Cybermedicine: Computing to Empower Patients and Doctors for Better Health Care

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## Comparison Between Physicians and Computer when Interviewing Patients About Problems with Allergies

<table>
<thead>
<tr>
<th>Problems</th>
<th>Problems Detected by Both Physician &amp; Computer</th>
<th>Problems Detected by Physician Only</th>
<th>Problems Detected by Computer Only</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urticaria</td>
<td>0</td>
<td>0</td>
<td>12</td>
</tr>
<tr>
<td>Allergic rhinitis</td>
<td>2</td>
<td>0</td>
<td>7</td>
</tr>
<tr>
<td>Asthma</td>
<td>4</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td>Drug allergy</td>
<td>7</td>
<td>0</td>
<td>1</td>
</tr>
</tbody>
</table>

Slack, W.Y. et al, New England Journal of Medicine, 1966
HAVE YOU EVER HAD AN ALLERGIC REACTION TO PENICILLIN?

1. YES
2. NO
3. DON'T KNOW
4. DON'T UNDERSTAND

YOUR ANSWER IS?
Cybermedicine for the Patient

Early results led to further study of medical histories and efforts with interviews to enhance rapport and yield further control.
Yielding Control

- requesting permission to proceed
Yielding Control

- requesting permission to proceed
- providing sufficient information
Yielding Control

- requesting permission to proceed
- providing sufficient information
- respecting priorities
Yielding Control

- requesting permission to proceed
- providing sufficient information
- respecting priorities
- offering alternatives
Yielding Control

- requesting permission to proceed
- providing sufficient information
- respecting priorities
- offering alternatives
- respecting the right to decide
Yielding Control

- requesting permission to proceed
- providing sufficient information
- respecting priorities
- offering alternatives
- respecting the right to decide
- respecting the right not to decide
Yielding Control

- requesting permission to proceed
- providing sufficient information
- respecting priorities
- offering alternatives
- respecting the right to decide
- respecting the right not to decide
- helping with uncertainty
Yielding Control

- requesting permission to proceed
- providing sufficient information
- respecting priorities
- offering alternatives
- respecting the right to decide
- respecting the right not to decide
- helping with uncertainty
- respecting reluctance to respond
Collecting results of physical exam

5. Left, Handwritten portion of a physical examination taken from a chart. Right, Computer-based record of the physical examination shown for comparison.
Announcing the only foolproof, guaranteed indecipherable, absolutely confidential hospital records security system:

DOCSCRIPT!
On to Boston: BIH and HMS

Formation of the Division
A Computer-Based Health Care Interview for Hospital Personnel

The Seven Health-Related Sections of the Interview

- General medical history
- Nutrition history
- Exercise patterns
- Habits
- Safety
- Environment
- Stress
Stress

In the PAST MONTH have you felt sad, Discouraged, or hopeless?

1. Yes
2. No

Answer:
Stress

In the PAST MONTH have you felt sad, discouraged, or hopeless?

1. Yes
2. No
3. Maybe

Answer:
Stress

In the PAST MONTH have you felt sad, Discouraged, or hopeless?

1. Yes
2. No
3. Maybe
4. Don’t understand

Answer:
Stress

In the PAST MONTH have you felt sad, Discouraged, or hopeless?

1. Yes
2. No
3. Maybe
4. Don’t understand
5. Skip it

Answer:
Stress

In the PAST MONTH has life sometimes seemed like it’s not worth living?

1. Yes
2. No
3. Maybe
4. Don’t understand
5. Skip it

Answer: 1
Stress

When life seems like it’s not worth living, it’s often helpful to speak to someone about these feelings.
Stress

There are several places where you could call at any time to speak in confidence about these feelings.
Help is available any time day or night through the:

Employee Assistance Program - (617) 123-1234

Samaritans - (617) 222-3131

Or you can always contact the Emergency Room (Ext. 3337)

Please be assured that whatever you say will be kept confidential
In the past month have you felt sad, discouraged, or hopeless?

