

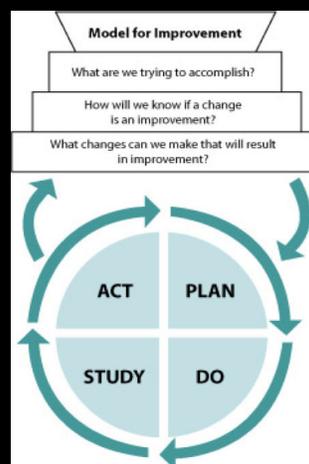
Implementing a Standardized Radiograph and MRI Reporting System for Suspected Pedal Osteomyelitis

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GIVING LIFE TO POSSIBLE

Our project utilized the Institute for Healthcare Improvement methodology



IHI.org

What are we trying to accomplish?

Improve underlying issues with the appropriate imaging and reporting of pedal osteomyelitis

- Ambiguous reports
- Confusion among ordering clinicians
- Poorly defined extent of disease
- Inconsistent and non evidence-based recommendations

How will we know if a change is an improvement?

- Intradepartmental compliancy
- Survey feedback from ordering clinicians

What changes can we make that will result in an improvement?

- Map recommendations to the clinical treatment algorithm
- Standardize report impressions, terminology, and protocols.
- Eliminate ambiguous terminology
- Provide definitive, actionable recommendations

PLAN – Research

**ACR Appropriateness
Criteria**

**Meeting with other
Stakeholders**

2012 Infectious Diseases Society of America
Clinical Practice Guideline for the Diagnosis
and Treatment of Diabetic Foot Infections

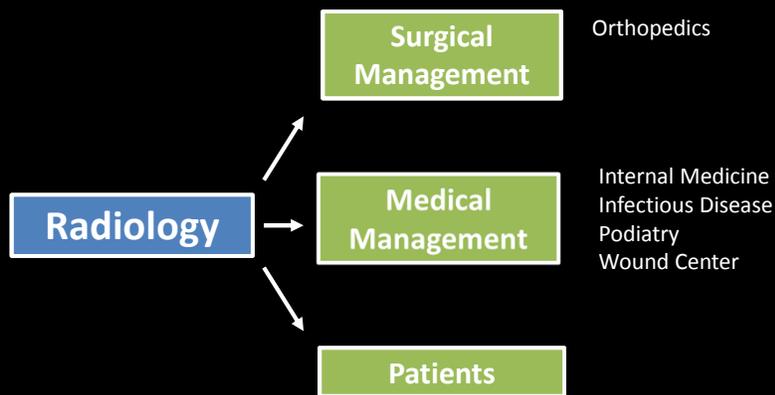
**Interdepartmental
Research and Planning**

PLAN – Research

ACR Appropriateness Criteria

Clinical Condition:		Suspected Osteomyelitis of the Foot in Patients with Diabetes Mellitus	
Variant 3:		Soft-tissue swelling without neuropathic arthropathy with ulcer.	
Radiologic Procedure	Rating	Comments	RRL*
X-ray foot	9	Initial study. Radiographs and MRI are complementary, and both are indicated. The results of initial x-ray examination do not preclude the necessity for additional studies.	☼
MRI foot without and with contrast	9	Radiographs and MRI are complementary, and both are indicated. MRI is useful preoperatively to identify the extent of involvement and to map devitalized areas. See statement regarding contrast in text under "Anticipated Exceptions."	O
MRI foot without contrast	9	Radiographs and MRI are complementary, and both are indicated.	O
Labeled leukocyte scan foot (In-111 or Tc-99m)	3	May be appropriate in certain circumstances such as if MRI is contraindicated or unavailable.	☼☼☼☼
Tc-99m 3-phase bone scan and labeled leukocyte scan (In-111 or Tc-99m) foot	1		☼☼☼☼
Tc-99m 3-phase bone scan foot	1		☼☼☼

PLAN - Stakeholders



PLAN – Design

Radiography

Standardize radiograph impressions to improve treatment and ordering patterns.

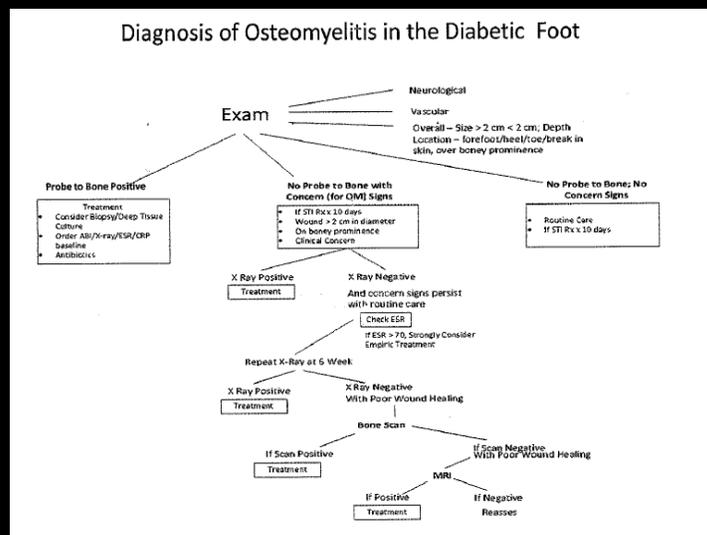
Hard recommendations implemented into every impression

MRI

MRI impression construct includes four categories based upon the suspicion for osteomyelitis.

