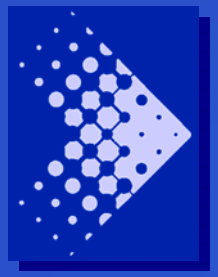
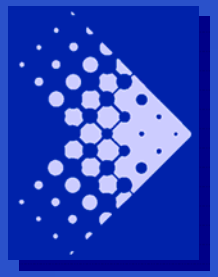
HST.921 / HST.922 Information Technology in the Health Care System of the Future, Spring 2009
Harvard-MIT Division of Health Sciences and Technology
Course Directors: Dr. Steven Locke, Dr. Bryan Bergeron, Dr. Daniel Sands, and Ms. Mirena Bagur

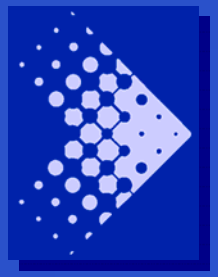


Information Technology in the Healthcare System of the Future

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

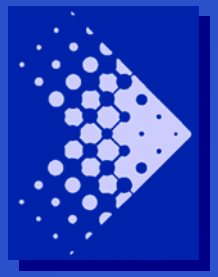


Cybermedicine for the Clinician



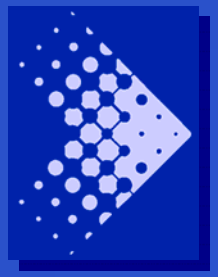
Clinical Use

- Provides clinical information upon request



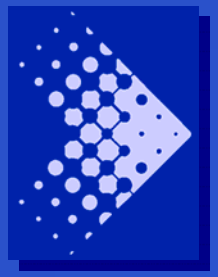
00000000 Paxton, Minnette 3/21/97 97F

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

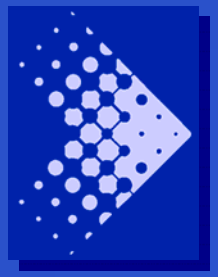


Clinical Use

- Gives support with decisions
  - Advice and consultation

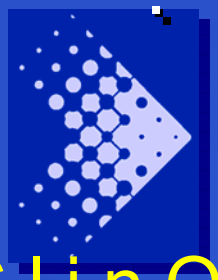
Clinical Use

- 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



C l i n Q u e r y

Sat Mar 17, 2001 3:07 pm

ClinQuery covers 495,448 admissions from 1984 through 2000.

Please enter the year or range of years (e.g. 85-90) you are going to search.

Year(s): 1999

C l i n Q u e r y Year 99 Sat Mar 17, 2001 3:09 pm

Look For: age

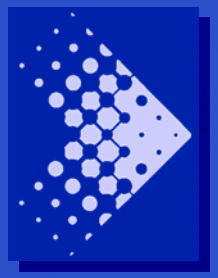
1. Admin/Demography
2. Laboratory Results
3. Blood Bank
4. Medications
5. Surgical Pathology
6. Radiology
7. Cardiac Cath
8. Outpatient
9. Diagnosis/procedure
10. DRG

Or enter ? for more information

Age

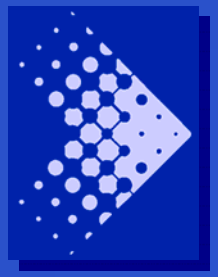
Choice	Values	Admissions
1)	<--- .9	5145
2)	1.0-9.9	1
3)	10.0-17.9	91
4)	18.0-19.9	261
5)	20.0-29.9	2723
6)	30.0-39.9	5614
7)	40.0-49.9	3427
8)	50.0-59.9	3602
9)	60.0-64.9	1847
A)	65.0-69.9	2009
B)	70.0-79.9	4278
C)	80.0 --->	3961

Choices:



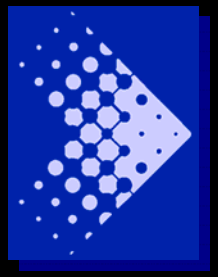
Clinical Use

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



Clinical Use

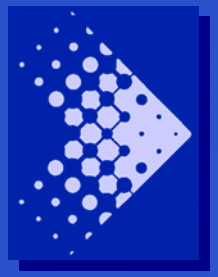
- Provides clinical information upon request
- Gives support with decisions
- Assists with communication



E-Mail

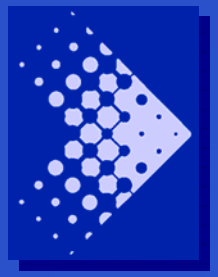
Retract Mail

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



Clinical Use

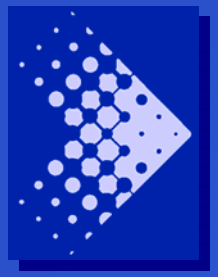
- Provides clinical information upon request
- Gives support with decisions
- Assists with communication
- Assists with clinical practice



Clinical Use

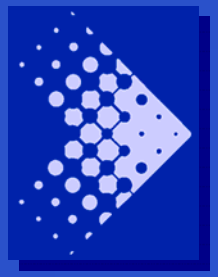
- Assists with clinical practice

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**



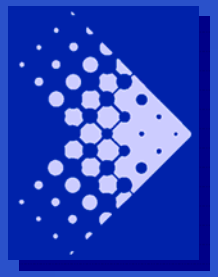
Clinical Use

- Assists with requests (order entry)
- Provides clinical information upon request
- Gives support with decisions
- Assists with communication
- Assists with clinical practice
- Assists with education

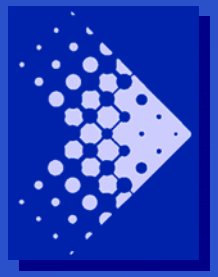


- Instructional Programs
- Learning by Doing

  In the tradition of John Dewey (1859-1952), cybermedicine promotes learning in the context of caring for real patients.