<table>
<thead>
<tr>
<th>Response</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>811</td>
<td>(42%)</td>
</tr>
<tr>
<td>No</td>
<td>890</td>
<td>(46%)</td>
</tr>
<tr>
<td>Maybe</td>
<td>190</td>
<td>(10%)</td>
</tr>
<tr>
<td>Don’t understand</td>
<td>12</td>
<td>(1%)</td>
</tr>
<tr>
<td>Skip it</td>
<td>34</td>
<td>(2%)</td>
</tr>
</tbody>
</table>
In the past month has life sometimes seemed like it’s not worth living?

<table>
<thead>
<tr>
<th>Option</th>
<th>Count</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes</td>
<td>106</td>
<td>(6%)</td>
</tr>
<tr>
<td>No</td>
<td>812</td>
<td>(42%)</td>
</tr>
<tr>
<td>Maybe</td>
<td>57</td>
<td>(3%)</td>
</tr>
<tr>
<td>Don’t understand</td>
<td>3</td>
<td>(0%)</td>
</tr>
<tr>
<td>Skip it</td>
<td>33</td>
<td>(2%)</td>
</tr>
</tbody>
</table>
Assessment of the Interview

- Interview Worthwhile: 90%
- Easy to understand: 93%
- Informative about health: 37%
- Length about right: 68%
Preference
Computer vs. Doctor or Nurse

- **Doctor or nurse**: 46%
- **Computer**: 39%
- **No preference**: 3%
- **Skip it**: 12%
Did the computer sometimes ask more than you wanted to tell?

- Yes: 16%
- No: 78%
- Uncertain: 6%

Did you sometimes want to tell the computer more than it asked?

- Yes: 50%
- No: 42%
- Uncertain: 8%
<table>
<thead>
<tr>
<th>Health-Related Program Requests</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fitness Center</td>
</tr>
<tr>
<td>Stress Reduction</td>
</tr>
<tr>
<td>Time Management</td>
</tr>
<tr>
<td>Low-Back Protection</td>
</tr>
<tr>
<td>Smoking Cessation</td>
</tr>
<tr>
<td><strong>Total</strong></td>
</tr>
</tbody>
</table>
Revelation in the Absence of a Face-to-Face Encounter

Early on, patients often told us they found it easier to communicate with the computer than to their doctor about potentially embarrassing matters---a finding subsequently corroborated by many others.

Revelation in the Absence of a Face-to-Face Encounter

Computer-based interview of potential blood donors elicited more HIV-related factors in the health histories than either the questionnaire or the interpersonal interview in use at the Red Cross.
Computer-Based Screening for HIV Risk

Locke SE, et al. JAMA, 1992
Cybermedicine for the Patient

Premise:

The largest, least well utilized health-care resource, world wide is the patient or prospective Patient.

Possible solution:

The Interactive computer is well positioned to help patients to help themselves.
Patient-Computer Dialogue

- Urinary Tract Infection
Patient-Computer Dialogue

- Teaching program for use of the computer
- General medical history, conditions for referral, and referral if indicated
- History referable to urinary tract infection
- Urine culture
- Discussion of therapy
- Patient’s Choice about treatment
- Therapy
- Return Visit
Results (46 Patients)

10 referred by the program for further evaluation

35 decided to take sulfisoxazole

1 decided to wait for culture, which was negative
Patients’ Reaction to the Computer

How has it been to decide for yourself about taking sulfa?

A good thing 30
Better left up to someone else 1
No preference either way 3
Not sure 2
Soliloquy Therapy

Initial Study:

