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# Isabel, a Clinical Decision Support System

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***ONLINE UPDATES: A COLUMN FOR SEARCH ANALYSTS***

**Emily Vardell, Column Editor**

**Isabel, a Clinical Decision Support System**

**Emily Vardell**

**Mary Moore**

**ABSTRACT.** A Clinical Decision Support System (CDSS) is an interactive tool designed to assist clinicians in making decisions, such as determining a diagnosis. The Isabel Database is a CDSS featuring a clinical checklist and topic-specific knowledge components. This column contains an overview of the database, provides searching tips, and places Isabel within the context of the CDSS field.

**KEYWORDS.** CDSS, Clinical Decision Support Systems, Isabel, point-of-care systems

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When health practitioners want assistance with clinical decision making, they may turn to a colleague, or to the literature, or in some cases, to a Clinical Decision Support System (CDSS). These systems, first documented in the 1950s,<sup>1</sup> are designed to assist individuals at the point of care. Examples include MYCIN, developed in the 1970s by Stanford University to aid diagnoses of bacterial diseases<sup>2</sup>; DXplain from Massachusetts General Hospital, released in 1986, still functional today, and covering 2,400 diagnoses<sup>3,4</sup>; and Isabel<sup>5</sup> from Isabel Healthcare, now one of the most comprehensive tools available to support diagnostic decisions.

### ***BACKGROUND***

In 1999, when the daughter of the founder became gravely ill as the result of misdiagnosis, he was inspired to found the Isabel CDSS, named for his daughter. In 2002, the first version, for pediatrics, was launched in the UK. The adult version of Isabel became available worldwide in 2005 and now covers thousands of diagnoses. The resource is a teaching tool to help faculty, students, and clinicians remain up-to-date on new studies.

Isabel consists of two parts, the Isabel Diagnosis Checklist System (IDCS) and the Knowledge component (the latter of which will be covered later in the article). The IDCS is comprised of a database of more than 11,000 diagnoses and 4,000 drugs. To use the IDCS, a clinician enters a patient's symptoms and clinical signs, or the data is extracted from the electronic medical record. Isabel then checks the inputted symptoms and signs against its database to provide a list of likely diagnoses and/or medications that might cause specific symptoms. Isabel uses proprietary natural language processing software to search its database of

medical textbooks and journals. The database and the quality of search results are validated each week by a team of clinicians.

One of the benefits of Isabel is that it requires no formal training. Isabel is designed to be easy and quick to use. The home page of Isabel is appropriately simplified, featuring a box where the physician inputs patient information and symptoms in the left-hand column and results based on this information are displayed in the right-hand column (this is the user-side of the IDCS). In the “enter clinical features” box, the first drop-down menu requires a patient’s age (categories include neonate, infant, younger child, older child, adolescent, young adult, adult, and geriatric, each with corresponding age brackets). This is the only required patient characteristic in Isabel.

In addition, the user can select the gender of the patient. If female is selected along with an appropriate age box, an additional drop-down menu appears allowing the user to specify if the patient is pregnant or not (not specified is allowed). Once this background information has been entered, the user can enter clinical features keeping the “3 golden rules” in mind:

- Be as specific as possible (i.e., Isabel will understand “persistent cough,” which is preferable to “cough”)
- Do not use negatives (e.g., “no fever”)
- Do not use numbers (instead describe numerical results in words, e.g., elevated white blood cell count).<sup>6</sup>

### ***SAMPLE SEARCH***

To conduct a sample search, the author selected the geriatric age bracket (65 years and over) and male as the gender. In the clinical features section, she entered “rales,” “smoker,” “low oxygen saturations,” and “persistent cough.” With the autosuggest feature, one can simply begin entering

in the symptoms and Isabel will make suggestions of which symptoms one might be most interested in.

After clicking “get checklist,” Isabel displayed a list of possible diagnoses (as shown in Figure 1). The number of diagnoses displayed can be controlled by using the “show” function. The default sort option is by “most relevant,” but one can also sort by “most common” or “don’t miss diagnoses.” The “don’t miss diagnoses” are also indicated with a red flag on the diagnoses list. The entire list can be saved, printed, or e-mailed using the “action” drop-down menu.

