Health IT and Diagnosis

Mark L. Graber, MD, FACP

CMO, Founder and President-Emeritus – SIDM
Fellow-Emeritus – RTI International
Professor Emeritus – SUNY Stony Brook
Mark.Graber@improvediagnosis.org

Society to Improve Diagnosis in Medicine

VISION: We envision a world where no patients are harmed by diagnostic error. Diagnosis should be accurate, timely, efficient, & SAFE

Who Is This Person?

Thomas Eric Duncan

Summer, 2014: Ebola epidemic in W. Africa; CDC alerts

Sept 25, 2014: ER visit #1

- Dizzy, nauseated, headache (8/10), fever 103F
- EHR Nurse's note: Documents recent travel from Liberia
- EHR MD note: Dx = Sinusitis? Discharged to home

Sept 27: ER visit #2

Admitted and died of Ebola infection

The EHR Wall

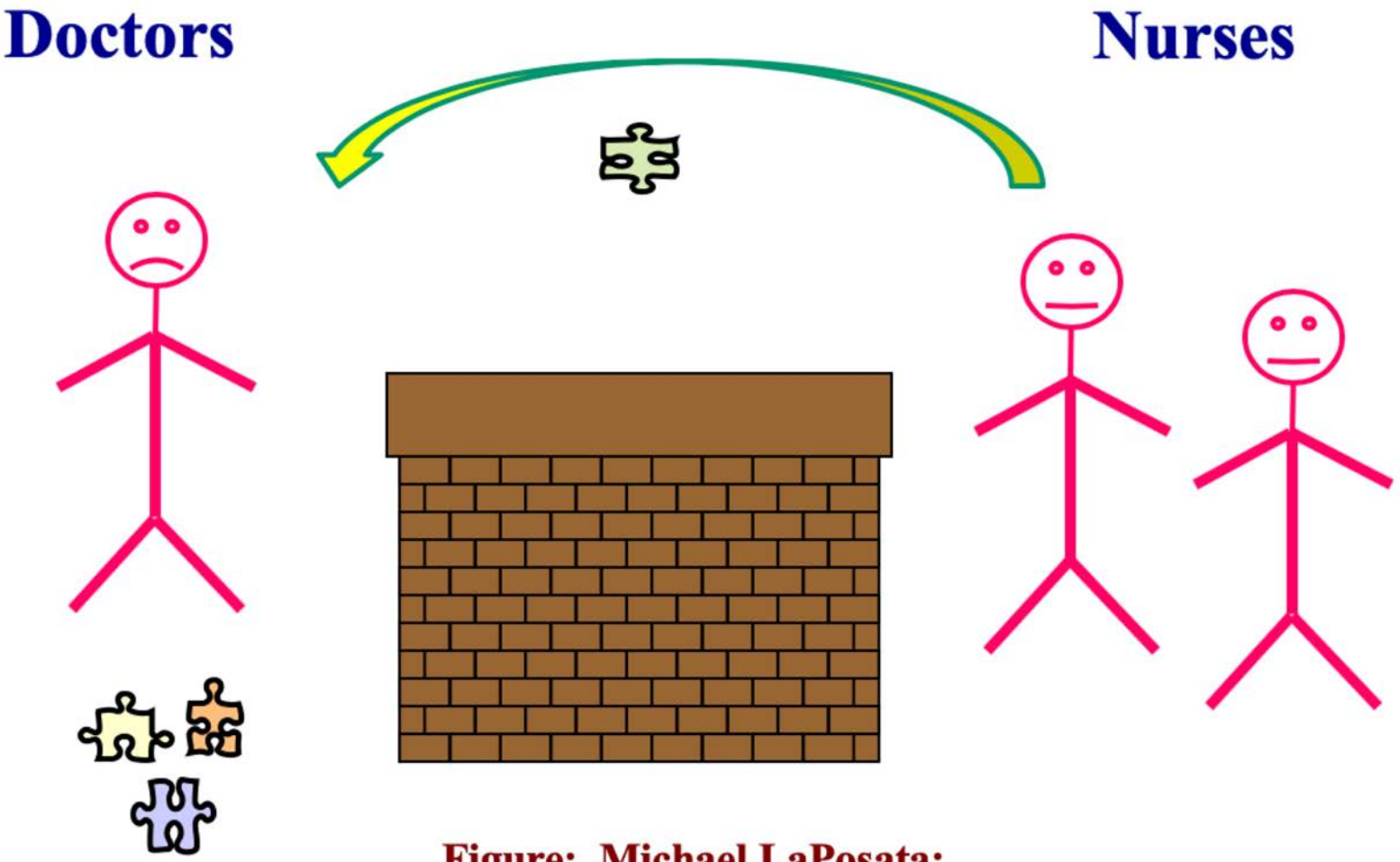


Figure: Michael LaPosata;

