

Using the Electronic Health Record to Improve Patient Safety

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Overview

- Nature/scope of safety
- Impact/potential of IS
- National developments
- Future opportunities
- Leadership role
- Conclusions

Leadership and IT

Leadership is the capacity to hold a shared vision of that we wish to create.

– Peter Senge

Prioritizing Safety

“Safety is not a ‘top priority.’ Safety is a precondition.”

Paul O’Neil, former CEO, Alcoa

Handwriting example

Arundel 4 May 1800

Pharmacy Computer System Field Test of Unsafe Orders

	<i>Unsafe Order Not Detected</i>
<i>Vincristine 3 mg IV x 1 dose (2-year-old)</i>	62%
<i>Cephadrine oral suspension IV</i>	61%
<i>Colchicine 10 mg IV for one dose (adult)</i>	66%
<i>Cisplatin 204 mg IV x 1 dose</i>	63%

Source: ISMP Medication Safety Alert! Feb 10, 1999

Average Fatal Accident Frequency Rates

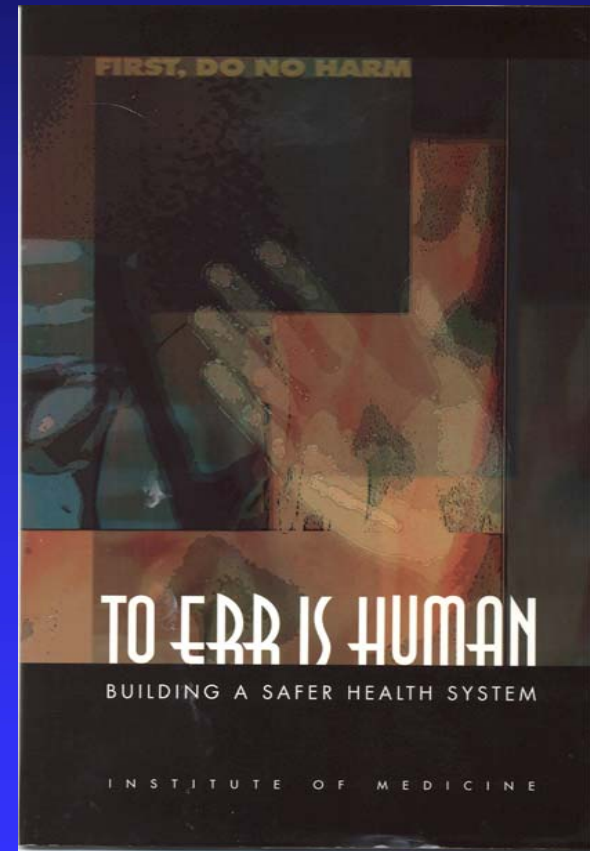
Being pregnant	1
Working at home	8
Being in traffic	50
Working in construction	67
Flying commercially	100
Being a hospitalized patient	2000
Being anesthetized	2000
Parachute jumping	20000
Having elective AAA surgery	200000

Deaths per million hours of exposure

Adapted from Zelders

To Err is Human

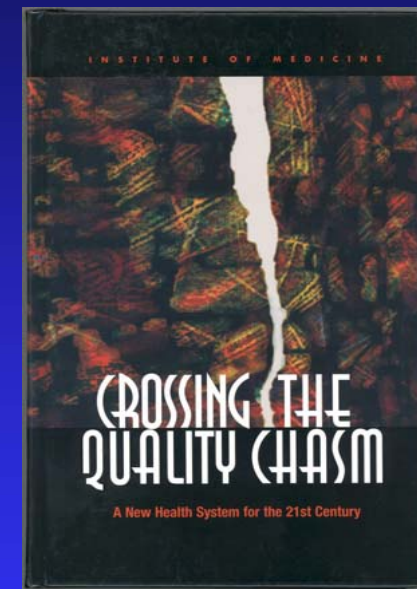
- Errors are common
- Errors are costly
- Systems cause errors
- Errors can be prevented and safety can be improved



Current State of Healthcare

- Care is complex
- Care is uncoordinated
- Information is often not available to those who need it when they need it
- As a result patients often do not get care they need or do get care they don't need

Between the care we have, and the care we could have, lies not just a gap, but a chasm.



