Health IT: The Use of Diagnostic Decision Support Systems (DDSS)

David C Classen MD MS
University of Utah
Pascal Metrics
Quick Medical Reference (QMR) : 1986

Contains 130 Hypotheses arranged by relative score (1-100)

Fever and
Splenomegaly Moderate and
Heart Murmur Present and
Hemoglobin Blood Less Than 12

Endocarditis Subacute Infective Left Heart

Leukemia Acute Lymphoblastic 86
Rheumatoid Arthritis
Causes Anemia Of Chronic Disease 85
Endocarditis Acute Infective Left Heart 83
Rheumatoid Arthritis
is the Systemic Component of Feltys Syndrome
Causes Anemia Of Chronic Disease 82

Line 1 of 416
The Isabel diagnosis reminder system is designed ONLY to suggest a checklist of likely diagnoses based on the clinical features you enter. **It is not meant to replace your clinical judgement.**

### How do I use Isabel?

- How do I use the gender and age group fields?
- Do I have to choose a regional preference?
- What clinical features can I type in?
- Rules for data entry
- Does Isabel recognise US/UK spelling differences, slang/abbreviations?

### Useful Info

- Interactive demo (recommended for first-time users)
- FAQs

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**diagnosis reminder system**

**age**

--- select age group ---

**gender**

(unspecified gender)

**from**

(no regional preference)

**with the following clinical features:**

Would you like a sub-specialist differential diagnosis...?

(no sub-specialty)
The utility of an online diagnostic decision support system (Isabel) in general practice: a process evaluation

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Summary

**Objectives** To evaluate the utility of Isabel, an online diagnostic decision support system developed by Isabel Healthcare primarily for secondary medical care, in the general practice setting.

**Design** Focus groups were conducted with clinicians to understand why and how they used the system. A modified online post-use survey asked practitioners about its impact on their decision-making. Normalization process theory (NPT) was used as a theoretical framework to determine whether the system could be incorporated into routine clinical practice.

**Setting** The system was introduced by NHS County Durham and Darlington in the UK in selected general practices as a three-month pilot.

**Participants** General practitioners and nurse practitioners who had access to Isabel as part of the Primary Care Trust's pilot.

**Main outcome measures** General practitioners' views, experiences and usage of the system.

**Results** Seven general practices agreed to pilot Isabel. Two practices did not subsequently use it. The remaining five practices conducted searches on 16 patients. Post-use surveys (n = 10) indicated that Isabel had little impact on diagnostic decision-making. Focus group participants stated that, although the diagnoses produced by Isabel in general did not have an impact on their decision-making, they would find the tool useful if it were better tailored to the primary care setting. Our analysis concluded that normalization was not likely to occur in its current form.

**Conclusions** Isabel was of limited utility in this short pilot study and may need further modification for use in general practice.
A ‘Green Button’ For Using Aggregate Patient Data At The Point Of Care

My Patient

A 55 year old female of Vietnamese heritage with known asthma presents to her physician with new onset moderate hypertension

Intervention

antihypertensives

Outcome

Diastolic pressure < 90 mm Hg

Variables associated with Outcome

- Drug A
- Asthma
- Ethnicity
- HDL
- HbA1c > 10%

Diastolic BP with Drug A: 245
Diastolic BP with Drug B: 989

[Graph showing variables and outcomes]
Sixty-six percent of Internet users in the United States in 2007 used a search engine to research health information to help themselves make health-related decisions. As a result physicians are increasingly compelled to defend their diagnoses and clarify the information their patients have found. The researchers propose the development of patient-oriented decision support systems by which laypersons can retrieve medical information. Through utilizing semi structured decision support systems that incorporate the latest standards in evidence-based medicine patients and care-givers can receive current, accurate and appropriate information. The exigencies of managed care have increased time pressures among most medical practices. Yet addressing concerns based on potentially misleading or harmful internet based information has garnered an increasing portion of practitioners’ time and mandates urgent attention.
What is Clinical Decision Support (CDS)?

