New England HIMSS
January11, 2018

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

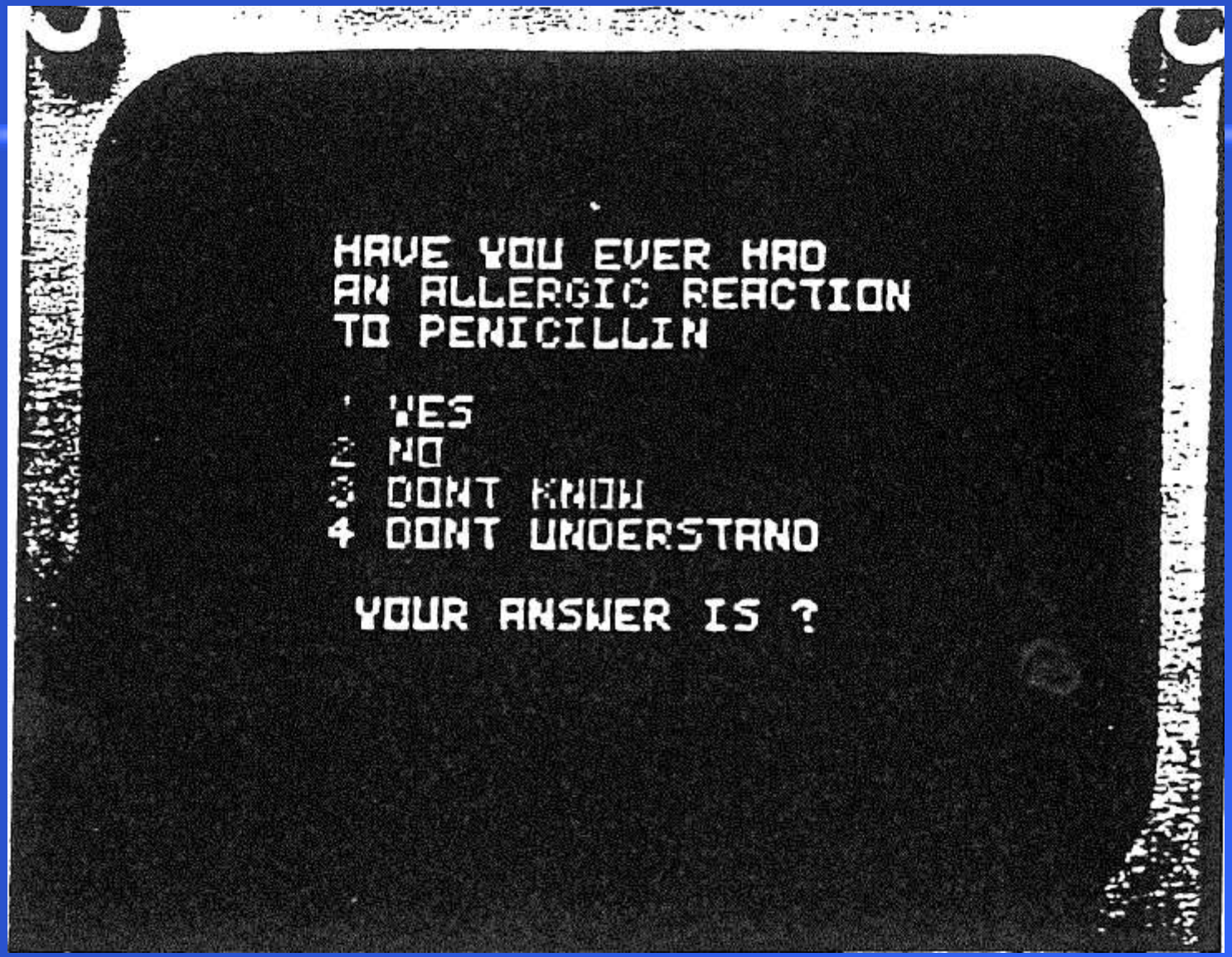
Warner V. Slack, M.D.
Division of Clinical Informatics,
Department of Medicine
Beth Israel Deaconess Medical Center
Harvard Medical School

wslack@bidmc.harvard.edu

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

Problems	Problems Detected by Both Physician & Computer	Problems Detected by Physician Only	Problems Detected by Computer Only
Urticaria	0	0	12
Allergic rhinitis	2	0	7
Asthma	4	0	2
Drug allergy	7	0	1

Slack, W.V. et al, New England Journal of Medicine, 1966


HAVE YOU EVER HAD
AN ALLERGIC REACTION
TO PENICILLIN
1 YES
2 NO
3 DONT KNOW
4 DONT 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