IOM, Crossing the Quality Chasm

Quality: Basic Precepts

- Care should be safe
- Care should be effective
 - ◆ Based on sound knowledge
- Care should be patient-centered
 - ◆ Respectful, responsive to individual preferences, needs and values
- Care should be timely
 - ◆ Unnecessary waits should be reduced

Quality: Basic Precepts

- Care should be efficient
- Care should be equitable
 - ◆ Should not vary in quality because of patient characteristics, such as ethnicity, or geographic location

Rates of Adverse Events

- 3.7% of hospitalizations in New York
 - ◆ 58% preventable
- 2.8% Colorado-Utah
- 16.6% in Quality in Australian Health Care study
- 10.8% in UK pilot study (Vincent)
 - ◆ Half preventable
 - ◆ 1/3 resulted in moderate or greater disability or death
- Most recent international studies show rates of ~10%

Types of Complications

Overall

- Adv. drug events 19%
- Wound infections 14%
- Technical complcns 13%

Almost half were associated
with a surgical procedure

Non-Operative

- Adv drug events 37%
- Diagnostic mishaps 15%
- Therapeutic mishaps 14%
- Procedure-related 13%
- Falls 5%

Costs to the System

■ QAHCS

- ◆ 8% of hospital bed days
- ◆ \$4.7 billion/year

■ UK

- ◆ 8.5 days/adverse event
- ◆ Costs to NHS 1 billion pounds/year

■ US

- ◆ Costs of ADEs in hospitals \$2 billion/year
- ◆ All drug-related problems \$177.4 billion/year!

■ Limited data from other areas all suggest similar

Incidence and Severity of Adverse Events after Discharge

- 400 medical inpatients
- Adverse event rate 19%
 - ◆ 6% preventable
 - ◆ 48% of ADEs resulting in at least non-permanent disability preventable
 - ◆ 6% ameliorable
- Of adverse events
 - ◆ 66% were ADEs
 - ◆ 17% procedure-related

Sample Preventable Adverse Event

- Patient with CHF started on spironolactone
 - ◆ Already on ACE, lasix, K
- No electrolyte monitoring
- Extreme weakness and anorexia developed at 2 weeks
 - ◆ K was over 7.5

Systems Improvement and IT in Healthcare

- Systems should
 - ◆ Make errors less likely
 - ◆ Catch those that do occur
- Current systems communicate poorly
 - ◆ Health care spends little on IT
- Implementation is challenging, turnover high
 - ◆ Writing a large check doesn't guarantee success

Reengineering Medicine: The Role of IS

- Could be changed by providing external aids
 - ◆ Linking medical knowledge and patient-specific data
 - ◆ Identifying options
- Without such tools, experts
 - ◆ Make errors
 - ◆ Overlook available knowledge
 - ◆ Don't sufficiently account for uniqueness of patients

Weed LL, Weed L, *Federation Bulletin*, 1994

Ways IT Can Improve Safety

- Prevent errors and adverse events
- Facilitating a more rapid response after an adverse event has occurred
- Tracking and providing feedback about adverse events

Bates and Gawande, NEJM 2003

Main Strategies for Preventing Errors and AEs Using IT

- Tools to improve communication
- Making knowledge more readily accessible
- Requiring key pieces of information
- Assisting with calculations
- Performing checks in real time
- Assisting with monitoring
- Providing decision support

Bates and Gawande, NEJM 2003

Specific IT Applications

- Computerized physician order entry
- Smart pumps
- Smart monitoring
- Computerized notification about critical test results
- Computerized ADE monitoring
- Tracking abnormal test results
- Electronic health record (outpatient)
 - ◆ Includes computerized prescribing

IS and Adverse Events in Hospitals

- Adverse drug events
- Nosocomial infections
- Asynchronous events
- Coverage-related events