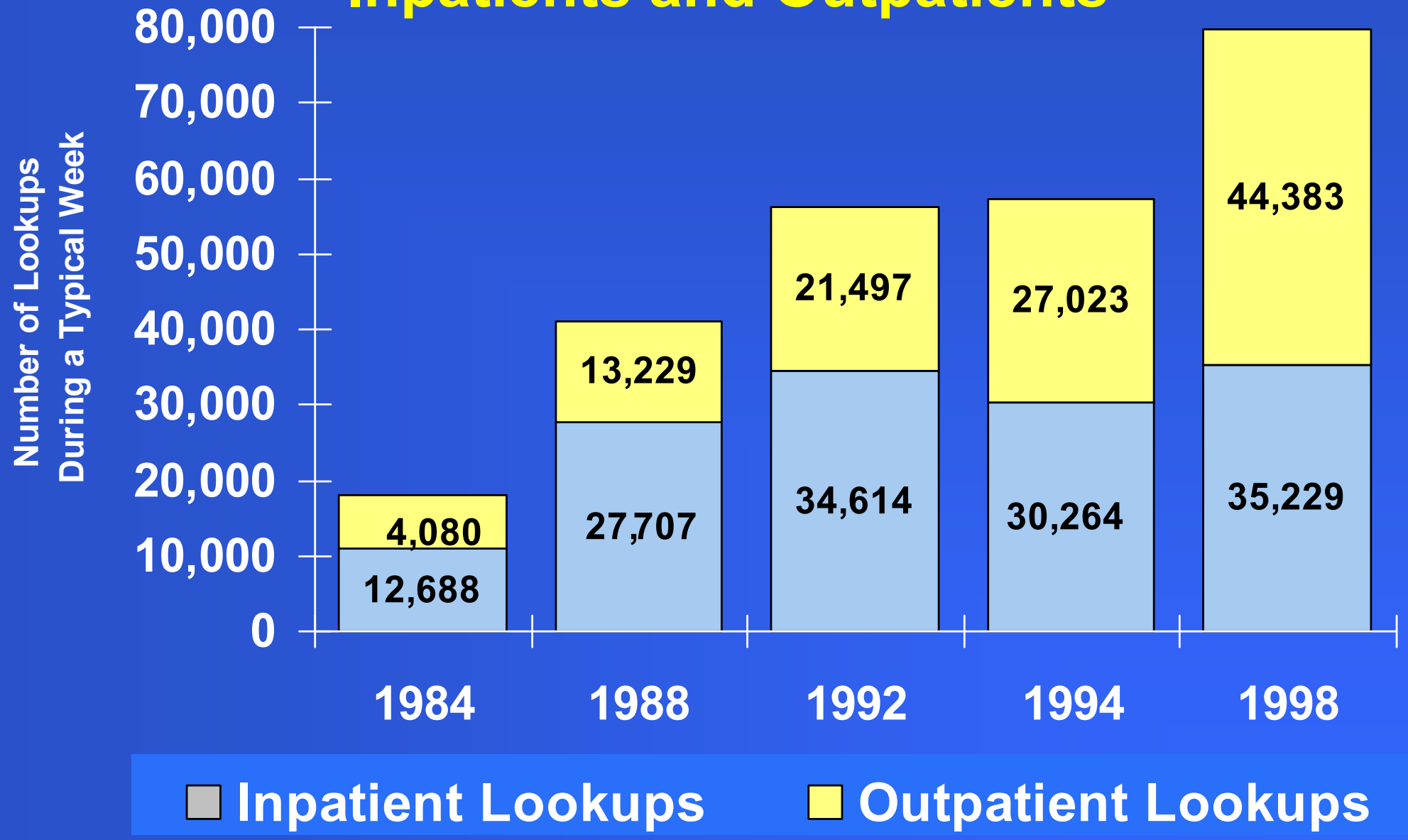
- Evaluating Cybermedicine



- Use of the system by voluntary users

  (A behaviorist's paradigm)

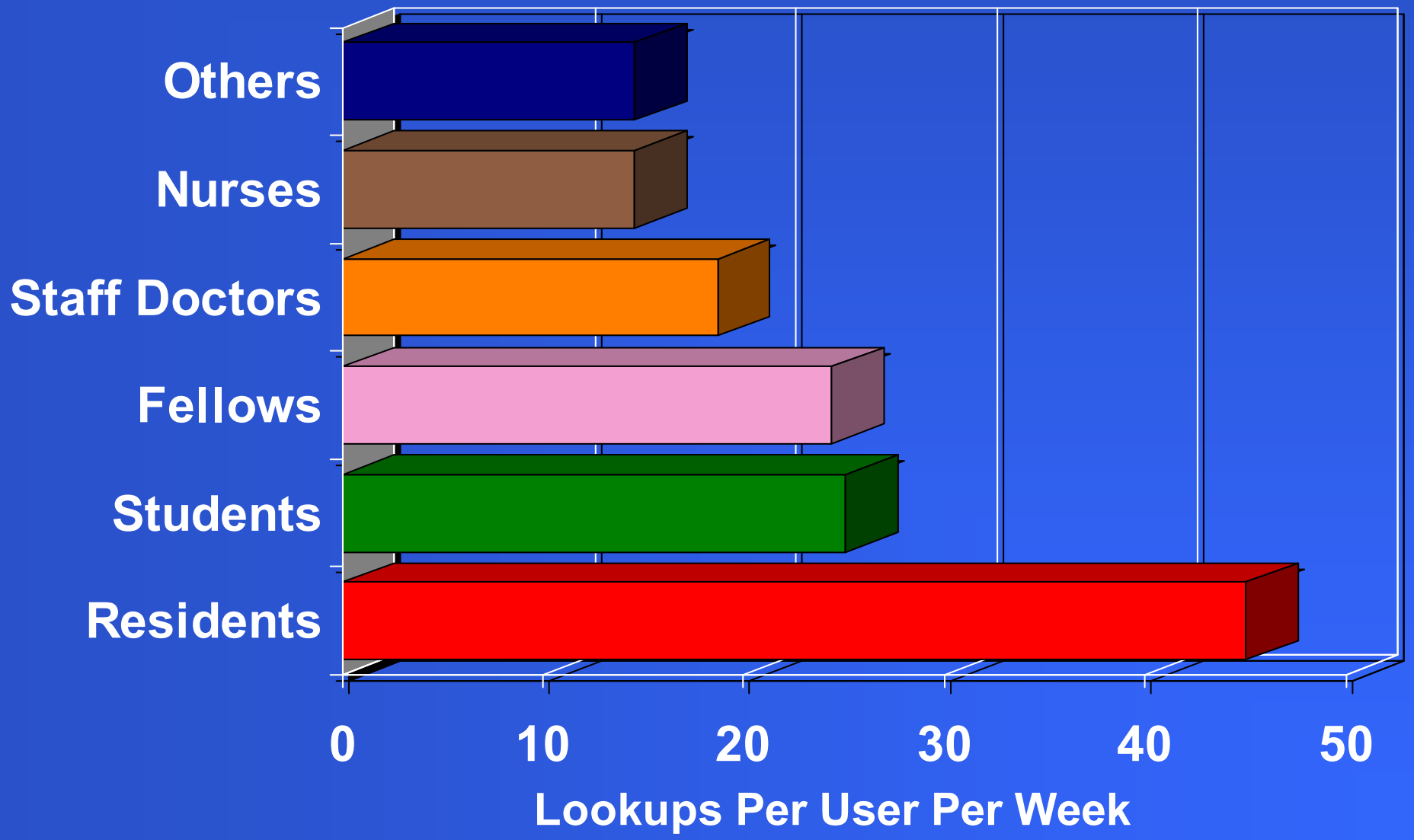
Beth Israel Deaconess Use of Patient Lookup: Inpatients and Outpatients

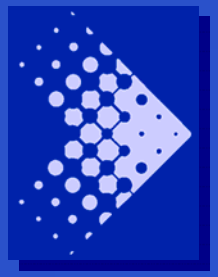


Use of Patient Lookup According to Type of Inquiry at Beth Israel Deaconess, April 27-May 3, 1998

	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

Use of Patient Lookup

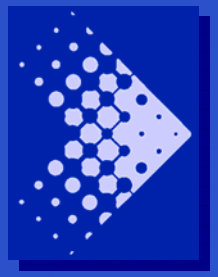




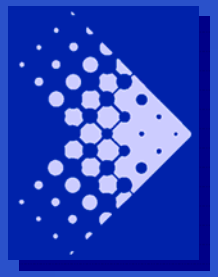
- Use of the system by voluntary users
- Attitude toward the system

Effect on Work

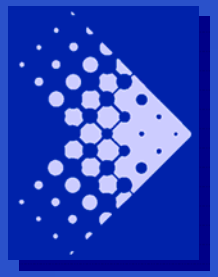
	Accuracy	Speed	Ease	Interest
Definitely worse	4	15	8	3
Probably worse	13	24	13	10
No difference	88	54	48	147
Probably better	204	192	182	190
Definitely better	236	260	294	195
Total	545	545	545	545



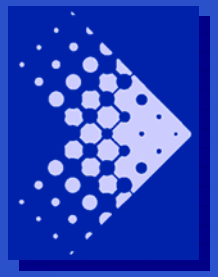
- Use of the system by voluntary users
- Attitude toward the system
- Educational power of the system