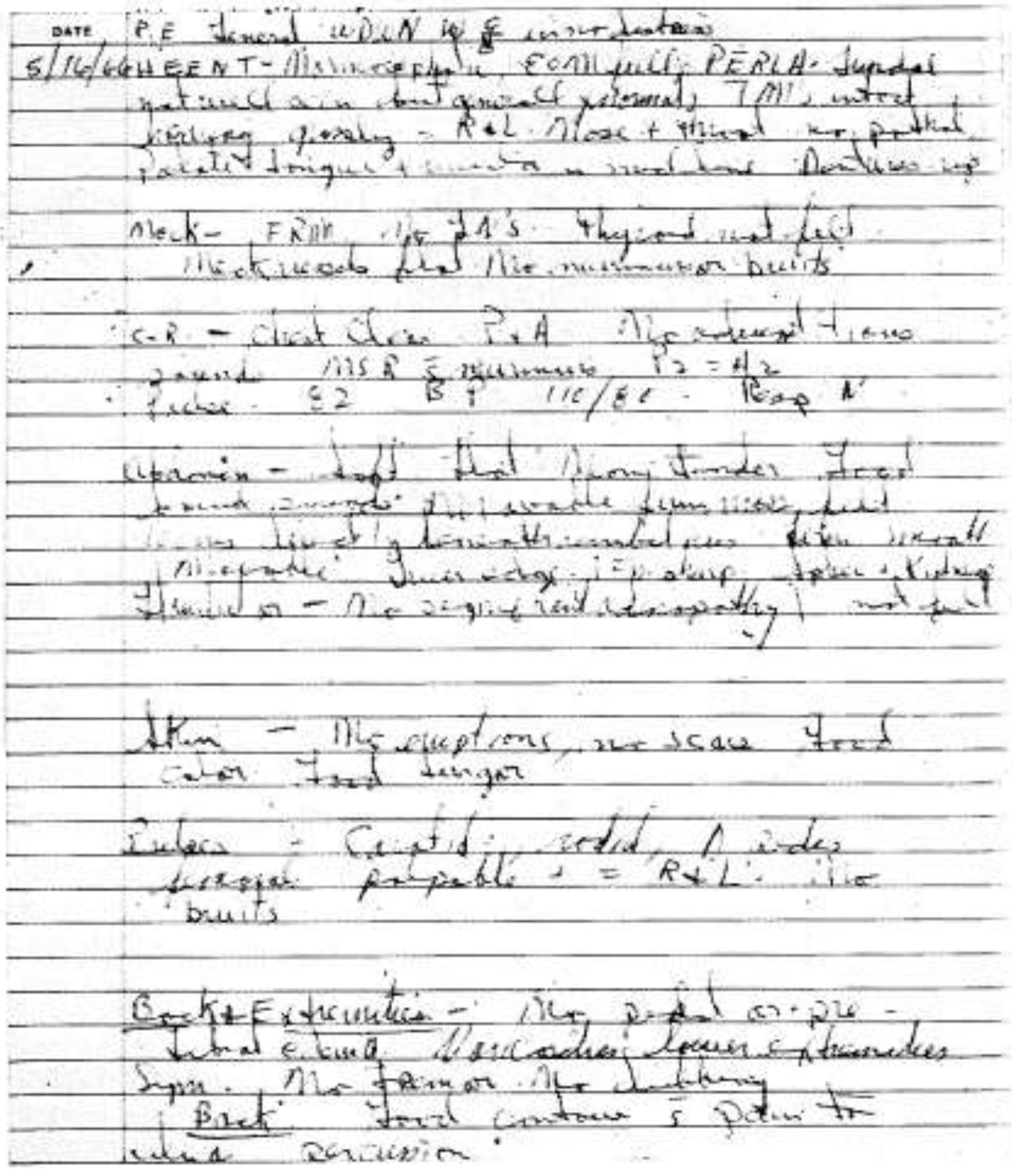
Yielding Control

- 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

- Slack WV, Peckham BM, Van Cura LJ, Carr WF. A computer-based physical exam system. JAMA 1967; 200: 224-8.

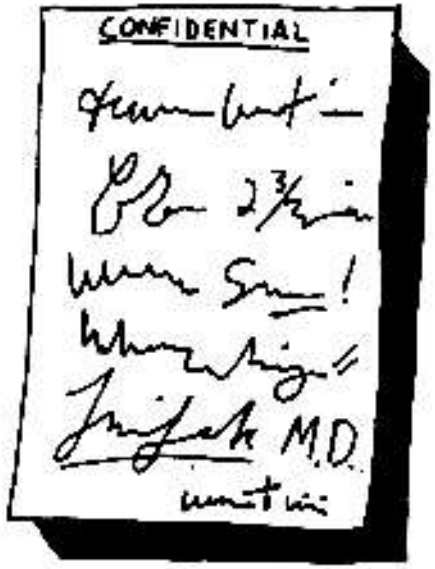
5. ***Left,*** **Handwritten portion of a physical examination taken from a chart.**
Right, **Computer-based record of the physical examination shown for comparison.**



1. VITAL SIGNS
   BLOOD PRESSURE 147-80
   RADIAL PULSE 86 PER MIN
   NORMAL FEEL AND RHYTHM
   RESPIRATIONS 16 PER MIN
   NORMAL
   TEMPERATURE 98 DEGREES F.
   WEIGHT 167 POUNDS
2. GENERAL APPEARANCE
   WELL-NOURISHED
   OBESE
   APPEARANCE COMPATIBLE WITH STATED AGE
3. MENTAL STATUS
   ALERT, ORIENTED REGARDING TIME, PLACE AND PERSON -- MEMORY NORMAL
4. NO ACUTE MEDICAL DISTRESS
5. SKIN
   NORMAL COLOR AND TEXTURE
   HAIR TEXTURE AND DISTRIBUTION NORMAL FOR SEX
   NO SCARS
   NO SKIN ERRUPTION
   NO JUNCTIONAL NEVI, SPIDER HEMANGIOMATA, POSSIBLE
   CANCEROUS OR PRE-CANCEROUS LESIONS
   NO ULCERS, SEBORRHEIC DERMATITIS OR MUCOUS MEMBRANE ABNORMALITIES
6. HEAD
   NORMOCEPHALIC
   NO PARANASAL SINUS TENDERNESS
7. EYES
   CONJUNCTIVAE AND SCLERAE CLEAR
   PUPILS ROUND, EQUAL, AND REACT TO LIGHT AND ACCOMMODATION
   NO PTOSIS EXOPTHALMUS, PROPTOSIS, OR EXTRAOCULAR
   MUSCLE ABNORMALITY
   EXTRAOCULAR MUSCLES INTACT
   VISUAL FIELDS GROSSLY NORMAL
   INTRAOCULAR TENSION NORMAL
   FUNDUSCOPIC -- MEDIA, DISCS, VESSELS AND MACULAE NORMAL
8. EARS
   MASTOID PROCESSES, AURICLES, CANALS AND TYMPANIC MEMBRANES NORMAL
   HEARING GROSSLY NORMAL
9. NOSE
   NORMAL
10. MOUTH AND THROAT
    MOUTH NORMAL
    NO DENTURES OR PLATES
    UVULA, TONSILS AND POSTERIOR PHARYNX NORMAL
11. NECK
    NO RIGIDITY OR LIMITATION OF MOTION
    CAROTID PULSES EQUAL BILATERALLY
    NO VENOUS DISTENTION, MASSES, TRACHEAL DEVIATION
    OR THYROID ABNORMALITY
12. SPINE - NORMAL
13. THORAX
    NORMAL CONFIGURATIONS, SYMMETRY, AND RESPIRATORY MOVEMENTS
    PERCUSSION OVER LUNGS NORMAL
    LUNG AUSCULTATION NORMAL

ANNOUNCING THE ONLY FOOLPROOF, GUARANTEED INDECIPHERABLE, ABSOLUTELY CONFIDENTIAL HOSPITAL RECORDS SECURITY SYSTEM:

DOCSCRIPT!



