- ☐ Cocaine use/abuse <obtain> Details
- ☐ Other substance use/abuse <obtain> Details

- ☐ Homeless <obtain> Details

[Technical Note: Provide link to Homelessness Documentation Template KNART]

- ☐ Unstable home environment <obtain> Details
- ☐ Home environment conducive to healing <obtain> Details
- ☐ Geographically remote (40+ mile drive to medical care) <obtain> Details

[End Social History section.]

## 7. Imaging History

[Begin Imaging History section.]

[Section Prompt: Imaging History]

[Section Prompt: The most recent imaging studies in each category should be included:]

[Technical Note: Result text should be attached automatically if available for the Cervical Spine X-Ray Interpretation field.]

- <obtain> Cervical Spine X-rays Interpretation with dynamic flexion and extension
- [Link Images: Cervical Spine X-Rays.]

[Technical Note: Result text should be attached automatically if available for the Cervical Spine MRI Interpretation field.]

- <obtain> Cervical Spine MRI Interpretation
- [Link Images: Cervical Spine MRI.]

[Technical Note: Result text should be attached automatically if available for the Cervical Spine Myelogram Interpretation field.]

- <obtain> Cervical Spine Myelogram Interpretation
- [Link Images: Cervical Spine Myelogram.]

[Technical Note: Result text should be attached automatically if available for the Cervical Spine CT Interpretation field.]

- <obtain> Cervical Spine CT Interpretation
- [Link Images: Cervical Spine CT.]

[End Imaging History section.]

## 8. Medications

[Begin Medications List section.]

<obtain> Current pain medication list

<obtain> Current anticoagulation and antiplatelet list

[End Medications List section.]

## 9. Surgical Candidacy

[Begin Surgical Candidacy section.]

[Section Prompt: Does patient want to be considered for surgery?

- ☐ Yes
- ☐ No <obtain> reason for neurosurgical consult

[End Surgical Candidacy section.]

[End Documentation Template.]



---

# Chapter 4. Order Set

[Begin Order Set.]

## 1. Knowledge Narrative

[See Clinical Context in Chapter 1.]

## 2. Medications

[Begin Medications section]

[Section Prompt: Based upon clinical judgment and if not otherwise contraindicated, consider initiating a new order for one or more of the following medications prior to the neurosurgery consultation.]

[Section Prompt: NSAIDs]

[Section Prompt: NSAIDs increase the risk of serious gastrointestinal adverse events including bleeding, ulceration, and perforation of the stomach or intestines, which can be fatal. The prevailing recommendations in consensus-based clinical guidelines recommend that NSAID/Cyclo-oxygenase-2 (COX-2) should be avoided in Chronic Kidney Disease (CKD).]

[Technical Note: Provide link to <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3417055/#R6/link>]

[Section Selection Behavior: Select only one. Optional.]

- ☐ Ibuprofen 400 mg tablet oral every 6 hours as needed for neck or arm pain; may increase dose frequency to one tablet every 4 hours 100 tablets 2 refills
- ☐ Naproxen sodium 550 mg tablet oral every 12 hours as needed for neck or arm pain 100 tablets 2 refills

[Section Prompt: Other Analgesics]

[Section Selection Behavior: Select only one. Optional.]

- ☐ Acetaminophen 325 mg tablet oral two tablets every 6 hours as needed for neck or arm pain; may increase dose frequency to two tablets every 4 hours; do not take more than 10 tablets per day 100 tablets 2 refills

[Section Prompt: Glucocorticoids, Oral]

[Section Selection Behavior: Select only one. Optional.]

- ☐ Methylprednisolone 4 mg tablet oral by taper:
  - take 6 tablets at once on day 1
  - On day 2 take one tablet before breakfast, one after lunch, one after dinner, and two at bedtime
  - On day 3 take one tablet before breakfast, one after lunch, one after dinner, and one at bedtime
  - On day 4 take one tablet before breakfast, one after lunch, and one at bedtime
  - On day 5 take one tablet before breakfast and one at bedtime
  - On day 6 take one tablet before breakfast.
- 21 tablets 0 refills

[End Medications section.]

### 3. Procedures

[Begin Procedures section.]

[Section Prompt: Consider ordering the following procedures in conjunction with the neurosurgery consult. Typically for pain management, unless contraindicated for any reason, one would order glucocorticoid injection from the list below first, and if indicated, proceed to selective nerve block based on clinical outcome of patient's symptoms following completion of the series of 3 glucocorticoid injections.]

[Section Selection Behavior: Select any or none. Optional.]