Upadhyay et al Ebola patient zero… DIAGOSIS. 2014

Objectives

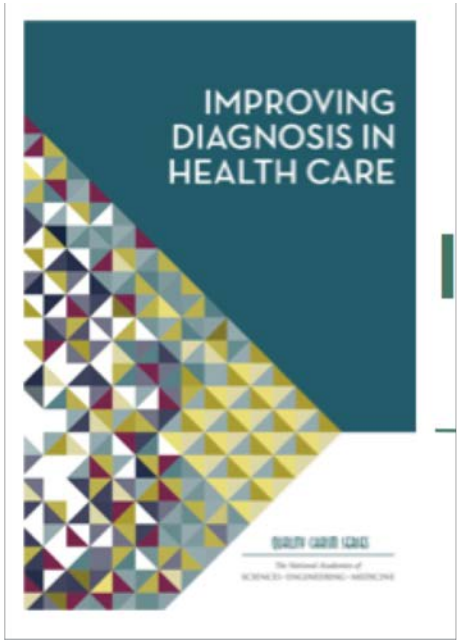
The problem of diagnostic error

How health IT improves diagnosis

How health IT degrades diagnosis

A peak at the future …

What do we know about diagnostic errors ?



They are common

They happen in every setting

They arise from the complexity of the diagnostic process, and shortcomings in cognitive- and system-related factors

National Academy of Medicine
Improving Diagnosis in Health Care

Estimates of the Diagnostic Error Rate

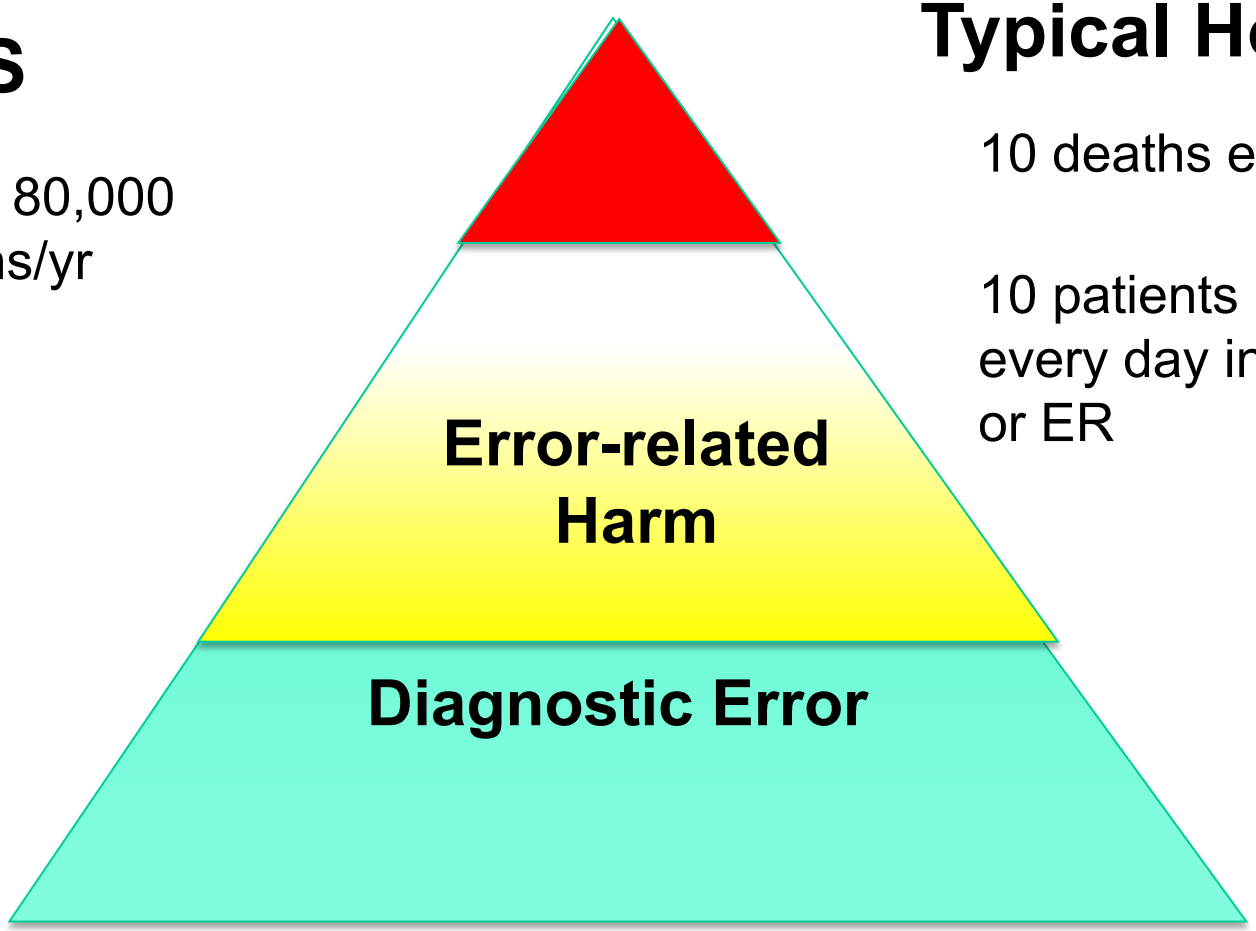
Malpractice Claims	Diagnostic error is the most frequent allegation
Standard Patients	Internists misdiagnosed 13% of patients presenting with common conditions to clinic (COPD, RA, others)
Chart Reviews	One in twenty primary care patients will experience a diagnostic error every year
Autopsies	Major unexpected discrepancies that would have changed the management are found in 10-20%