- Normal
- Low Suspicion
- High Suspicion
- Compatible with Osteomyelitis

PLAN - Previous Treatment Algorithm



DO – Implement changes

Standardized Radiograph Impressions and Recommendations

Negative Radiograph

"No radiographic evidence of osteomyelitis. If clinical signs of osteomyelitis persist with routine care, recommend repeat radiographs in 6 weeks."



Follow-up Negative

"No radiographic evidence of osteomyelitis. In the setting of poor wound healing, recommend MRI of the (forefoot/midfoot/hindfoot/foot) WITH and WITHOUT contrast for a more sensitive evaluation."

Positive

"Radiographic findings compatible with osteomyelitis. A MRI of the (forefoot/midfoot/hindfoot/foot) WITH and WITHOUT contrast would provide additional information regarding the extent of the osteomyelitis."

DO – Implement changes

Revised MRI Classification of Suspected Pedal Osteomyelitis

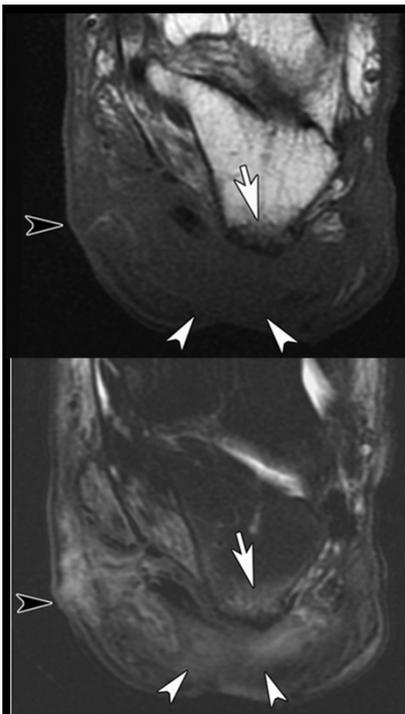
Classification	T1 Signal	Secondary Sign
Normal	Normal	Absent
Low Suspicion	Reticular Nonconfluent	Absent
High Suspicion	Reticular Nonconfluent	Present (ulcer, abscess, sinus track)
Compatible with Osteomyelitis	Reticular Confluent	Present (ulcer, abscess, sinus track)



Low suspicion

- Nonconfluent, reticular, hypointense T1 signal
- No secondary signs (ulcer, abscess, sinus tract)

Liu PT, Dorsey ML. MRI of the foot for suspected osteomyelitis: improving radiology reports for orthopaedic surgeons. *Semin Musculoskelet Radiol.* 2007;11(1):28-35.



High suspicion

- Nonconfluent, reticular, hypointense T1 signal
- Secondary sign present (ulcer, abscess, sinus tract)

Donovan A, Schweitzer ME. Use of MR imaging in diagnosing diabetes-related pedal osteomyelitis. *Radiographics.* 2010;30(3):723-36.

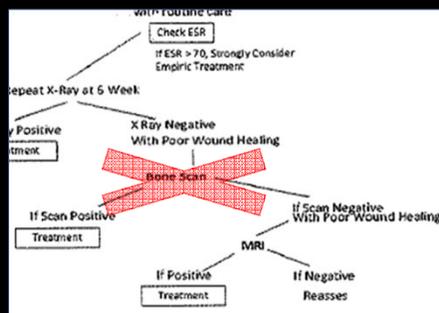


Compatible with Osteomyelitis

- Abnormal, low signal which is CONFLUENT
- Secondary sign present (ulcer, abscess, sinus tract)

