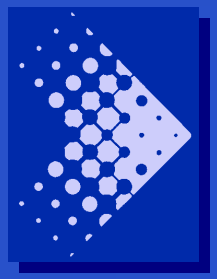


Cybermedicine

Warner V. Slack, M.D.

Center for Clinical Computing,
Harvard Medical School, and
Beth Israel Deaconess Medical Center

Seven Principles of Clinical Computing

- Information should be captured directly at computer terminals located at the point of each transaction, not on pieces of paper.

Seven Principles of Clinical Computing

- Information captured at a terminal or automated device anywhere in the hospital or clinic should be available immediately, if needed, at any other terminal.

Seven Principles of Clinical Computing

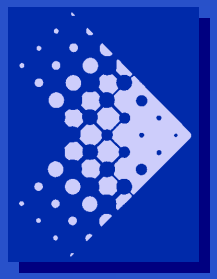
- The response time of the computer should be rapid.

Seven Principles of Clinical Computing

- The computer should be reliable and accurate.

Seven Principles of Clinical Computing

- The computer programs should be friendly to the user and reinforce the user's behavior.



Seven Principles of Clinical Computing

- There should be a common registry for all patients.

Seven Principles of Clinical Computing

- Confidentiality should be protected.

Clinical Computing

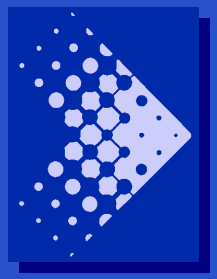
- Registration
- Laboratories
- Clinical Departments
- Finance
- Clinical use

Clinical Use

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

Clinical Use

- Provides clinical information upon request



Patient ID: Poxtun, Monnotte

9999999 Paxton,Minnette 04/21/03 F 97 111-11-1111

(Access Restricted)

Arthur Marguetite Richard M Townsend

OK? Y //

00000000 Doe, John 3/21/70 31M

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

)000000 Admitted: 03/13 Room: 12R-1275
ed
* Current Medications

edication	Dose	Route	Schedule	Start (-End)
---------- IV's and injectibles ----------				
efazolin	2 GM	IV PIGGY	QBH	08/16
---------- PO and Non-injectibles ----------				
cyclovir	200 MG	PO CAP	SX/D	08/13
otrimazole	10 MG	PO TAB TC	QID	08/13
otassium Chloride	40 MEQ	PO TAB	QD	08/19
---------- PRN, Let-call, and Single dose----------				
cetaminophen	650 MG	PO TAB	FS Q4H"24HR	08/13
sacodyl	10 ML	PR SUPP	FS PRN	08/18
lotzer's Solution	100 ML	IRR IRR	LC	08/13
ystatin	6000 UNITS	PO SUSP	LC PRN QID	08/13
rochorperazine	10 MG	PO TAB	PRN Q6H	08/13

Clinical Use

- Gives support with decisions

Clinical Use

- Gives support with decisions
  - Advice and consultation

Clinical Use

- Gives support with decisions
  - Advice and consultation

    Acid-Base Evaluation

ELECTROLYTE AND ACID-BASE EVALUATION:

Saturday March 17, 2001 2:37 pm

To enter your own values, enter "_" (underscore)

Patient ID:

Clinical Use

- Gives support with decisions
  - Advice and consultation
    - Acid-Base Evaluation
    - Drug Information

Drug Information

- Hospital Formulary Information
- Infectious Disease - Therapy and Guidelines
- Medications - Descriptions, Interactions, Costs
- Physician Desk Reference - PDR

For Prozac

1. Description
2. Clinical Pharmacology
3. Indications and Usage
4. Contraindications
5. Warnings
6. Precautions
7. Drug Interactions
8. Adverse Reactions
9. Drug Abuse
10. Overdosage
11. Dosage
12. How Supplied

Clinical Use

- Gives support with decisions
  - Advice and consultation
    - Acid-Base Evaluation
    - Drug Information
    - Clinical Formulas

Clinical Formulas

1. Alveolar-Arterial Oxygen Difference
2. Free Water Deficit or Sodium Deficit
3. Calcium Correction for Hypoalbuminemia
4. Creatinine Clearance
5. Fractional Excretion of Sodium
6. QT Interval Correction
7. Body surface Area and Body Mass Index
8. Hemodynamics
9. Bayes' Theorem

Free Water Deficit or Sodium Deficit

Free H20 Deficit = TBW -TBW x (Desired Na/Measured Na)
NA Deficit = TBW x (Desired NA - Measured Na)
TBW = WGT X [0.6 (Male) or 0.5 (Female)]

Weight =		lbs or	57 kg
Male or Female?			Female
Current Serum Na	=		160 mEq/L
Desired Na	=		140 mEq/L

Free H20 Deficit = 3.6 Liters

Notes:
1) Correct about half of total deficit in first 24 hours
2) Correction rate should be 0.5 mEq/L/hr (12 mEq/day)
3) Recompile deficit frequently
4) Add insensible fluid losses to computed values

Look at References? N

Clinical Use

- Gives support with decisions
  - Advice and consultation
    - **Acid-Base Evaluation**
    - **Drug Information**
    - **Clinical Formulas**
    - **HIV ProtoCall**

Welcome to ***HIV ProtoCall***

An information guide to research drugs for human immunodeficienvy virus infection and associated opportunistic infections.

Press <Enter>

Clinical Use

- Gives support with decisions
  - Advice and consultation
    - **Acid-Base Evaluation**
    - **Drug Information**
    - **Clinical Formulas**
    - **HIV ProtoCall**
    - **Withdrawal of therapy**

Withdrawal of Therapy

Life-Sustaining Treatment Guidelines

1. Overview
2. Definitions
3. Treatment Options
4. Documentation

Please choose and option:

Withdrawal of Therapy

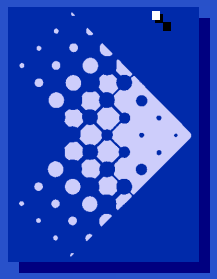
Overview

1. Policy Statement
2. DNR vs. CPR not Indicated
3. Withholding/Withdrawing Other Treatment
4. Support and Counseling

Choose option(s), or ‘A’ for All:

Clinical Use

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



PaperChase

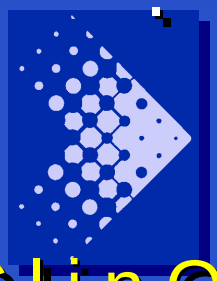
(MEDLINE now has over nine million references to articles from over forty-three hundred journals)

LOOK FOR:

For HELP, type ? and press <ENTER>

Clinical Use

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



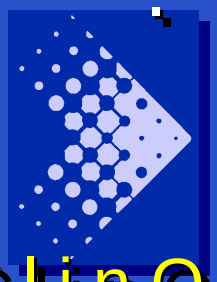
ClinQuery

Sat Mar 17, 2001 3:07 pm

ClinQuery covers 495,448 admissions from 1984 through 01/31/01.