On to Boston: BIH and HMS

Formation of the Division

Cybermedicine for the Patient

A Computer-Based Health Care Interview for Hospital Personnel

Slack WV, Safran CS, Kowaloff HB, Pearce J, Delbanco TL. A computer-administered health screening interview for hospital personnel. MD Comput 1995; 12: 25-30.

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.

<ENTER>

Stress

There are several places where you could call at any time to speak in confidence about these feelings.

<ENTER>

Stress

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?

Yes	811	(42%)
No	890	(46%)
Maybe	190	(10%)
Don’t understand	12	(1%)
Skip it	34	(2%)

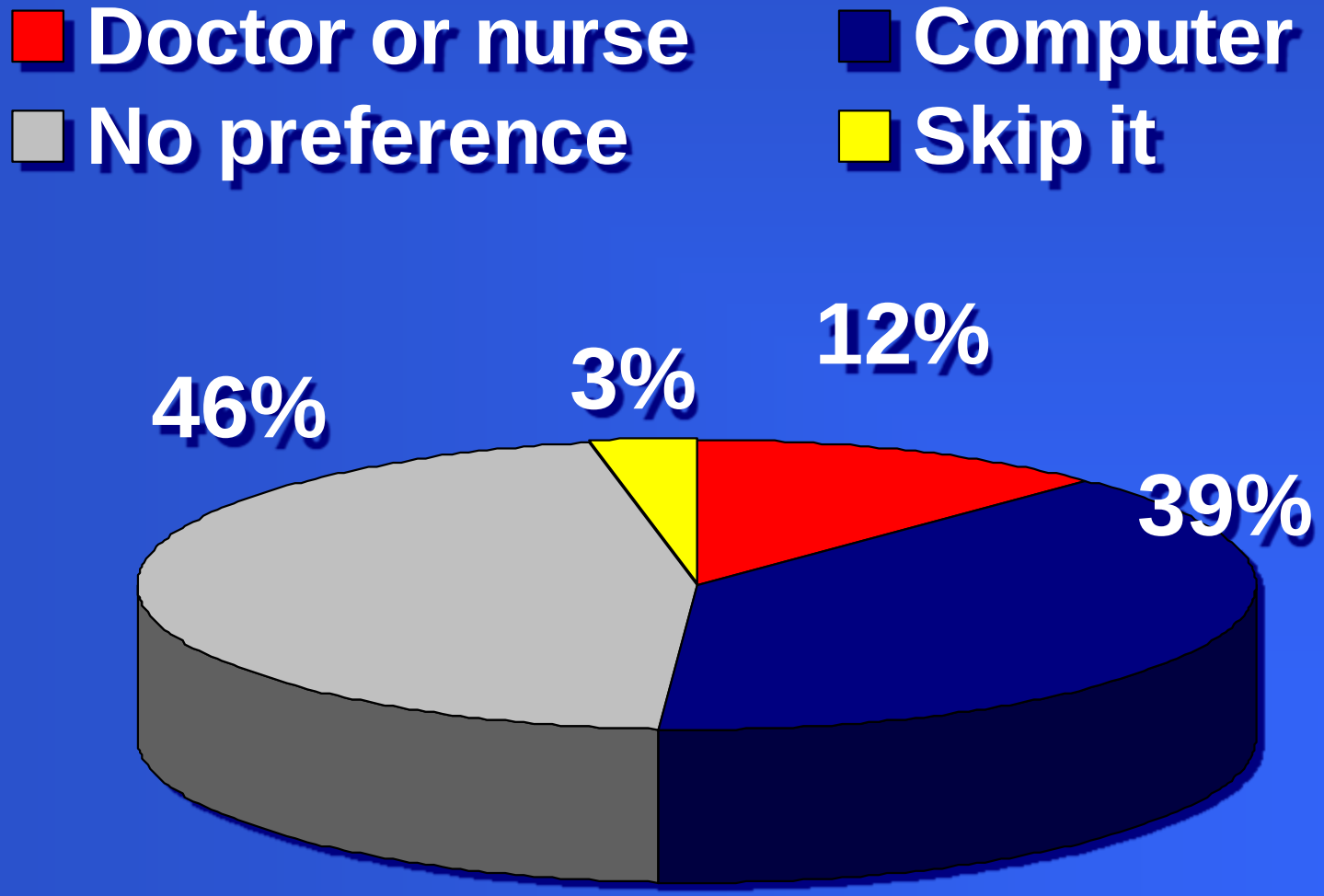
In the past month has life sometimes seemed like it's not worth living?

Yes	106	(6%)
No	812	(42%)
Maybe	57	(3%)
Don't understand	3	(0%)
Skip it	33	(2%)

Assessment of the Interview

Interview Worthwhile	90%
Easy to understand	93%
Informative about health	37%
Length about right	68%

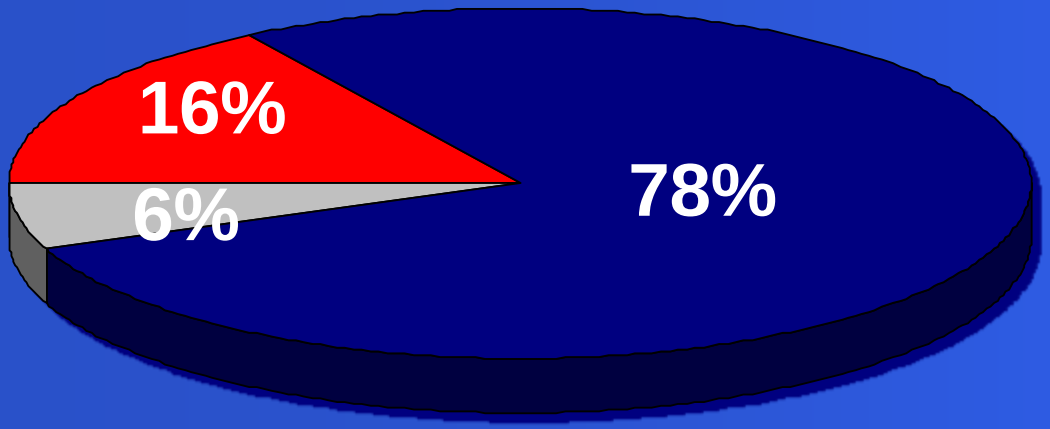
Preference
Computer vs. Doctor or Nurse



Did the computer sometimes ask more than you wanted to tell?