- ☐ Epidural glucocorticoid injection under fluoroscopic or CT guidance per interventionist (series of three)
- ☐ Selective nerve root block per interventionist to distinguish symptomatic level(s) following identification of compressive lesions at multiple levels on MRI or CT myelography
- ☐ Selective nerve root block per interventionist to distinguish symptomatic level(s) in patient with discordance between clinical symptoms and findings on MRI or CT myelography

[End Procedures section]

### 4. Imaging

[Begin Imaging section]

[Section Prompt: Consider ordering one of the following imaging studies in conjunction with the neurosurgery consult.]

[Section Selection Behavior: Select only one. Optional.]

- ☐ X-ray cervical spine anteroposterior (AP) and lateral for neck pain
- ☐ MRI cervical spine without intravenous (IV) contrast (consider for: chronic neck pain, failed conservative management, candidate for surgical intervention)
- ☐ CT cervical spine without IV contrast (consider for: chronic neck pain, failed conservative management, candidate for surgical intervention, MRI contraindicated, IV contrast contraindicated)
- ☐ CT myelography cervical spine (consider for: chronic neck pain, failed conservative management, candidate for surgical intervention, MRI contraindicated)
- ☐ CT myelography cervical spine (consider for: chronic neck pain, failed conservative management, candidate for surgical intervention, clinical findings discordant with MRI findings)

[End Imaging Section.]

### 5. Additional Consults

[Begin Additional Consults section.]

[Section Prompt: Consider ordering the following consults in conjunction with the neurosurgery consult.]

[Section Selection Behavior: Optional. Select as many as desired.]

- ☐ Consult physical therapy to evaluate for conservative therapy for cervical radiculopathy (e.g., cervical halter traction, electrical stimulation, acupuncture, exercise instruction)
- ☐ Consult psychiatry to evaluate for depression and other psychological factors that may affect patient's perception of pain and ability to manage pain

- ☐ Consult social services to evaluate social factors (e.g., joblessness, homelessness, financial concerns) that may affect patient's ability to adhere to conservative treatment
- ☐ Consult pain management to address modalities for treating chronic pain

[End Additional Consults section.]

## 6. Patient Education

[Begin Patient Education section.]

[Section Prompt: Consider ordering patient education in conjunction with the neurosurgery consult.]

[Section Selection Behavior: Select any or none. Optional.]

- ☐ Cervical radiculopathy education (level-appropriate materials on natural progression, conservative management, and procedural management)

[End Patient Education section.]

[End Order Set.]

---

# Bibliography/Evidence

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# Appendix A. Appendix: Existing VA Artifacts

Figure A.1. Neurosurgery Consult

The image shows a screenshot of a software window titled "Neurosurgery" with a "Done" button in the top right corner. The window contains the following text:

**Emergent Consult:**  
1) Order consult and diagnostic tests.  
2) Page on-call Neurosurgery Resident.

**Routine Referral:**  
1) Order appropriate studies. (listed under each diagnosis)  
2) **Order consult when studies completed.**

**NOTE:**  
**It is essential that studies are completed prior to ordering a consult.**  
**Studies should be no more than 5-6 months old at the time patient is seen in Neurosurgery Clinic.**  
**Outside Imaging MUST BE sent to PVAMC Film Library.**

Consults...

**Figure A.2. Neurosurgery Spine Consults**

**Neurosurgery** Done

**Spine - Consults:**

- <<Traumatic fx/dislocations>>...
- <<Spondylolisthesis/Subluxation>>...
- <<Osteomyelitis>>...
- <<Neoplastic Spine>>....
- <<Cervical/Thoracic Radiculopathy>>...
- <<Cervical/Thoracic Myelopathy>>...
- <<Lumbar Radiculopathy>>...
- <<Lumbar Neurogenic Claudication>>...

<< E Consults >>

**NOTE: Studies must be done within 6 months of patient being seen in clinic.**

**Information Only:**

- <<Neck Pain>>...
- <<Low Back Pain>>...
- <<Frequently Asked Questions>>...

<<Clinical Practice Guidelines>>

**Cranial:**

- << AVM/ANEURYSM >>
- <<Chiari Malformation>>...
- << Trigeminal Neuralgia >>
- <<Intracranial Mass>>...
- <<Normal Pressure Hydrocephalus>>...

**Plastic Surgery:**

- <<Carpal Tunnel Syndrome>>...
- <<Ulnar Neuropathy>>...

**Carotid Stenosis:**

**Refer to Vascular Surgery or Neurology.**

Vascular Surgery...

Neurology...