- Use of the system by voluntary users
- Attitude toward the system
- Educational power of the system
- Effect of the system on quality of care

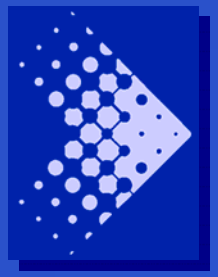


- Indirect Evidence

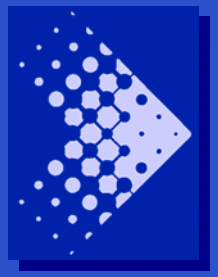


- Indirect Evidence

  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



Direct Evidence

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

- Direct Evidence

  (*Bates, Kuperman, Teich, et al*:)

  Physicians at Brigham and Women's Hospital, who now routinely use the computing system to request laboratory tests and prescribe medications…

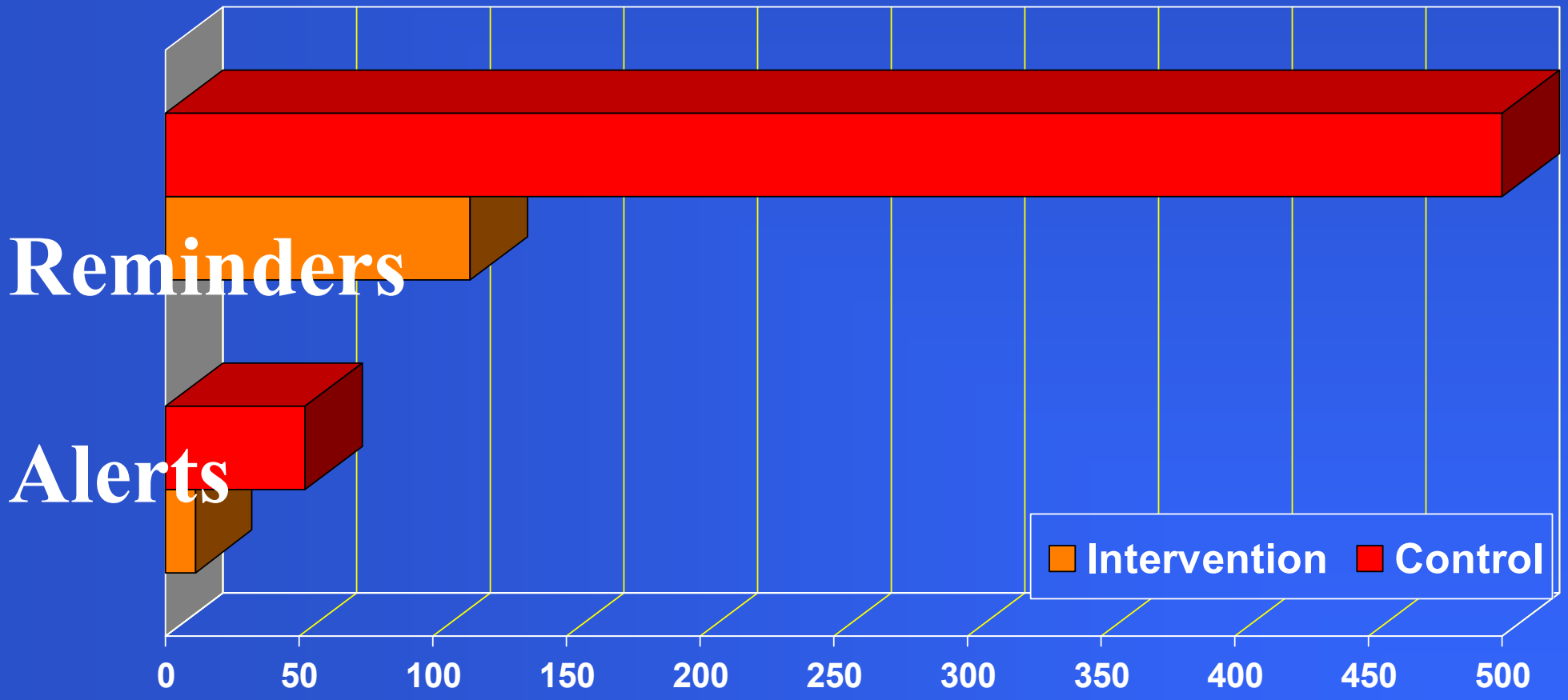
- Direct Evidence

  (*Bates, Kuperman, Teich, et al*:)

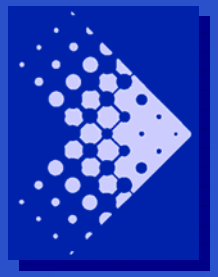
  …make significantly fewer errors.

  (serious errors in medications have been reduced by 55%)

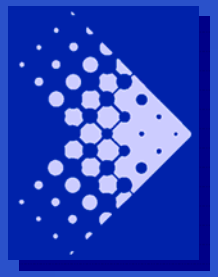
Clinician Response Time



(days)