Computerized Physician Order Entry

- Single most powerful intervention for improving medication safety to date
- Over 80% reduction in medication error rate
- Need to have associated decision support if want to see high level of benefit

Improving Drug Ordering With Order Entry

■ Streamline, structure process

- ◆ Doses from menus
- ◆ Decreased transcription
- ◆ Complete orders required

■ Give information at the time needed

- ◆ Show relevant laboratories
- ◆ Guidelines
- ◆ Guided dose algorithms

■ Perform checks in background

Drug-allergy

Dose ceiling

Drug-drug

Drug-patient characteristic

Drug-laboratory

NEPHROS study

Effect of real-time decision support for patients with renal insufficiency

- Of 17,828 patients, 42% had some degree of renal insufficiency

	Interv	Control
Dose	67%	54%
Frequency	59%	35%

- LOS 0.5 days shorter

Chertow et al, JAMA 2001

Select pt

OETEST, TOM

BWH 11489879

42y M

Pt Details



- Orders
- LMR
- Results
- Handbook
- Phone Dir
- Help
- Feedback
- Exit

Active App: ORDERS

Drug Warning(s) Found Active Pt: OETEST, TOM

DRUG WARNING(S)

Current Order:

NAFCILLIN IV

Warning(s):

Status	Order
New Order	Allergy to: Penicillins Reaction: Anaphylaxis

Message:

Reaction: Anaphylaxis. The patient has a DEFINITE sensitivity to NAFCILLIN.



Keep (override) order

Cancel (D/C) order

Use mouse or arrow keys to select an Order. Alt-K to Keep (override) order. Alt-C to cancel.

Bar-coding

- Technology is inexpensive
- Would help in:
 - ◆ Matching medication orders and drug products
 - ◆ Medications dispensed/administered
 - ◆ Identifying correct patient
- Will know
 - ◆ What/how much/who/when
- Few published data so far, but experience in other industries suggest important benefit

Impact of “Smart” IV Pumps

- Few administration errors get caught
 - ◆ Yet intravenous errors can be especially dangerous

Case

- Heparin bolus dose of 4000 units, followed by an infusion of 890 units/hr
 - ◆ 4000 unit bolus dose was given appropriately
 - ◆ But nurse misinterpreted the order and programmed the infusion device to deliver 4000 U/hour, not 890 U/hour
- Smart pump alerted nurse
- Early data—2 such errors/day in 400-bed hospital

“Smart” Monitoring

- Monitoring is inherently boring
 - ◆ Computers can do better than people
 - ◆ People are better than computers at evaluating importance of signals
- “Smart” monitoring will have huge impact
 - ◆ ICUs
 - ◆ General care units
 - ◆ Home