Clinical decision support is a process for enhancing health-related decisions and actions with pertinent, organized clinical knowledge and patient information, to improve health and healthcare delivery.
Types of Clinical Decision Support

• Drug-Drug Interactions
• Drug-Allergy interactions
• Dose Range Checking
• Pick lists
• Standardized evidence based order sets
• Links to knowledge references
• Links to local policies
• Alerts

• Rules to meet strategic objectives (core measures, antibiotic usage, blood management)
• Documentation templates
• Relevant data displays
• Point of care reference information (i.e. InfoButtons)
• Web based reference information
• Diagnostic decision support systems (DDSS)
Types of Diagnostic Decision Support

- Diagnosing—QMR, DX Explain, Isabel, Watson
- Critiquing—Antibiotic Assistant,
- Assisting—EKG, Imaging, Theradoc
- Alerts and Reminders—EHRs
- Predictive, Population, Genomic
- Many More!
<table>
<thead>
<tr>
<th>Type of HIT Tool</th>
<th>Information gathering</th>
<th>DDx generation</th>
<th>Weighing dx</th>
<th>Testing and dx plan</th>
<th>Follow-up and assessment of response</th>
<th>Early detection in asymptomatic patients</th>
<th>Collaboration with team</th>
<th>Feedback/insight into dx process</th>
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<tbody>
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<td>Computer-based interviewing</td>
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<td>Interactive voice response (IVR)</td>
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<td>Unsolicited alerts</td>
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<td>Tele-medicine consult systems</td>
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**Figure 3** Main types of diagnostic health information technology (HIT) tools and steps in diagnosis targeted by each type.
Box 1  Condensed set of categories describing different steps in diagnosis targeted by diagnostic health information technology (HIT) tools

- Tools that assist in information gathering
- Cognition facilitation by enhanced organisation and display of information
- Aids to generation of a differential diagnosis
- Tools and calculators to assist in weighing diagnoses
- Support for intelligent selection of diagnostic tests/plan
- Enhanced access to diagnostic reference information and guidelines
- Tools to facilitate reliable follow-up, assessment of patient course and response
- Tools/alerts that support screening for early detection of disease in asymptomatic patients
- Tools that facilitate diagnostic collaboration, particularly with specialists
- Systems that facilitate feedback and insight into diagnostic performance
Systematic review
Can computerized clinical decision support systems improve practitioners' diagnostic test ordering behavior? A decision-maker-researcher partnership systematic review

Results
Thirty-five studies were identified, with significantly higher methodological quality in those published after the year 2000 ($p = 0.002$). Thirty-three trials reported evaluable data on diagnostic test ordering, and 55% (18/33) of CCDSSs improved testing behavior overall, including 83% (5/6) for diagnosis, 63% (5/8) for treatment monitoring, 35% (6/17) for disease monitoring, and 100% (3/3) for other purposes. Four of the systems explicitly attempted to reduce test ordering rates and all succeeded. Factors of particular interest to decision makers include costs, user satisfaction, and impact on workflow but were rarely investigated or reported.
Mixed Results In The Safety Performance Of Computerized Physician Order Entry

ABSTRACT Computerized physician order entry is a required feature for hospitals seeking to demonstrate meaningful use of electronic medical record systems and qualify for federal financial incentives. A national sample of sixty-two hospitals voluntarily used a simulation tool designed to assess how well safety decision support worked when applied to medication orders in computerized order entry. The simulation detected only 53 percent of the medication orders that would have resulted in fatalities and 10–82 percent of the test orders that would have caused serious adverse drug events. It is important to ascertain whether actual implementations of computerized physician order entry are achieving goals such as improved patient safety.

Many people have suggested that electronic health records represent essential infrastructure for the provision of safe health care in the United States. For several years, the Institute of Medicine, the Leapfrog Group, the National Quality...
Simulations of EHR Use with CPOE

The assessment pairs medication orders that would cause a serious adverse drug event with a fictitious patient.

A physician enters the order …

<table>
<thead>
<tr>
<th>Patient AB</th>
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<tbody>
<tr>
<td>Female</td>
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<tr>
<td>32 years old</td>
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<tr>
<td>Weighs 60 kg</td>
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<tr>
<td>Allergy to morphine</td>
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<tr>
<td>Normal creatinine</td>
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<tr>
<td>Pregnant</td>
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</tbody>
</table>

and observes and records the type of CDS-generated advice that is given (if any).