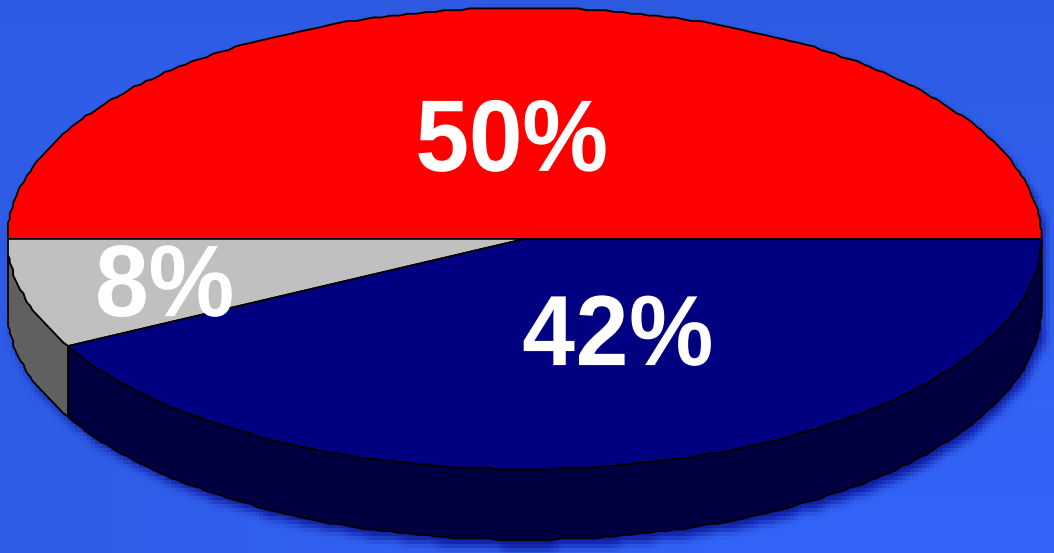
Yes

No



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

Uncertain



Health-Related Program Requests

Fitness Center	1385
Stress Reduction	724
Time Management	457
Low-Back Protection	260
Smoking Cessation	126
Total	2952

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

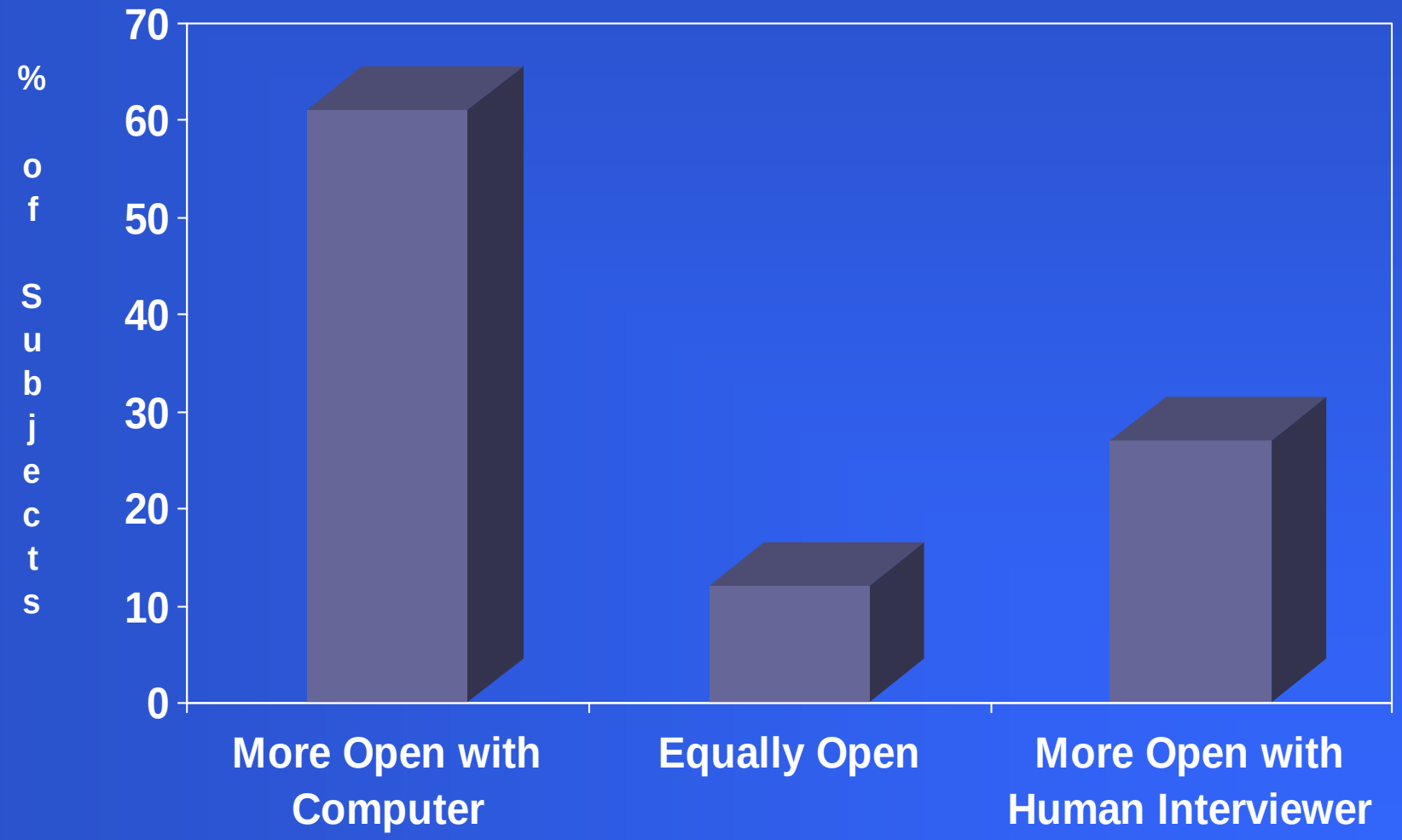
Early on, patients often told us they found it easier to communicate with the computer than to their doctor about potentially embarrassing matters---a finding subsequently corroborated by many others.