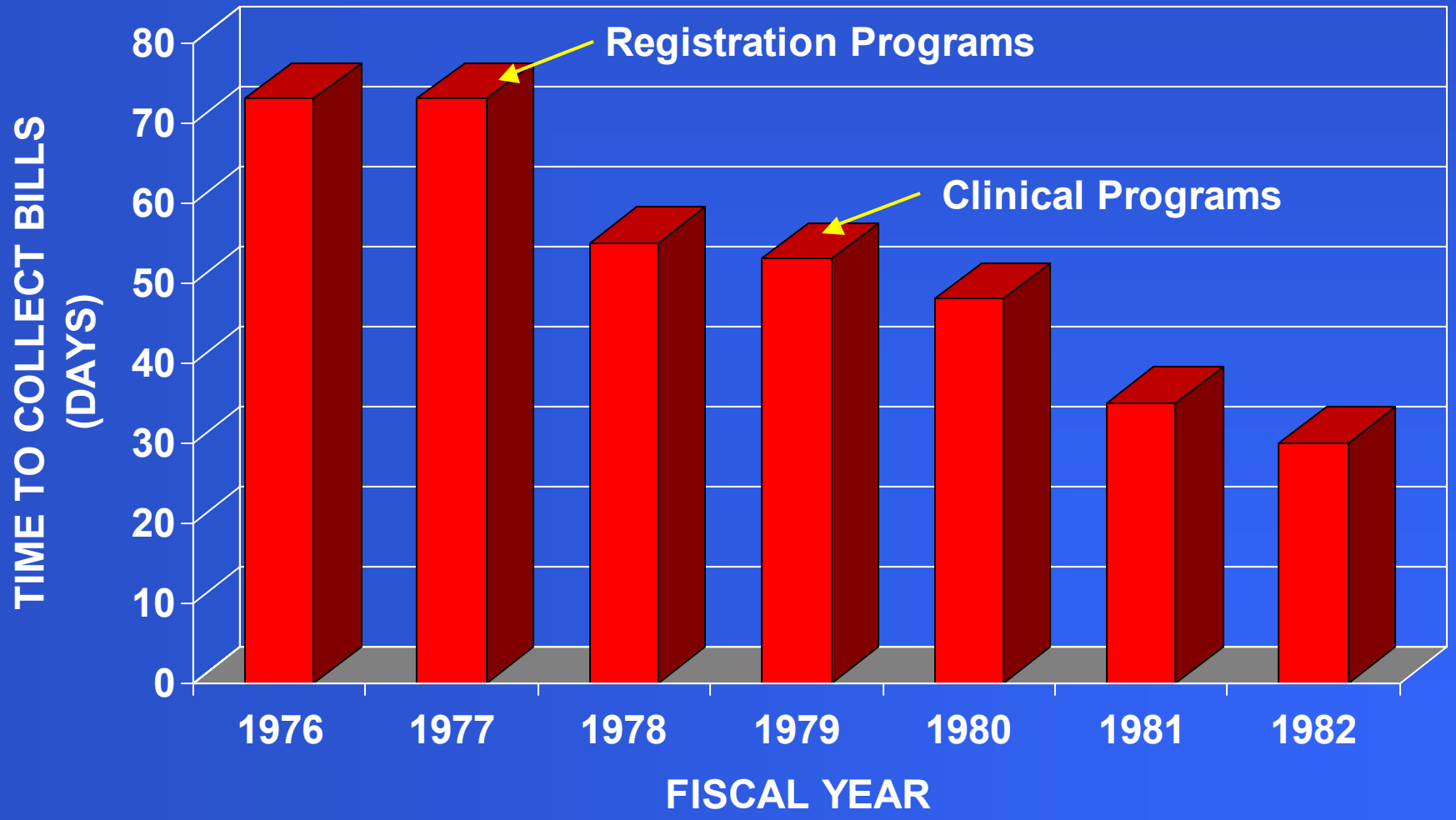


- Use of the system by voluntary users
- Attitude toward the system
- Educational power of the system
- Effect of the system on quality of care
- Cost of the system

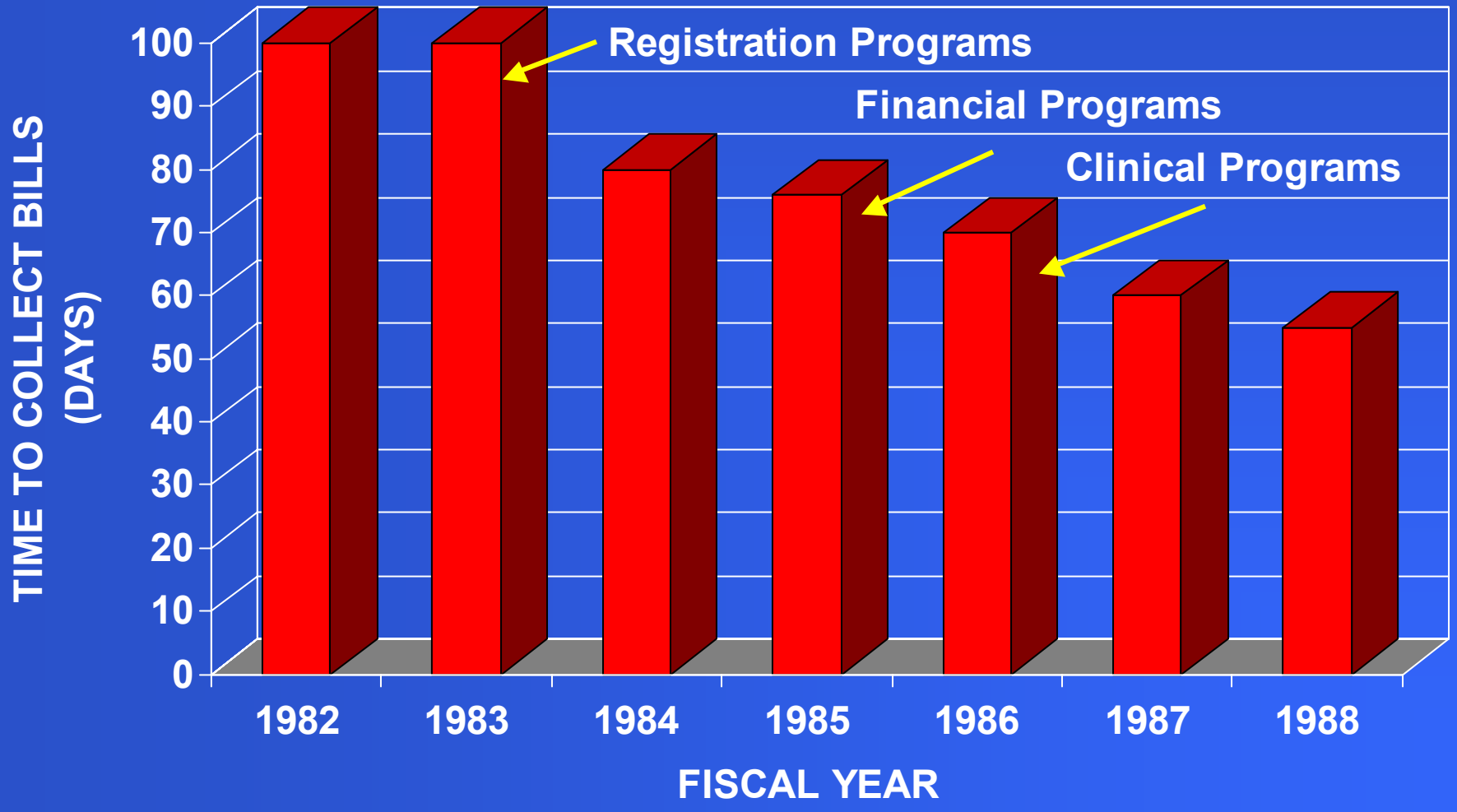


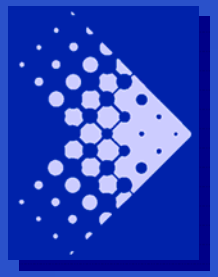
- Use of the system by voluntary users
- Attitude toward the system
- Educational power of the system
- Effect of the system on quality of care
- Cost of the system
- Effect of system on hospital finances

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

Break

"Analysis of 1353 questionnaires from 12 lectures showed that student concentration rose sharply to reach a maximum in 10-15 min, and fell steadily thereafter. The data suggest that the optimum length of a lecture may be 30 instead of 60 minutes."

Stuart J, Rutherford RJ. Medical student concentration during Lectures. Lancet 1978; 8088: 514-6.

Cybermedicine for the Patient

Fig. 6.1 The LINC (Laboratory Instrument Computer) in use in a medical interview in 1968. (Reproduced from Slack WV, Van Cura LJ. Patient reaction to computer-based medical interviewing. *Computers and Biomedical Research* 1968; **1**:527-531 with permission.)

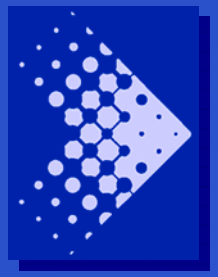
Cybermedicine for the Patient

- The First Study: A History of Allergies

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

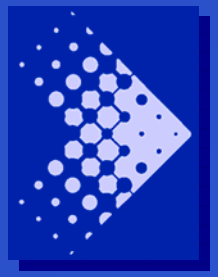
Problems	Problems Detected by Both Physician & Computer	Problems Detected by Physician Only	Problems Detected by Computer Only
Urticaria	0	0	12
Allergic rhinitis	2	0	7
Asthma	4	0	2
Drug allergy	7	0	1