**PADRECC OPTIONS: ONLY for PADRECC PROVIDERS**

- << DBS for Parkinsons Disease >>
- << DBS for Essential Tumor >>
- << Thalamotomy >>

**Figure A.3. Cervical/Thoracic Radiculopathy**

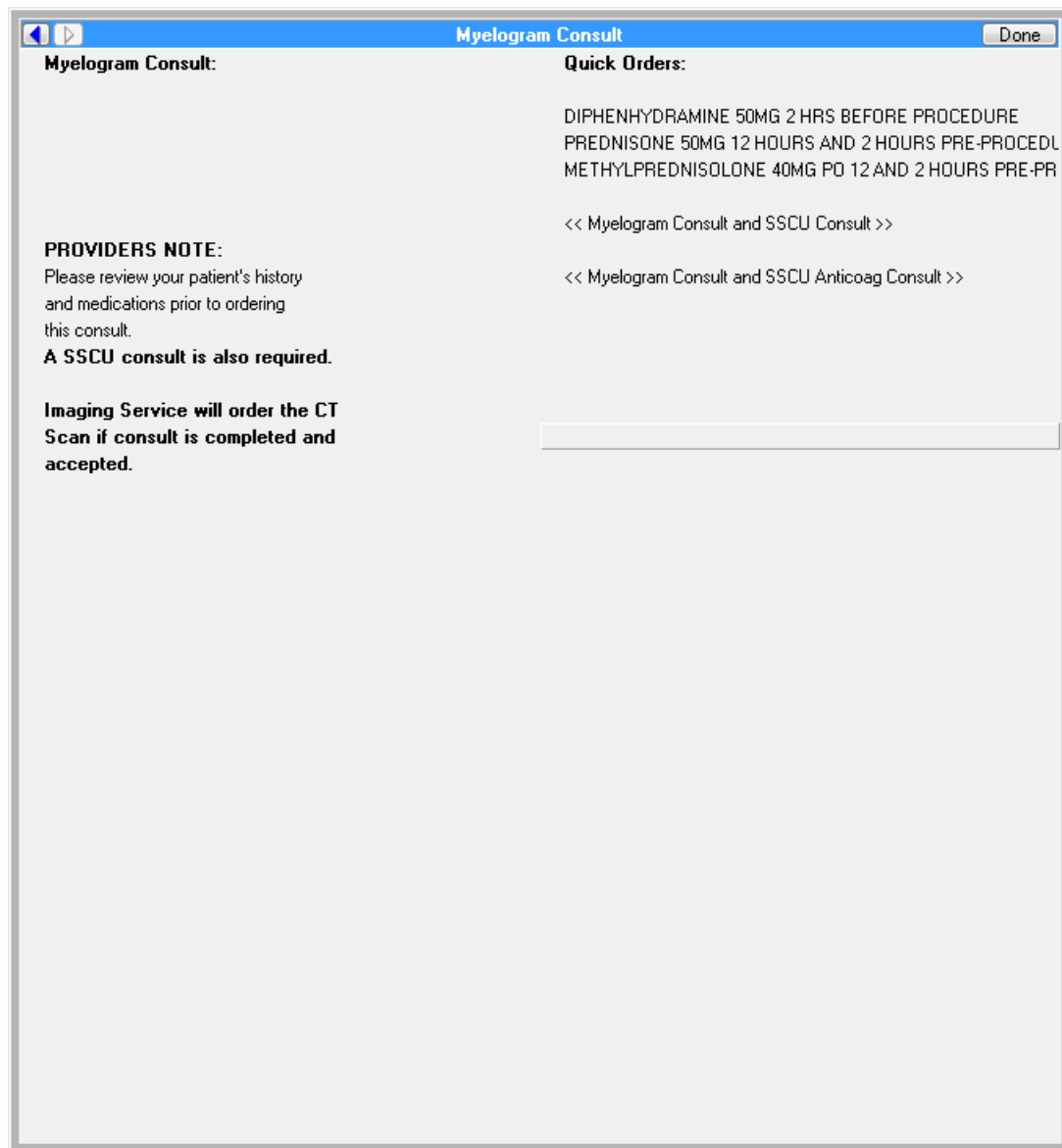
The screenshot shows a software window titled "Neurosurgery" with a "Done" button in the top right corner. The window is divided into two main sections. The left section, titled "Cervical/Thoracic Radiculopathy:", contains two sub-sections: "Urgency Criteria:" and "Required Tests/Treatments:". The "Urgency Criteria:" section lists two numbered items: 1) "Acute or rapidly progressing weakness should be considered urgent." with sub-points A) "Order diagnostic tests and consult." and B) "Page on-call Neurosurgery Resident."; 2) "Pain or sensory changes do not require an urgent consult." with sub-points A) "Order diagnostic studies. AFTER completion of studies order consult." and B) "Order Routine Consult.". The "Required Tests/Treatments:" section lists four numbered items: 1) "MRI or CT Myelogram done within 6 months AND POSITIVE for nerve root compression OR Foraminal Stenosis which correlate with symptoms. IF HX Foraminal Stenosis which correlate with symptoms. IF HX previous surgery order MRI w/wO contrast."; 2) "Documented detailed Physical Exam to include Neurological findings."; 3) "Documented PT for 6 weeks."; 4) "If patient is NOT interested in surgical intervention, REFER TO Chronic Pain.". The right section, titled "Quick Orders:", contains three lines of text: "<<MRI>>...", "Myelogram Consult", and "<< Neurosurgery Consult >>". Below these are two more lines: "<< Neurosurgery E-Consult >>" and "Northwest Pain Consult Menu". At the bottom of the right section is a "PROVIDERS NOTE:" section with the text: "To be a surgical candidate for an elective spine procedure BMI must be < 30."