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

Year(s): 1999



ClinQuery 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

ClinQuery Year 1999 Sat Mar 17, 2001 3:09 pm

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

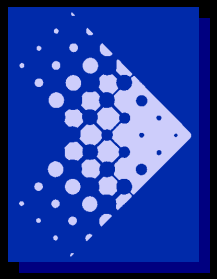
Choices:

Clinical Use

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

Clinical Use

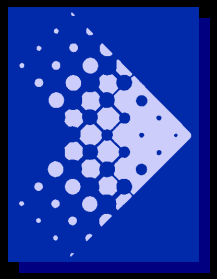
- Assists with communication



E-Mail

Inquire If Message Read

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



E-Mail

Retract Mail

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

Clinical Use

- Assists with clinical practice

Clinician's Option:

1. Admissions or Labs by Service, Firm or Team
2. Adverse Drug Reaction Reporting
3. Confidential Counseling for House Staff
4. Cross Coverage Options
5. Incomplete Medical Records
6. Personal Patient Lookup
7. Resident/Medical Student Log
8. View Clinician's Hospitalized Patients

Clinician's Options

- Confidential counseling for house staff

House Staff Support and Consultation

From time to time a House Officer or Fellow may have a personal matter that motivates him or her to seek professional counseling.

Psychiatric consultation and referral that is confidential and independent of administrative reporting is readily available.

Please feel free to call or page any of the psychiatrists listed on the next screen.

Your call will remain confidential.

Confidential Counseling for House Staff

Academic Year	Accesses
1995	388
1996	380
1997	382
1998	424
1999	330
2000	287

Clinical Use

- Assists with education

Clinical Use

- Assists with education
  - -ECG case of the week

*** Select ECG case of the week

1. 12/30/96

   First line of description

   83 yr old woman with CHF. What is the likely etiology? Clue : axis
2. 12/30/96

   First line of description

   86 yr old man with slow pulse.
3. 12/30/96

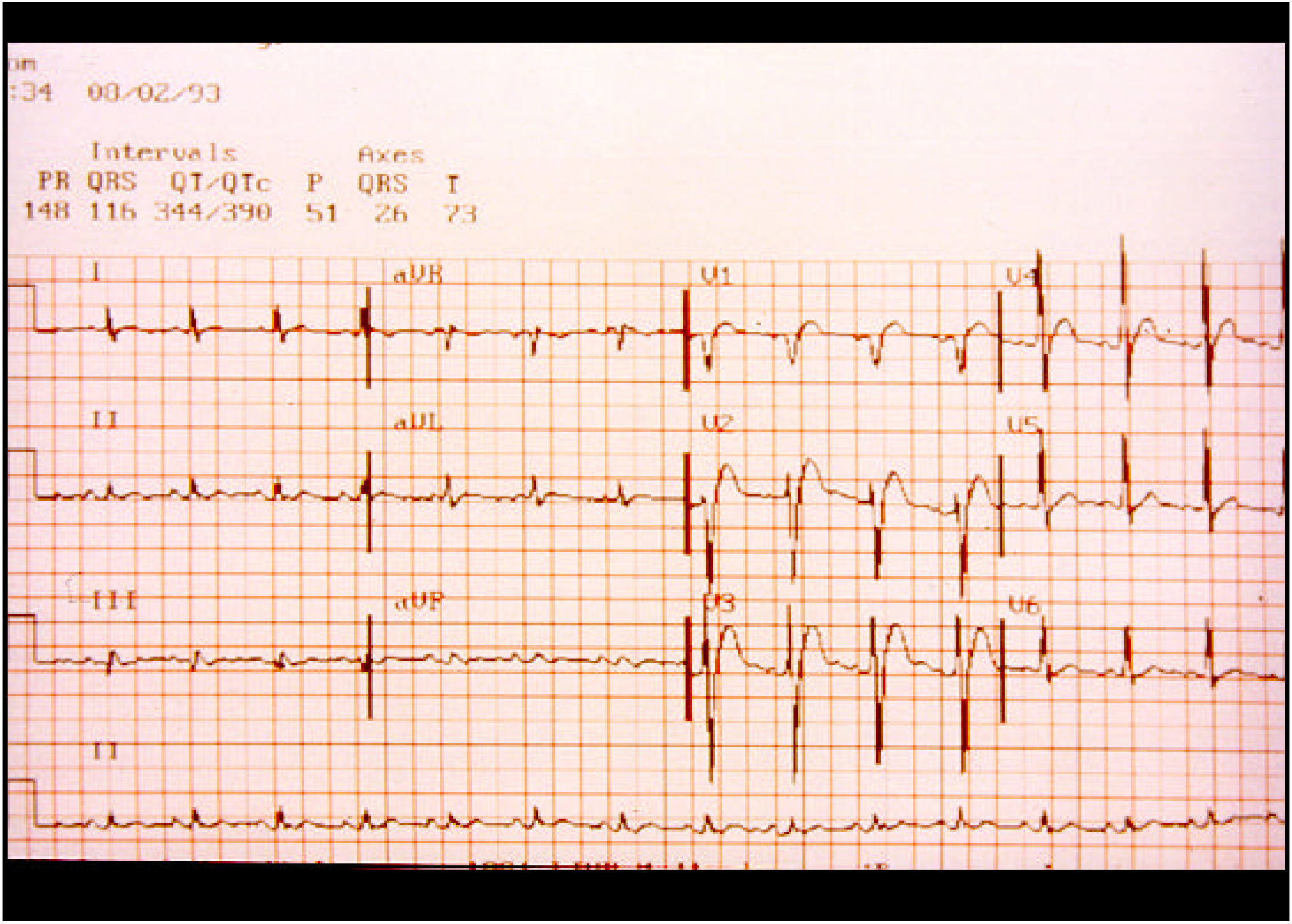
   First line of description

   29 yr old man with chest pain/dyspnea. Diagnosis still possible despite artifact.