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



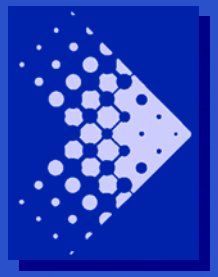
Yielding Control

- requesting permission to proceed



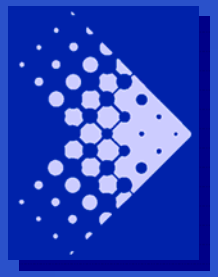
Yielding Control

- requesting permission to proceed
- providing sufficient information



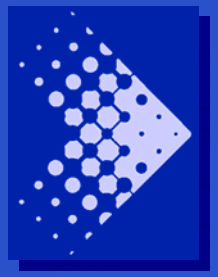
Yielding Control

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



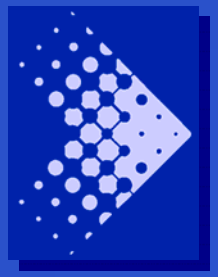
Yielding Control

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



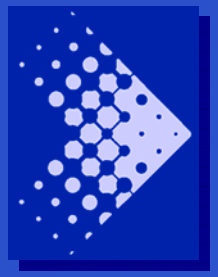
Yielding Control

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



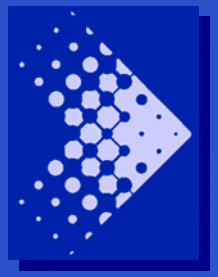
Yielding Control

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



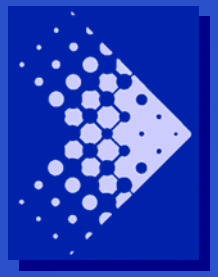
Yielding Control

- 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



Patient-Computer Dialogue

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
3. Maybe
4. Don't understand
5. Skip it

Answer: 1

Stress

In the PAST MONTH has life sometimes seemed as if 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)

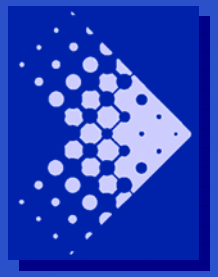
Please be assured that whatever you say will be kept confidential

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%)

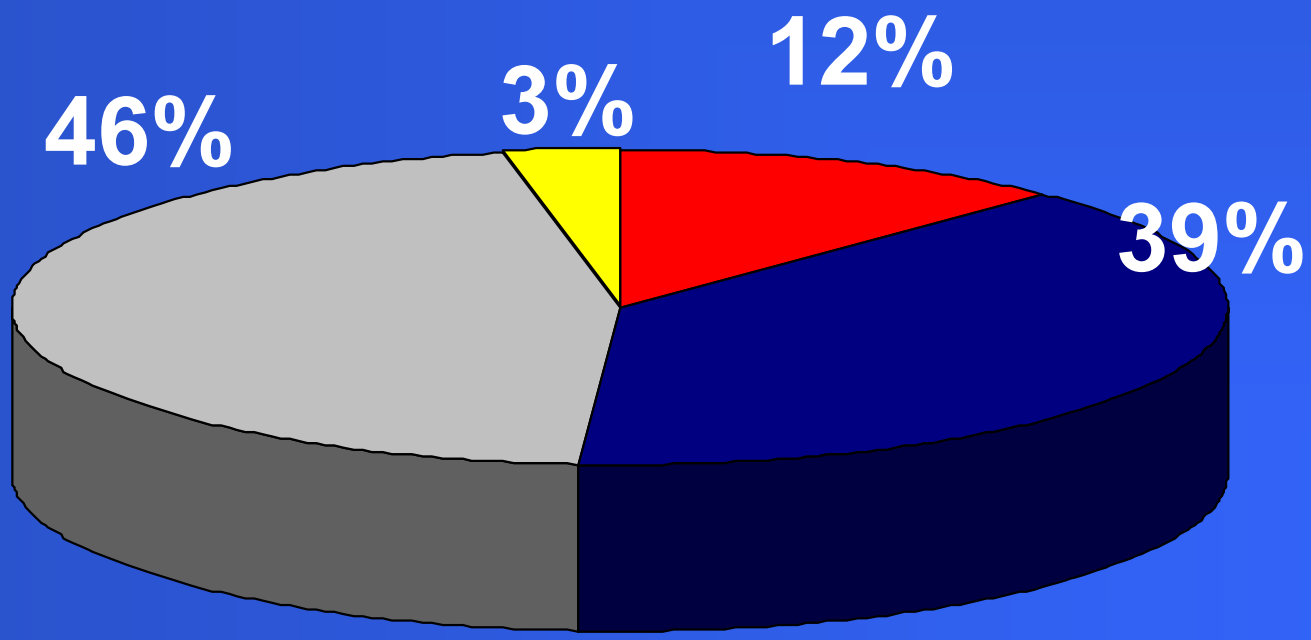


Cybermedicine for the Patient

Concerns about the computer as a negative, depersonalizing influence would prove unfounded.

Preference
Computer vs. Doctor or Nurse

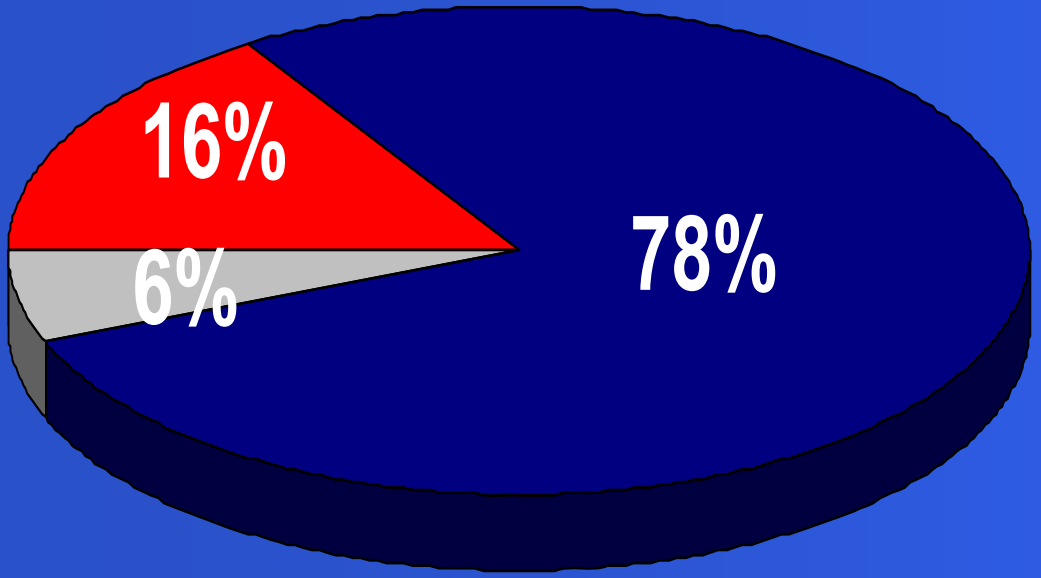
- Doctor or nurse
- Computer
- No preference
- Skip it