The screenshot shows the Isabel interface with the following components:

- Header:** Isabel logo, University of Miami, and LOUIS CALDER MEMORIAL LIBRARY.
- Navigation:** Home, CHECKLIST, KNOWLEDGE, START CME Capture, Administration Menu, IDEAS, Support, Training Tools, Mobile Access, Logout.
- Left Panel (enter clinical features):**
  - age\*: young adult (17-29yrs)
  - gender:  female,  male
  - pregnancy: (- not specified -)
  - Refine search: travel history: North America
  - show me:  diagnoses,  causative drugs,  bioterrorist agents
  - Enter clinical features, no negatives, no numbers:
    - nasal congestion
    - rhinorrhea
    - persistent cough
  - + add a clinical feature
  - get checklist button
  - clear search
  - Isabel is not meant to replace your clinical judgment.
- Right Panel (diagnoses):**
  - Most Relevant
  - sort by: most relevant
  - action: -select-
  - show: 10 20 30 all
  - Diagnosis list with icons for flags, help, and actions:

Diagnosis	Flags	Action	System
Headache Disorders	🚩	?	NEURO
Vasomotor Rhinitis	🚩	?	RESP
Sinusitis	🚩	?	RESP
Allergic Rhinitis	🚩	?	ALLERG
Wegener's Granulomatosis	🚩	?	RHEUM
Kartagener Syndrome	🚩	?	RESP
Influenza Viruses	🚩	?	INFEC
Mucormycosis / Zygomycosis	🚩	?	INFEC
Sarcoidosis	🚩	?	RESP
Rhinoviral Infection	🚩	?	INFEC
Common Cold / Nasopharyngitis	🚩	?	RESP
Pet Allergy	🚩	?	ALLERG
Cystic Fibrosis	🚩	?	RESP
Human Metapneumovirus	🚩	?	INFEC
Relapsing Polychondritis	🚩	?	RHEUM
Bronchiectasis	🚩	?	RESP
Brain Neoplasms	🚩	?	NEURO
Rhinitis Medicamentosa	🚩	?	RESP
Emphysema	🚩	?	RESP
Gastroesophageal Reflux	🚩	?	GASTRO
- Feedback:** feedback: [input] submit
- Callout Box:** New! What do you think of the Checklist? Give us your feedback! Select or next to each diagnosis?
- Footer:** If this page is not displaying / functioning correctly, please [click here](#)

Legend: FIGURE 1. Isabel checklist.

Next to the name of each diagnosis there are thumbs up and thumbs down icons, allowing users to provide feedback to Isabel. Next to these feedback mechanisms is a question mark icon. When clicked, a “Why did this diagnosis come up?” box appears, explaining the logic behind each diagnosis. This box outlines which terms in the Isabel database were matched to the entered search terms as well as the degree of match. Beside the question mark icon is a prefix designating which specialty this particular diagnosis is associated with.

It is also interesting to note that once a list of possible diagnoses appears, additional search options are displayed on the left-hand side of the screen. Under the patient specifications, the “Refine search” options allow a user to input travel history [Western Europe, Eastern Europe, Central Africa, North Africa, East Africa, Southern Africa, West Africa, Southeast Asia, East Asia, South Asia, Caribbean, North America, Central America, South America (trop), South America (temp), Australasia, and Middle East]. In addition, users can select “causative drugs” and “bioterrorist agents” under the “Show me” section instead of the default “diagnoses.” Clicking on “causative drugs” immediately changes the checklist to a list of medications displayed similarly to the diagnoses, with the thumbs up and thumbs down feedback mechanism and a question mark icon, which will display an answer to “Why did this drug come up?” Clicking on “bioterrorist agents” will do much the same, with a list of possible agents displayed.

### ***KNOWLEDGE WINDOW***

Clicking on a particular diagnosis on the checklist will open up a Knowledge Window particular for that diagnosis. For example, the author clicked on “Asbestosis,” opening a window displaying a wealth of information on that topic (see Figure 2). The window includes a left-hand

column with quick links to relevant information from a host of sources. The default information source is *The 5 Minute Clinical Consult*, the full text of which is displayed in the largest part of the window, including a description of the disease, signs and symptoms, causes, risk factors, differential diagnoses, and drugs of choice. It is important to note that all of this information is available through an Isabel subscription and a separate subscription to the resource is not required to view the information (e.g., although the University of Miami does not currently subscribe to *Griffith's 5 Minute Clinical Consult* separately, UM affiliates are able to access it using Isabel as seen in Figure 2).

Click on diagnoses to browse related content

- Sinusitis
  - Fungal Rhinosinusitis
  - Bacterial Rhinosinusitis

Related content:

- Griffith's 5 Minute Clinical Consult
- Oxford Textbook of Medicine
- Journal Abstracts
- What's New
- Lessons Learned
- Images
  - Google Images
- Web Resources
  - Louis Calder Memorial Library
  - UpToDate
  - DynaMed
  - Md Consult
  - CDC
  - PubMed
  - Medline Plus
  - eMedicine (free reg. required)
  - Google
  - Wikipedia
  - eMedicine Health
- Guidelines
  - Institutions can link their own guidelines, protocols, algorithms & orders sets here.