Description :

The patient is an elderly woman with a known history of left bundle branch block who presented to the emergency ward with shortness of breath.

Do you wish to view the wave format (approx 30 seconds)? (Y/N) Y//


:34 08/02/93
Intervals Axes
PR QRS QT/QTc P QRS T
148 116 344/390 51 26 73
I
aVR
V1
II
aVL
V2
V5
III
aVF
V3
V6
II

ANSWER TO THIS QUIZ

DX: Sinus bradycardia, LBBB with primary st-t wave changes

The ECG demonstrates a left bundle branch block morphology with primary biphasic and inverted t waves in leads 2,3, and F. Uncomplicated bundle branch blocks should have “seconday” t wave changes. That is the stt waves should be opposite in direction to the major vector of the QRS. For example, if this ECG with LBBB was uncomplicated the stt waves in the inferior leads would be upright. This patient has inverted t waves suggesting that a “primary” or ischenic process is evolving in the inferior distribution.

She did in fact rule in for a myocardial infarction with a CK of 700 and 21% MB fraction. This message is that ischemic ECG changes can be read in the presence of a bundle branch block.

Clinical Use

- Assists with education
  - -ECG case of the week
  - -Universal precautions

Standard/Universal Precautions

Welcome to your training in

standard/universal precautions

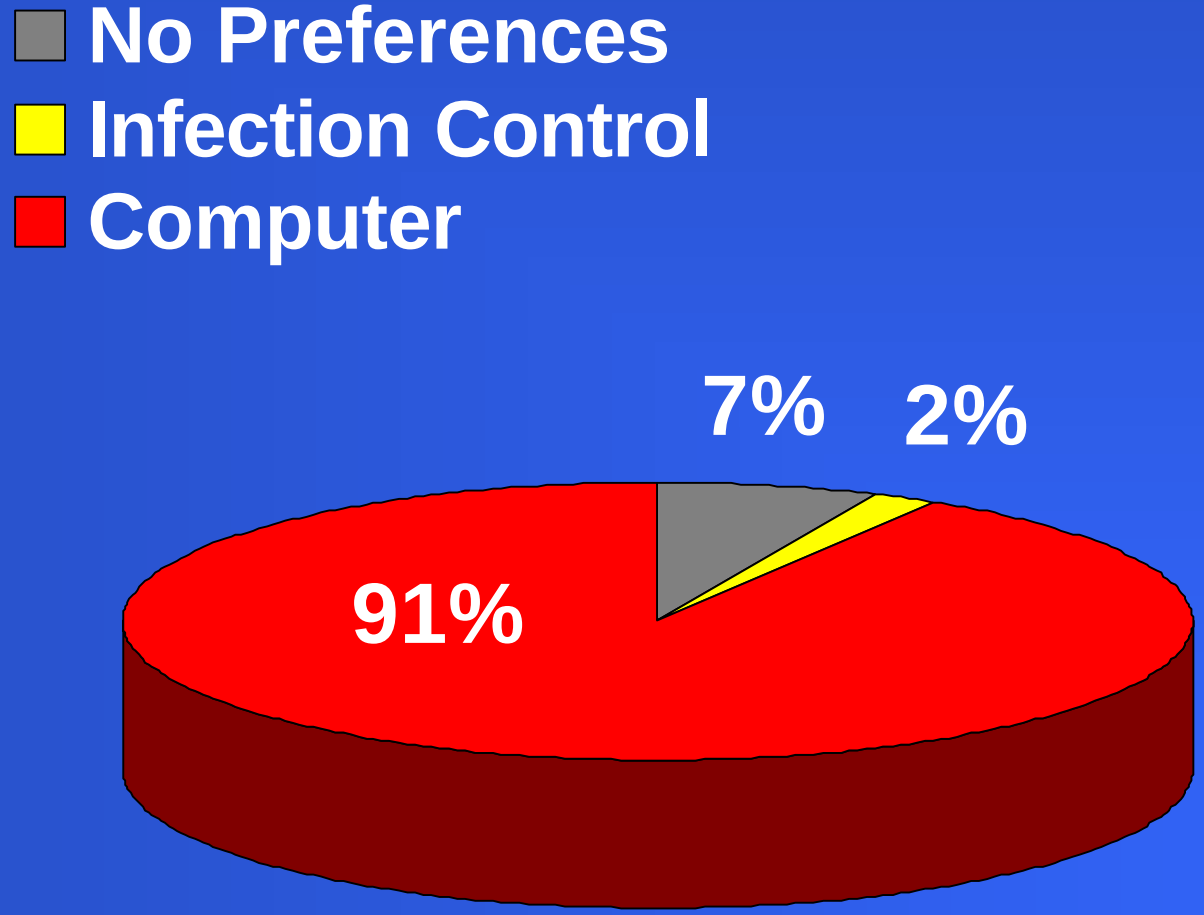
To quit <tab>

To continue <enter>

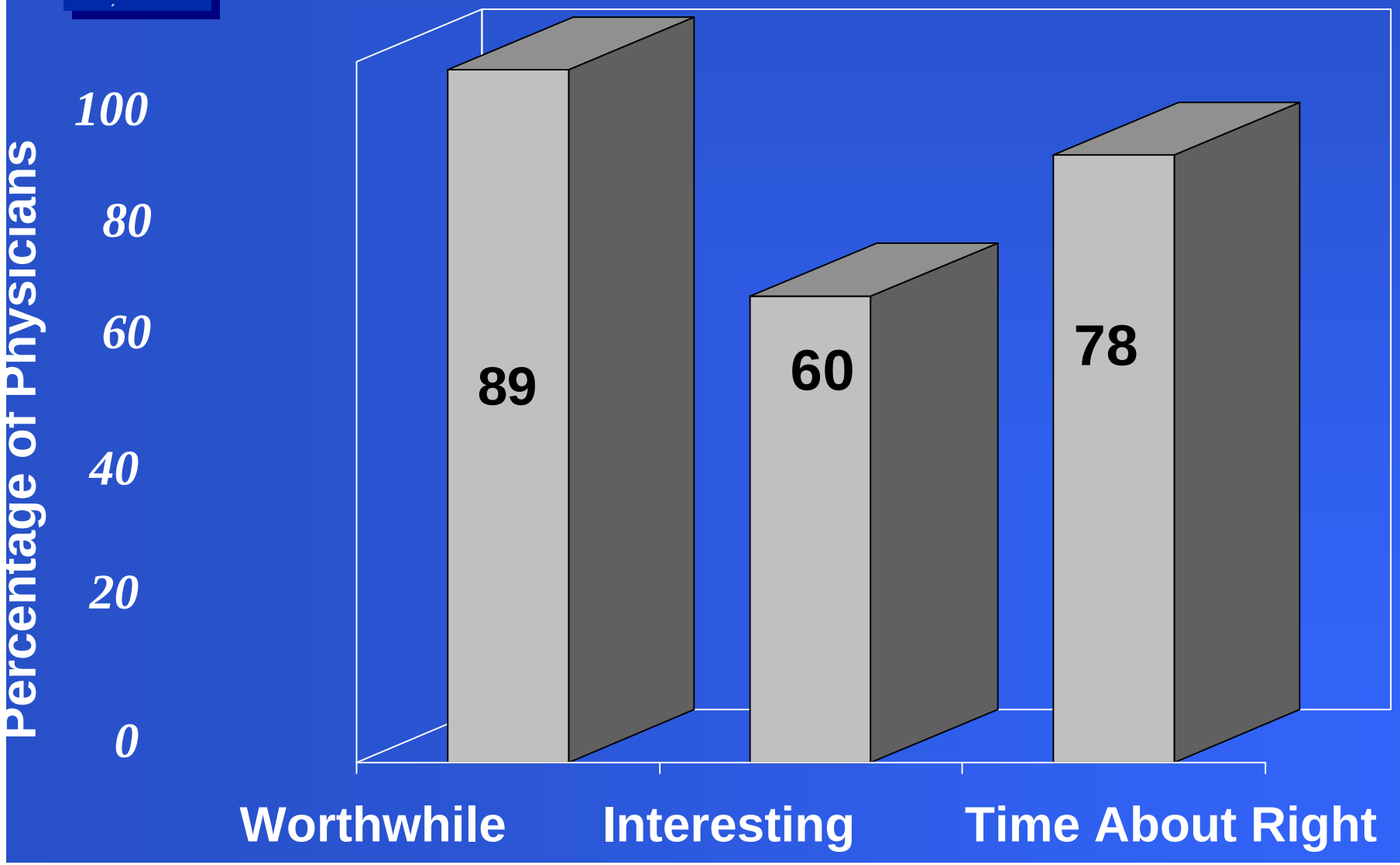
Successful Completion

First time	881 (89%)
At a later date	70 (7%)

Preference - Computer vs. Infection Control Personnel

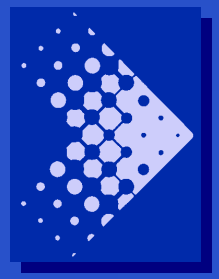


Reaction to Computer Interview



Nursing Option

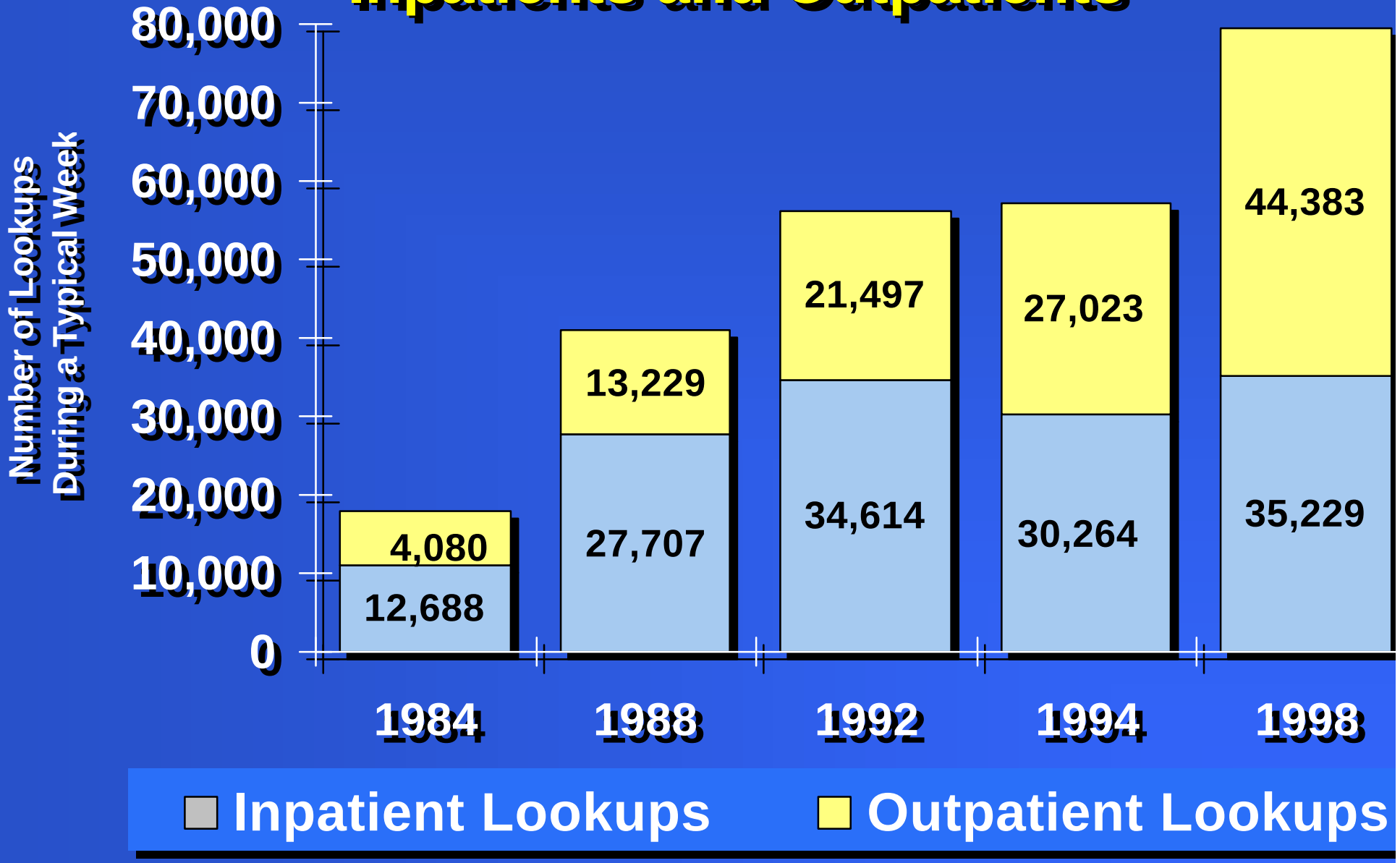
1. Condition Display
2. Dietary Orders
3. Functional Health Pattern Assessment
4. Last Primary Nurse
5. Patient Classification System
6. Pre-operative Telephonic Enter/Edit