Nosocomial Infections

Timely preoperative antibiotics

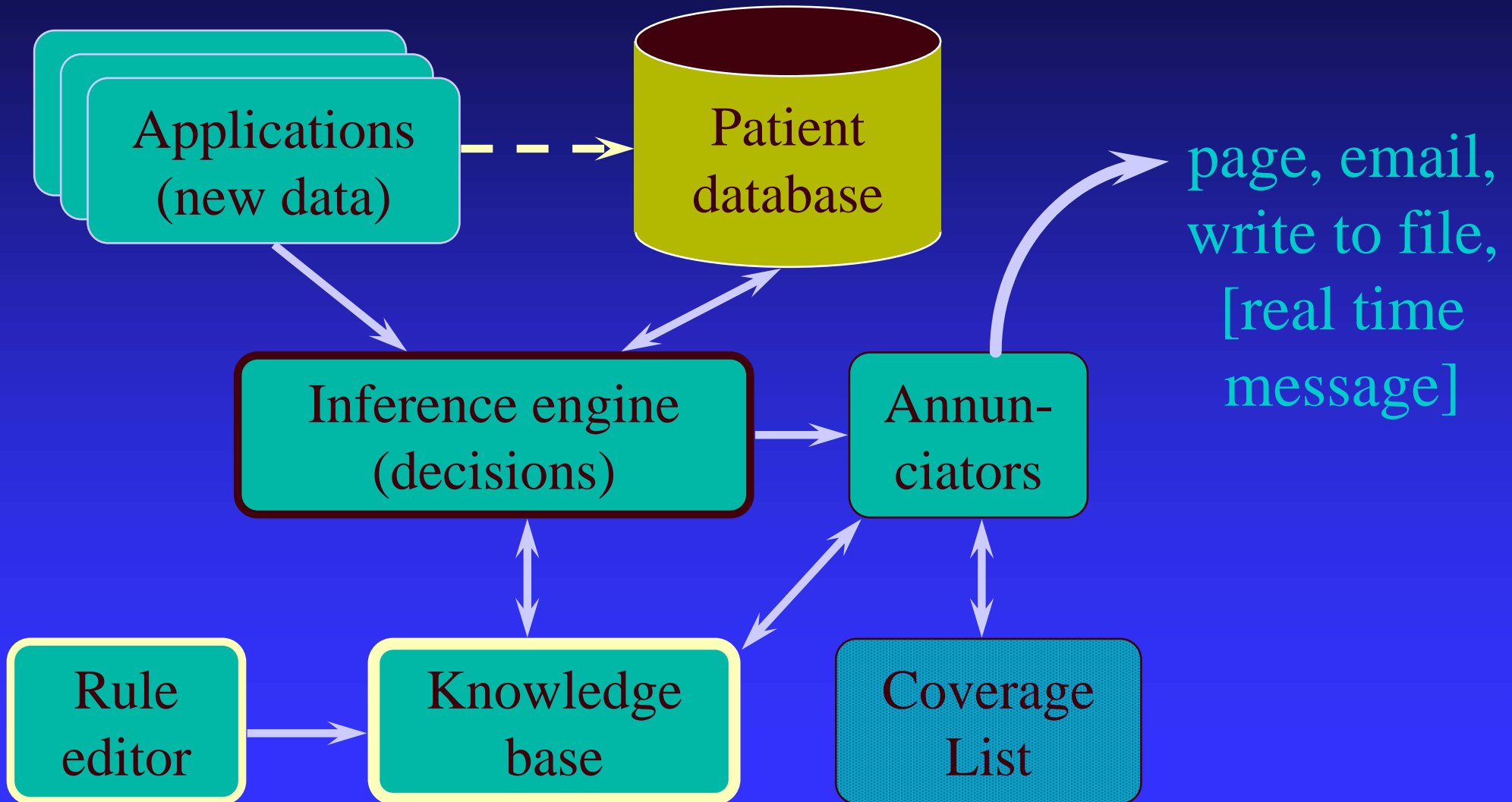
- Major reduction in post-surgical infection rate

Computer-assisted antibiotic management

- In intervention period, those who always got recommended rx vs. not:
 - ◆ Lower antiinfective costs (\$102 vs. \$427)
 - ◆ Total hospital costs (\$26,315 vs. \$44,865)
 - ◆ LOS (10.0 vs. 16.7 days)

Evans RS, NEJM 1998

Event monitor architecture



RCT to Improve Response to Critical Labs

- Mean time to rx 11% shorter
- For events not meeting lab's calling criteria (half of events), 21% shorter
 - ◆ Nearly identical for events meeting criteria
- Mean time to resolution 29% shorter
- Mortality was 7% in intervention group, 13% control group (p=0.19)
- 95% physicians pleased to be paged

Kuperman, JAMIA 2000

Coverage-Related Events

- Before data showed patients being cross-covered at 5-fold excess risk of adverse event
- After computerized signout introduction, no excess risk
 - ◆ Included medications
- Simple from informatics perspective but major benefit

Petersen, Jt Comm JI

Other Non-IT Inpatient Approaches

- IT not only way to improve safety by any means
- 66% reduction in preventable ordering ADEs with pharmacist participation in ICU rounds

Leape, JAMA, 2000

- Building a culture of safety is extremely important

Outside the Hospital: Problem Areas in which IT Can Help

- Prescribing
- Monitoring
- Following up important abnormalities
 - ◆ Results Manager