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Sinusitis

A. Peter Catinella MD PULMONARY

BASICS

DESCRIPTION

Acute sinusitis is a symptomatic inflammation of the paranasal sinuses of less than 4 weeks duration occurring as a result of impaired drainage and retained secretions. Subacute when symptomatic from 4-12 weeks. Chronic when symptomatic for greater than 12 weeks. Acute exacerbation of chronic disease when worsening of already symptomatic patient.

System(s) affected

Pulmonary

Genetics

No known genetic pattern

Incidence/Prevalence in USA

16% of population annual diagnosis of sinusitis

Fifth leading reason for antibiotic prescriptions

Approximately 5% of office visits for young adults

Incidence of both acute and chronic sinusitis increases in the latter part of childhood

Incidence increases up to age 75 and then decreases

Predominant age

All ages

Predominant sex

Both sexes equally

SIGNS & SYMPTOMS

Symptoms predictive of bacterial sinusitis:

- Persistent duration of symptoms for at least one week
- Purulent nasal discharge
- Maxillary tooth or facial pain (especially if unilateral)
- Unilateral maxillary sinus tenderness
- Worsening of symptoms after initial improvement

Other associated symptoms:

- Headache
- Retro-orbital pain
- Otagia
- Hyposomia
- Halitosis
- Chronic cough

Symptoms indicating urgency:

- Orbital pain
- Visual disturbances, especially diplopia
- Periorbital swelling or erythema
- Facial swelling or erythema
- Mentation change

**Legend: FIGURE 2. Asbestosis Knowledge Window**



If relevant, related diagnoses are linked to in the upper left-hand corner. Below this top section is a long list of links to related information, both clinical and patient-oriented. For “Asbestosis,” the top related content is from *The 5 Minute Clinical Consult* and the *Oxford Textbook of Medicine*. Clicking on one of these links will open the resource within the same window.

Beneath that resource are links to “What’s New” and “Lessons Learned” taken from journal abstracts in PubMed. Clicking on these links will directly link to citations within the PubMed database by performing a predetermined search. In the case of “What’s New,” the search is limited to the last two years; the search is limited to case reports with “Lessons Learned.” For example, the predetermined “What’s New” search for Asbestosis (when conducted January 31, 2011) was as follows:

*asbestosis[Title/Abstract] AND (hasabstract[text] AND "humans"[MeSH Terms]  
AND English[lang] AND jsubsetaim[text] AND "2009/01/31"[PDAT] :  
"2011/01/31"[PDAT])*

Following this section is a link to Google Images and then a long list of other “Web Resources.” The first on this list is the subscriber’s home page (in this case, the University of Miami’s Louis Calder Memorial Library). This is followed by a link to UpToDate. If a user’s institution does not have a subscription to UpToDate, the user will be in “Preview” mode, with only partial amounts of the available information accessible. Patient information from UpToDate is accessible in the preview mode, but much (if not all) of the clinical-oriented information is not.

The third and fourth resources on the checklist are DynaMed and MD Consult, respectively. Just as with the other databases, by clicking on these links, the window displays a search within the database of that topic. DynaMed displays a long list of search results (as is the

norm in a DynaMed search), and MD Consult displays a list of recommended resources targeted to the most current and clinically useful content. If there is an MD Consult topic page for the diagnosis, the content is organized by overview, signs and symptoms, etiology, diagnosis, treatment and management, patient education, practice guidelines, and drugs. Each of these sections has a handful of resources culled from the MD Consult database most relevant to this topic. If no topic page exists, as is the case with asbestosis, the Knowledge Window displays a search in MD Consult, organized by books, journals, clinics, patient education, drugs, guidelines, images, and news. As with UpToDate, if an institution or a user does not pay for a subscription to these databases, users will only have access to that which is made broadly available (e.g., patient-oriented content).

Beneath these commercial databases are links to government resources including the Center for Disease Control (CDC), PubMed, and MedlinePlus. Clicking on the CDC link will automatically perform a search of the topic in the CDC's website. The PubMed link leads to a simple search of "Asbestosis" in PubMed, and the MedlinePlus link opens a new window with the search results from that robust consumer health database.

The remaining tools in the Web Resources section are links to additional free information sources, including eMedicine (which requires free registration), Google, Wikipedia, and eMedicine Health. The Google automated search was *Asbestosis more:for\_health\_professionals*, which displayed links to Wikipedia, Mayo Clinic, MedlinePlus, etc. Wikipedia displayed the relevant topic page, and clicking on eMedicine Health performed a search of "asbestosis" within that database.