Follow-up Study
COMPUTERS SUCCESSFULLY REPLACE PSYCHOTHERAPISTS IN BOSTON EXPERIMENT.
(News Item)
<table>
<thead>
<tr>
<th>Reason(s) For Appointment</th>
<th>Review of Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Problem List (in patient’s words)</td>
<td>General Health</td>
</tr>
<tr>
<td>Medications</td>
<td>Lymph Nodes</td>
</tr>
<tr>
<td>▪ Current medications</td>
<td>Skin</td>
</tr>
<tr>
<td>▪ Allergies or adverse reactions</td>
<td>Hematopoetic System</td>
</tr>
<tr>
<td>Preventive Measures</td>
<td>Rheumatology</td>
</tr>
<tr>
<td>Positive Findings (taken from review of systems)</td>
<td>Allergies</td>
</tr>
<tr>
<td>Personal and Social History</td>
<td>Endocrine system</td>
</tr>
<tr>
<td>▪ Residence</td>
<td>Immunizations</td>
</tr>
<tr>
<td>▪ Marital history</td>
<td>Childhood Infections</td>
</tr>
<tr>
<td>▪ Living conditions</td>
<td>Eyes, Ears, Nose, Mouth, and Throat</td>
</tr>
<tr>
<td>▪ Children</td>
<td>Sexually Transmitted Diseases</td>
</tr>
<tr>
<td>▪ Education</td>
<td>Gastrointestinal System</td>
</tr>
<tr>
<td>▪ Occupation</td>
<td>Respiratory System</td>
</tr>
<tr>
<td>▪ Habits</td>
<td>Genitourinary system</td>
</tr>
<tr>
<td>▪ Dietary supplements</td>
<td>Psychiatric History</td>
</tr>
<tr>
<td>▪ Exercise</td>
<td>Nervous System</td>
</tr>
<tr>
<td></td>
<td>Family History</td>
</tr>
</tbody>
</table>
Personal Health Record

Patient Site (a secure Web Site)
- view results of diagnostic studies
- view medications
- request prescriptions
- request appointments and referrals
- communicate with doctors & staff
- shared notes
- cybermedicine medical history (in process)
Patient’s Assessment of the History

(32 Primary Care Patients)

How respectful of your feelings were the questions?

<table>
<thead>
<tr>
<th>Not at all respectful</th>
<th>Very respectful</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 2 3 4 5 6 7 8 9 10</td>
<td>0 0 0 1 0 1 1 4 21</td>
</tr>
</tbody>
</table>

Mean = 9.2

Family History

High blood pressure (father); Type II diabetes (paternal uncle); Breast cancer (mother);
Prostate cancer (maternal uncle)

History negative for: heart disease, type I diabetes, kidney disease, arthritis, gout, allergies,
bleeding problems, overweight, anemia, phlebitis, jaundice, colon cancer, lung cancer, other
types of cancer, migraine, stroke, epilepsy, psychiatric problems, and alcohol problems
Patient-Computer Dialogue
Comparison with the clinician

- disadvantages
Patient-Computer Dialogue
Comparison with the clinician

- disadvantages
  - less interactive
Patient-Computer Dialogue
Comparison with the clinician

- disadvantages
  - less interactive
  - insensitive to most (but not all) nonverbal information
Response Latency vs. Age

MEAN RESPONSE LATENCY (seconds)

Age (years)

18-30 31-40 41-50 51-60 61-70 71-80

Sample Size

265 88 36 36 17 16

“No” Responses
“No” Responses

“Yes” Responses

“All” Responses

“All” Responses
Patient-Computer Dialogue

Comparison with the clinician

- disadvantages
  - less interactive
  - insensitive to most (but not all) nonverbal information
  - difficulty with free text and spoken words
Patient-Computer Dialogue
Comparison with the clinician

- disadvantages
  - less interactive
  - insensitive to most (but not all) nonverbal information
  - difficulty with free text and spoken words
  - lacking existential human qualities
Patient-Computer Dialogue Comparison with the clinician

- advantages
Patient-Computer Dialogue
Comparison with the clinician

- advantages
  - reliability and consistency
Patient-Computer Dialogue
Comparison with the clinician

- advantages
  - reliability and consistency
  - automatic processing
Patient-Computer Dialogue
Comparison with the clinician

- advantages
  - reliability and consistency
  - automatic processing
  - economy: the patient does the data entry
Patient-Computer Dialogue
Comparison with the clinician

- advantages
  - reliability and consistency
  - automatic processing
  - economy: the patient does the data entry
  - anonymity (when desirable)
Patient-Computer Dialogue
Comparison with the clinician

- advantages
  - reliability and consistency
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  - economy: the patient does the data entry
  - anonymity (when desirable)
  - individualization without accusation
Patient-Computer Dialogue