Neurosurgery	
<b>Cervical/Thoracic Radiculopathy:</b>	<b>Quick Orders:</b>
<b>Urgency Criteria:</b>	<<MRI>>...
1) Acute or rapidly progressing weakness should be considered urgent.	Myelogram Consult
A) Order diagnostic tests and consult.	
B) Page on-call Neurosurgery Resident.	<< Neurosurgery Consult >>
2) Pain or sensory changes do not require an urgent consult.	<< Neurosurgery E-Consult >>
A) Order diagnostic studies. AFTER completion of studies order consult.	
B) Order Routine Consult.	Northwest Pain Consult Menu
<b>Required Tests/Treatments:</b>	<b>PROVIDERS NOTE:</b>
1) MRI or CT Myelogram done within 6 months AND POSITIVE for nerve root compression OR Foraminal Stenosis which correlate with symptoms. IF HX Foraminal Stenosis which correlate with symptoms. IF HX previous surgery order MRI w/wO contrast.	To be a surgical candidate for an elective spine procedure BMI must be < 30.
2) Documented detailed Physical Exam to include Neurological findings.	
3) Documented PT for 6 weeks.	
4) If patient is NOT interested in surgical intervention, REFER TO Chronic Pain.	





Figure A.5. Myelogram Consult



The window titled "Myelogram Consult" has a "Done" button in the top right corner. It is divided into two main sections: "Myelogram Consult:" on the left and "Quick Orders:" on the right.

**Myelogram Consult:**

**PROVIDERS NOTE:**  
Please review your patient's history and medications prior to ordering this consult.  
**A SSCU consult is also required.**

**Imaging Service will order the CT Scan if consult is completed and accepted.**

**Quick Orders:**

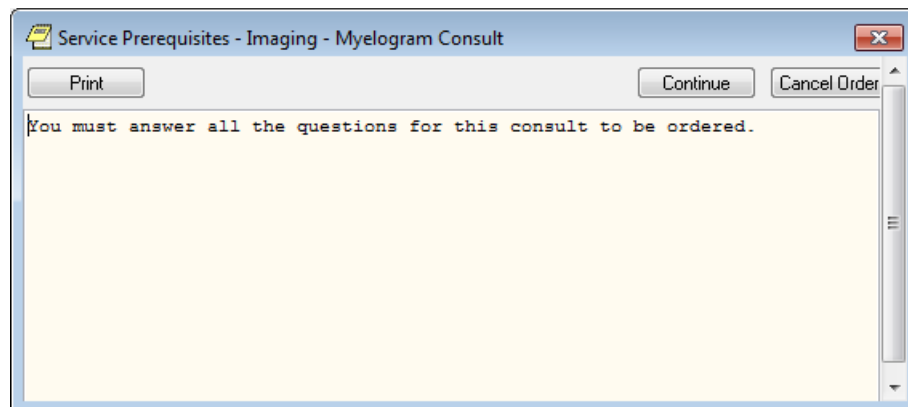
DIPHENHYDRAMINE 50MG 2 HRS BEFORE PROCEDURE  
PREDNISONE 50MG 12 HOURS AND 2 HOURS PRE-PROCEDL  
METHYLPREDNISOLONE 40MG PO 12 AND 2 HOURS PRE-PR

<< Myelogram Consult and SSCU Consult >>

<< Myelogram Consult and SSCU Anticoag Consult >>

Below the "Quick Orders" section is a horizontal line and a large empty rectangular area for additional notes or orders.