- Evaluating Cybermedicine

- Use of the system by voluntary users

Beth Israel Deaconess Use of Patient Lookups
Inpatients and Outpatients



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

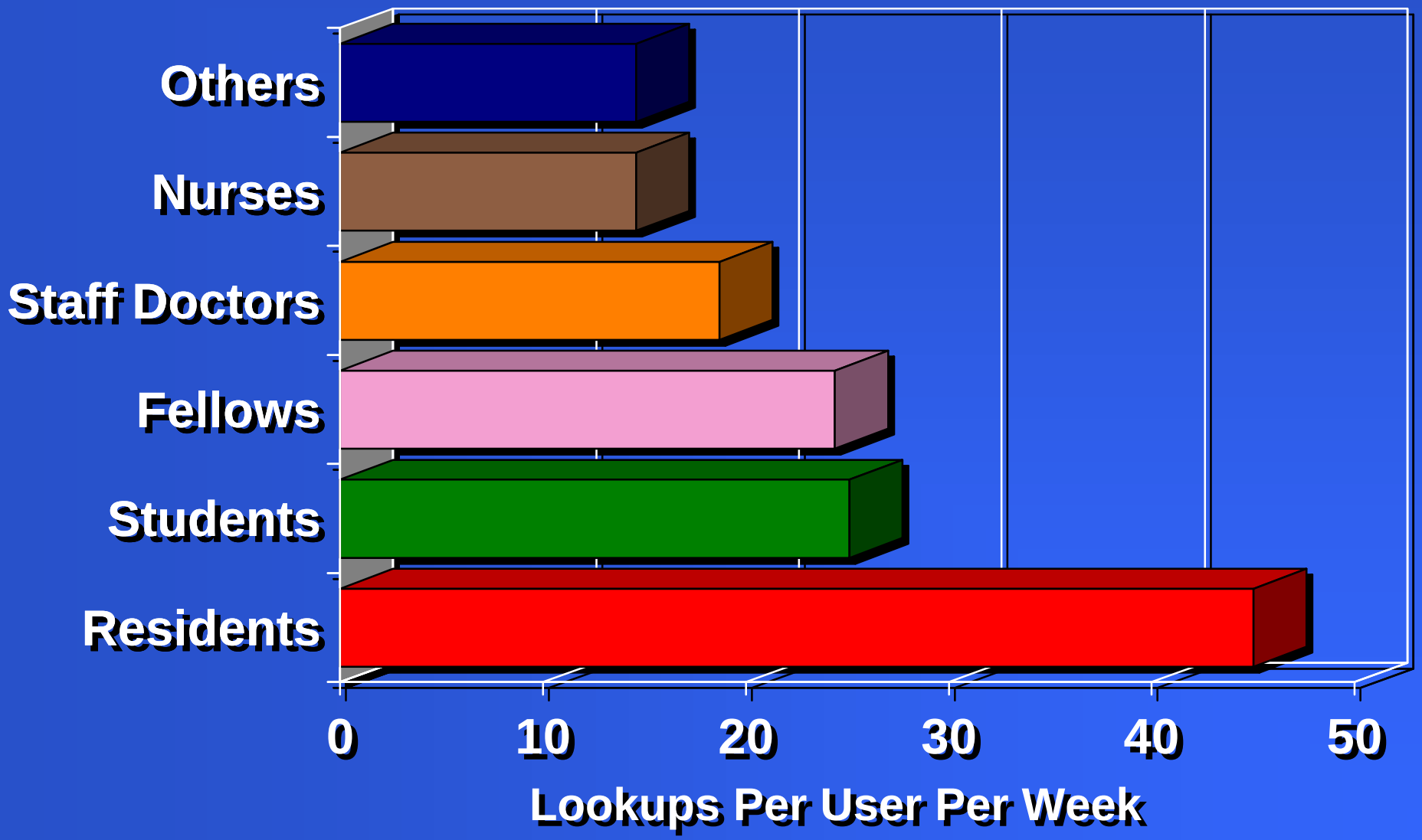
	Inpatients	Outpatients	Total
All Labs – Most Recent Results	17,018	10,044	27,062
Demographics	3,277	9,420	12,697
Chemistry	4,310	4,793	9,103
Radiology	2,681	6,028	8,709
Narrative Notes	1,163	3,893	5,056
Cardiology	1,548	2,697	4,245
Pathology	528	3,562	4,090
Microbiology	1,990	1,001	2,991
Hematology	1,014	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

Passwords to the CCC Cybermedicine System at Beth Israel Deaconess

(winter 2000/2001)

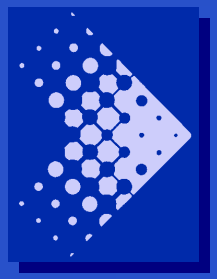
Staff Physicians	1,034
Nurses	1,983
Clinical Fellows	258
House Officers	630
Medical Students	395

Use of Patient Lookup



Electronic Mailbox

Students	2,134
Residents	9,385
Fellows	1,396
Staff	2,455
Nurses	10,980
Others	3,650
Total	30,000



- 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

E-mail Questionnaire Results

- 89% felt e-mail made life easier
- 11% felt e-mail made life harder
- 61% felt e-mail had a humanizing influence
- 13% felt e-mail had a dehumanizing influence

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

- Indirect Evidence

If it can be agreed that doctors for the most part engage in their diagnostic efforts with good reason and good will and with beneficial results for their patients…