Comparison with the clinician

- **advantages**
  - reliability and consistency
  - automatic processing
  - economy: the patient does the data entry
  - anonymity (when desirable)
  - individualization without accusation
  - endurance (unaffected by fatigue)
Patient-Computer Dialogue
Comparison with the clinician

- advantages
  - reliability and consistency
  - automatic processing
  - economy: the patient does the data entry
  - anonymity (when desirable)
  - individualization without accusation
  - endurance (unaffected by fatigue)

- Global Health: Multilingual, Multicultural
Patient-Computer Dialogue
Comparison with the clinician

- advantages
  - reliability and consistency
  - automatic processing
  - economy: the patient does the data entry
  - anonymity (when desirable)
  - individualization without accusation
  - endurance (unaffected by fatigue)

- Global Health: Multilingual, Multicultural
- Global Health: Availability
BIH, BWH, and HMS

Formation of the Division

Cybermedicine for the Patient

Cybermedicine for the Clinician
Cybermedicine for the Clinician

- Hospital-Wide Clinical Computing:
Among the unique features: all data were stored in a common database shared by all applications, with an audit trail kept for all users.
Cybermedicine for the Clinician

Clinical Use

Inpatient and Ambulatory
Clinical Use

- Provides clinical information upon request
1. All Labs
2. Blood Bank
3. Blood Gas
4. Cardiology
5. Chemistry
6. Cytogenics
7. Cytology
8. Demographics
9. Electrocardiograms
10. Hematology
11. Result Over Time
12. Microbiology
13. Neurophysiology
14. Online Medical Record
15. Outside/Lexington Lab
16. Pharmacy
17. Pulmonary Function
18. Radiology
19. Clinical Pathology
20. Urinalysis
Clinical Use

- Provides clinical information upon request
- Gives support with decisions
Clinical Use

- Gives support with decisions
- Advice and consultation
Clinical Use

- Gives support with decisions
  - Advice and consultation
  - Bibliographic retrieval (PaperChase)
Clinical Use

- Gives support with decisions
  - Advice and consultation
  - Bibliographic retrieval (PaperChase)
  - Searching the clinical database
Clinical Use

- Gives support with decisions
  - Advice and consultation
  - Bibliographic retrieval (PaperChase)
  - Searching the clinical database
  - Alerts and reminders
Clinical Use

- Provides clinical information upon request
- Gives support with decisions
- Assists with interpersonal communication
Clinical Use

- Provides clinical information upon request
- Gives support with decisions
- Assists with interpersonal communication
- Assists with clinical practice
Clinical Use

- Assists with routines of clinical practice
  1. Assists with requests (order entry)
  2. Assists with administrative chores
  3. Adverse Drug Reaction Reporting
  4. Cross Coverage Options
  5. Personal Patient Lookup
  6. Resident/Medical Student
  7. Confidential Counseling for House Staff
Clinical Use

- Provides clinical information upon request
- Gives support with decisions
- Assists with interpersonal communication
- Assists with routines of clinical practice
- Assists with education
In the tradition of John Dewey (1859-1952), cybermedicine promotes learning in the context of caring for real patients.
Cybermedicine for the Clinician

☐ Evaluation of cybermedicine with criteria that remain valid to this day:
Behaviorist’s Criterion

- Are the consequences of use reinforcing?
  (Behavior is shaped by its consequences)
Behaviorist’s Paradigm

We could assess the strength of reinforcement early on because use was voluntary; and a distinguishing feature was the intensiveness and extensiveness of use without coercion.
Voluntary Use of Patient Lookup at BIDMC: Inpatients and Outpatients
Voluntary use of Patient Lookup According to Type of Inquiry at BIDMC, April 27-May 3, 1998