Figure A.6. Service Prerequisites for Imaging Myelogram Consult



The window titled "Service Prerequisites - Imaging - Myelogram Consult" has a "Print" button on the left and "Continue" and "Cancel Order" buttons on the right. The main area contains a text box with the message: "You must answer all the questions for this consult to be ordered."

**Figure A.7. Reason For Request Myelogram**

Reason for Request: Imaging - Myelogram Consult

Consult requested: Myelogram

- Does patient have a previous history of contrast reaction, (even mild): \* ☒ Yes ☐ No  
If yes, prescribe:  
1) Methylprednisilone 40mg (or 50mg prednisone) PO as 12hrs and 2hrs before the procedure.  
2) Diphenhydramine (Benadryl) 50mg PO 2hrs before the procedure
- Is Patient on Glucophage for diabetes: \* ☒ Yes ☐ No  
Rare risk of lactic acidosis following renal failure.  
If yes, consider discontinuing it the morning of the procedure and for 48hrs following the procedure.
- Is Patient on drugs that lower the seizure threshold: \* ☒ Yes ☐ No  
Tricyclic antidepressants: DISCONTINUE for two weeks before the myelogram.  
These include Elavil, Endep, Etrafon, Limbitrol, Ludiomil, Norpramin, Pamelor, Sindquan, Surmontil, Tofranil, Triavil, Vivactil.

The following need to be stopped before the procedure (length to be determined by referring physician):  
PHENOTHIAZINES (chlorpromazine, prochlorperazine, perphenazine, thioridazine).  
ANTIPSYCHOTICS (thiothixene, haloperidol, droperidol).  
CNS stimulants (methylphenidate, ephedrine, pseudoephedrine).  
MAO INHIBITORS (tranylcypromine, procarbazine).  
Others (lithium, reserpine, isoniazid).

- I have read the above med lists and have reviewed the patient's current medications: \* ☒ Yes ☐ No
- Area: \*  
☐ C - SPINE  
☐ L - SPINE  
☐ T - SPINE
- Reason for Request: \*

\* Indicates a Required Field      Preview      OK      Cancel

Figure A.8. Reason for Request Imaging Myelogram Consult

Reason for Request: Imaging - Myelogram Consult

Even mild - ☐ Yes ☒ No

If yes, prescribe:

- 1) Methylprednisilone 40mg (or 50mg prednisone) PO as 12hrs and 2hrs before the procedure.
- 2) Diphenhydramine (Benadryl) 50mg PO 2hrs before the procedure

2) Is Patient on Glucophage for diabetes: \* ☒ Yes ☐ No

Rare risk of lactic acidosis following renal failure.  
If yes, consider discontinuing it the morning of the procedure and for 48hrs following the procedure.

3) Is Patient on drugs that lower the seizure threshold: \* ☒ Yes ☐ No

Tricyclic antidepressants: DISCONTINUE for two weeks before the myelogram.  
These include Elavil, Endep, Etrafon, Limbitrol, Ludiomil, Norpramin, Pamelor, Sindquan, Surmontil, Tofranil, Triavil, Vivactil.

The following need to be stopped before the procedure (length to be determined by referring physician):  
PHENOTHIAZINES (chlorpromazine, prochlorperazine, perphenazine, thioridazine).  
ANTIPSYCHOTICS (thiothixene, haloperidol, droperidol).  
CNS stimulants (methylphenidate, ephedrine, pseudoephedrine).  
MAO INHIBITORS (tranlycypromine, procarbazine).  
Others (lithium, reserpine, isoniazid).

4) I have read the above med lists and have reviewed the patient's current medications: \* ☒ Yes ☐ No

5) Area: \*

☐ C - SPINE  
☐ L - SPINE  
☐ T - SPINE

6) Reason for Request: \*

Please enter your pager and phone number where you can be reached in the event there is a critical finding.  
Pager: \*  
Phone: \*

\* Indicates a Required Field

Preview OK Cancel

**Figure A.9. Reason for Request Short Stay Unit**

Reason for Request: Short Stay Care Unit

Consult requested: SSCU - Post Myelogram

Admit patient to SSCU:

Requested date:  Service:

1) Injection time was at:

2) Record VS in CPRS and on SSCU flow sheet upon arrival to unit.

3) Monitor VS every 15 minutes X 2, then every hour X 2 and at discharge.

4) Diet:

- ☐ Clear liquids
- ☐ Nothing per mouth
- ☐ No diet restrictions
- ☐ Regular diet, force fluids
- ☐ As tolerated
- ☐ Other -

5) Activity: \*

- ☐ No restrictions
- ☐ Bedrest
- ☐ Bedrest with bathroom privileges
- ☐ Elevate HOB 30 degrees or more

6) Call MD for persistent Nausea and Vomiting.