The last section on the left-hand column of the Knowledge Window is labeled "Guidelines." This is a section where the institution can select to link to their own guidelines,

protocols, algorithms, and orders. This section might be most helpful if Isabel were to be directly linked within an electronic health record.

### ***MOBILE ACCESS***

Isabel is formatted for hand-held, mobile devices,<sup>6</sup> including Androids, iPads, iPhones and the iPod touch, along with any laptop, workstation, or tablet device. The mobile version of Isabel is very similar to the desktop version. The first screen in the mobile version simply shows the “enter clinical features” box. It asks the same questions (age, gender, and pregnancy) and asks for clinical features. The mobile version even features the autosuggest tool. After clicking “get checklist” a list of the top 10 diagnoses appears in a “diagnoses” window and the “enter clinical features” box moves to the bottom of the screen. It remains on the screen to allow for refinement of the search (e.g., travel history and “show me” causative drugs or bioterrorist agents instead of the default diagnoses).

In the mobile version, the knowledge window is considerably simplified. In the sample search of “asbestosis,” the window displayed links to *The 5 Minute Clinical Consult* (which was the default resource displayed), Google, and Google images. This is a limitation of the mobile version, as not all of the information available in the desktop version is displayed in the mobile version. Consumer health information is nonexistent in the mobile version as well as links to databases such as UpToDate, DynaMed, and MD Consult.

### ***ADDITIONAL RESOURCES***

Isabel is recognized for AMA PRA Category 1 as a point-of-care learning system. By signing into the system, Isabel can capture an individual user's session including such details as queries and knowledge components used. Users must simply click "START CME Capture" on the top bar. Once a session has ended, the user must click "END CME Capture." After the capture has ended, a questionnaire is displayed, inviting users to enter information about how the information will be used. Questions include:

- What was your primary reason for accessing Isabel on this occasion?
- How did the information from Isabel influence your diagnostic assessment?
- Did using the Isabel system help you consider important diagnoses you hadn't thought of?
- How did using the Isabel system impact your management plans?
- To what extent did use of the Isabel system affect the quality of care the patient received or will receive?
- Other comments: *(with a field for users to enter their feedback)*

After filling out the questionnaire, a User session summary is displayed, with a breakdown of all the checklist searches, results, and components clicked on. Below this summary is a list of the answers to the above questions. This information must be printed, saved, or e-mailed at the time of the capture, as it is not saved in an individual's account. This is a convenient way to earn CME credits, as it requires minimal extra effort. Capturing a user's session allows Isabel to evaluate their product as well as a clinician to track the kind of information he or she seeks using the tool.

The remaining links at the top of the Isabel home page include:

- **Administration Menu** – reserved for institutional client partner administrators

- **IDEAS** – includes known cases, where the user reviews the case, determines the key clinical features and potential diagnosis with the use of Isabel and then compares the user’s determination to the known values (requires additional fee)
- **Support** – opens an email to the Isabel support desk
- **Training Tools** – features pamphlets and videos on how to search Isabel
- **Mobile Access** – links users to the mobile version of the database

### *EVALUATING CLINICAL DECISION SUPPORT SYSTEMS*

A comparative evaluation of four clinical decision support systems was conducted and published in 1994.<sup>7</sup> This study found that although the systems never included all possible diagnoses, they did provide a mean of two additional possible diagnoses in addition to those diagnoses most obvious to the clinicians studied.

In 1998, a systematic review on the effects of clinical support systems on physician decisions and patient outcomes was published.<sup>8</sup> This highly cited article concluded that, at the time, systems used to support diagnosis had not amalgamated enough compelling evidence to prove that they improved diagnostic performance.

The question of what metrics to use to compare or evaluate decision support systems is a difficult one. In 2003, Berner suggested that producing the correct diagnosis is only part of the criteria for success. Berner wrote that an ideal system would also include high quality assistance with the differential, appropriate management suggestions, user satisfaction, aspects of usability, and more.<sup>9</sup>

In Graber's study of medical students,<sup>10</sup> he discusses the tendency for clinicians to "solve problems by "satisficing," accepting the first diagnosis that seems to adequately explain all the facts at hand, without a conscious consideration of other possibilities." Those seeking to add a CDSS might consider Graber's conclusion that CDSSs "have the potential to ameliorate these cognitive tendencies by assisting the clinician to consider a broader range of different diagnostic possibilities." Though certainly no substitute for clinical judgment, Isabel may improve diagnostic accuracy, particularly in complex cases that are difficult to diagnose.

### ***FOR MORE INFORMATION***

For more information on Isabel, please direct queries to:

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Queries may also be sent via the "contact" link on the Isabel home page or directly at  
<<http://www.isabelhealthcare.com/home/contactnew>>.

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