Prenatal vitamin 1 tab PO QD, Zocor 20mg PO QD
Information Overload and Missed Test Results in EHR-based Settings

Hardeep Singh, MD, MPH, Christiane Spitzmueller, PhD, Nancy J. Petersen, PhD, Mona K. Sawhney, MD, MS, and Dean F. Sittig, PhD
## Multiple Sociotechnical Issues

<table>
<thead>
<tr>
<th>Issue</th>
<th>Examples</th>
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<tbody>
<tr>
<td><strong>Software</strong></td>
<td>no functionality for saving, tracking, and retrieving alerts</td>
</tr>
<tr>
<td><strong>Content</strong></td>
<td>too many unnecessary alerts</td>
</tr>
<tr>
<td><strong>Usability</strong></td>
<td>poor signal to noise ratio on screen</td>
</tr>
<tr>
<td><strong>Workflow</strong></td>
<td>“surrogate feature” to forward alerts when providers out of office not used properly</td>
</tr>
<tr>
<td><strong>Providers</strong></td>
<td>lack of knowledge/training</td>
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<tr>
<td><strong>Organizational</strong></td>
<td>policies for follow-up ambiguous</td>
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</tbody>
</table>
Electronic Health Record-Based Surveillance of Diagnostic Errors in Primary Care

Hardeep Singh, MD, MPH\(^1\), Traber Davis Giardina, MA, MSW\(^1\), Samuel N. Forjuoh, MD, MPH, DrPH\(^2\), Michael D. Reis, MD\(^2\), Steven Kosmach, MSN, RN\(^3\), Myrna M. Khan, PhD, MBA\(^1\), and Eric J. Thomas, MD, MPH\(^4\)

**Background**—Diagnostic errors in primary care are harmful but difficult to detect. We tested an electronic health record (EHR)-based method to detect diagnostic errors in routine primary care practice.

**Methods**—We conducted a retrospective study of primary care visit records “triggered” through electronic queries for possible evidence of diagnostic errors: Trigger 1: A primary care index visit followed by unplanned hospitalization within 14 days; and Trigger 2: A primary care index visit followed by ≥ 1 unscheduled visit(s) within 14 days. Control visits met neither criterion. Electronic trigger queries were applied to EHR repositories at two large healthcare systems between October 1, 2006 and September 30, 2007. Blinded physician-reviewers independently determined presence or absence of diagnostic errors in selected triggered and control visits. An error was defined as a missed opportunity to make or pursue the correct diagnosis when adequate data was available at the index visit. Disagreements were resolved by an independent third reviewer.

**Results**—Queries were applied to 212,165 visits. On record review, we found diagnostic errors in 141 of 674 Trigger 1-positive records (PPV=20.9%, 95% CI, 17.9%-24.0%) and 36 of 669 Trigger 2-positive records (PPV=5.4%, 95% CI, 3.7%-7.1%).
27 year old women evaluated in the ER for severe lower abdominal pain

Taken to surgery for what was felt to be an acute abdomen

At surgery she was found to be pregnant and the fetus did not survive

On review of the case a problem with interoperability lead to another patients lower abdominal ultrasound report being inadvertently inserted into this patients EHR record
Improving Safety Requires a Learning System Built from a Sociotechnical Approach

- Safety is a characteristic of a **sociotechnical system**
- System-level failures occur almost always because of unforeseen combinations of component failures

![Sociotechnical System Diagram](image)

**FIGURE 3-1**
Sociotechnical system underlying health IT-related adverse events.

SOURCE: Adapted from Harrington et al. (2010), Sittig and Singh (2010), and Walker et al. (2008).
Reccommendations-HealthIT

– What recommendations do you think this committee should make to improve diagnosis and reduce diagnostic error?
– What is the most important thing this committee could do to reduce the frequency and severity of diagnostic error?
– What action(s) to improve diagnosis would you prioritize first?