7) Discharge home after 3.5 hours post injection. VS @ baseline and discharge criteria is met per SSCU Operating policy.

8) Review and send written Discharge instructions with patient. Encourage slow movements for 24 hours.

Please enter any additional comments or information below:

\* Indicates a Required Field

Preview OK Cancel

**Figure A.10. Order Consult Myelogram**

The screenshot shows a software window titled "Order a Consult" with a close button in the top right corner. The window is divided into several sections:

- Consult to Service/Specialty:** A list box containing "Imaging - Myelogram Consult", which is currently selected and highlighted in blue.
- Urgency:** A dropdown menu set to "ROUTINE".
- Attention:** An empty dropdown menu.
- Clinically indicated date:** A text input field with a calendar icon.
- Patient will be seen as an:** Radio buttons for "Inpatient" and "Outpatient", with "Outpatient" selected.
- Place of Consultation:** A dropdown menu set to "CONSULTANT'S CHOICE".
- Provisional Diagnosis:** A text input field with a "Lexicon" button next to it.
- Reason for Request (not editable):** A large text area with a yellow background containing the following text:

```
Consult requested: Myelogram  
  
1) Does patient have a previous history of contrast reaction,  
   (even mild):Yes  
  
2) Is Patient on Glucophage for diabetes: Yes  
  
3) Is Patient on drugs that lower the seizure threshold: Yes  
  
...
```
- Summary:** A text box at the bottom left showing "Imaging - Myelogram Consult Cons CONSULTANT'S CHOICE".
- Buttons:** "Accept Order" and "Quit" buttons at the bottom right.

Figure A.11. Short Stay Orders

Reason for Request: Short Stay Care Unit

Consult requested: SSCU - Post Myelogram

Admit patient to SSCU:

Requested date:  ... Service:

1) Injection time was at:  ...

2) Record VS in CPRS and on SSCU flow sheet upon arrival to unit.

3) Monitor VS every 15 minutes X 2, then every hour X 2 and at discharge.

4) Diet:

- ☐ Clear liquids
- ☐ Nothing per mouth
- ☐ No diet restrictions
- ☐ Regular diet, force fluids
- ☐ As tolerated
- ☐ Other -

5) Activity: \*

- ☐ No restrictions
- ☐ Bedrest
- ☐ Bedrest with bathroom privileges
- ☐ Elevate HOB 30 degrees or more

6) Call MD for persistent Nausea and Vomiting.

7) Discharge home after 3.5 hours post injection. VS @ baseline and discharge criteria is met per SSCU Operating policy.

8) Review and send written Discharge instructions with patient. Encourage slow movements for 24 hours.

Please enter any additional comments or information below:

\* Indicates a Required Field

Preview OK Cancel

**Figure A.12. Short Stay Care Unit Consult**

**Order a Consult**

Consult to Service/Specialty  
Short Stay Care Unit

Urgency: ROUTINE

Attention:

Clinically indicated date:

Patient will be seen as an:  
☐ Inpatient ☒ Outpatient

Place of Consultation: CONSULTANT'S CHOICE

Provisional Dx (REQUIRED)

Reason for Request  
Consult requested: SSCU - Post Myelogram  
Admit patient to SSCU:  
Requested date: Mar 14,2017 Service: CARDIOLOGY  
1) Injection time was at: Mar 14,2017  
2) Record VS in CPRS and on SSCU flow sheet upon arrival to unit.  
3) Monitor VS every 15 minutes X 2, then every hour X 2 and at discharge.  
4) Diet: Clear liquids  
Short Stay Care Unit Cons CONSULTANT'S CHOICE

Accept Order Quit

**Figure A.13. Service Prerequisite Questions**

**Service Prerequisites - Imaging - Myelogram Consult**

Print Continue Cancel Order

You must answer all the questions for this consult to be ordered.

**Figure A.14. Cervical/Thoracic Myelogram, Urgency Criteria and Required Tests**

**Neurosurgery** Done

**Cervical/Thoracic Myelopathy:**

**Urgency Criteria:**

- 1) Acute or rapidly progressing weakness should be considered urgent.
- A) Order diagnostic tests and consult.
- B) Page on-call Neurosurgery Resident.
- 2) Pain or sensory changes do not require an urgent consult.

**Required Tests:**

- ...MRI or CT Myelogram within 6 months.
- ...positive for cervical or thoracic central canal stenosis.
- ...Ensure that outside studies come with patient.