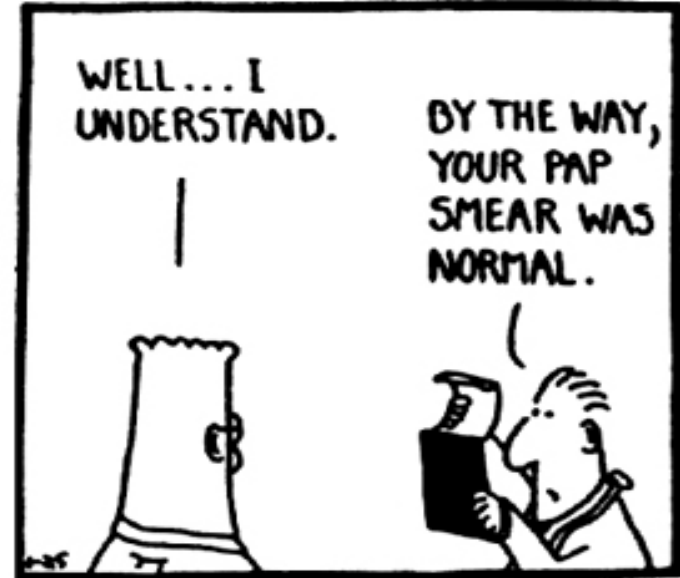
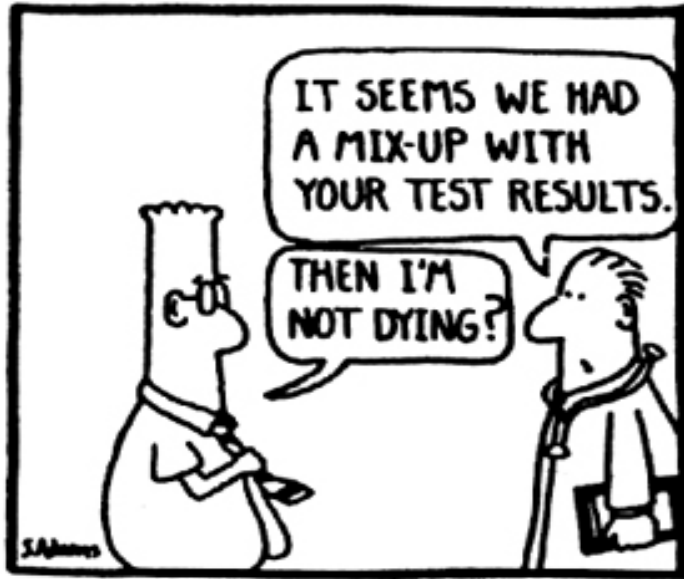
Prescribing and Monitoring

- Prescribing—no RCT yet, but results forthcoming soon
 - ◆ Observational data show high error rates in outpatient prescriptions
- Monitoring
 - ◆ Few patients on amiodarone receive appropriate monitoring

Stelfox, 2003

- ◆ Only about half of patients on thyroid supplement received appropriate monitoring

Stelfox, 2003



Dilbert

Evidence of Need

■ RMF data

- ◆ 1/4 of diagnosis-related malpractice cases were attributable to failures in the follow-up system

■ AMQUIP data

- ◆ 37% of women with abnormal didn't get repeat mammogram within suggested time

■ National data


- ◆ 35% of patients with abnormal pap smear are lost to follow-up

Results Manager Home Page

LMR QMA2 - Microsoft Internet Explorer

File Edit View Favorites Tools Help





Address <http://webqa.partners.org/scripts/phsweb.swl?APP=LMR&OPT=LMR&SESSION=1055150> Go

PE010
BIMA 

Select Desktop: RM 2 Patient Chart Custom Reports Admin Sign Results Resource

View Options: Open Visits Only Provider: Poon, Eric Gon-Chee, M.D.

