

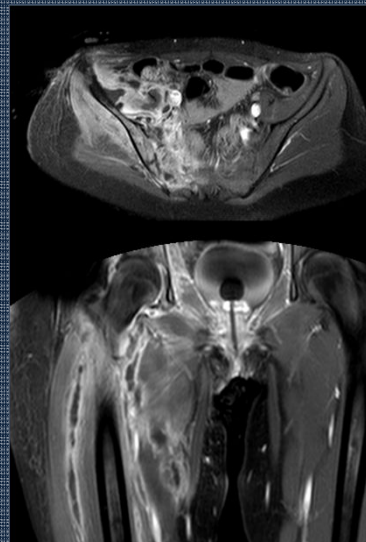
MULTI-DISCIPLINARY GUIDELINE RESULTS IN IMPROVED MAGNETIC RESONANCE IMAGING UTILIZATION FOR CHILDREN WITH MUSCULOSKELETAL INFECTION

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(worst) Case scenario

- 15 year-old female with pain, fevers, chills, leukocytosis
- Time from triage to MRI: 42 hours
- Scan duration: 4 hours, 24 minutes
- # of sequences: 13
- Initial surgery on hospital day #4
- Ultimately required 3 surgeries and prolonged hospitalization
- Final diagnosis: right iliac osteomyelitis; right pelvic abscess and pyomyositis; right hip septic arthritis; right thigh abscess



Mission statement

- Improve magnetic resonance imaging (MRI) utilization for children evaluated for musculoskeletal infection following implementation of a guideline for sedated imaging focused on the processes of ordering, interpreting, and responding to the results of the MRI.

Background

- The evaluation and treatment of children suspected to have musculoskeletal infection (MSI) is a complex multi-disciplinary process that relies on MRI with sedation for diagnostic accuracy and consistency of treatment. A multi-disciplinary guideline and continuous process improvement were instituted at a tertiary pediatric medical center, resulting in improved clinical, process, and patient safety outcomes based on
 - Scan duration
 - Number of anatomic regions imaged
 - Number of MRI sequences performed
 - Timing of surgical intervention (single anesthesia from magnet to operating room)
 - Length of hospitalization (LOS)
 - Readmission rate

Background: Key quality drivers in MSI

■ Efficiency and Accuracy of Diagnosis

- Sedated MRI (allow for less motion-related artifact)
- Proper microbiologic culture acquisition

■ Consistency and Efficacy of the Treatment

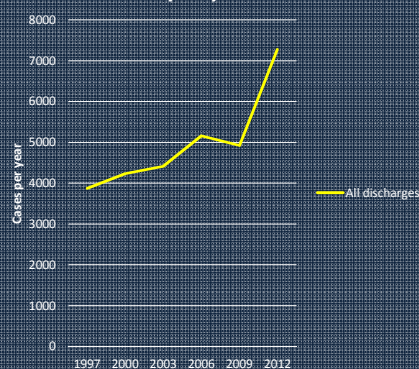
- Appropriate selection and timing of antibiotic
- Definitive surgery when indicated

■ Satisfaction (Child and Parents)

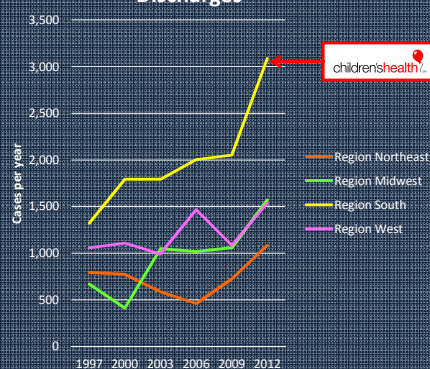
- Patient and family centered care
- Interdisciplinary communication