Slack WV, Van Cura LJ. Patient reaction to computer-based medical interviewing. Comput Biomed Res 1968; 1: 527-31.

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

Computer-Assisted Psychotherapy
Soliloquy Therapy

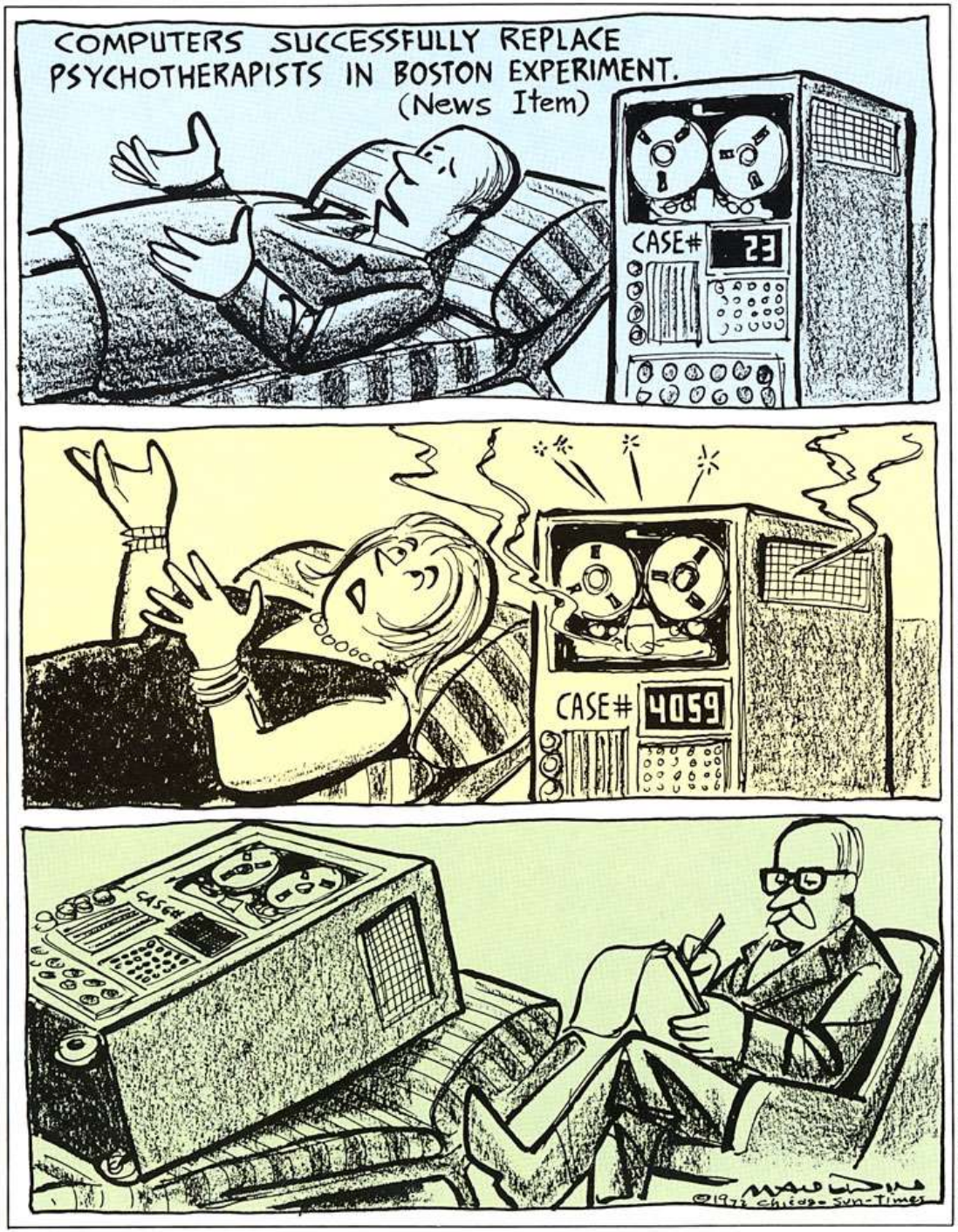
- Soliloquy Therapy

  Initial Study :

  Slack WV, Slack CW. Patient-computer dialogue. N Engl J Med 1972; 286: 1304-9

  Follow-up Study

  Slack WV, Porter D, Balkin P, Kowaloff HB, Slack CW. Computer-assisted soliloquy as an approach to psychotherapy. MD Comput 1990; 7: 37-42, 58.



Cybermedicine Medical Interview Outline

- Reason(s) For Appointment
- Problem List (in patient's words)
- Medications
  - Current medications
  - Allergies or adverse reactions
- Preventive Measures
- Positive Findings (taken from review of systems)
- Personal and Social History
  - Residence
  - Marital history
  - Living conditions
  - Children
  - Education
  - Occupation
  - Habits
  - Dietary supplements
  - Exercise
- Review of Systems
  - General Health
  - Lymph Nodes
  - Skin
  - Hematopoetic System
  - Rheumatology
  - Allergies
  - Endocrine system
  - Immunizations
  - Childhood Infections
  - Eyes, Ears, Nose, Mouth, and Throat
  - Sexually Transmitted Diseases
  - Gastrointestinal System
  - Respiratory System
  - Genitourinary system
  - Psychiatric History
  - Nervous System
- Family History

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?