View Ticklers 4 Overdue, 1 Pending **View To Do** 0 Overdue, 50 Pending

Visit Date	Patient Name / MRN	CDR Results	Abn	Ack	Visit Note	Patient Letter	User Flags/Comments	Test Arrived
<input type="checkbox"/> 11/06/2002	B [REDACTED]	H	!!!				----	<input type="checkbox"/>
<input type="checkbox"/> 11/02/2002	H [REDACTED]	H	!!!				----	<input type="checkbox"/>
<input type="checkbox"/> 11/04/2002	F [REDACTED]	P	!!				----	<input type="checkbox"/>
<input type="checkbox"/> 11/02/2002	C [REDACTED]	P	!!				----	<input type="checkbox"/>
<input type="checkbox"/> 11/04/2002	D [REDACTED]	H	!			 p	----	<input type="checkbox"/>
<input type="checkbox"/> 11/04/2002	G [REDACTED]	C	!				----	<input type="checkbox"/>
<input type="checkbox"/> 11/04/2002	B [REDACTED]	P	!				----	<input type="checkbox"/>
<input type="checkbox"/> 11/03/2002	S [REDACTED]	C	!	✓		 p 	----	<input type="checkbox"/>
<input type="checkbox"/> 11/02/2002	K [REDACTED]	C	!		 F		----	<input type="checkbox"/>
<input type="checkbox"/> 11/02/2002	BROWN, MARY	C, R	!				----	<input type="checkbox"/>
<input type="checkbox"/> 11/02/2002	D [REDACTED]	H					----	<input type="checkbox"/>
<input type="checkbox"/> 11/02/2002	H [REDACTED]	H					----	<input type="checkbox"/>
<input type="checkbox"/> 11/02/2002	C [REDACTED]	H					----	<input type="checkbox"/>
<input type="checkbox"/> 11/02/2002	RI [REDACTED]	H					----	<input type="checkbox"/>

Brown, Mary

08790800 (BWH)

06/22/1948 (54 yrs.) F

PE010

BIMA



Select

Desktop

Patient Chart: Results

Custom

Reports

Admin

Sign

Results

Resource

Result

Letter

Tickler

To Do

Patient Called

-Paragraphs-

- Letter Templates -

 Import in Spanish[Add addr & salutation](#)

Arial

10



ABC

1000 BACON ST
BROOKLINE, MA 02446

Dear Ms. Brown,

I have just received your test results and I would like to review them with you.

The mammogram performed on 07/08/2002 showed no abnormalities. However, because of technical reasons, the images could not be fully evaluated. As a result our radiologist thought that additional imaging would be helpful. If arrangements for further imaging studies have not been made, please schedule an appointment with myself so that we can make the arrangements to do so.

Your chemistry results were entirely normal.

 Acknowledge Result

Forward Result

Add Result Interpretation

[Back to Result List](#)**Alerts and Guidelines**

Incomplete assessment. Follow recommendations from radiologist. [More info...](#)

Medications (Add New)

Mvi therapeutic QD
Magnesium gluconate 1 QD
Xanax 0.25 QD PRN
Premarin 0.625 OD

Problems (Add New)

Marginally abn mammogr...
Cad
Ger
Pvd

Reporting

- Main tool now used to identify adverse events
 - ◆ Yet spontaneous reporting detects only about 5% of events
 - ◆ Computerized detection works much better
- Large aggregations of self-reported events helpful
 - ◆ Australian national database
 - ◆ Aviation model in U.S.

Signature Initiatives

- 6 network-wide initiatives
- One focuses on IT
 - ◆ Inpatient CPOE
 - ◆ Outpatient EHR
- Another on safety
 - ◆ Standardizing medication-related decision support
 - ◆ Implementing proactive tools to look for ADEs, implementing standard web-based reported
 - ◆ Making more uniform decisions about administration
 - ◆ Standardizing information exchanged at transfers

Who Is Leapfrog

Leapfrog represents..