Radiology, Pathology	**2-5% error rate**
Primary Care	**10 % error rate**
Specialty Care	**???**

The toll of Dx Error in the US

US

40,000 – 80,000 deaths/yr



Typical Hospital

10 deaths every year

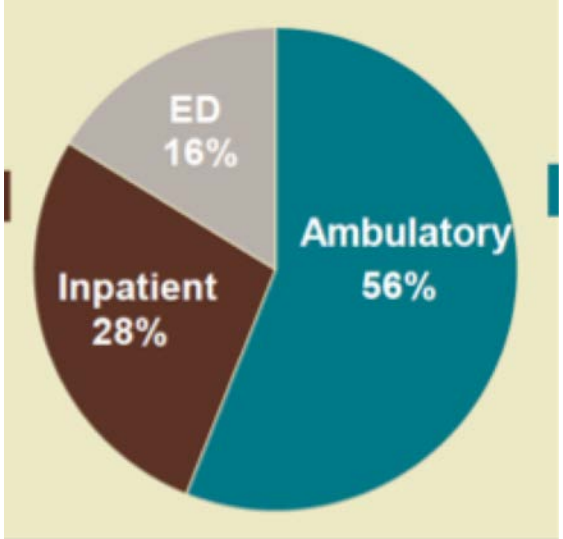
10 patients harmed every day in clinics or ER

Leape et al. JAMA 288:2405, 2002
Singh et al. BMJ Qual Safety 21: 93-100, 2012

IOM:

“It is likely that most of us will experience at least one diagnostic error in our lifetime, sometimes with devastating consequences.”

Where do they happen?



CRICO - Analysis of 4519 claims related to diagnostic error

Ambulatory care clinics—it's NOT just rare conditions. Dx errors are COMMON in patients with anemia, asthma, COPD

Diagnosis is HARD!

PATIENT VARIABLES

- Stage of disease
- How it manifests
- How it is perceived
- How it is described
- When help is sought

SYSTEM COMPLEXITY

- Disjointed care
- Communication barriers
- Production pressure
- Tight coupling
- Access to care & expertise