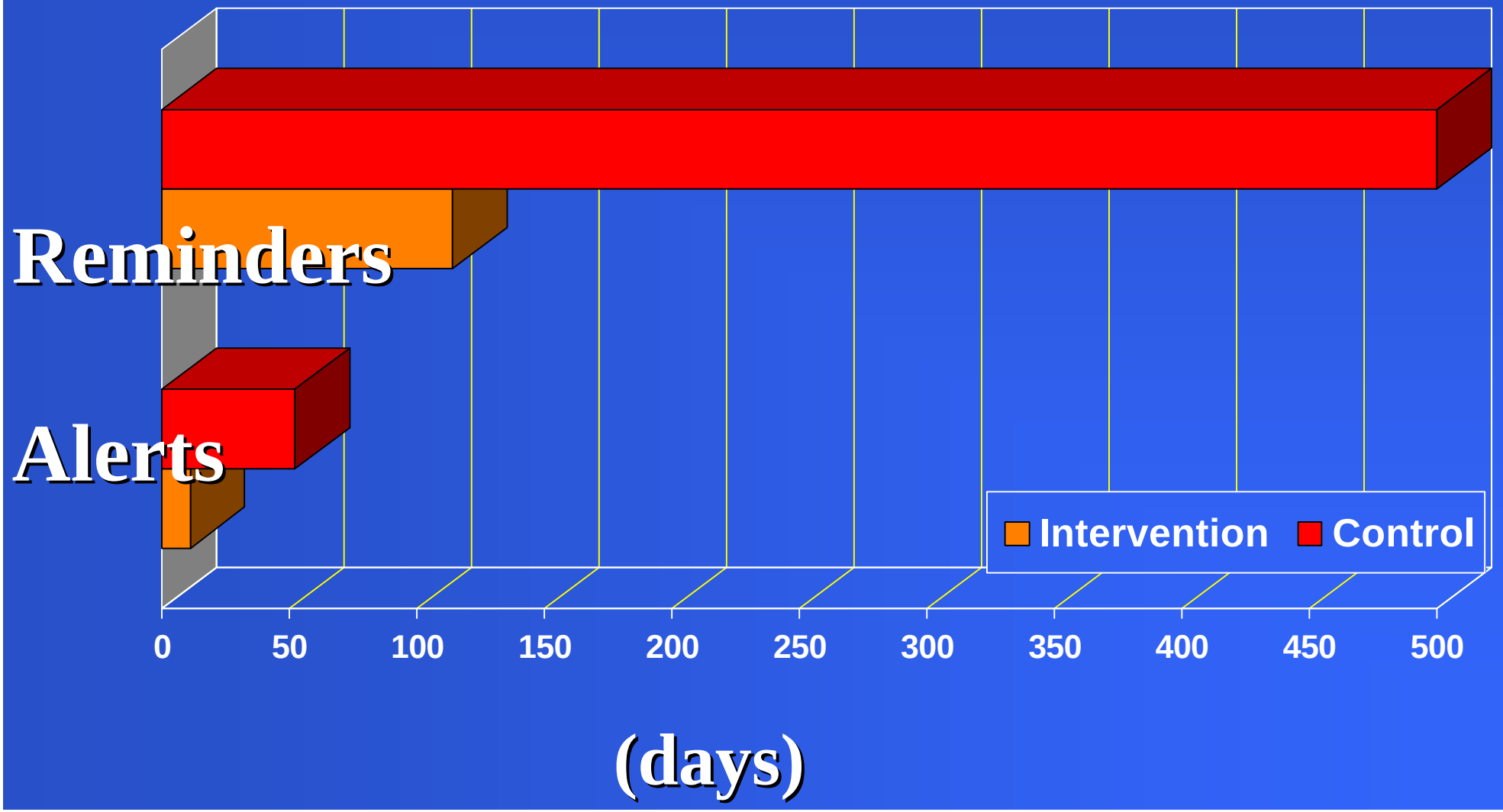
- Indirect Evidence

…then the computing system that offers them the information they have requested , with more ease, speed reliability, and accuracy than is otherwise possible, is improving the quality of care.

- Direct Evidence

The time to act on important clinical events, such as the need for a vaccination or change in a medication causing adverse side effects is significantly reduced when the physician is reminded or alerted by the computer of the need to act.

Clinician Response Time



- Direct Evidence

Bates, Kuperman, Teich, et al:

Physicians at BWH now routinely use the computing system to order laboratory tests and prescribe medications…

- Direct Evidence

Bates, Kuperman, Teich, et al:

Errors have been dramatically reduced at BWH with their order entry and alerting system; e.g., serious errors in medications have been reduced by *55 percent*.

- ERRORS IN MEDICINE

To Err is Human

(Institute of Medicine Report, fall 1999)

"…as many as 98,000 people die in any given year from medical errors that occur in hospitals."

- Errors in Medicine

The extent of the problem is debatable but

Most would agree there is a problem

- Errors in Medicine

Two approaches to mistakes by doctors:

To expose and criticize

or, far better,

To make it as easy as possible for the doctor to practice good medicine

- Errors in Medicine

My argument: We know enough already to reduce substantially important errors in medicine through the good use of cybermedicine.

- Errors in Medicine

If the cybermedicine programs provide the results of diagnostic studies immediately upon request, with abnormal and critical values highlighted to avoid their being overlooked;

- Errors in Medicine

If the cybermedicine programs offer unsolicited alerts and reminders about clinical events that need attention, either immediately or in the near future;

- Errors in Medicine

If the cybermedicine programs offer advice and consultation, when requested, about diagnosis and treatment;

- Errors in Medicine

If the cybermedicine programs offer ready access to current, reliable medical literature;

- Errors in Medicine

If the cybermedicine programs offer access to information about the diagnosis and treatment of patients from the past (with protection of confidentiality) for comparison with the diagnosis and treatment of patients in the present;

- Errors in Medicine

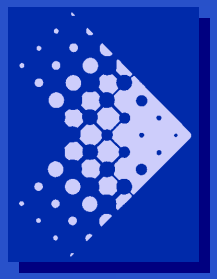
If the cybermedicine programs assist with (or better, eliminate) administrative chores, thereby freeing more time for medical matters,

- Errors in Medicine

And if the cybermedicine programs have educational value,

- Errors in Medicine

Then the doctor is far less likely to make mistakes in the practice of medicine.



