



Visual Informatics: Real-time Visual Decision Support

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Text-Based Image Reference
- Versus -
Software Decision Support



Abstract

Searchable image databases can provide access to medical photographs, but until now they have not been designed to support the diagnostic evaluation. VisualDx is a JAVA based decision support application focusing on visually diagnosable diseases. Generalist physicians and dermatologists participated in a randomized trial of the software tool in comparison to text based resources. Accuracy of differential diagnosis was found to be significantly higher among non-dermatologist physicians using the software intervention in comparison to standard textbooks.

Background

It has been estimated that 10-20% of all primary care physician visits include at least one skin complaint. Yet, there is evidence that generalist physicians frequently order the wrong tests and misdiagnose dermatologic and other visually diagnosable problems, increasing the cost of health care delivery and delaying appropriate treatment.

Though photographs of skin disease contained in textbooks and atlases have been used for well over a century to assist diagnosis, computer based resources offer unique advantages.

Print Resources

Space constraints
Small images
Indexing limitations
Memory Based Care

Computer Resources

Unlimited images
Large color images
Multitaxial indexing
Decision Support



Image based on a clinical photograph



VisualDx is a JAVA based, point of care decision support tool. The software facilitates the task of image matching for the end user, by combining graphical search tools, a computerized knowledge base of relationships between findings and diagnoses, and thousands of digital images.

Display disease variation. Possible diagnoses can number in the hundreds and their related images in the thousands. To facilitate a diagnostic search, images are grouped into diagnostic "stacks". Images within "stacks" are sorted by the user morphology query, allowing for the viewing of relevant images. Stacking images by diagnosis condenses the "thumbnail contact sheet" information space, easing user comparison of relevant images and related diagnostic knowledge.

Objective

To assess physician diagnostic accuracy when using a visual decision support tool in comparison to referencing textbooks to solve 4 "unknown" cases.

Methods

Recruitment

Emergency, internal medicine, family medicine and dermatologist physicians were recruited by telephone, mail and e-mail. A total of 140 physicians were contacted. 50 physicians participated.

*Chief Scientific Officer of Logical Images, Inc.
**Chen, RA and Krasner, RL. The Cost of Missing Appropriate Therapy for Skin Disease: A Comparison of Dermatologists and Family Physicians. Journal of the American Academy of Dermatology 9(5): 787-796, 1983.
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Case Selection

Case presentations were abstracted from the medical literature by conducting a MEDLINE search for cases presenting with fever and a rash in adults.*** Four cases were found to have pictures both in the reference texts and intervention software.



Study Design

Training: study assistant followed 4 minute script to demonstrate the basic software functionality. Physician self-trial of the software followed. Physicians were randomized to "Case mix groups" (see below). After reading a "case" and before using a reference, subjects were asked to write preliminary diagnoses ranked by 1st choice, 2nd choice and 3rd choice. Responses were collected, and then depending upon randomization, the subject used either the textbooks or the software intervention. The participant then provided their 1st choice, 2nd choice and 3rd diagnostic choices as they did prior to using the intervention reference. Depending upon the randomization of the case mixes, subjects either began with 2 computer-assisted cases, or with 2 textbook assisted cases. **Scoring: 3 points for 1st choice, 2 points 2nd choice, 1 point 3rd choice, 0 points wrong answer**

Case Mix Groups

1. Books with Cases 1 & 2 followed by Software with Cases 3 & 4
2. Software with Cases 1 & 2 followed by Books with Cases 3 & 4
3. Books with Cases 3 & 4 followed by Software with Cases 1 & 2
4. Software with Cases 3 & 4 followed by Books with Cases 1 & 2

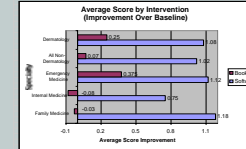
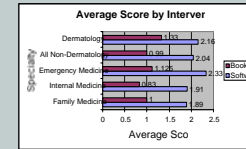
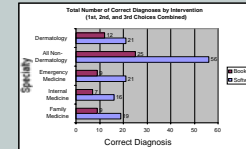


Software Application
VisualDx/Fever & Rash, JAVA 2 applet/software application, Logical Images Inc., Rochester, NY, 2001

- Texts**
- * Andrews' Diseases of the Skin: Clinical Dermatology, 9th edition, Richard B. Odom, William D. James, and Timothy G. Berger, 1135 pp, with 1271 illustrations, Philadelphia, PA, WB Saunders Co, 2003
 - * Fitzpatrick's Dermatology in General Medicine, volumes 1-2, 5th edition, Irwin M. Freedberg, Arthur Z. Eisen, Klaus Wolff, et al, 3129 pp, with 2000 illustrations, New York, NY, McGraw-Hill, 1999
 - * Mandell Douglas and Bennett's Principles and Practice of Infectious Diseases, 4th edition, Churchill Livingstone, with approximately 1000 illustrations, 1996
- Computer**
Dell laptop with 700-MHz Pentium III processor and 15" LCD TFT display

Results

Average training provided by study assistant was 4 minutes.
Software "self-study" time (non-dermatology) mean 4.53 minutes.



	Chi-Square	P<	Chi-Square
Dermatology	2.8772	<.0898	
Non-Dermatology	20.1888	<.0001	
Emergency Medicine	3.2267	<.0724	
Internal Medicine	7.8204	<.0052	
Family Medicine	9.1572	<.0025	

Significance of Intervention effect (Improvement over baseline) using Wilcoxon Rank Sum Tests, Kruskal-Wallis Test

Discussion

Is there a particular software functionality responsible for the increase in accuracy?

There may be many. Possibilities include:

- ability to search by animated graphical icons of skin lesion morphologies and distributions
- differential diagnosis listed within the software
- large number and high quality images
- combinatorial searching with dynamic redisplay of diagnosis image stacks

Subjective data suggested the physician subjects favored the morphology and distribution combinatorial approach to searching as compared to the use of an index in the back of a text. The graphical searching, and variety, depth and quality of images were all seen as strengths.

If a problem-oriented text existed for the same problem domain could it perform as well as the software?

Conceptually, any text-based reference would be limited in the number of images, and would have little or no searchability beyond a standard index. No such text exists today to conduct a comparison study.

Future work will include comparing the software with the images removed (the user will view text-based differentials), to a system that contained images associated with diagnoses in lists but without a database. In addition the system will be deployed within an emergency department and users will be randomized to the software-versus-books again as they evaluate actual patients with fever and a rash.

Conclusion

- ▶ Correct diagnoses more than doubled among the non-dermatologists and was statistically significant.
- ▶ Physicians subjectively preferred the software system as contrasted to textbooks.
- ▶ With minimal training, physicians learned to effectively use the tool.