

Dx Error Evaluation Research Projects Lessons and Questions

Gordon Schiff MD
Associate Professor of Medicine
Harvard Medical School

Associate Director Center for Patient
Safety Research and Practice
Brigham & Women's Hospital





AHRQ DEER & Harvard RMF Dx Error Projects

Starting points

1. Learn about diagnosis in naturalistic environment
Need to understand more before proposing solutions
Real, rather than simulated cases
2. Errors ubiquitous, mostly overlooked
3. Patient safety, especially medication safety
represents paradigm needed to be infused
4. Multidisciplinary “views” needed for/offered
new vantage points
5. Databases ripe for mining, linking, learning

2 Projects: AHRQ DEER Harvard RMF/CRICO Dx Error

- A. Diagnosis Error and Evaluation Research
 - Weekly probing of (putative) dx error cases
 - Clinician survey: 3 cases @
 - Linking lab and pharmacy data
- B. Using Feedback to Close Loop on Dx Errors at Brigham Hospital and Clinics
 - Series of dedicated Dx Error M&M's
 - Harvesting, integrating disparate Departmental M&Ms
 - Mining risk management database
 - Screen return visits to ED; new review tool
 - Other electronic screens: weight loss, hyponatremia

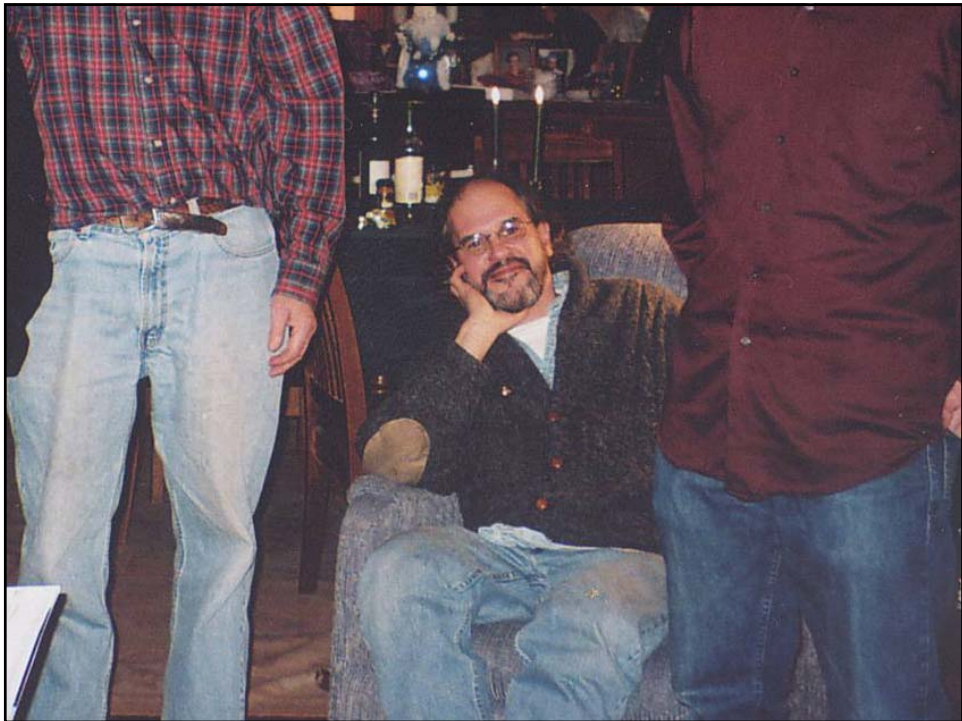
DEER Weekly case conference What did we fight about?

- Struggled around
.....just about everything!
- Convenience sample of cases
- 12 questions emerged

Illustrative Patient

- Ed: 52 y.o. study group friend—
“I think I had a stroke last week.”





Special Patient

- Ed: 52 y.o. study group friend—
“I think I had a stroke last week.”
- Sounds likely; see in my clinic next day
- Order CT, PT, Aspirin
- CT – comes back scheduled for December
- Plan: call to argue for earlier CT
- Called by his friend 6 weeks later:
“Ed is in ICU with ruptured aneurysm and
massive bleed”

Devastating Error

12 Challenging Questions in Investigating Diagnosis Error Cases

Uncertainties about diagnosis & findings

1. What *is* the correct dx?
 - How much certainty do we have, *even now*, about what is the correct diagnosis?
2. What *were* actual findings at various times
 - At points in time when pt seen; how much certainty that particular dx and findings were present at time(s) we are positing an error?

Relationship between diagnosis failure and adverse outcomes

3. What is the probability that the “error” resulted in the adverse outcome?
 - How *treatable* is the condition?
 - How *critical is timely dx and rx* for outcome (in general and this case)?
4. How did the error in the diagnostic process contribute to making wrong dx and giving wrong treatment?

Clinician assessment & actions

5. What *was* MD’s diagnostic assessment?
 - How much consideration given to correct dx?
 - Often difficult to reconstruct as differential dx not well documented
6. How good was dx assessment based on evidence MD *had on hand* at that time?
 - Obvious?...vs no way anyone could have suspected?

Clinician assessment & actions

7. How “erroneous” was diagnosis based on difficulty in making dx at this point?

- Difficult “*signal to noise*” situation; rare low-probability diagnosis; atypical presentation

8. How “justifiable” was failure to obtain additional information (history, tests)?

- Both absolutely, & relative to constraints
 - How difficult was it to obtain missing/needed data:
 - Patient withholding/refusing to give accurate hx
 - Resource constraints: test backlog, cost

Improvement opportunities I?

9. Was there problem in assessment of the severity of the illness?

- With resulting failure to closely observe or follow-up in more timely way
 - Both absolutely and relative to constraints

10. To what extent did clinician actions deviate from “standard of care?”

- Negligent care: failure to follow accepted guidelines, expected practices, pursue abnl finding that should never be ignored?

Improvement opportunities II?

11. How preventable is error in future?

- How ameliorable or amenable to change are factors/problems that contributed to the error?
- What would the changes cost? \$\$, time

12. What should we do better next time we encounter similar pt or situation?

- Is there general rule, or systemic measures
- How to ensure these are reliably done next/each time?

