OVERDIAGNOSIS OF CELLULITIS AND SOFT TISSUE INFECTIONS

Designing Decision Support Systems to Reduce Predictable Diagnostic Error

UNIVERSITY of ROCHESTER   VisualDx visual clinical decision support software

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A Pilot Study: Cellulitis Diagnostic Accuracy

Hypothesis
Soft tissue infections (cellulitis infections) are frequently overdiagnosed, resulting in the unnecessary use of antibiotics and hospital admission.

Method
Consecutive inpatient and observation unit admissions at a large tertiary hospital were reviewed daily for an admitting diagnosis of cellulitis. Inclusion criteria consisted of the following:

1) Hospital inpatient admission
   -or-
2) Twenty-three hour observation unit admission for the admitting diagnosis of cellulitis

Independent diagnostic evaluations were performed by dermatologists and infectious disease physicians. The medical history, physical exam, photograph of presentation, and laboratory studies were obtained. Primary and secondary diagnoses were recorded, and the level of physician diagnostic certainty was recorded using a 5-point Likert scale.

Results
Twenty percent of patients did not have cellulitis. There was complete independent diagnostic agreement between the dermatology and the infectious disease physicians.

Out of 15 total patients, 1 was diagnosed with an intra-abdominal abscess that was miscoded as cellulitis of the trunk, and 3 were misdiagnosed with cellulitis. These "false-positive" diagnoses were venous stasis dermatitis, bullous pemphigoid, and panniculitis.

Conclusion
The consulting physicians had a high degree of certainty with respect to the 3 misdiagnosed cases of cellulitis. The findings from this pilot study have since lead to the deployment of 2 larger studies being held at the University of Rochester and Harbor - UCLA Medical Center.

20% of Patients Misdiagnosed

Total Patients in Pilot Study: 15
Accurately Diagnosed as Cellulitis: 11
Misdiagnosed as Cellulitis: 3
Miscoded Abdominal Abscess: 1

CASE 2: Cellulitis

Example of "true" bacterial cellulitis following trauma to a hand. This patient had lymphangitic streaking proximally on the arm, suggesting bacterial cellulitis.

CASE 15: Panniculitis

The patient had multiple emergency visits in 2 states spanning a 3-month period. Antibiotics were administered for each episode. A biopsy was taken, proving the final diagnosis to be panniculitis.

Note: Bacterial cellulitis rarely presents as a bilateral process.

CASE 11: Bullous Pemphigoid

Image 1 shows the patient with an immunobullous disorder misdiagnosed as cellulitis.

Image 2 shows small bullae on the patient's contralateral limb, suggesting the alternative diagnosis.

Decision Support Designed to Reduce Diagnostic Error

Problem: Overdiagnosis of Cellulitis
Generalists and emergency physicians tend to "overcall" or prematurely close on the diagnosis of cellulitis. Red and inflamed skin is a sign of cellulitis, but skin redness is present in many other non-bacterial disease processes.

Solution: A Visual Decision Support System
A clinical diagnostic decision support system (CDSS) is assisting physicians in more accurate pattern recognition and diagnosis at over 700 clinical sites. The visual CDSS is designed to ease the rapid development of problem-oriented differential diagnosis components for any clinical decision area. The medical literature was reviewed for case reports of diseases presenting within the differential diagnosis of cellulitis, and the photographic repositories of University of Rochester, UCLA, and NYU were accessed to develop a comprehensive visual differential diagnosis of cellulitis.

The system integrates photographs of diseases with a searchable medical knowledge base to aid clinicians in the evaluation of the patient with presumed cellulitis. A problem-oriented, modular design simplifies the evaluation to 3 key questions (Diagram A). Each condition is presented visually with multiple images and disease variants to aid recognition and perception (Diagram B).

Summary: Embracing Technology Driven by Need
Cellulitis is a common infectious process affecting the skin and subcutaneous tissues, estimated to be the 18th most common reason for hospital admission. The diagnosis and management of presumed cellulitis resulted in more than $3.7 billion in spending on approximately 240,000 inpatient admissions for cellulitis in the US in 2004.** The outpatient visits and related use of antibiotics for skin and soft tissue infections is likely 1 or 2 orders of magnitude more common. Growing use of visual decision support (1.2 million images were viewed in 2007) suggests fulfillment of a clinical information need as well as acceptability. Further research is required to validate and define the proper integration of the cellulitis differential diagnosis visual CDSS into the clinical work flow of primary care and emergency departments.

**Solucient 2004 Report, Thomson Healthcare

Misdiagnosed:
Patient presented with bilateral leg swelling that wept for days. After 5 days of unsuccessful therapy for cellulitis, this patient was seen by a physician who used a visual CDSS to assist in determining the correct diagnosis: stasis dermatitis.
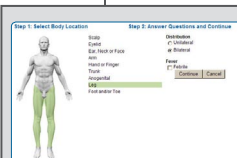
A. A visual differential diagnosis is displayed in fewer than 5 seconds.

B. The visual differential diagnosis includes 70 diagnoses and 1,157 disease images.