- Use of the system by voluntary users
- Attitude toward the system
- Effect of the system on the quality of medical care
- The Teaching Power of Cybermedicine

- Teaching

In the tradition of John Dewey, who advocated “learning by doing,” cybermedicine promotes learning in the context of caring for real patients

- Teaching

e.g., if a medical student caring for an elderly man is informed by the computer that the patient has a low serum Na, a low BUN, and a chest film that shows hilar adenopathy with pleural effusion....

- Teaching

the student can request computer-based consultation on diagnosis and treatment (data from the labs are transferred to the consultation programs automatically)…

- Teaching

and discover (or be reminded) that the findings are suggestive of oat ce carcinoma of the lung with inappropriate secretion of antidiureti hormone…

- Teaching

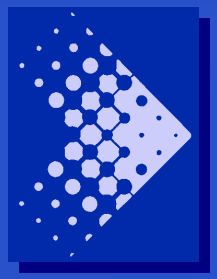
and then use ClinQuery to find information on other patients with these abnormalities…

- Teaching

use PaperChase to search for related articles in the medical literature…

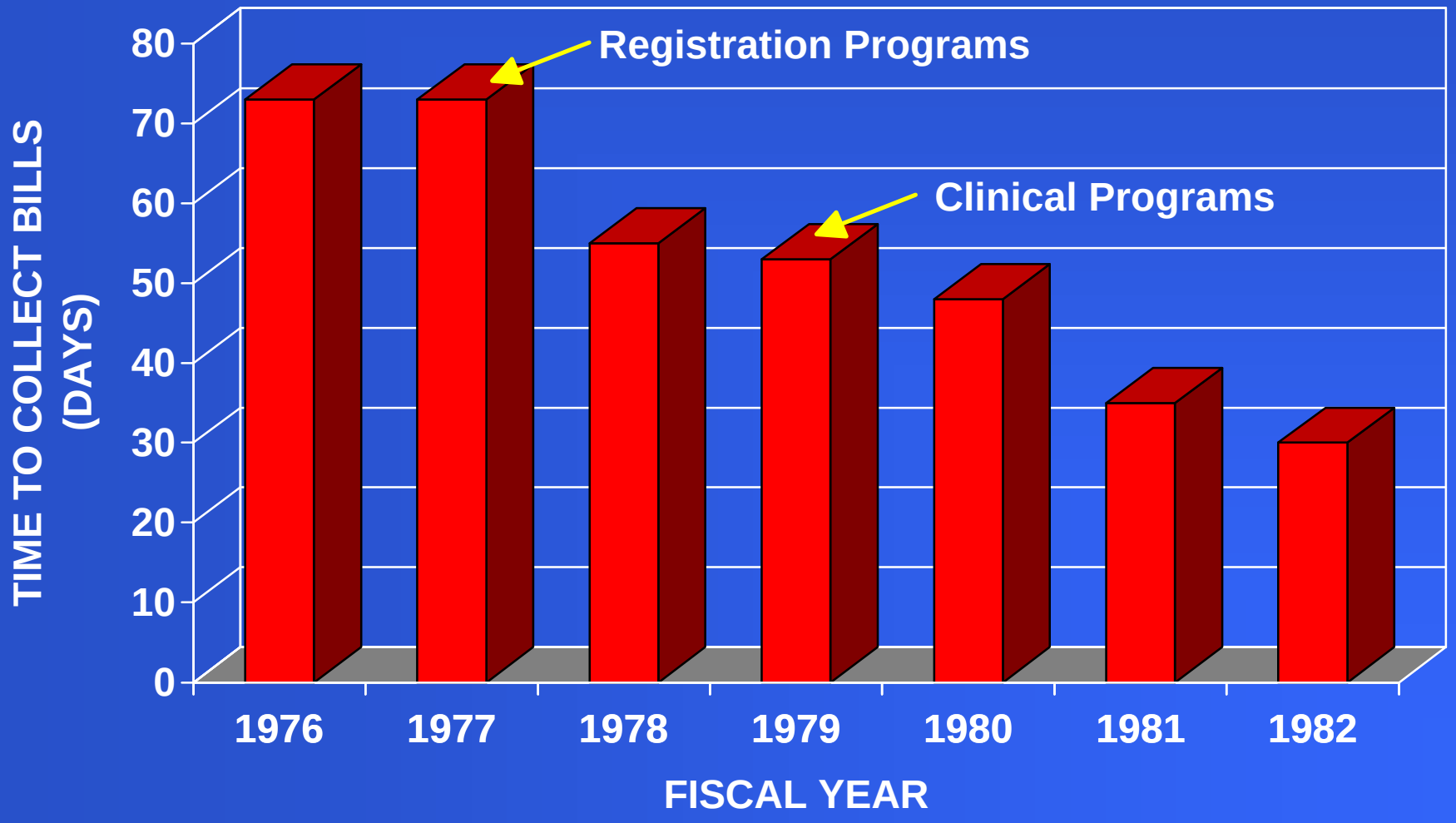
- Teaching

and use electronic mail to communicate with other students, house officers, or staff physicians, all from the same computer terminal.