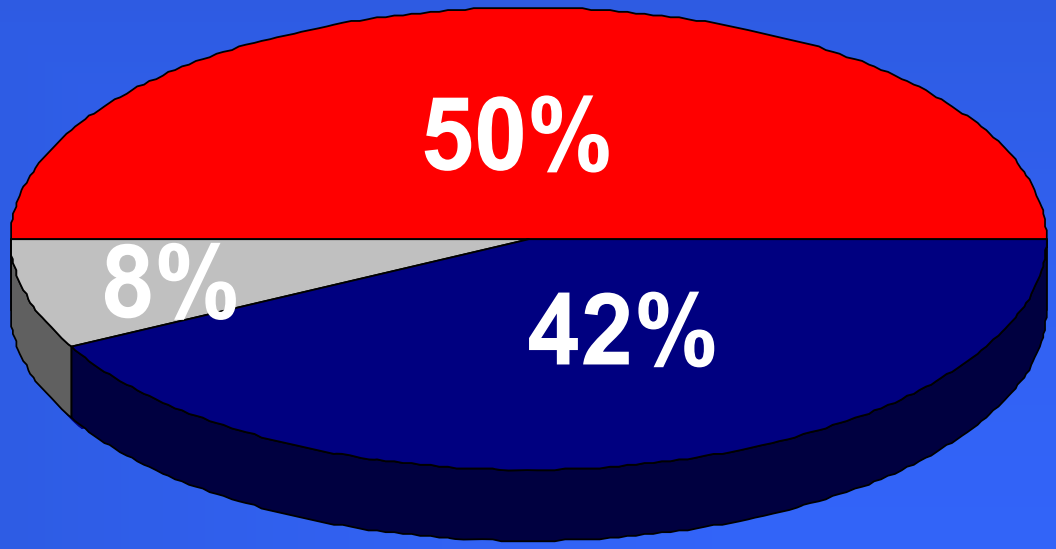
Assessment of the Interview

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

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



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



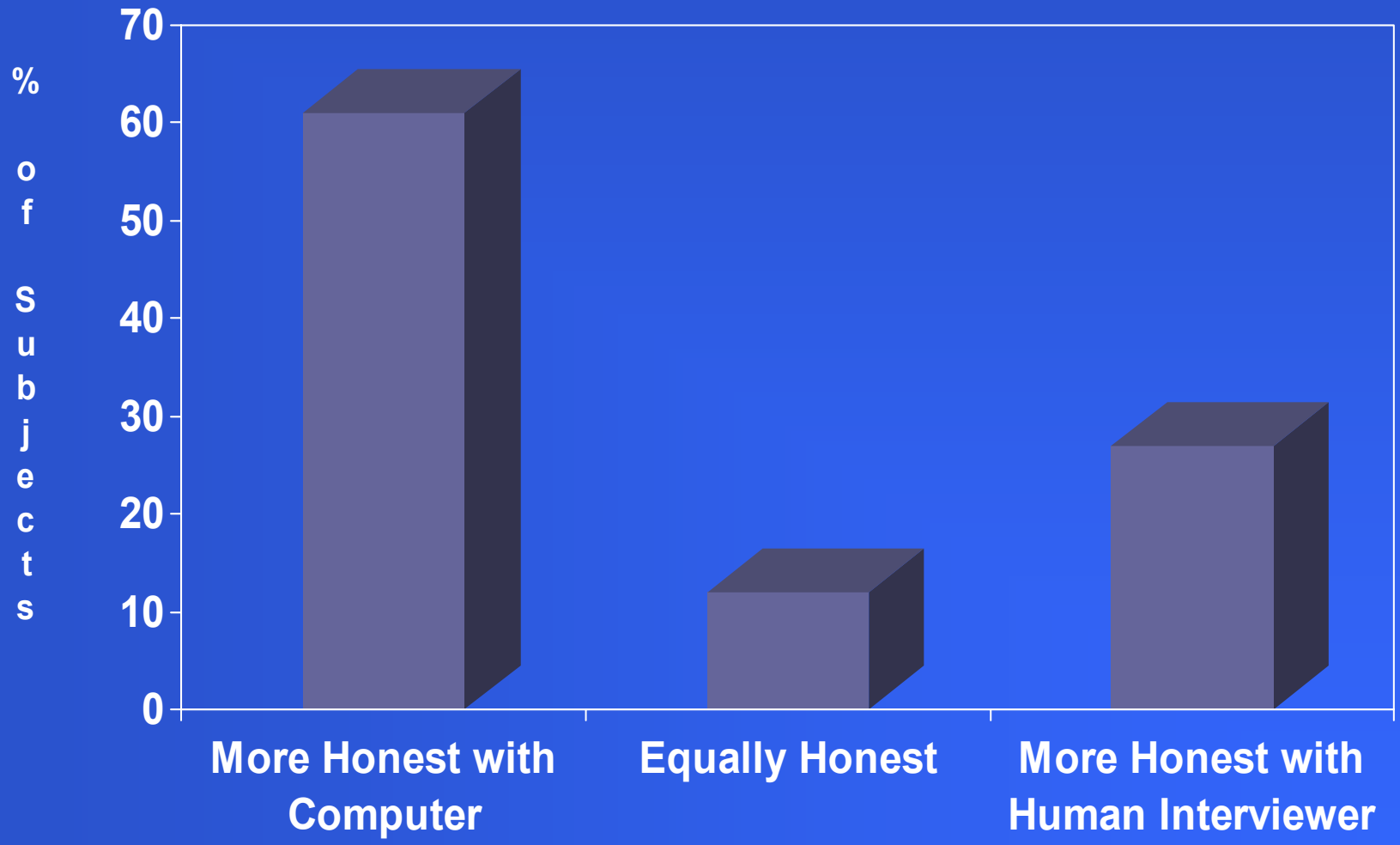
Revelation in the Absence of a Face-to-Face Encounter

(Abreaction or Disinhibition)

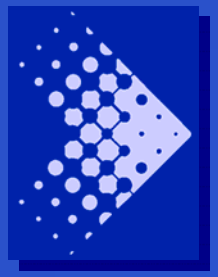
Revelation in the Absence of a Face-to-Face Encounter

Computer-based interview of potential blood donors elicited more HIV-related factors in the health histories than the standard questionnaire and interpersonal interviewing methods currently in use at the Red Cross.

Computer-Based Screening for HIV Risk



Locke SE, et al. JAMA, 1992



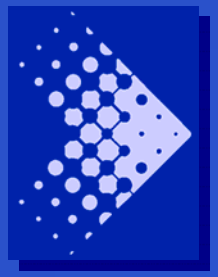
Cybermedicine for the Patient

Premise:

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

Possible solution:

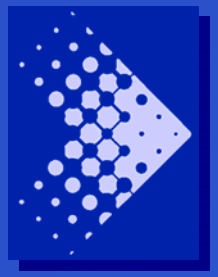
The Interactive computer is well positioned to help patients to help themselves.



Cybermedicine for the Patient

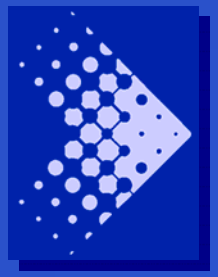
When the forces of supply and demand dictate it, patients do very well in managing even complex medical problems.

Example: Type I Diabetes



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

Patient-Computer Dialogue

After mastery of the keyboard, the program offers a bit of reinforcement,

e.g.“ You have a nice touch with the keys.”

Patient-Computer Dialogue

If it is OK with you, we would now like to ask a few questions about urinary symptoms...

Patient-Computer Dialogue

Are you bothered by pain or burning when you urinate?

1. Yes
2. No
3. Maybe (don’t know)
4. Don’t understand
5. Skip it

Patient-Computer Dialogue

Of these:

1. How well does the medicine work?
2. How much does it cost?
3. How safe is it?
4. How often must it be taken?
5. Is it a pill or an injection?
6. Can I get well without it?

Which is most important to you: 1

Patient-Computer Dialogue

Of these:
1. How well does the medicine work?
2. How much does it cost?
3. How safe is it?
4. How often must it be taken?
5. Is it a pill or an injection?
6. Can I get well without it?

Which is most important to you: 1

and which is least important : 5

Patient-Computer Dialogue

You indicated that knowing how well sulfa works is perhaps most important to you...

Let’s consider this first.

Patient-Computer Dialogue

Before deciding about sulfa, would you like to go over anything again?