Background: Increasing volume of MSI

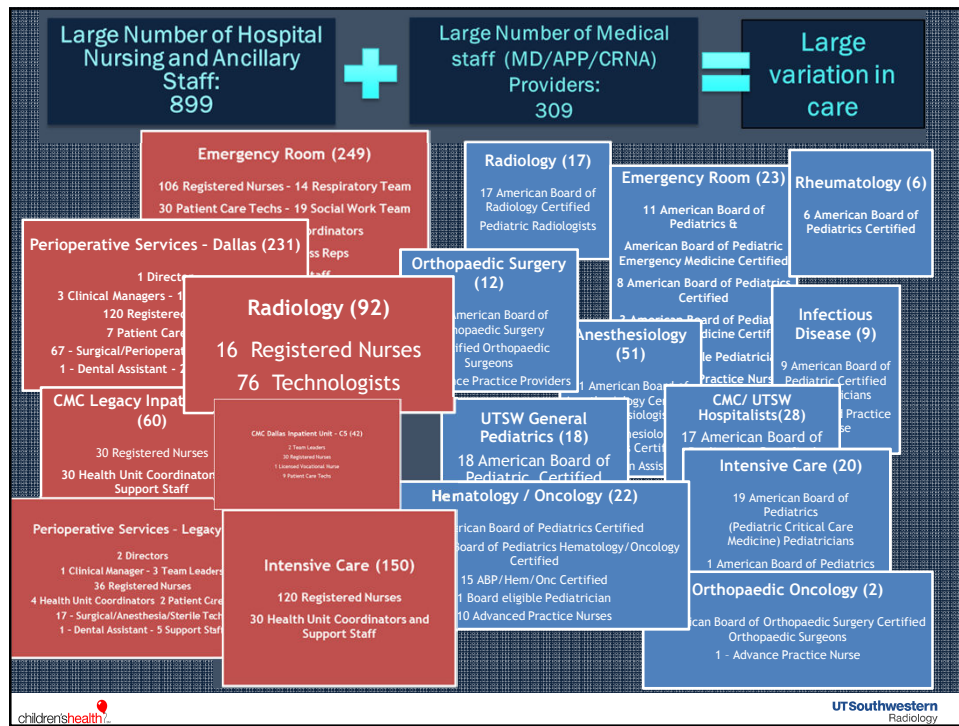
Growing Problem Nationally:
Osteomyelitis, Septic Arthritis,
Pyomyositis