Self reported 583 Diagnosis Errors

- 669 Cases of Diagnosis Error solicited from 310 physicians by mail and at Grand Rounds presentations
- Excluding non-dx errors (e.g. medication error) and insufficient data:
Total of 583 reported errors
- 178 (30%) committed self
396 (68%) witnessed others

Schiff [Arch Intern Med](#) 11/2009

Diagnosis	# cases	%
Pulmonary embolism	26	4.5%
Poisoning, ADR, overdose	26	4.5%
Lung cancer	23	3.9%
Colorectal cancer	19	3.3%
Acute coronary syndrome	18	3.1%
Breast cancer	18	3.1%
Stroke	15	2.6%
Congestive heart failure	13	2.2%
Fracture	13	2.2%
Abscess	11	1.9%
Pneumonia	10	1.7%
Aortic aneurysm/dissection	9	1.5%
Appendicitis	9	1.5%
Depression	9	1.5%

Diagnosis	# cases	%
Diabetes mellitus	8	1.4%
Tuberculosis	8	1.4%
Anemia	6	1.0%
Bacteremia	6	1.0%
Metastatic cancer	6	1.0%
Spinal cord compression	6	1.0%
Subtotal	259	44.4%

Q&A

A CONVERSATION WITH LUCIAN LEAPE, M.D.

The way to reduce errors in health care is to change systems, says this Harvard educator. Punishment encourages people to cover up.

MOVING BEYOND A PUNITIVE MIND-SET



Lucian L. Leape, M.D., is a health policy analyst whose research has focused on error

Safer practice can only come about from acknowledging the potential for error and building in error reduction strategies at each stage of clinical practice

L. Leape

DEER TAXONOMY

1. Access/Presentation	<input type="checkbox"/>	Denied care			
	<input type="checkbox"/>	Delayed presentation			
2. History	<input type="checkbox"/>	Failure/delay in <i>eliciting</i> critical piece of history data			
	<input type="checkbox"/>	Inaccurate/misinterpretation "			
	<input type="checkbox"/>	Suboptimal weighing "			
	<input type="checkbox"/>	Failure/delay to follow-up "			
3. Physical Exam	<input type="checkbox"/>	Failure/delay in eliciting critical physical exam finding			
	<input type="checkbox"/>	Inaccurate/misinterpreted "			
	<input type="checkbox"/>	Suboptimal weighing "			
	<input type="checkbox"/>	Failure/delay to follow-up "			
4. Tests (Lab/Radiology)	<input type="checkbox"/>	Ordering			
	<input type="checkbox"/>	Failure/delay in ordering needed test(s)			
	<input type="checkbox"/>	Failure/delay in performing ordered test(s)			

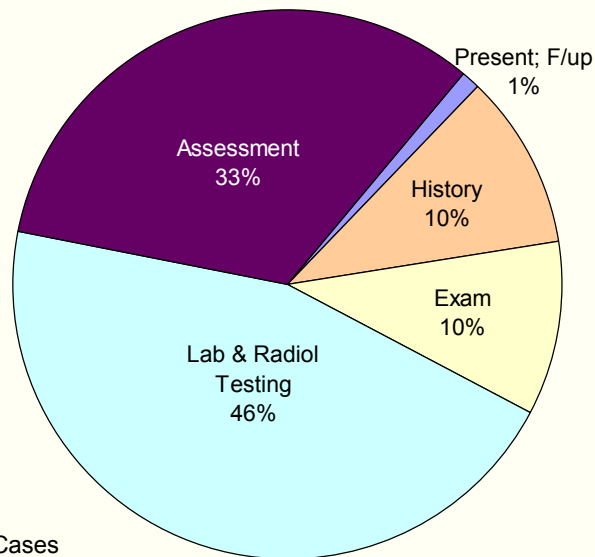
DEER TAXONOMY

4. Tests (Lab/Radiology)	<input type="checkbox"/>	Ordering			
	<input type="checkbox"/>	Failure/delay in ordering needed test(s)			
	<input type="checkbox"/>	Failure/delay in performing ordered test(s)			
	<input type="checkbox"/>	Suboptimal test sequencing			
	<input type="checkbox"/>	Ordering of unnecessary test(s)			
	<input type="checkbox"/>	Performance			
	<input type="checkbox"/>	Sample mixup/mislabeled (eg wrong patient)			
	<input type="checkbox"/>	Technical errors/poor processing of specimen/test			
	<input type="checkbox"/>	Erroneous lab/radiol reading of test			
	<input type="checkbox"/>	Failed/delayed communication of test			
	<input type="checkbox"/>	Clinician processing			
	<input type="checkbox"/>	Failed/delayed follow-up of test			
	<input type="checkbox"/>	Erroneous clinician interpretation of test			