PHYSICIAN VARIABLES

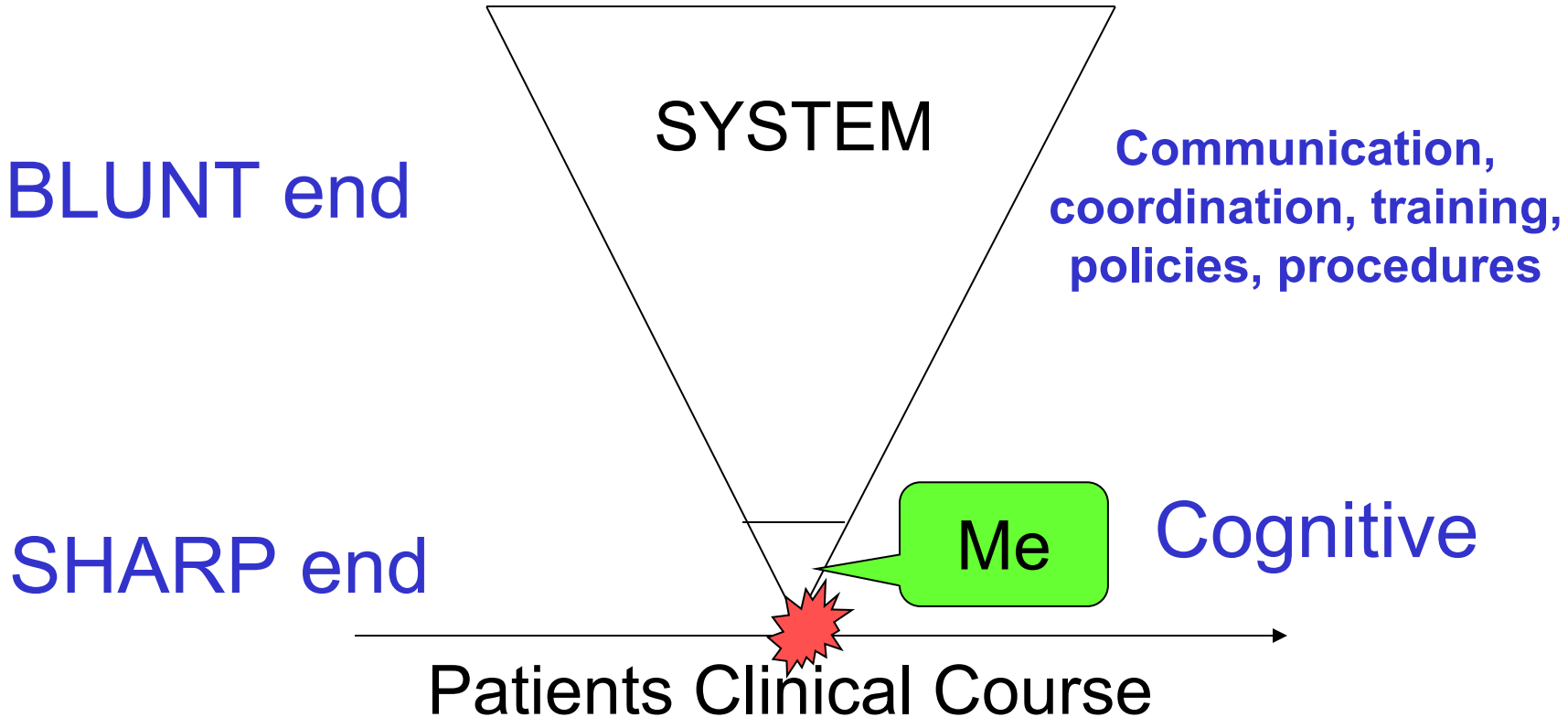
- Knowledge and experience
- Access to patient data, tests, consults
- Skill in clinical reasoning
- Stress, distractions, mood, time to think

10,000+ unique diagnoses; 5,000 lab tests

"Root cause analysis"