Growing Problem Locally:
Regional Variation in MSI
Discharges

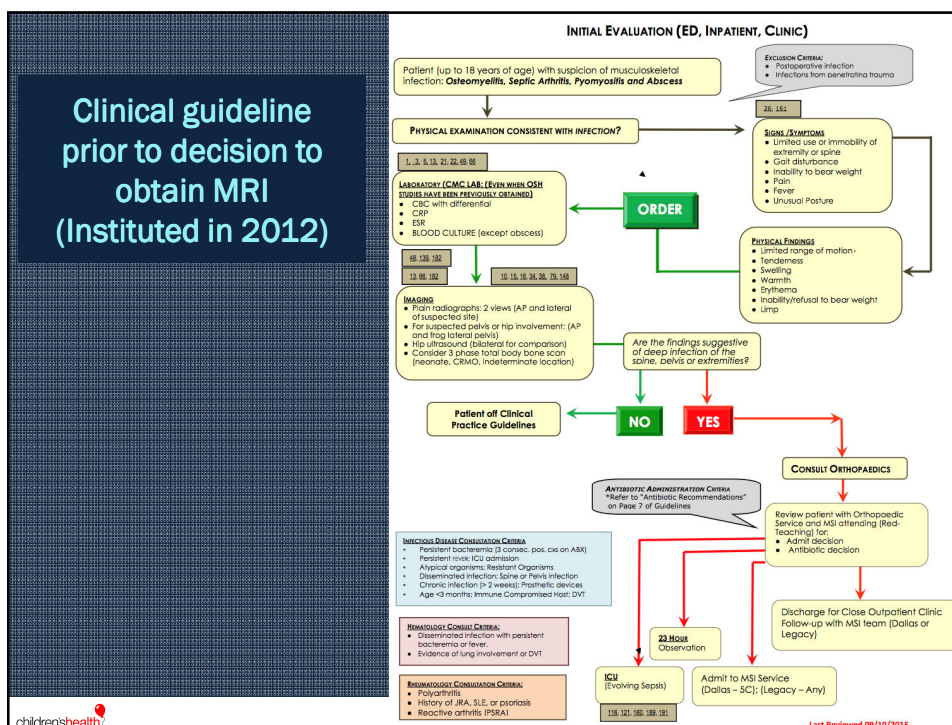
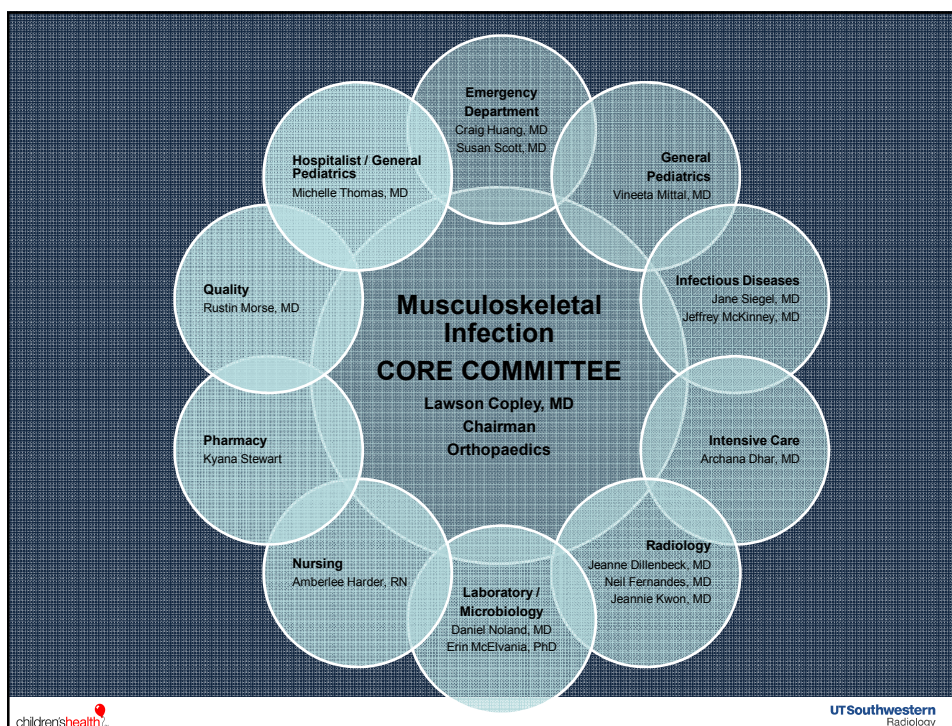


* reference: HCUPnet Kid Database 1997-2012

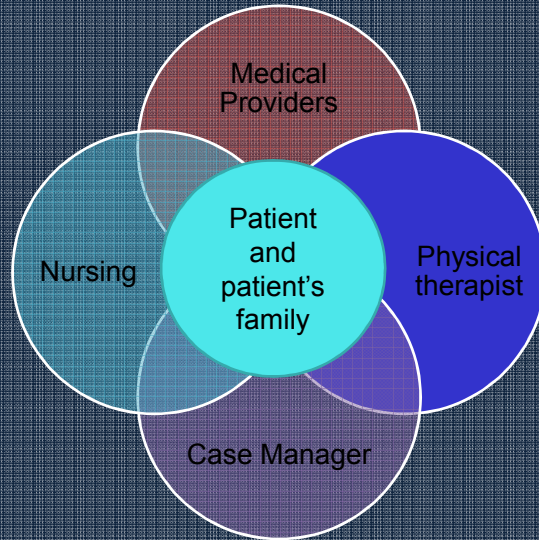


Single institutional experience: 2003-2015

- 1500 - Osteomyelitis, septic arthritis, pyomyositis
- 450 - Abscesses requiring surgical drainage
- 2600 - Evaluations of conditions related to MSI
- Guideline instituted in 2012
- Pre-guideline data from 2009
- Initial post-guideline data from July 2012-2013
- Subsequent post-guideline data from 2014



Family-centered multi-disciplinary evaluation



Family-centered multi-disciplinary evaluation

■ Care Progression Huddles (2012-2015)

■ Rounding events (667)

■ Attendance

- General Pediatrics – 95%
- Infectious Disease – 95%
- Nurse – 95%
- Case Manager – 85%
- Orthopedics – 95%
- Parents – 91%