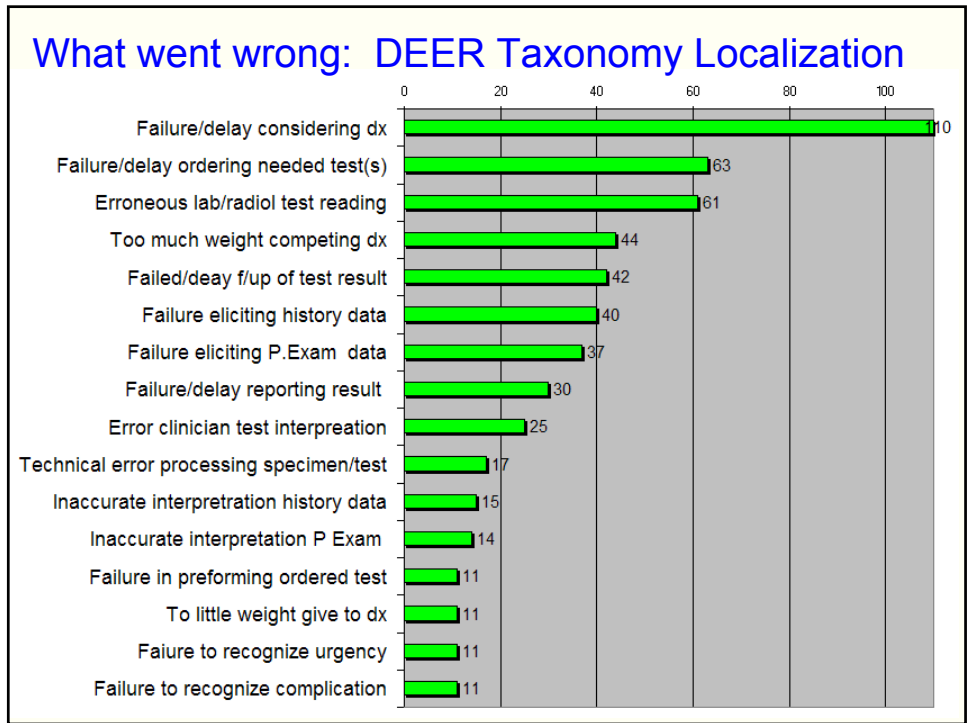
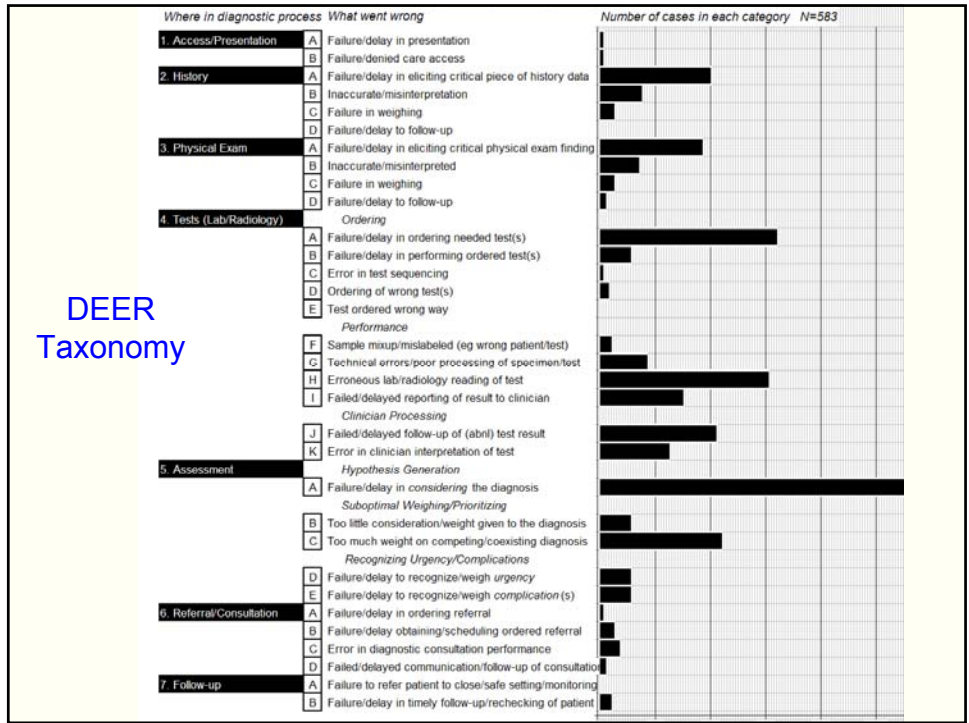
DEER TAXONOMY

5. Assessment		Hypothesis Generation		
	<input type="checkbox"/>	Failure/delay in <i>considering</i> important diagnosis		
		Suboptimal weighing/prioritizing		
	<input type="checkbox"/>	Too much weight to low(er) probability/priority dx		
	<input type="checkbox"/>	Too little consideration of high(er) probability/priority dx		
	<input type="checkbox"/>	Too much weight on <i>competing</i> diagnosis		
		Recognizing Urgency/Complications		
	<input type="checkbox"/>	Failure to appreciate urgency/acuity of illness		
	<input type="checkbox"/>	Failure/delay in recognizing complication(s)		
6. Referral/Consultation	<input type="checkbox"/>	Failed/Delayed in needed referral		
	<input type="checkbox"/>	Inappropriate/unneeded referral		
	<input type="checkbox"/>	Suboptimal consultation diagnostic performance		
	<input type="checkbox"/>	Failed/delayed communication/followup of consultation		
7. Followup	<input type="checkbox"/>	Failure to refer patient to close/safe setting/monitoring		
	<input type="checkbox"/>	Failure/delay in timely follow-up/rechecking of patient		

Where & When in Dx Process are Errors Occurring?