Not at all respectful								Very respectful		
1	2	3	4	5	6	7	8	9	10	
0	0	0	1	0	1	1	4	4	21	Mean= 9.2

Slack WV, Kowaloff HB, Davis RB, Delbanco TL, Locke SE, Safran C, Bleich H. Evaluation of computer-based medical histories taken by patients at home. J Am Med Inform Assoc 2012;

Cybermedicine Medical Interview
Family History

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

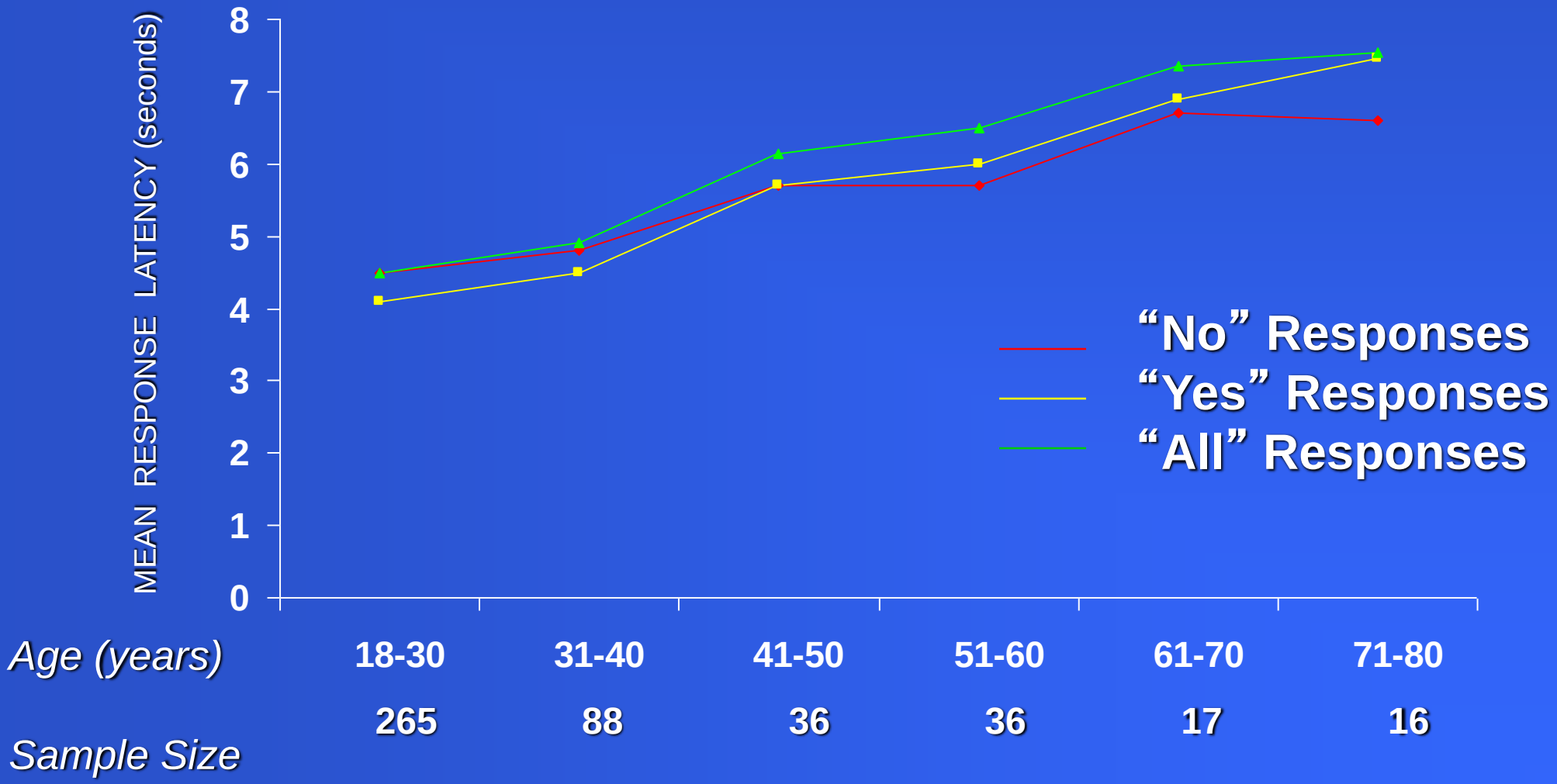
Patient-Computer Dialogue
Comparison with the clinician

- 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



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
  - automatic processing
  - 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:

Cybermedicine for the Clinician

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

00000000 Paxton, Minnette 3/21/97 97F

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

E-Mail

Retract Mail

Read Mail
Write Message
Retract Mail
Inquire If Message Read
Personal Menu
Help

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

Learning by doing

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

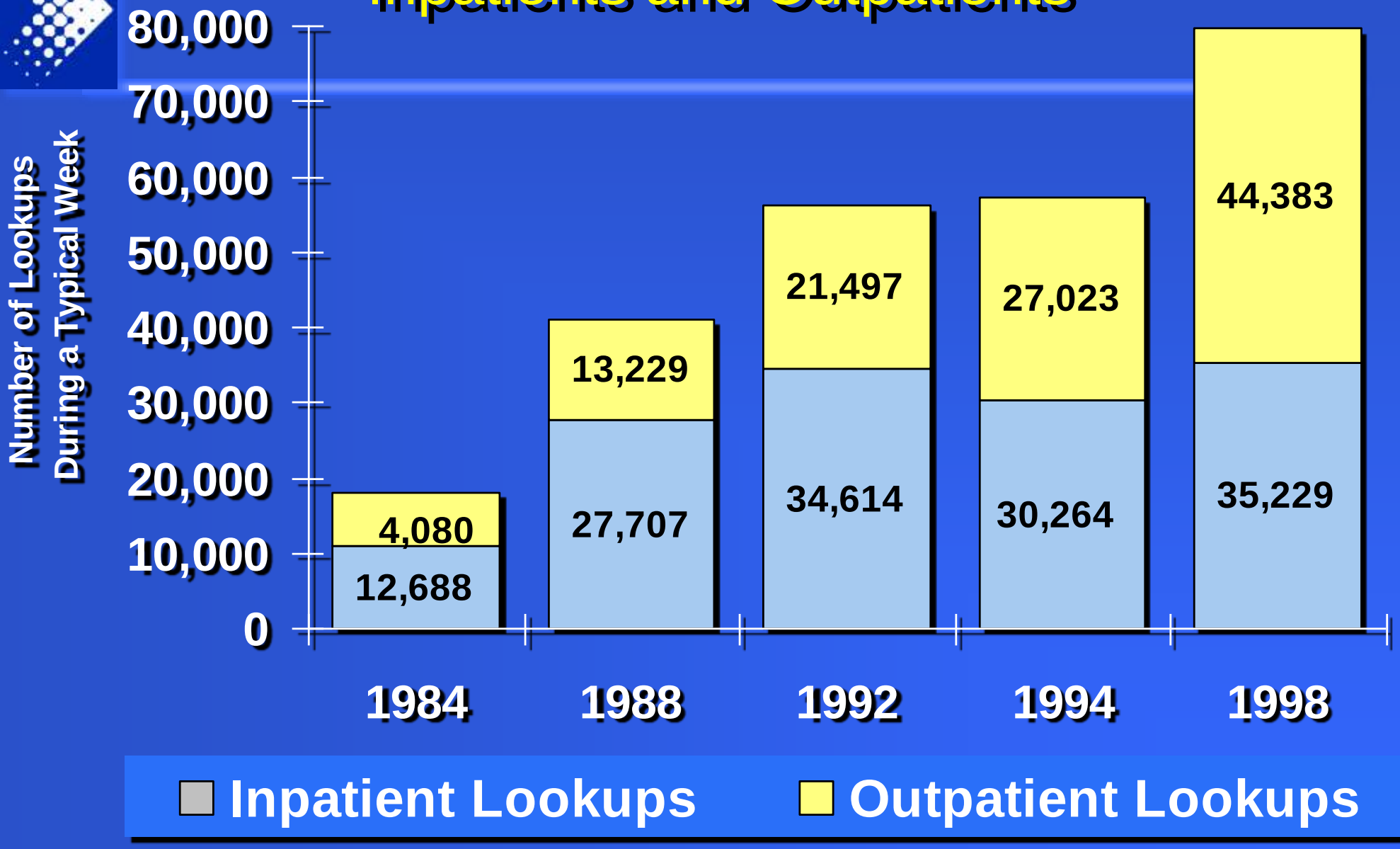
- Are the consequences of use reinforcing?

  (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

	Inpatients	Outpatients	Total
All Labs – Most Recent Results	17,018	10,044	27,062
Demographics	3,277	9,420	12,697
Chemistry	4,310	4,793	9,103
Radiology	2,681	6,028	8,709
Narrative Notes	1,163	3,893	5,056
Cardiology	1,548	2,697	4,245
Pathology	528	3,562	4,090
Microbiology	1,990	1,001	2,991
Hematology	1,014	1,786	2,800
Blood Bank	743	439	1,182
Pharmacy	753	282	1,035
Neurophysiology	96	251	347
Pulmonary Function	108	187	295
Total	35,229	44,383	79,612