- 164 large health care purchasers
- More than 35 million Americans
- More than \$64.9 billion in health care expenditures



Regional Approach to Change



Regions must have:

- Effective leadership
- Competitive HC market
- Concentration of Leapfrog lives

23 Regional Roll-Outs

(Regions in Green)

Leapfrog Leaps

- CPOE
- ICU physician staffing
- Evidence-based hospital referral
- Leapfrog Quality Index
 - ◆ Based on 27 National Quality Forum practices (plus the above three)
- Planned release later this year: computerized decision support in outpatient setting including computerized prescribing

Evaluating Leapfrog's Progress

- More purchasers joining Leapfrog – 7 to 160
- More hospitals reporting results—marketplace transparency
- Health plan user groups collaborating to institute change and offering incentives and rewards
- Wide-spread promotion among employees

10 Commandments for Effective Clinical Decision Support

1. **Speed Is Everything.**
2. **Anticipate Needs and Deliver in Real Time.**
3. **Fit into the User's Workflow.**
4. **Little Things Can Make a Big Difference.**
5. **Recognize that Physicians Will Strongly Resist Stopping.**
6. **Changing Direction Is Easier than Stopping.**
7. **Simple Interventions Work Best.**
8. **Ask for Additional Information Only When You Really Need It**
9. **Monitor Impact, Get Feedback, and Respond.**
10. **Manage and Maintain Your Knowledge-based Systems.**

Summary: Sleep and Attention

- Compared traditional schedule and schedule in which extended duty shifts were eliminated and interns were sent home at 9
- On traditional schedule, interns:
 - ◆ Worked 19.5 hours more per week
 - ◆ Slept 5.8 hours less per week
 - ◆ Had twice as many attentional failures while working at night
 - ◆ Did same number of procedures

Summary: Patient Safety

- On traditional schedule, interns made 36% more serious medical errors
 - ◆ 27% more intercepted near misses
 - ◆ 57% more non-intercepted near misses
 - ◆ Non-significant trend toward more preventable adverse events
- By error type, interns made
 - ◆ 21% more serious medication errors
 - ◆ 5 times as many serious diagnostic errors
- Unit-wide, 22% more serious errors on traditional schedule
- No difference in error rates of sr. residents or other staff

Implications

- Eliminating interns' 30-hour work shifts and shortening their work weeks can improve sleep, decrease attentional failures, and decrease serious medical errors
 - ◆ These shifts should be eliminated
- Need close attention to improving handoffs

PATIENT GATEWAY

- Home
- Feedback
- Sitemap
- Logout
- Site/Privacy

Information about our practice

- Mail
- Requests
- Health Record
- Health Library
- Practice
- My Profile
- Help

- General Information
- Directions
- Services
- Professional Staff
- Contact Us

Welcome

Welcome Bilbo Oetest

You have no new messages in your Inbox.

THE BRIGHAM AND WOMEN'S PHYSICIAN GROUP provides comprehensive adult medical care, from routine health screening to complex diagnostic evaluations. Our 10-physician general medicine practice includes a nephrologist, endocrinologist and cardiologist. All of these physicians are affiliated with Brigham and Women's Hospital and are faculty of Harvard Medical School.



Future Potential of IT

- Huge, hard to estimate
 - ◆ Very large improvement with medication errors
- With surgical errors won't be as big
 - ◆ Yet communication is key
- For many types of errors in outpatient setting such as monitoring will be enormous

Bottom line: current systems far from Fedex level of accountability, need IT to get there

What Leadership Can Do

- Create a “systems” climate
- Push for systems changes that work
 - ◆ Physician order entry
 - ◆ Bar-coding
 - ◆ Changing pharmacist roles
 - ◆ Others
- Support development of effective on-going monitoring
 - ◆ Computerized surveillance

Conclusions

- Healthcare today is inefficient, error-prone, of variable quality
 - ◆ Safety especially is approachable
- IT can substantially improve care by:
 - ◆ Bringing decision support to point of care
 - ◆ Improving communication
 - ◆ Closing “open-loop” systems
 - ◆ Allowing routine quality measurement

Reducing Error in Medicine

“I don’t want to make the wrong mistake.”

Yogi Berra