N= 583 Cases



The 2010 Australian **Diagnostic Error** Survey

Carmella Crock Neil Jones et al

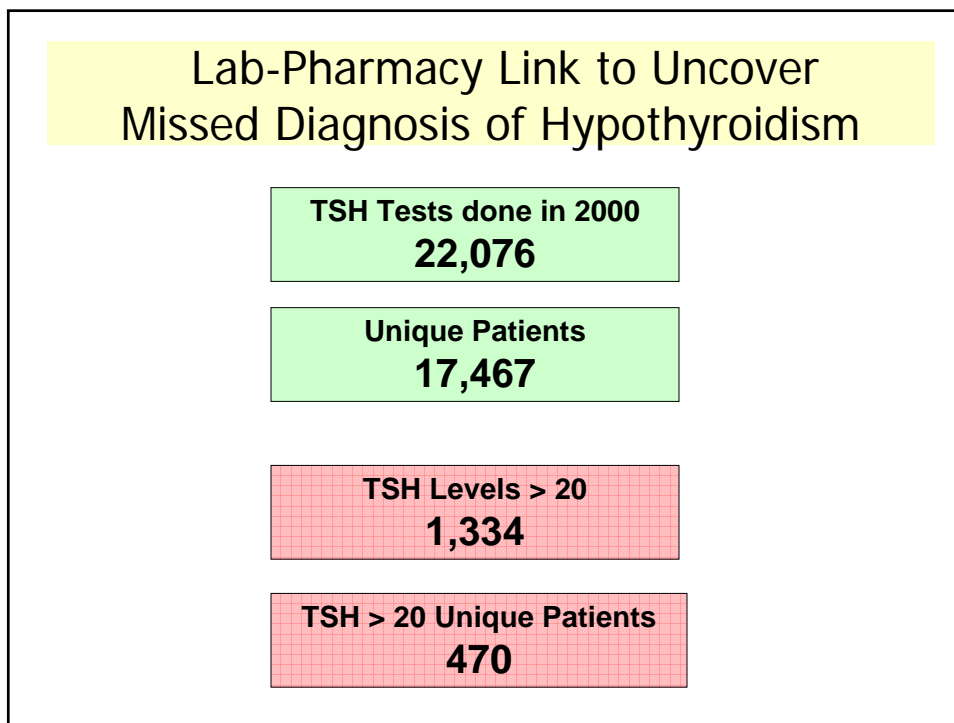
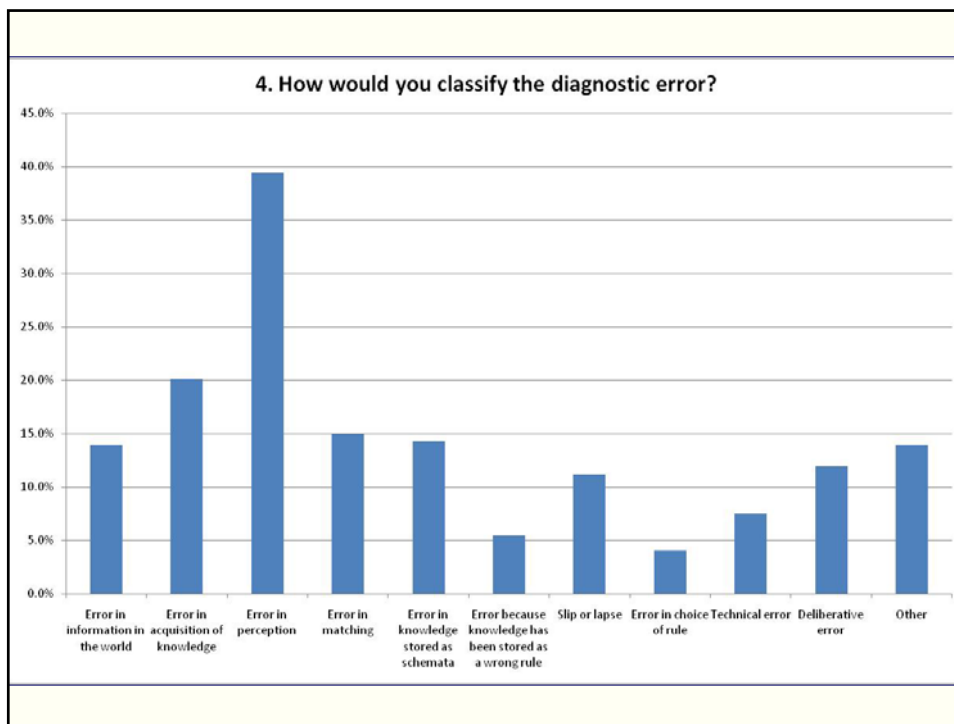
1st ever in Australia!

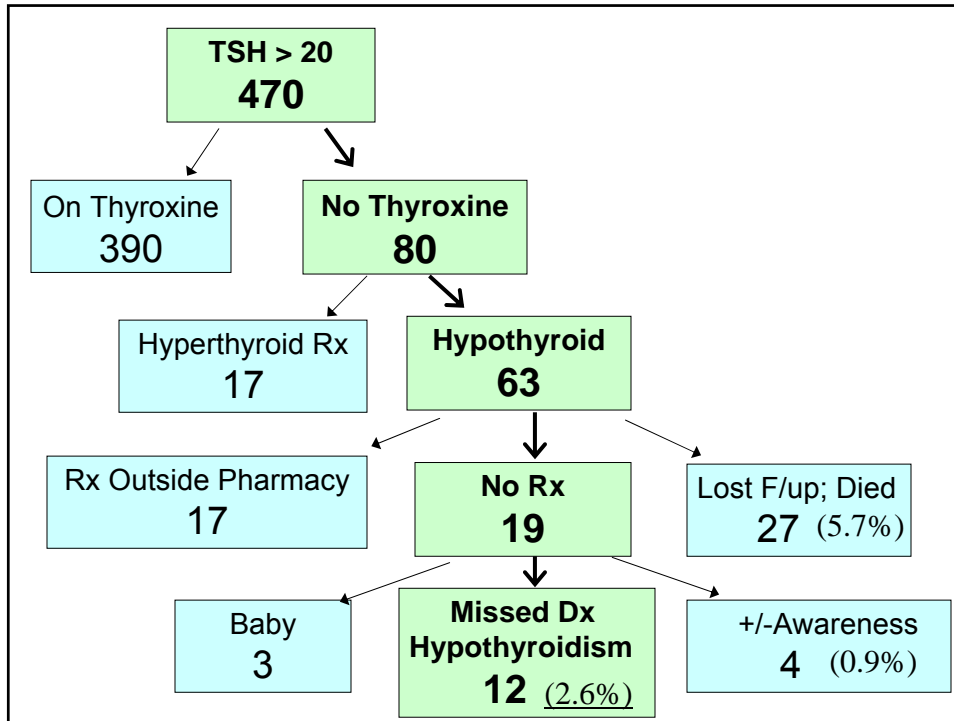


*Contributes to **international** benchmarking!*

Preliminary Results/Themes

- **Most commonly reported conditions misdiagnosed:** Cx spine #, Ca lung, pneumothorax, perforated viscus
- **Contributing factors:** Workload, supervision, communication, follow up test results
- **Classification:** mainly perceptual errors
- **Prevention:** Realtime reporting





Year	2000		2001	
	N	%	N	%
Total TSH done	22,076		24,524	
Unique patients	17,467		19,293	
TSH levels > 20	1,334		744	
TSH > 20 unique patients	470		512	
On thyroxine	390		415	
No thyroxine	80	17.0%	97	18.9%
Hyperthyroid Rx	17	3.6%	20	3.9%
Rx outside pharmacy	17	3.6%	34	6.6%
No Rx	19	4.0%	16	3.1%
Lost F/up or died	27	5.7%	27	5.3%
Babies	3		3	
Awareness but failed F/up	4		2	
Missed Dx hypothyroidism	12	2.6%	11	2.1%

Year	2000		2001	
	N	%	N	%
Total TSH done	22,076		24,524	
Unique patients	17,467		19,293	
TSH levels > 20	1,334		744	
TSH > 20 unique patients	470		512	
On thyroxine	390		415	
No thyroxine	80	17.0%	97	18.9%
Hyperthyroid Rx	17	3.6%	20	3.9%
Rx outside pharmacy	17	3.6%	34	6.6%
No Rx	19	4.0%	16	3.1%
Lost F/up or died	27	5.7%	27	5.3%
Babies	3		3	
Awareness but failed F/up	4		2	
Missed Dx hypothyroidism	12	2.6%	11	2.1%