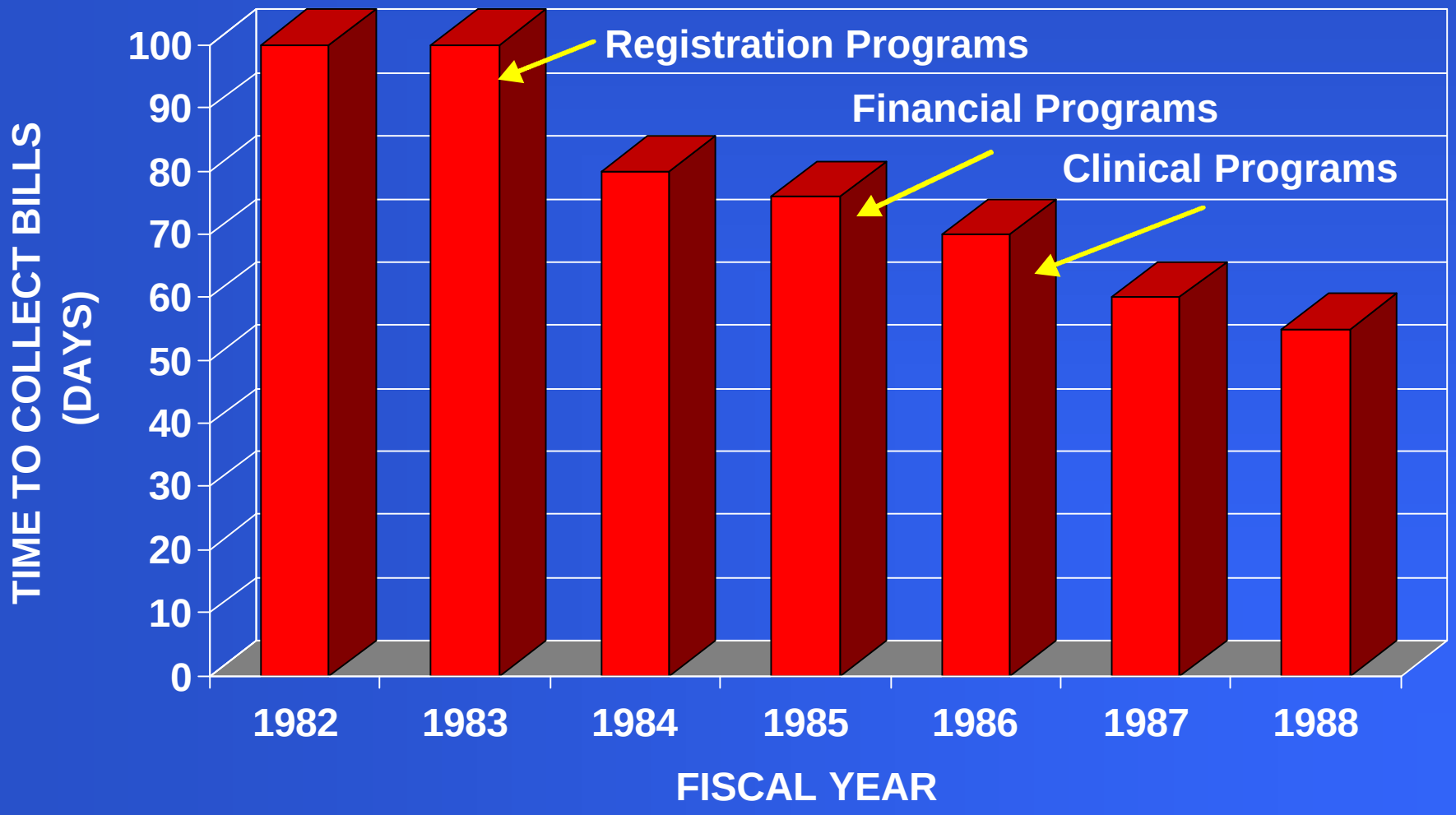


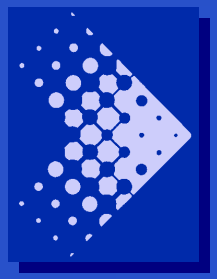
- Use of the system by voluntary users
- Attitude toward the system
- Effect of the system on the quality of medical care
- The Teaching Power of Cybermedicine
- Effect of the System on Hospital Finances

Time needed to collect bills in relation to use o computing programs at Beth Israel Hospital

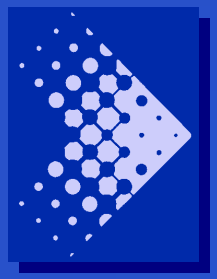


Time needed to collect bills in relation to use of computing programs at Brigham & Women's Hospital





- Use of the system by voluntary users
- Attitude toward the system
- Effect of the system on the quality of medical care
- The Teaching Power of Cybermedicine
- Effect of the System on Hospital Finances
- Cost of the System



Confidentiality

Measures in Use for Protection of Patient Confidentiality

- All users are told that the password is equivalent to a legal signature, and that under no circumstances should it be shared with anyone.

Measures in Use for Protection of Patient Confidentiality

- Access can be restricted by password and by terminal location.

Measures in Use for Protection of Patient Confidentiality

- Physicians' passwords are issued by the Executive Director's office when the physician is given hospital credentials.

Individuals who have access to the Beth Israel Deaconess computerized patient
nformation system can obtain records pertaining to the care and treatme
hospital patients. Under Massachusetts law and the hospital's patient confidentiality policy, such records are confidential.

We ask you to sign the following agreement.

Press <Enter>

Measures in Use for Protection of Patient Confidentiality

- Terminals are frozen if illegal passwords are entered a few times.

Measures in Use for Protection of Patient Confidentiality

- Users are automatically signed off after a time-out period of approximately five minutes.

Measures in Use for Protection of Patient Confidentiality

- Access from home by telephone dial-up requires a second password.

Measures in Use for Protection of Patient Confidentiality

- The computer system stores each access to patient information indexed by person, professional role (staff doctor, nurse, resident, student, other), location, type of information retrieved, date, and time.

Measures in Use for Protection of Patient Confidentiality

- All patients (and their doctors) can request a list of persons who have looked at their records.

Measures in Use for Protection of Patient Confidentiality

- Employees who use the computer system have an option under Utilities that displays the names of persons who have looked at their electronic record.

Utility Options

Telephone Directory	462
Doctor's Office Directory	182
View Lookups of Own File	176
How to use the Computer Terminal	46

Measures in Use for Protection of Patient Confidentiality

- Terminals automatically display confidentiality warnings if a user looks at a record of a VIP.
- Terminals randomly display confidentiality warnings from time to time for all patients.

Beth Israel Deaconess Patient Lookup
Tues Mar 20, 2001 3:29 pm

End response by pressing return key. For help type ?

Patient ID: Townsend,Minnette

9999999 Paxton,Minnette 04/21/03 F 97 111-11-1111

(Access Restricted)

Arthur Marguetite Richard M Townsend

OK? Y //

To protect each patient's confidentiality only those who are responsible for a patient's care should use this option. We record the identity of each user of patient lookup and will give this information to the patient or the patient's physician upon request.

Type 'Y'es to proceed, otherwise press return. N//

In the Hands of Strangers

For purposes of reimbursement, hospitals and clinics are now required to send confidential clinical information, linked to charges, to a broad array of third-party payers - - strangers who are beyond the control of the hospital, clinic, doctor, or patients. Are they to be trusted?

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

DOCSCRIPT!