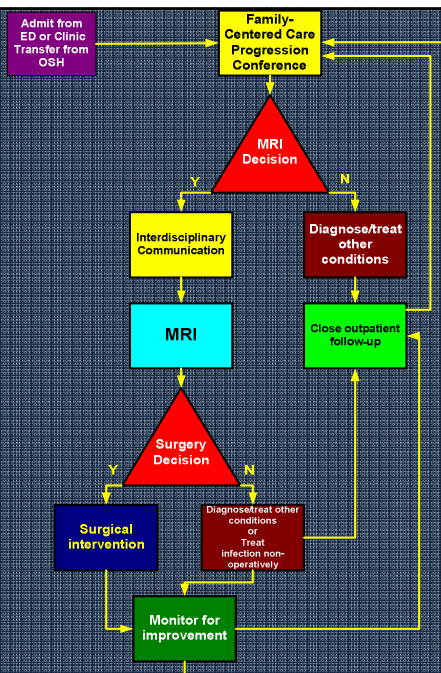


Inter-disciplinary Emphasis on communication

- Care progression huddles (2012-2015)
 - Meeting with family multi-disciplinary care team and patient family
 - Discussion regarding patient's condition, medical options, shared treatment decision-making. Average time: ten minutes per family per day
- Inter-disciplinary communication
 - Orthopedics/Radiology: Discuss level of clinical suspicion; precise anatomic focus for tailored field-of-view to minimize under- or over-imaging. Average time: 5 minutes
 - Orthopedics/Anesthesiology: Discuss anticipated duration of sedation for imaging and potential for surgery to coordinate single-anesthesia episode between MRI and operating room (OR). Average time: 5 minutes
- In our experience, this small investment of time results in substantial time savings by the avoidance of confusion and disorder that may occur at large tertiary pediatric centers.

Process map for MRI and OR

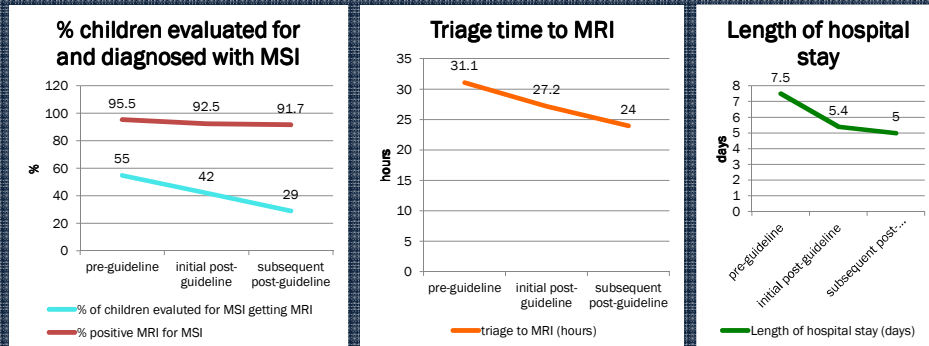
- Key component of MRI and OR timing is the reservation of a mid-day time slot in the MRI schedule, reserved daily for potential MSI patients.
- Slots unscheduled by 9am are released for other add-on studies.
- This also allows for coordination with OR for anticipated time of surgery, optimally under a single anesthesia episode.



MRI protocol

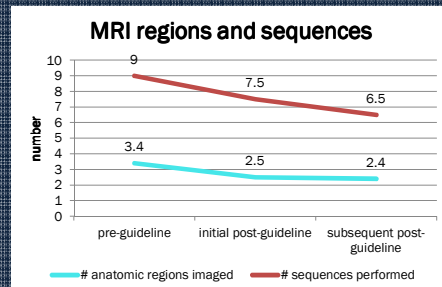
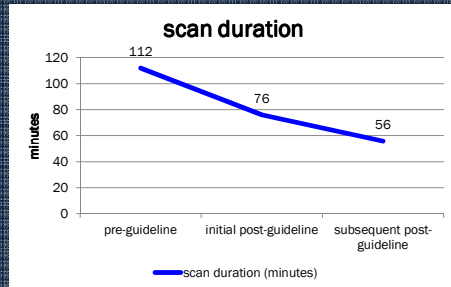
- Notes
 - Tailored protocol to exact area of clinical concern - as per discussion with orthopedic surgery
 - Radiologist should comment on desired planes and FOV
- Initial sequences
 - Coronal STIR (wide FOV)
 - Coronal T1-W FSE (wide FOV)
 - Axial STIR
 - MRI tech calls MD to check coronal STIR while running coronal T1-W FSE to determine necessary FOV for axial STIR and need for post-contrast imaging. In many cases, contrast may be avoided when, based on pre-contrast imaging, it adds no further support to the diagnosis or decision making.
- If indicated, additional sequences:
 - Coronal T1-W with fat saturation post-gadolinium
 - Axial T1-W with fat saturation post-gadolinium (focused FOV)
 - Sagittal: STIR, Post T1-W with fat saturation post-gadolinium (Optional at Elbow/Ankle)