NPSF study: 100 cases – 535 root causes

Graber et al. Arch Int Med 165:1493-9, 2005



Common Causes of Diagnostic Error

Cognitive

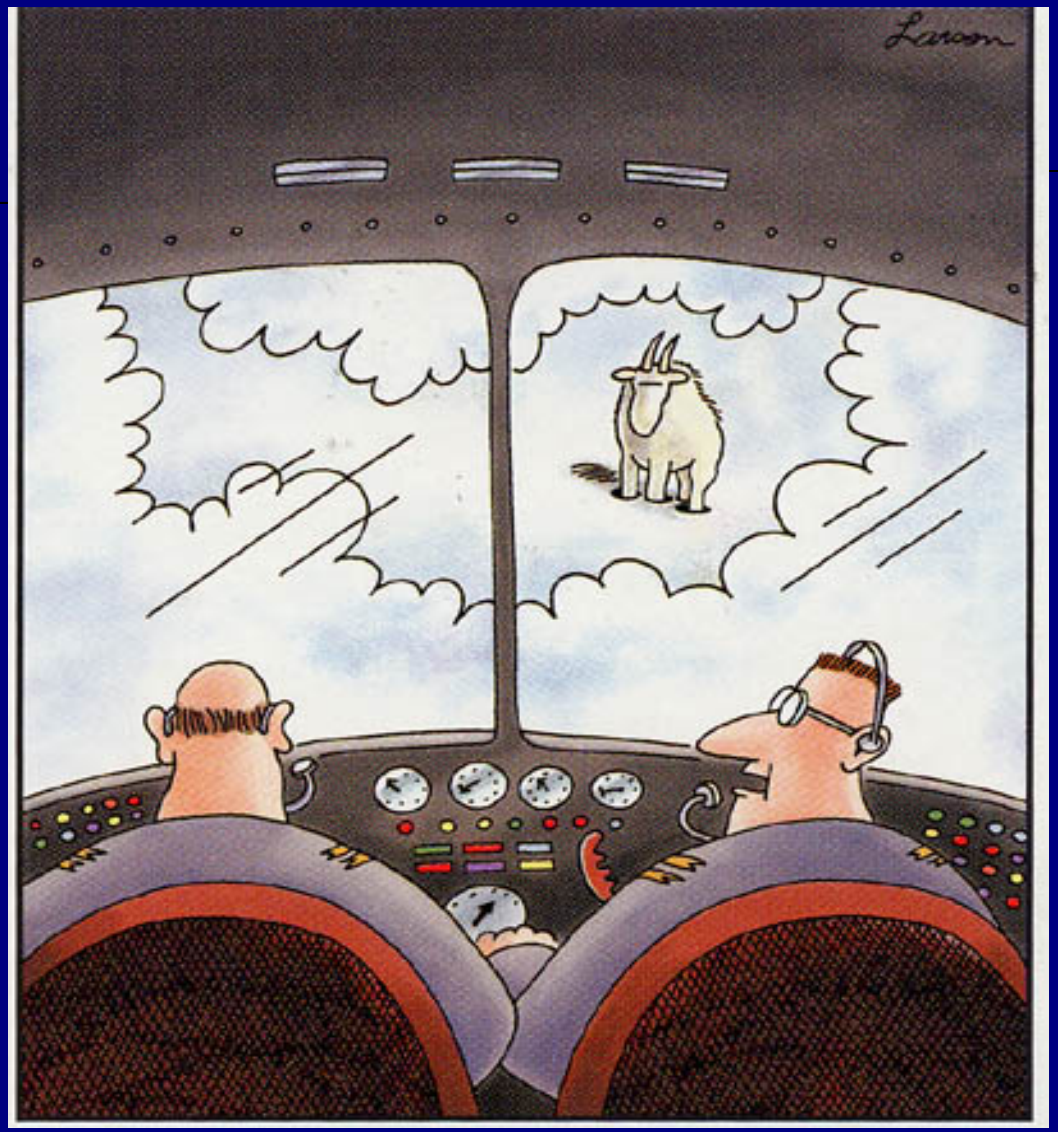
- **Knowledge deficit**
- **Faulty data-collection\interpretation**
- **Clinical reasoning is suboptimal**

  (context errors; premature closure)

System-related

- **Breakdowns in communication & care coordination**
- **Difficulty accessing experts, resources, information**
- **Non-supportive culture; weak teamwork**

CONTEXT ERRORS



“ Say … What’s a mountain goat doing way up here in a cloud bank ?”

Premature closure = Satisficing

= Falling in love with the first puppy …

(Herbert Simon)

Delayed Diagnosis of Ebola Infection

Cognitive Errors

- Knowledge: ???
- Data collection: Incomplete
- Synthesis: Faulty
  Wrong context; Premature closure

System Errors

- Classic failure to communicate
- EHR-induced "siloing"
- Decision support not available or not used