Year	2000		2001	
	N	%	N	%
Total TSH done	22,076		24,524	
Unique patients	17,467		19,293	
TSH levels > 20	1,334		744	
TSH > 20 unique patients	470		512	
On thyroxine	390		415	
No thyroxine	80	17.0%	97	18.9%
Hyperthyroid Rx	17	3.6%	20	3.9%
Rx outside pharmacy	17	3.6%	34	6.6%
No Rx	19	4.0%	16	3.1%
Lost F/up or died	27	5.7%	27	5.3%
Babies	3		3	
Awareness but failed F/up	4		2	
Missed Dx hypothyroidism	12	2.6%	11	2.1%



Every system is perfectly designed to deliver the results it does

Don Berwick IHI

Perfectly designed system to “miss” 12 patients a year and lose another 27 follow-up.





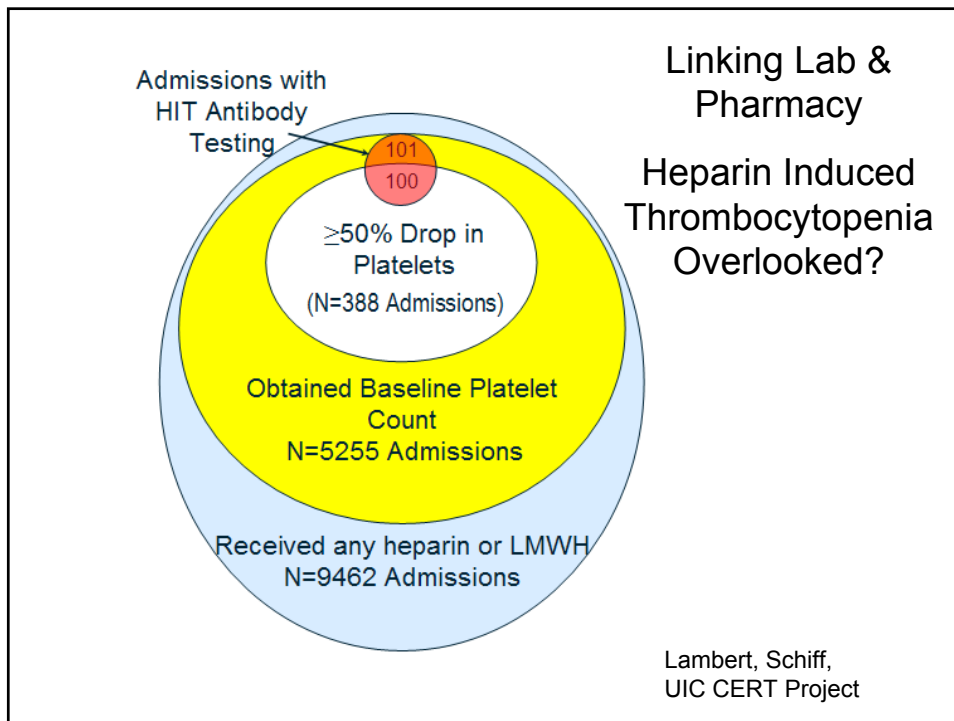
Figure 1.
Baseline view of HIT.



Figure 2.
Week one of treatment with trypsin-balsam of Peru-caster oil ointment.



Figure 3.
Week two of treatment. Essentially, full healing was achieved.



BWH Harvard RMF Project Diagnosis Error Project

-52 Cases from M&M's

-88 Cases from Risk Management

-ED Screen – ED visit w/in 30 days of ambulatory or prior ED visit

		Dx	#	
Harvard Risk Management Foundation BWH Project	52 Diagnosis Errors Harvested from M&M & Special M&M Cases	Skin/Soft Tissue Infection	3	5.8%
		CHF	3	5.8%
		Lung CA	3	5.8%
		Sepsis	3	5.8%
		PE	2	3.8%
		MI	2	3.8%
		Arrhythmia	2	3.8%
		CMV Infection	2	3.8%
		Guillain-Barre	2	3.8%
		Pancreatic Trauma Necrosis	2	3.8%
		Foreign body foot, ear	2	3.8%

Dx	#		
Melanoma	1	Ovarian Ca	1
C.Diff Colitis	1	Torsion Ovary	1
Bowel Ischemia	1	Renal Mass	1
Bowel Malrotation	1	Renal Infection	1
Diverticulitis	1	Psoas Abscess	1
Colon Ca	1	Malleolar Fx	1
Intestinal Perforation	1	Stroke/TIA	1
Small Bowel tumor	1	Brain Tumor	1
Cirrhosis	1	SAH	1
Post op Cholangitis	1	Parkinsons	1
GB Ca	1	Hernia-placental	1
Biliary Stone	1	Angiodema-	
Panc CA	1	Trauma Tongue	1
		Epidural Abscess	1

Risk Management Screen Case Selection

1594 new cases reported (24 months)