1. Yes
2. No
3. Maybe (don’t know)
4. Don’t understand
5. Skip it

Patient-Computer Dialogue

Very well then...would you like to

1. Take sulfa
2. Take nothing
3. Consider another medicine
4. Uncertain (can’t decide)

Patient-Computer Dialogue

It seems that you took some extra time with your answer. Does this mean that you've been:

1. Thinking it over and feel you've made the right choice?

2. Trying to get things clear but aren't sure about your choice?

Patient-Computer Dialogue

We hope it's OK then, to ask again what is your decision?

1. Uncertain (can't decide)
2. Consider another medicine
3. Take nothing
4. Take sulfa

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

Was the computer considerate?

Yes	34
No	0
Maybe	0
Don't understand	0
Skip it	2

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

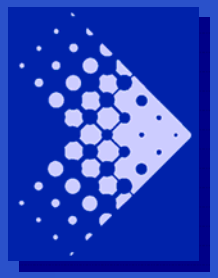
Patient-Computer Dialogue

Comparison with the clinician

Patient-Computer Dialogue

Comparison with the clinician

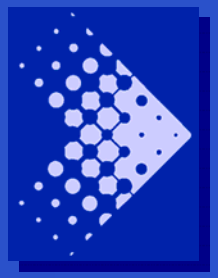
- disadvantages



Patient - Computer Dialogue

Comparison with the clinician

- disadvantages
  - –less interactive

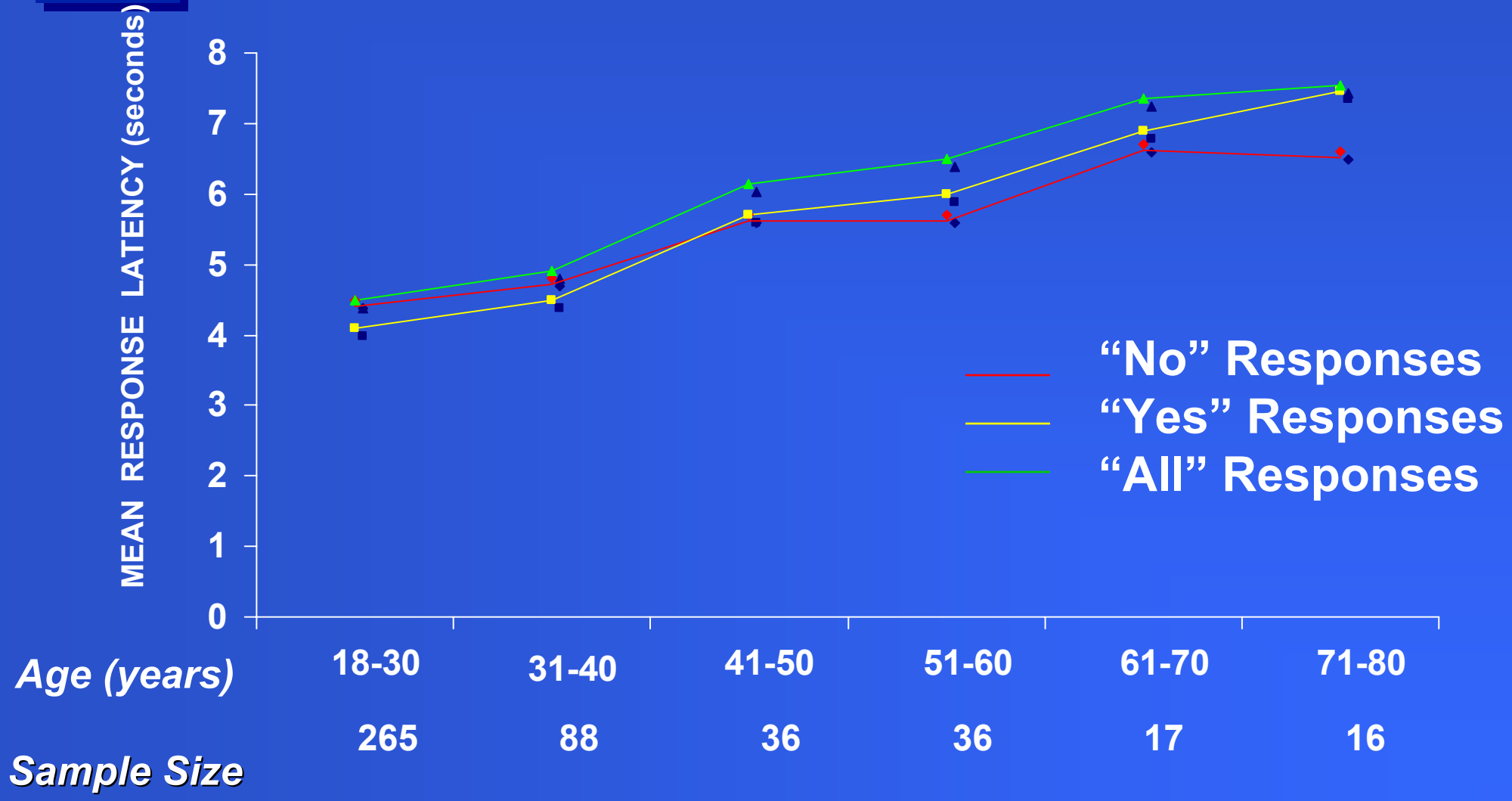


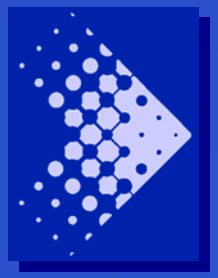
Patient-Computer Dialogue

Comparison with the clinician

- disadvantages
  - less interactive
  - insensitive to most (but not all) nonverbal information

Response Latency vs. Age

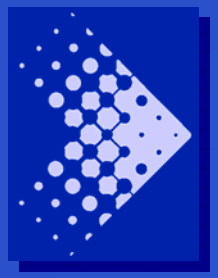




Patient- Computer Dialogue

Comparison with the clinician

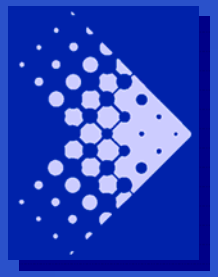
- disadvantages
  - less interactive
  - insensitive to most (but not all) nonverbal information
  - difficulty with free text and spoken words



Patient-Computer Dialogue

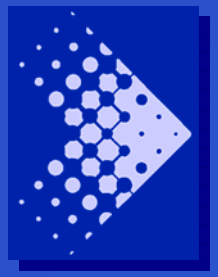
Comparison with the clinician

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



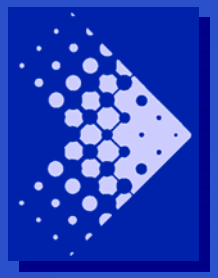
Patient-Computer Dialogue
Comparison with the clinician

- Φ advantages



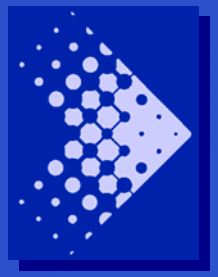
Patient-Computer Dialogue
Comparison with the clinician

- advantages
  - reliability and consistency



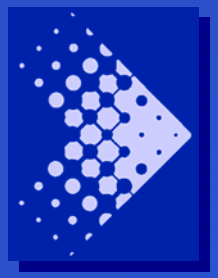
Patient-Computer Dialogue
Comparison with the clinician

- advantages
  - reliability and consistency
  - automatic processing



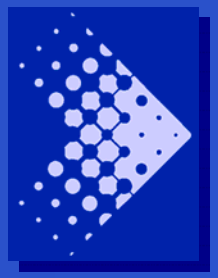
Patient-Computer Dialogue
Comparison with the clinician