<table>
<thead>
<tr>
<th>Service</th>
<th>Inpatients</th>
<th>Outpatients</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>All Labs – Most Recent Results</td>
<td>17,018</td>
<td>10,044</td>
<td>27,062</td>
</tr>
<tr>
<td>Demographics</td>
<td>3,277</td>
<td>9,420</td>
<td>12,697</td>
</tr>
<tr>
<td>Chemistry</td>
<td>4,310</td>
<td>4,793</td>
<td>9,103</td>
</tr>
<tr>
<td>Radiology</td>
<td>2,681</td>
<td>6,028</td>
<td>8,709</td>
</tr>
<tr>
<td>Narrative Notes</td>
<td>1,163</td>
<td>3,893</td>
<td>5,056</td>
</tr>
<tr>
<td>Cardiology</td>
<td>1,548</td>
<td>2,697</td>
<td>4,245</td>
</tr>
<tr>
<td>Pathology</td>
<td>528</td>
<td>3,562</td>
<td>4,090</td>
</tr>
<tr>
<td>Microbiology</td>
<td>1,990</td>
<td>1,001</td>
<td>2,991</td>
</tr>
<tr>
<td>Hematology</td>
<td>1,014</td>
<td>1,786</td>
<td>2,800</td>
</tr>
<tr>
<td>Blood Bank</td>
<td>743</td>
<td>439</td>
<td>1,182</td>
</tr>
<tr>
<td>Pharmacy</td>
<td>753</td>
<td>282</td>
<td>1,035</td>
</tr>
<tr>
<td>Neurophysiology</td>
<td>96</td>
<td>251</td>
<td>347</td>
</tr>
<tr>
<td>Pulmonary Function</td>
<td>108</td>
<td>187</td>
<td>295</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>35,229</strong></td>
<td><strong>44,383</strong></td>
<td><strong>79,612</strong></td>
</tr>
</tbody>
</table>
Consequences of use reinforcing
Attitude toward the system
Assessment by Clinicians:

With a computer-conducted interview, 849 polled, 662 responded (78 percent) 589 (89%) found the system “very helpful.”
A resident doctor at Beth Israel Hospital wrote:

“If we [had had the system when I was an intern] I estimate that I would have saved myself an hour a day at least.”
A staff doctor at Brigham and Women’s Hospital wrote:

“This has been a very helpful service and has added to our ability to provide good care, [to] communicate… and has been a real time saver as well.”
Consequences of use reinforcing
Attitude toward the system
Educational power of the system
A senior resident doctor at Beth Israel Hospital wrote:

“The system allows you to deliver much better patient care and do everything a doctor does much more efficiently because you have such quick, easy, and reliable access to test results and other patient information….But the computer is also a tremendous teacher. It allows you to follow up all you want on your patients. It’s probably the single most used thing in the hospital.”
Consequences of use reinforcing
Attitude toward the system
Educational power of the system
Effect of the system on quality of care
Indirect Evidence

Computing that offers information requested and advice on how to use it, with more ease, speed, reliability, and accuracy than otherwise possible, is improving the quality of care.
Direct Evidence

The time to act on important clinical events is significantly reduced when the doctor is reminded or alerted by the computer of the need to act.
Direct Evidence

Doctors at Beth Israel Deaconess Medical Center acted more quickly when offered reminders and alerts about procedures and medications.
Consequences of use reinforcing
Attitude toward the system
Educational power of the system
Effect of the system on quality of care
Cost of the system
To develop, implement, and evaluate

Total cost during the 1980s

<table>
<thead>
<tr>
<th>Institution</th>
<th>Cost Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>BIH</td>
<td>1.5 percent</td>
</tr>
<tr>
<td>BWH</td>
<td>2.0 percent</td>
</tr>
</tbody>
</table>
Consequences of use reinforcing
Attitude toward the system
Educational power of the system
Effect of the system on quality of care
Cost of the system
Effect of system on hospital finances
Time needed to collect bills in relation to use of computing programs at Beth Israel Hospital
Time needed to collect bills in relation to use of computing programs at Brigham & Women’s Hospital.
A theorem: the quality of the computing is inversely proportionate to the size of the instruction manual or to the length of the training period required for its use.
The electronic medical record systems are now supervised by administrators and have been moved to new, Web based technology, but the principles of clinical use and evaluation remain valid.
Hope for the future:
Clinical Informatics will become more and more helpful and less and less time-consuming for the clinician who will be freed to spend more and more valuable time with the patient.
Cybermedicine for the Clinician


Thank You!

Questions?????