420 cases selected by text query

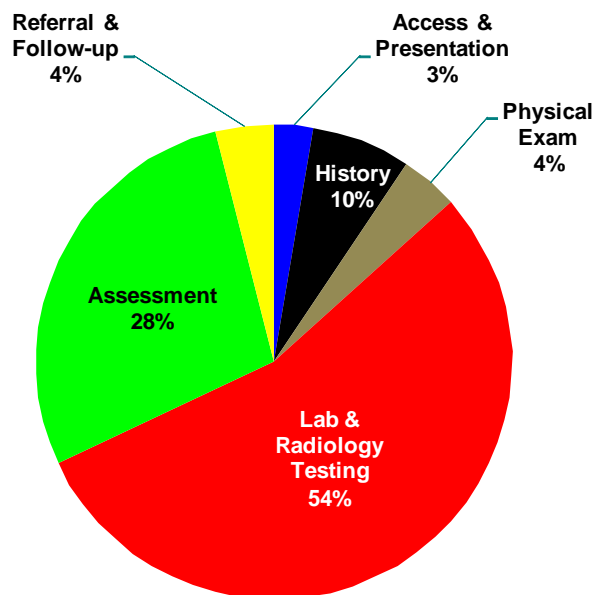
253 selected by research assistant

75 error cases identified by physicians

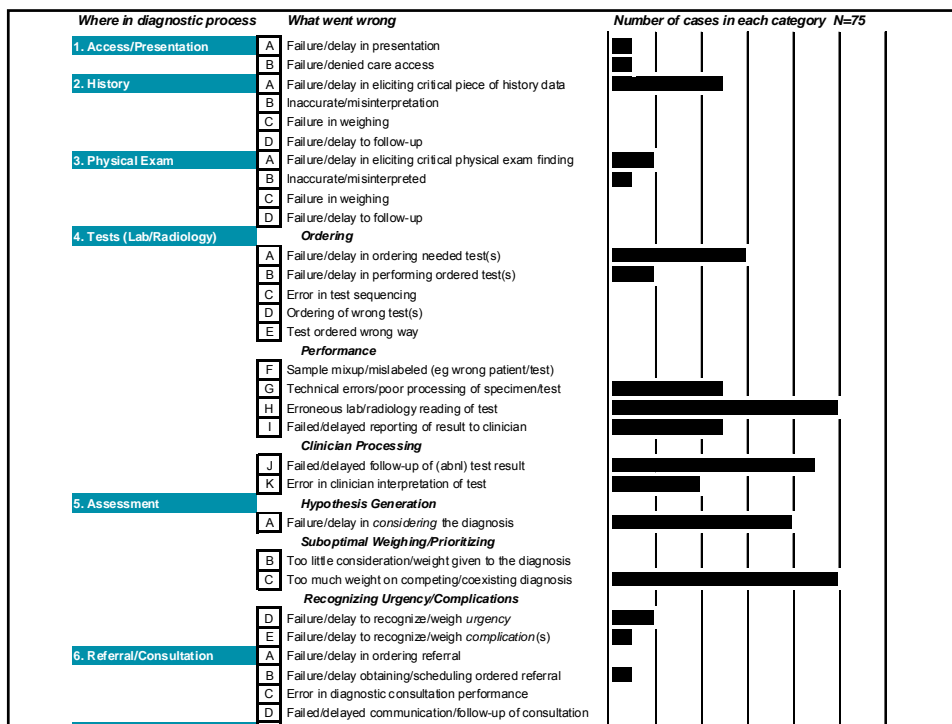
**Brigham Risk Management Database
Diagnosis Error Cases (N=88)**

Leading Diagnoses	Count	% of Total
Cancer (various types)	24	32.0%
Fracture (various types)	7	9.3%
Unknown	6	8.0%
Normal	4	5.3%
Stroke or SDH	3	4.0%
Birth defect	3	4.0%
Ectopic pregnancy	2	2.7%
Renal cyst	2	2.7%
Urinary tract infection	2	2.7%

Localization of diagnosis errors

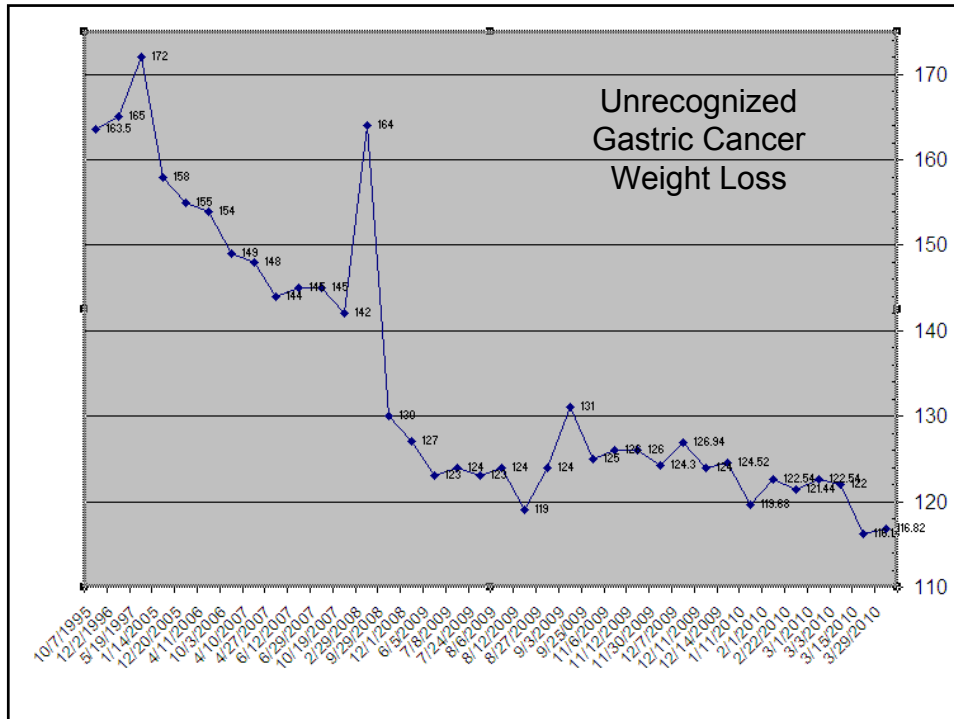


BWH Risk Database 2007-2009



Findings/Lessons BWH/RMF Project

- Dx errors “locked away” & compartmentalized
 - No code for “diagnosis error” in Risk Management database (only falls, med error, lost belongings)
 - M&M’s no standardized formats, systematic sharing across departments.
- Certain departments’ M&M more/less focused on dx error
 - Emergency Dept--obsessed; Surgery--off radar
- Defensiveness co-existing w/ enlightenment



Preliminary Data—Wt Loss Study

- 100 patients 10% wt loss
- Mean Wt loss 24 lbs 14% TBW
- Noted:

CC - 1 HPI -27 ROS 21

P.Exam – Wt documented -66
Wt Change Noted -13

Assessment/Plan

Diet/Obesity related – 22

Depression/Anxiety – 1

- **THUS - NO MENTION WT Loss 75% of time**

Home | Select | Desktop | Patient Chart | Oncology | Custom: Preferences | Reports | Admin | Sign | Results | ? | Resource | P

my schedule

Entire Practice

Document Manager

Clinical Messages

Referrals

Result Manager 2

Rx Refill Queue

New uploaded transcriptions in Document Management

New Clinical Messages

New Rx renewal requests/tasks

Prompt before sending if no patient is attached

Fax

E-mail

Clinical Message

Show Tip of Day

Show 10% weight change warning

Do not show Scanned Unacknowledged document alert

Do not show Family History on Problem List

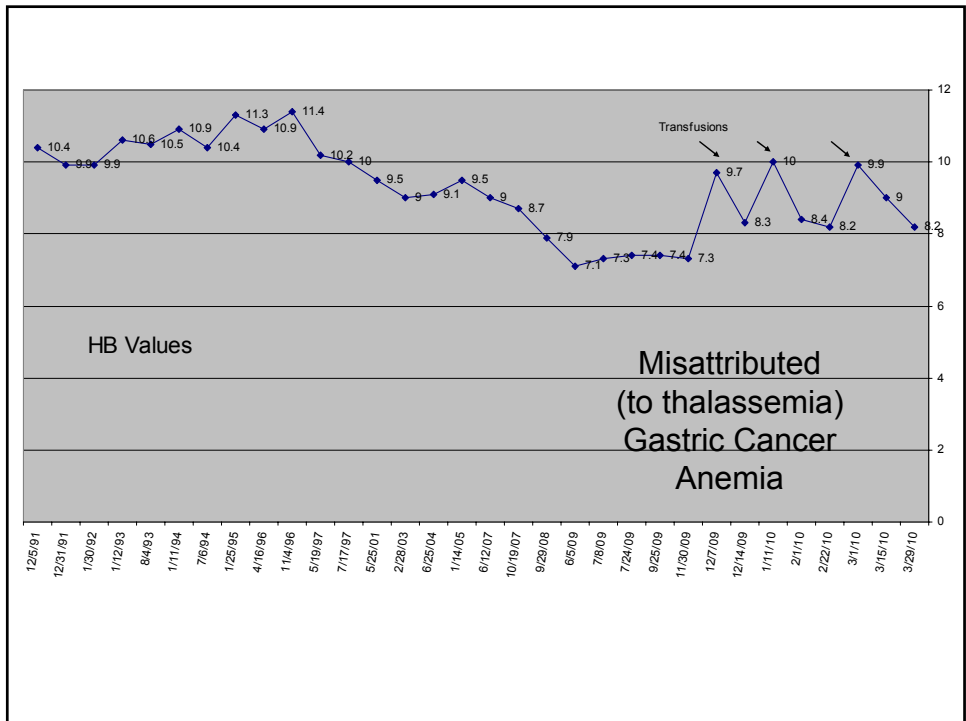
Do not show Shell Icons

Send email notification (PHS email only) for:

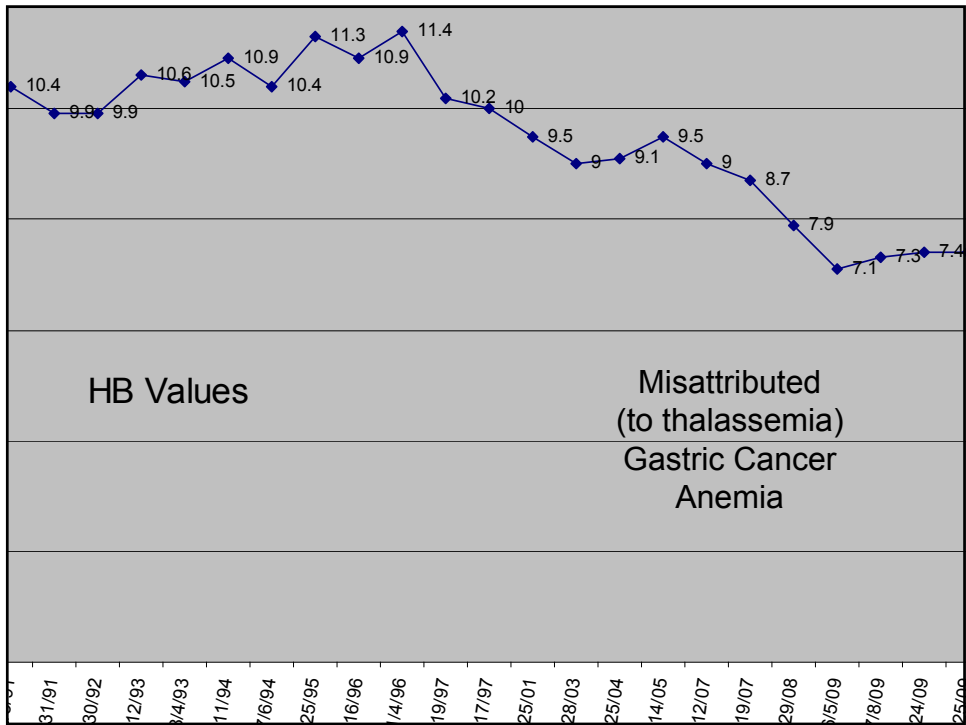
Clinical Message:

Preferred communication option(s):

Other Settings:



Active Problems (7) Inactive Problems (5) Procedures (0) All Practice My	
Add New Favorites Re-order Problems Inactivate Switch to Fam Hx	
<input type="checkbox"/>	Problem Description
<input type="checkbox"/>	HYPERTENSION
<input type="checkbox"/>	R BREAST CA 1988, LOCALIZED, TX W/ MRM
<input type="checkbox"/>	AODM, DIET CONTROLLED
<input type="checkbox"/>	GLAUCOMA
<input type="checkbox"/>	HYPERCHOLESTEROLEMIA
<input type="checkbox"/>	PERIPH VASCULAR DZ
<input type="checkbox"/>	Microcytic anemia
	Comments: ?thalassemia in the past



Key Issues

Recognition

Problem/threshold crossing; visual affordances

Attribution

“Longstanding anemia”, “voluntary wt loss”