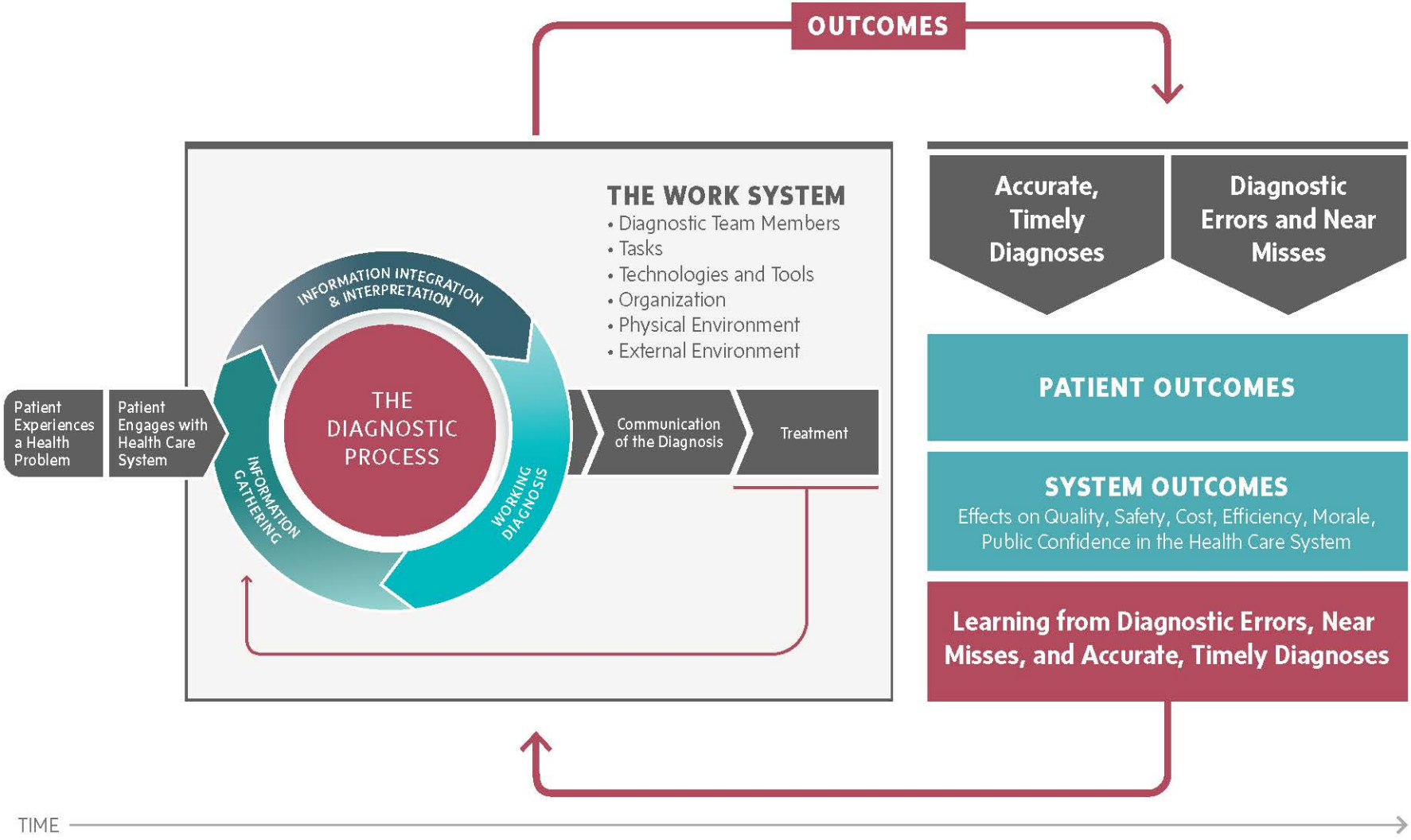
What do we know about health IT and diagnosis ?

Health IT is involved in EVERY step of the diagnostic process

The use of health IT is increasing exponentially

The efficiency, quality, and safety of diagnosis is intimately related to health IT and its use in medical care

The Diagnostic Process



The SaferDX Framework; Singh & Sittig, BMJ Qual Saf 2015

Diagnostic Process Step	How Health IT Applies
Access to Care	Portals; Open Notes
Obtain an accurate history	Templated & stored data
Find & review existing data	Easily review existing records
Physical exam findings	Point-of-Care diagnostic tools
Formulate a differential diagnosis	Decision support
Consultation	Electronic requests; note sharing
Diagnostic testing	Electronic reporting
Quality monitoring	Reports from administrative data

Electronic Medical Records

The Good, the Bad & the Ugly

EHR Problems

Copy – Paste
Note Bloat
Meaningless Alerts
Information Overload
Not connected
Time consuming
Detracts from interacting with the patient

Rand survey: 20% of physicians say they want to return to paper records

Friedberg et al. Factors Affecting Physician Professional Satisfaction and Their Implications for Patient Care, Health Systems, and Health Policy. Santa Monica, CA: RAND Corporation, 2013.