- advantages
  - reliability and consistency
  - automatic processing
  - economy: the patient does the data entry



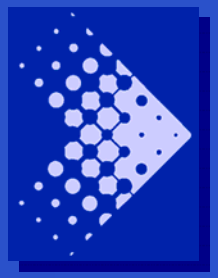
Patient-Computer Dialogue
Comparison with the clinician

- advantages
  - reliability and consistency
  - automatic processing
  - economy: the patient does the data entry
  - availability (of increasing importance)



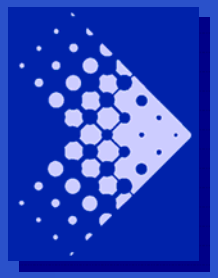
Patient-Computer Dialogue
Comparison with the clinician

- advantages
  - reliability and consistency
  - automatic processing
  - economy: the patient does the data entry
  - availability (of increasing importance)
  - anonymity (when desirable)



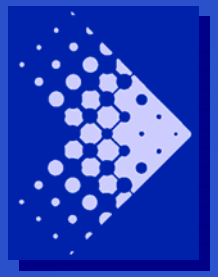
Patient-Computer Dialogue
Comparison with the clinician

- advantages
  - reliability and consistency
  - automatic processing
  - economy: the patient does the data entry
  - availability (of increasing importance)
  - anonymity (when desirable)
  - individualization without accusation



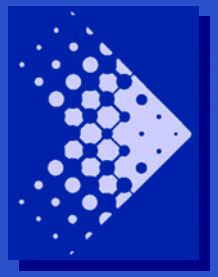
Patient-Computer Dialogue
Comparison with the clinician

- advantages
  - reliability and consistency
  - automatic processing
  - economy: the patient does the data entry
  - availability (of increasing importance)
  - anonymity (when desirable)
  - individualization without accusation
  - tracking



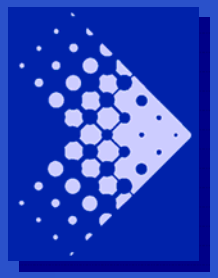
Patient-Computer Dialogue
Comparison with the clinician

- advantages
  - reliability and consistency
  - automatic processing
  - economy: the patient does the data entry
  - availability (of increasing importance)
  - anonymity (when desirable)
  - individualization without accusation
  - tracking
  - multilingual



Patient-Computer Dialogue
Comparison with the clinician

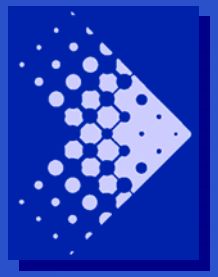
- advantages
  - reliability and consistency
  - automatic processing
  - economy: the patient does the data entry
  - availability (of increasing importance)
  - anonymity (when desirable)
  - individualization without accusation
  - tracking
  - multilingual
  - helpful with hearing disability



Patient-Computer Dialogue
Comparison with the clinician

- advantages
  - reliability and consistency
  - automatic processing
  - economy: the patient does the data entry
  - availability (of increasing importance)
  - anonymity (when desirable)
  - individualization without accusation
  - tracking
  - multilingual
  - helpful with hearing disability
  - endurance (unaffected by fatigue)

Cartoon removed due to copyright restrictions.
“Computers successfully replace psychotherapists in Boston experiment (News Item).”
Bill Mauldin, Chicago Sun Times, 1972.



Cybermedicine for the Patient

Dialogue between patient and doctor is the mainstay of clinical medicine, *but with problems*

Patient-computer dialogue is one possible Solution, *but is also with problems*

The “Interactive Benjamin Spock,” the Internet, and the Personal Health Record

Patient-Computer Dialogue

Patient Site (a secure Web Site)

Patient-Computer Dialogue

Patient Site (a secure Web Site)

view results of diagnostic studies

Patient-Computer Dialogue

Patient Site (a secure Web Site)

- view results of diagnostic studies
- view medications

Patient-Computer Dialogue

Patient Site (a secure Web Site)

- view results of diagnostic studies
- view medications
- request prescriptions

Patient-Computer Dialogue

Patient Site (a secure Web Site)

- view results of diagnostic studies
- view medications
- request prescriptions
- request appointments and referrals

Patient-Computer Dialogue

Patient Site (a secure Web Site)

- view results of diagnostic studies
- view medications
- request prescriptions
- request appointments and referrals
- communicate with doctors & staff

Patient-Computer Dialogue

Patient Site (a secure Web Site)

- view results of diagnostic studies
- view medications
- request prescriptions
- request appointments and referrals
- communicate with doctors & staff
- computer-based medical interview (exp)

Cybermedicine Medical Interview

Preliminary Study – 48 patients

- 6400 Total screens available
- 249 Screens presented to all patients
- Screens presented per patient
  - Median 622
  - Mean 545
  - Range 374-753
- Estimated time to complete interview 44 – 88 minutes

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

Cybermedicine Medical Interview Cardiovascular System

Have you been having any pain in your chest?

- Yes
- No
- Uncertain (Don't know, Maybe)
- Don't understand
- I'd rather not answer

Cybermedicine Medical Interview Cardiovascular System

Cardiovascular System

***Chest pain: most recently within the past month; onset within the past month; left sided in location; sharp in nature; intermittent in occurrence; typically seconds in duration; no radiation to shoulder; not brought on by activity; no relief with rest; moderate in intensity; unrelated to breathing; no diagnosis of angina**

***Hypertension: first diagnosed within the past 10 years; currently taking a thiazide, which has been helpful; pressure 'moderately high' before starting medication, in 'normal range' now**

History Negative for: orthopnea, feet or ankle edema, calf pain, hypersensitivity to cold, palpitations, skipped heart beats, tachycardia, diagnosis of arrhythmia, diagnosis of coronary artery disease, myocardial infarction, cholesterol elevation, rheumatic fever, phlebitis, and anticoagulant therapy

Cybermedicine Medical Interview

Personal and Social History

Residence: house; one flight of stairs
Marital History: currently married; uncertainty about year of marriage; living with wife; spouse in good health; no previous marriages; never fearful of anyone in the home
Biological children: none
Education: college graduate
Occupation: currently employed with job(s) described as 'engineer'; other daily activities listed as work about the home, visiting with friends, and 'skiing, reading, photography'
Habits: never smoked cigarettes, cigars, or a pipe; no coffee; no tea; alcohol, typically 1-2 drinks several times a week; usually wine; always careful not to drink and drive; uses seat belts regularly; no unsanctioned drugs or unsanctioned use of prescription medications
Exercise: exercises regularly by walking and bicycling, at a moderate level of activity
Dietary Supplements: none reported

Cybermedicine Medical Interview Preliminary Study Evaluation

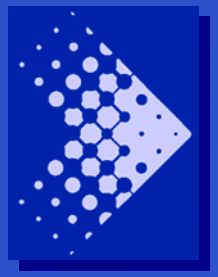
How easy were the questions to understand?

Very hard	1	2	3	4	5	6	7	8	9	10	Very easy
	0	0	0	0	0	0	2	4	7	35	

Cybermedicine Medical Interview Preliminary Study Evaluation

How respectful of your feelings were the questions?

Not at all	1	2	3	4	5	6	7	8	9	10	Most
	0	0	0	0	0	2	0	2	9	35	



Information Technology in the Healthcare System of the Future

A Hope for the Future: The ClinHaven

Cartoon removed due to copyright restrictions.
Poking fun at doctor's handwriting.

Information Technology in the Healthcare System of the Future

Questions for the Future

HST.921 / HST.922 Information Technology in the Health Care System of the Future

Spring 2009