Reconsideration

When and how to re-evaluate

Prioritization

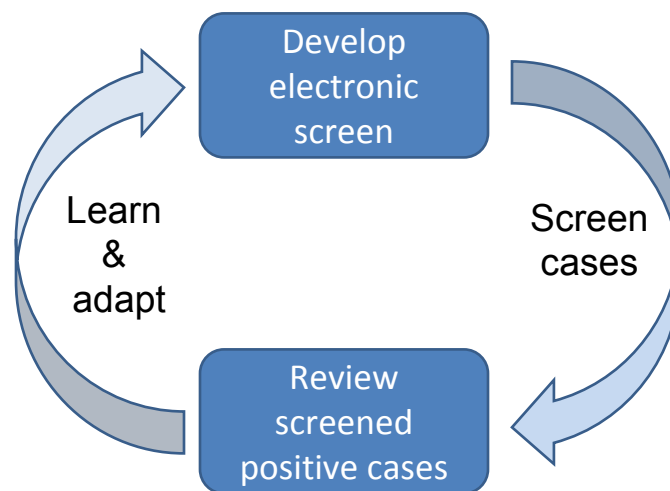
When/where does it really matter

Cancer outcomes modified once significant wt or is horse already out of barn

Clinical Documentation

Multiple ways can help (or hinder)

Development of Screening Criteria



DOE, JANE 59 F DOB 1/1/1950 Empi 999999999 MRN 99999999(BWH)

A 12/25/2008 Index ED Visit Dx:1 789.09 Abdmnal pain oth spcf:
 D 12/25/2008 Dx:2 250.00 DMII wo cmp nt st unc
 CC: ABD PAIN ADMIT Dx:3 272.0 Pure hypercholesterolem

Comparison Note
 2 Days Before Index Visit

EDVISIT^99999999^DOE, JANE^12/25/08^NO, DR
 I interviewed and examined the patient and I confirm the documentation on the written chart. Please see the written chart for details.

HISTORY OF PRESENT ILLNESS: Briefly, the patient is a middle-aged woman presenting with 3 days of right lower quadrant abd pain. The pain is crampy in nature, 8/10 in severity with radiation to the epigastric area. No change with intake of food. No sick contacts, recent travel or prior episodes of the symptoms. No recent ingestion of unusual food.

PHYSICAL EXAMINATION: The patient actually looked well and had normal vital signs, although earlier, she had a high fever of 101.5. Her abdominal exam revealed minor tenderness, mainly in the right lower quadrant. No rebound or guarding.

LABORATORY DATA: Checked and the blood count of 14 units.

INTERVAL HISTORY: This delightful 59-year-old woman has a history of diabetes and hyperlipidemia. She has been on insulin and a statin for quite some time. Today she complains of intermittent abdominal discomfort along with occasional chills. She gets cold very easily in her poorly heated apartment. The abdominal pain occurred after she ate a large burrito at a fast food restaurant 3 days ago. She is complaining of some constipation.

PHYSICAL EXAM:
 Temperature 99.8 and remainder of vitals are normal.
 Gen: Slightly uncomfortable
 HEENT: Most mucous membranes
 Abd: Soft, mildly tender in right lower quadrant.
 Ext: No edema

2 Days Before Index Visit

Source	DocType	Date
DCSummary	DC Summary	1/2/2009
Outpatient	Note	12/23/2008
Outpatient	Hospital Note	12/23/2008
Outpatient	Note	12/19/2008

ErrorConfidence Probable

Access History Physical Testing Assessment Referral Follow-up

Comment Failure/delay in considering the correct diagnosis:
 Patient ultimately diagnosed with appendicitis, and presented with right lower quadrant abdominal pain with fever at outpatient physician 3 days prior to admission. Appendicitis was not on the differential diagnosis and no bloodwork or imaging was ordered at that time.

Record: 1 | 2 of 2

Role for Electronic Documentation	Goals and Features of Redesigned Systems
Providing access to information	Ensure ease, speed, and selectivity of information searches; aid cognition through aggregation, trending, contextual relevance, and minimizing of superfluous data.
Recording and sharing assessments	Provide a space for recording thoughtful, succinct assessments, differential diagnoses, contingencies, and unanswered questions; facilitate sharing and review of assessments by both patient and other clinicians.
Maintaining dynamic patient history	Carry forward information for recall, avoiding repetitive pt querying and recording while minimizing erroneous copying and pasting
Maintaining problem lists	Ensure that problem lists are integrated into workflow to allow for continuous updating.
Tracking medications	Record medications patient is actually taking, patient responses to medications, and adverse effects to avert misdiagnoses and ensure timely recognition of medication problems.
Tracking tests	Integrate management of diagnostic test results into note workflow to facilitate review, assessment, and responsive action as well as documentation of these steps.

<i>Role for Electronic Documentation</i>	<i>Goals and Features of Redesigned Systems</i>
Ensuring coordination and continuity	Aggregate and integrate data from all care episodes and fragmented encounters to permit thoughtful synthesis.
Enabling follow-up	Facilitate patient education about potential red-flag symptoms; track follow-up.
Providing feedback	Automatically provide feedback to clinicians upstream, facilitating learning from outcomes of diagnostic decisions.
Providing prompts	Provide checklists to minimize reliance on memory and directed questioning to aid in diagnostic thoroughness and problem solving.
Providing placeholder for resumption of work	Delineate clearly in the record where clinician should resume work after interruption, preventing lapses in data collection and thought process.

Schiff & Bates [NEJM](#) 2010

<i>Role for Electronic Documentation</i>	<i>Goals and Features of Redesigned Systems</i>
Calculating Bayesian probabilities	Embed calculator into notes to reduce errors and minimize biases in subjective estimation of diagnostic probabilities.
Providing access to information sources	Provide instant access to knowledge resources through context-specific "infobuttons" triggered by keywords in notes that link user to relevant textbooks and guidelines.
Offering second opinion or consultation	Integrate immediate online or telephone access to consultants to answer questions related to referral triage, testing strategies, or definitive diagnostic assessments.
Increasing efficiency	More thoughtful design, workflow integration, easing and distribution of documentation burden could speed up charting, freeing time for communication and cognition.

Schiff & Bates [NEJM](#) 2010



Role for Patient

In Minimizing and Preventing Diagnosis Error and Delay

- Push for timely access
- Reliable follow-up, continuity
- Keen observer, reporter sx
- Proactive on test results
- Sharing hunches
- Curiously reading on own
- Meticulously adhering w/ empiric trial regimens
- Active as co-investigator
- Being patient: time & tests
- Recruiting family for support
- Respecting limits on staff time, society resources
- Agreeing to disagree
- Help in building, maintaining trust and communication
- Getting involved with patient organizations

Key question:

What will it take to support these roles and help them flourish?