- 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

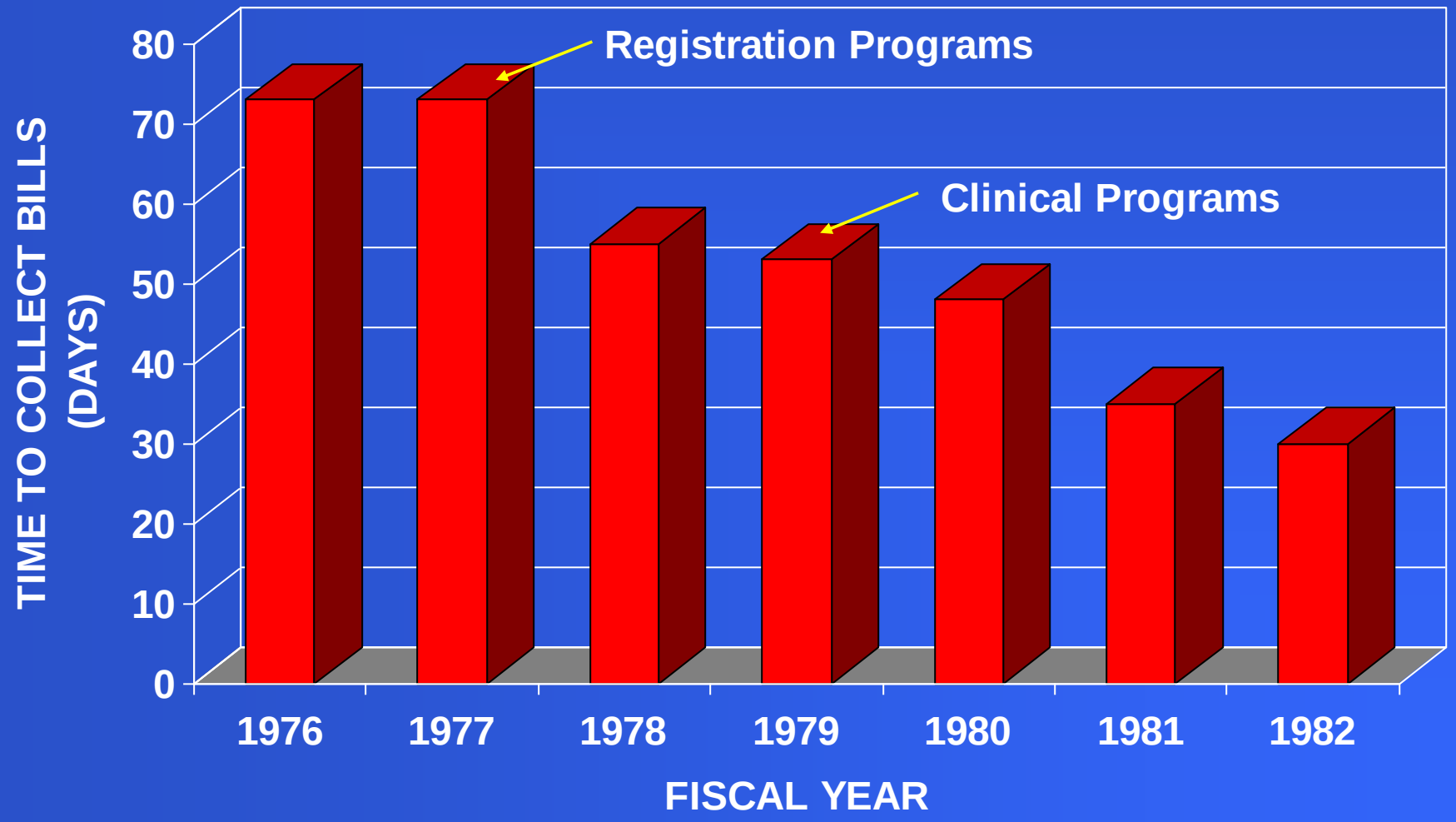
To develop, implement, and evaluate

Total cost during the 1980s

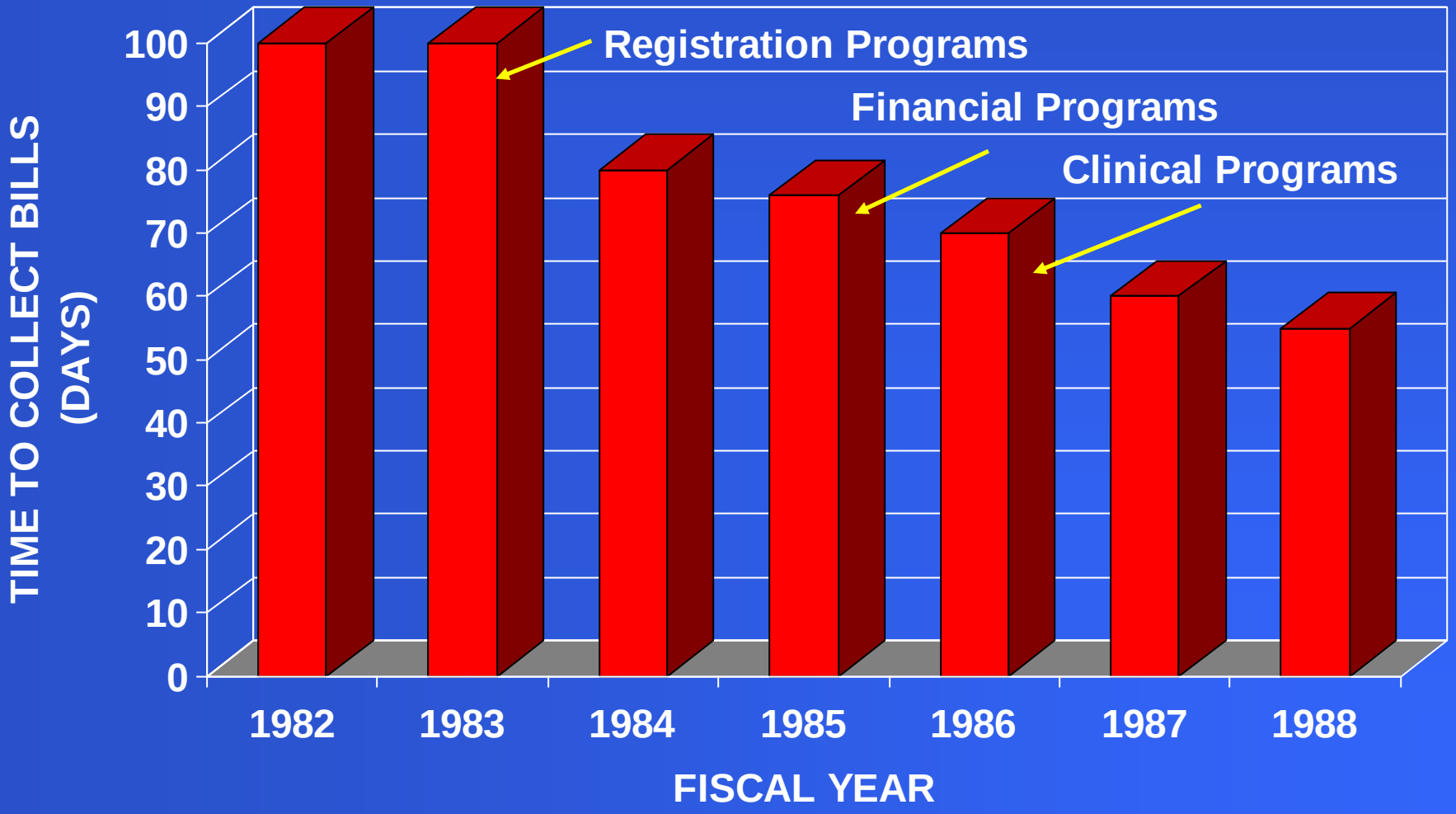
BIH	1.5	percent of operating budget
BWH	2.0	percent of operating budget

- 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



Cybermedicine

- 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.

Cybermedicine for the Clinician

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.

Cybermedicine for the Clinician

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

- Bleich HL, Beckley RF, Horowitz G, Jackson J, Moody E, Franklin C, Goodman SR, McKay MW, Pope RA, Walden T, Bloom SA, Slack WV. Clinical computing in a teaching hospital. N Engl J Med 1985; 312: 756-64.
- Safran C, Slack WV, Bleich HL. Role of computing in patient care in two hospitals. MD Comput 1989; 6: 41-8.
- Slack WV, Bleich HL. The CCC system in two teaching hospitals: a progress report. Int J Med Inform 1999; 54: 183-96.
- Bleich HL, Slack WV. Reflections on electronic medical records: when doctors will use them and when they will not. Int J Med Inform 2010; 79:1-4.

Thank You!

Questions????