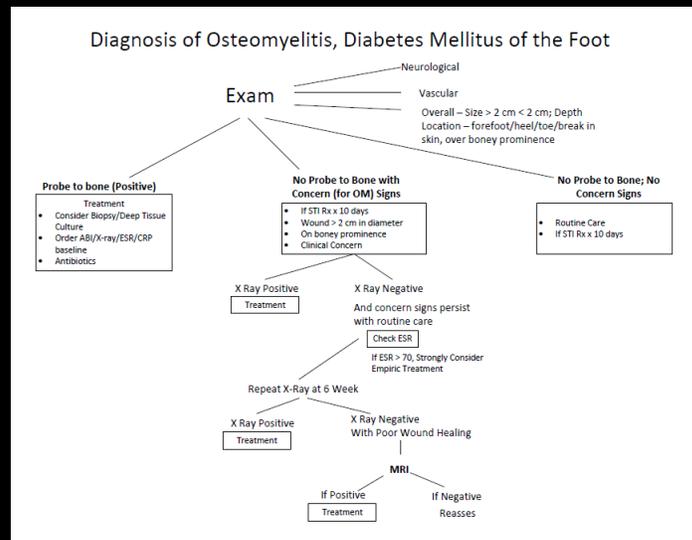
Liu PT, Dorsey ML. MRI of the foot for suspected osteomyelitis: improving radiology reports for orthopaedic surgeons. *Semin Musculoskelet Radiol.* 2007;11(1):28-35.

DO – Appropriateness of Recommendations



- Before implementation nuclear medicine scans were frequently recommended (15% of initial radiographs)
- The literature and appropriateness criteria only supports these studies in very limited circumstances.
- Evidence-based changes were made to the clinical treatment algorithm.
- Imaging recommendations were mapped to the revised algorithm

DO – Revised Treatment Algorithm



DO – Implement changes

- An oral presentation of changes was given to the radiology residents
- Hard copies of this information and templates were posted by each ER and MSK workstation
- Electronic copies were placed in PACS and on the residency website (blackboard.org)

STUDY – Measure Results

- For both MRI and radiography studies were compared before and after changes were implemented
- Studies were first filtered within PACS using the search term: “osteomyelitis”
- Forty studies from before and after implementation were chosen at random within a 3 month time interval

STUDY – Measure Results

- Internal
 - Template Compliancy
 - Appropriateness of recommendations
- External
 - Ordering clinician satisfaction survey

STUDY – MRI Compliancy Results

- For a report to be considered compliant:
 - Utilizes one of the department MRI templates
 - Impression includes probability of disease based on our construct.
 - Clearly defines extent of disease
- **Compliancy – 90%**
 - Only staffed by MSK section attendings

STUDY – Radiograph Compliancy Results

- For a report to be considered compliant:
 - Utilizes one of the department templates
 - Impression includes appropriate recommendation
- Total Compliancy – 36%
- MSK section compliancy – 73%
- Non-MSK section compliancy – 27%

STUDY – Survey Results

- Surveys were distributed to ordering attending physicians.
- Sample size – 10.
 - Response rate greater than 50%
- Survey consisted of 4 multiple choice questions and an additional comment field
- Each question used a five-level Likert scale

STUDY – Survey Results

Questions standardized into a five-level Likert scale

1. Clarity of radiograph and MRI reports:
 - Anchors: Always unclear to Always clear
 - Before: **2.8**
 - After: **3.6**
2. Confidence in the Diagnosis based on the imaging impression:
 - Anchors: Not confident at all to Always confident
 - Before: **3.1**
 - After: **3.9**
3. How often is there a need to clarify an impression?
 - Anchors: Never to Always
 - Before: **3.0**
 - Always: **3.8**
4. Overall satisfaction with pedal osteomyelitis improvement project:
 - Anchors: Very unsatisfied to Very satisfied
 - Before: **3**
 - After: **3.9**

STUDY – Survey Results

Examples of specific comments:

“The standardization has vastly improved my confidence in the radiograph reports. The issue was never about the MRI reports, but about when to order an MRI.”

“Since implementation the need for MRI's ordering has gone down and the confidence that an MRI does or does not need to be ordered has gone up.”

“This has reduced the cost of healthcare treatment”

STUDY - Radiograph Compliancy

	Pre-implementation	Post-implementation
Ambiguous reports	27.5%	10%
Hard recommendations	5%	25%
Soft recommendations	37.5%	15%
MSK staff compliancy	na	73%
Non-MSK staff compliancy	na	27%
Total staff compliancy	na	36%

STUDY - Assess Internal Results

MRI compliancy likely superior to xrays due to a smaller cohort reading those studies.

- MSK section – 3 members in section
 - (73% compliancy)
- Other staff – 14 members in cohort
 - (27% compliancy)

Prioritize compliancy in the next improvement cycle, especially among non-MSK staff.

ACT – Next Cycle, CQI

- Discussion for a system-wide implementation is already underway
- Increase compliancy of standardized impressions, especially among non-MSK staff
- Add recommendations for the setting of potential osteomyelitis with coexisting neuropathic arthropathy.
- Improve ordering within the electronic medical record.
 - The chief of infectious disease recommends the addition of discrete fields for diabetes, presence of skin defect, peripheral vascular disease, etc

Summary

This project demonstrates that when standardized impressions and recommendations are mapped to a clinical treatment algorithm, radiologists have the opportunity to lead quality improvement at the interdepartmental and system-wide levels.

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