Results



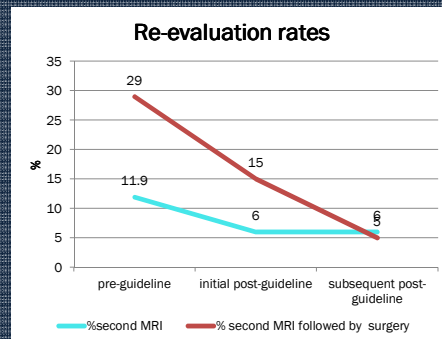
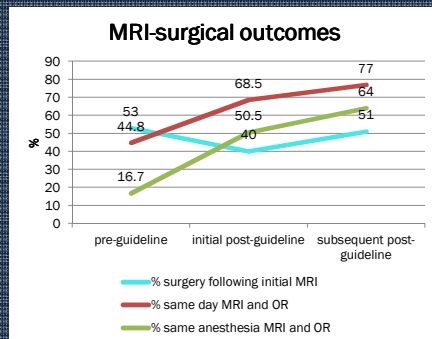
- Smaller percentage of children getting MRI, but MSI rate overall stable = better clinical triaging
- Less delay in obtaining MRI due to reserved time slot in MRI schedule for non-emergent exam
- Shorter length of stay due to more efficient resource utilization and definitive care

Results



- Shorter scan time = shorter anesthesia, greater patient safety, more efficient use of resources
- Fewer anatomic regions and sequence types = shorter scan time

Results



- Stable rate of MSI patients requiring surgical intervention after MRI = judicious clinical triaging for MRI
- Improved same-day surgery rates = definitive care
- Improved same-anesthesia for MRI and OR rates = patient safety and efficiency
- Decrease rate of obtaining second MRI and delayed or repeat surgical intervention = countermeasure to monitor for unintended sequela of decreased resource utilization

Discussion

- The principles which have led to greater focus of MRIs in our system include:
 - Careful history and physical examination prior to imaging to focus Field-of-view; and
 - Direct verbal communication of the orthopedic surgeon's clinical impression with the radiologist prior to imaging.
 - Too much variation is introduced in the process when these two activities are delegated to **those with less experience or who are not ultimately responsible for the care of the child**. Accepting this degree of variability can lead to misadventures in imaging which can be very time consuming.

Discussion

- Additional value which this guideline offers is the improvement in safety through the continuation of anesthesia and airway protection from MRI scanner to operating room.
 - Minimizes the need for sequential sedations for children who would otherwise be awakened and extubated and then induced and re-intubated for surgery.
 - Prevents inadvertent violations of a nothing by mouth order while the surgical team decides whether or not to perform surgery on the basis of the MRI findings.

Key points

- Requires strong physician leadership to drive communication
- MRI coverage area tailored to patient's exam with real-time monitoring to avoid unnecessary imaging
- **Expert physical exam, informed team decision-making, and a well-timed, reserved sedated MRI slot is likely to drive the care process more efficiently for these children in any setting.**
- Organized approach to surgical intervention under continued anesthesia immediately following the MRI improves safety and airway protection from MRI scanner to operating room.
- This program led to conservation of 809 hospital bed days within 30 months at a tertiary pediatric medical center. It reduced the rate of initial MRI acquisition from 55% to 29% through careful evaluation by experienced physicians who practiced in a team approach to care. It also led to the conservation of approximately 264 hours of MRI scan time.