**Quick Orders:**

- <<MRI>>...
- <<Myelogram>>...
- << Neurosurgery Consult >>
- << Neurosurgery E-Consult >>

**PROVIDERS NOTE:**

To be a surgical candidate for an elective spine procedure BMI must be < 30.

**Figure A.15. The Neurosurgery Service Prerequisites Cervical/Thoracic Myelopathy Outpatient**

Service Prerequisites - Neurosurgery - Cervical/Thoracic Myelopathy Outpt

Print Continue Cancel Order

EXCEPT FOR SITUATIONS INVOLVING ACUTE ONSET WEAKNESS, PLEASE HAVE PATIENTS OPTIMIZE CONSERVATIVE THERAPIES (PHYSICAL THERAPY, NSAID REVIEW OF CLINICAL PRACTICE GUIDELINES MAY BE HELPFUL.

Thank you!

The Neurosurgery Team.



**Figure A.16. Neurosurgery Consult Cervical/Thoracic Myelopathy**

Template: Neurosurgery - Cervical/Thoracic Myelopathy

Choose from the following options:

☐ Required Pre-requisite Tests have been completed. ...

☐ Required Pre-requisite Tests have not been completed. ...

All None \* Indicates a Required Field Preview OK Cancel

**Figure A.17. Neurosurgery Consult Goals for Cervical/Thoracic Myelopathy**

Template: Neurosurgery - Cervical/Thoracic Myelopathy

Required Pre-requisite Tests have been completed.  
Would you please provide your Recommendations

☐ and return to PCP for therapy.

☐ start treatment and return to PCP for follow up and maintenance.

☐ start treatment, monitor for effect and when on stable therapy return to PCP.

☐ and treat as long as necessary (or indefinitely).

1) Description of symptoms and Physical Exam findings: \*

2) MRI Results: \*

Date and place images done: \*

3) Is patient interested in surgical intervention: \* ☐ Yes ☐ No

Please enter any additional comments or information below:

\* Indicates a Required Field

Preview OK Cancel

Figure A.18. Neurosurgery Consult Order

**Order a Consult**

Consult to Service/Specialty  
Neurosurgery - Cervical/Thoracic Myelopathy Outpt

Urgency: **ROUTINE**

Attention:

Clinically indicated date:

Patient will be seen as an:  
☐ Inpatient ☒ Outpatient

Place of Consultation: **CONSULTANT'S CHOICE**

Provisional Diagnosis:

Reason for Request (not editable)

Required Pre-requisite Tests have been completed.  
Would you please provide your Recommendations  
start treatment, monitor for effect and when on stable therapy return to PCP.

1) Description of symptoms and Physical Exam findings: test

2) MRI Results: test  
Date and place images done: test

3) Is patient interested in surgical intervention: Yes

Neurosurgery - Cervical/Thoracic Myelopathy Outpt Cons **CONSULTANT'S CHOICE**

Figure A.19. Neurosurgery Consult Request, Pre-requisite Tests not Completed

**Order a Consult**

Consult to Service/Specialty  
Neurosurgery - Cervical/Thoracic Myelopathy Outpt

Urgency: **ROUTINE**

Attention:

Clinically indicated date:

Patient will be seen as an:  
☐ Inpatient ☒ Outpatient

Place of Consultation: **CONSULTANT'S CHOICE**

Provisional Diagnosis:

Reason for Request (not editable)

Required Pre-requisite Tests have not been completed.  
If Tests have not been done a Neurosurgery Consult is not  
appropriate. If you have questions please order a Non Visit  
Consult and clearly explain issues.

Neurosurgery - Cervical/Thoracic Myelopathy Outpt Cons **CONSULTANT'S CHOICE**

**Figure A.20. Neurosurgery Consult Request**

Template: NEUROSURGERY CERVICAL SPINE OUTPT - WLA

☒ <<--- CLICK HERE TO START CONSULT REQUEST

\*\*\*\*\*

ZZTEST,A PATIENT GRACE 4399 77 Y/O FEMALE

SERVICE CONNECTED % - NONE FOUND

RATED DISABILITIES - NONE FOUND

-

\*\*\*\*\*

NEUROSURGERY CERVICAL DISEASE

For urgent request, please page the service: [Pager info link](#)

If clinically appropriate, this consult may be responded to using chart review (E-Consult).

\*\*\*Please note: Your consult WILL BE DENIED if this patient does not have relevant imaging within 1 year of your consult request. All outside images MUST be uploaded into our Vista Imaging/IMPAX system before submitting your request. This helps us screen patients and determine whether or not they would benefit from surgical intervention \*\*\*

☐ Cervical Stenosis

☐ Cervical Disc Disease

All None \* Indicates a Required Field Preview OK Cancel

Figure A.21. Neurosurgery Consult Request

Template: NEUROSURGERY CERVICAL SPINE OUTPT - WLA

ZZTEST,A PATIENT GRACE 4399 77 Y/O FEMALE  
 SERVICE CONNECTED % - NONE FOUND  
 RATED DISABILITIES - NONE FOUND  
 -  
 \*\*\*\*\*  
 NEUROSURGERY CERVICAL DISEASE  
 For urgent request, please page the service: [Pager info link](#)

If clinically appropriate, this consult may be responded to using chart review (E-Consult).

\*\*\*Please note: Your consult WILL BE DENIED if this patient does not have relevant imaging within 1 year of your consult request. All outside images MUST be uploaded into our Vista Imaging/IMPAX system before submitting your request. This helps us screen patients and determine whether or not they would benefit from surgical intervention \*\*\*

☒ Cervical Stenosis

☐ <====CLICK HERE TO CONTINUE

ALL are generally required to warrant neurosurgery:

1. Has an MRI without contrast (or a CT myelogram if contraindicated) been completed within 1 year of this consult request? \*☒ Yes ☐ No
2. History of tripping, falling, clumsiness, bladder and/or bowel incontinence, numbness of fingertips, and/or loss of fine motor control of the fingers. \*☒ Yes ☐ No  
 (Note: If new onset bladder/bowel incontinence (patient has lost the ability to sense the urge to urinate or defecate) or new/sudden onset weakness, please send patient to the Emergency Dept for immediate evaluation).
3. Patient agrees to surgical intervention, if appropriate. \*☒ Yes ☐ No  
 - If no, please do not refer this patient to our clinic unless there is evidence of spinal cord compression on MRI (consult PM&RS instead for conservative management)

Additional history and rationale for request:  
 \*

☐ Cervical Disc Disease

All None \* Indicates a Required Field Preview OK Cancel

Figure A.22. Neurosurgery Consult Request

Template: NEUROSURGERY CERVICAL SPINE OUTPT - WLA

RATED DISABILITIES - NONE FOUND

NEUROSURGERY CERVICAL DISEASE

For urgent request, please page the service: [Pager info link](#)

If clinically appropriate, this consult may be responded to using chart review (E-Consult).

\*\*\*Please note: Your consult WILL BE DENIED if this patient does not have relevant imaging within 1 year of your consult request. All outside images MUST be uploaded into our Vista Imaging/IMPAX system before submitting your request. This helps us screen patients and determine whether or not they would benefit from surgical intervention \*\*\*

☐ Cervical Stenosis

☒ Cervical Disc Disease

☐ <====CLICK HERE TO CONTINUE

ALL are generally required to warrant neurosurgery:

1. Has an MRI without contrast (or a CT myelogram if contraindicated) been completed within 1 year of this consult request? \*☐ Yes ☐ No
2. Has this patient had an epidural steroid injection? \*☐ Yes ☐ No
  - If yes, please provide the date:
  - If no, please consult interventional pain management prior to consulting neurosurgery (consults/procedure order menu-->WLA consults -->pain consults WLA-->interventional pain clinic)  
(The majority of herniated discs do NOT require surgery and can improve significantly with an epidural steroid injection).
3. Patient agrees to surgical intervention, if appropriate. \*☐ Yes ☐ No
  - If no, please do not refer this patient to our clinic (consult PM&RS instead for conservative management)
4. Does the patient have radiculopathy in a specific dermatomal distribution? \*☐ Yes ☐ No

Additional history and rationale for request:

\*

All None \* Indicates a Required Field Preview OK Cancel

Figure A.23. Service Prerequisites for Myelogram Consult

Service Prerequisites - Imaging - Myelogram Consult

Print Continue Cancel Order

You must answer all the questions for this consult to be ordered.

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## Appendix B. Acronyms

Acronym	Definition
AP	Anteroposterior
BMI	Body Mass Index
CDS	Clinical Decision Support
CKD	Chronic Kidney Disease
COX-2	Cyclo-oxygenase-2
CT	Computed Tomography
HL7	Health Level 7
IV	Intravenous
KBS	Knowledge Based Systems
KNART	Knowledge Artifact
MRI	Magnetic Resonance Imaging
NSAID	Nonsteroidal anti-inflammatory drug
OIIG	Office of Informatics and Information Governance
SME	Subject Matter Expert
TO	Task Order
VA	Department of Veterans Affairs