The EHR Wall

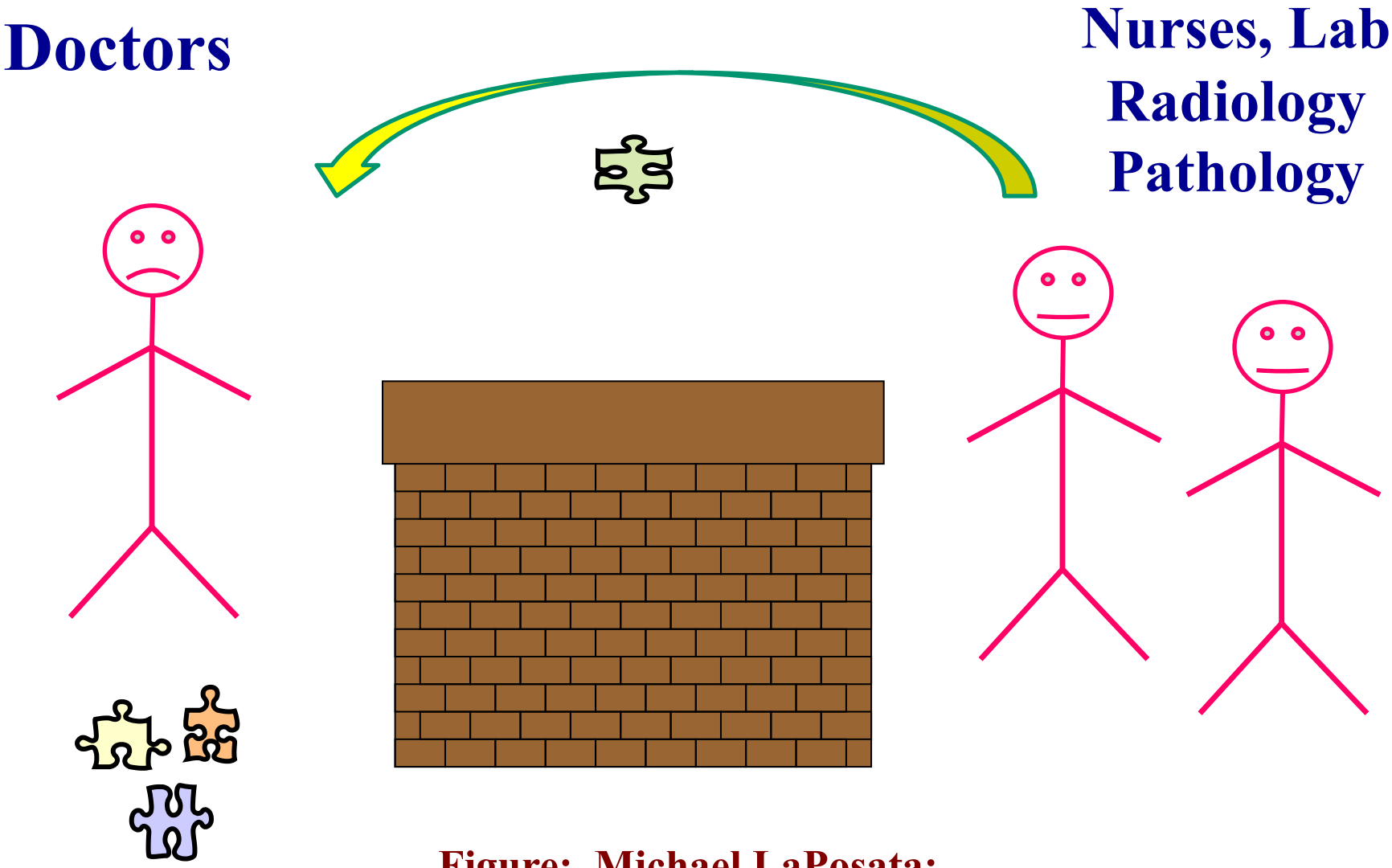


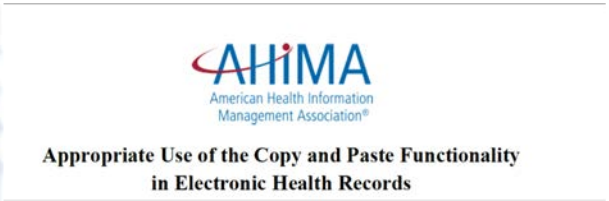
Figure: Michael LaPosata;
Reference: The Digital Docter, Robert Wachter

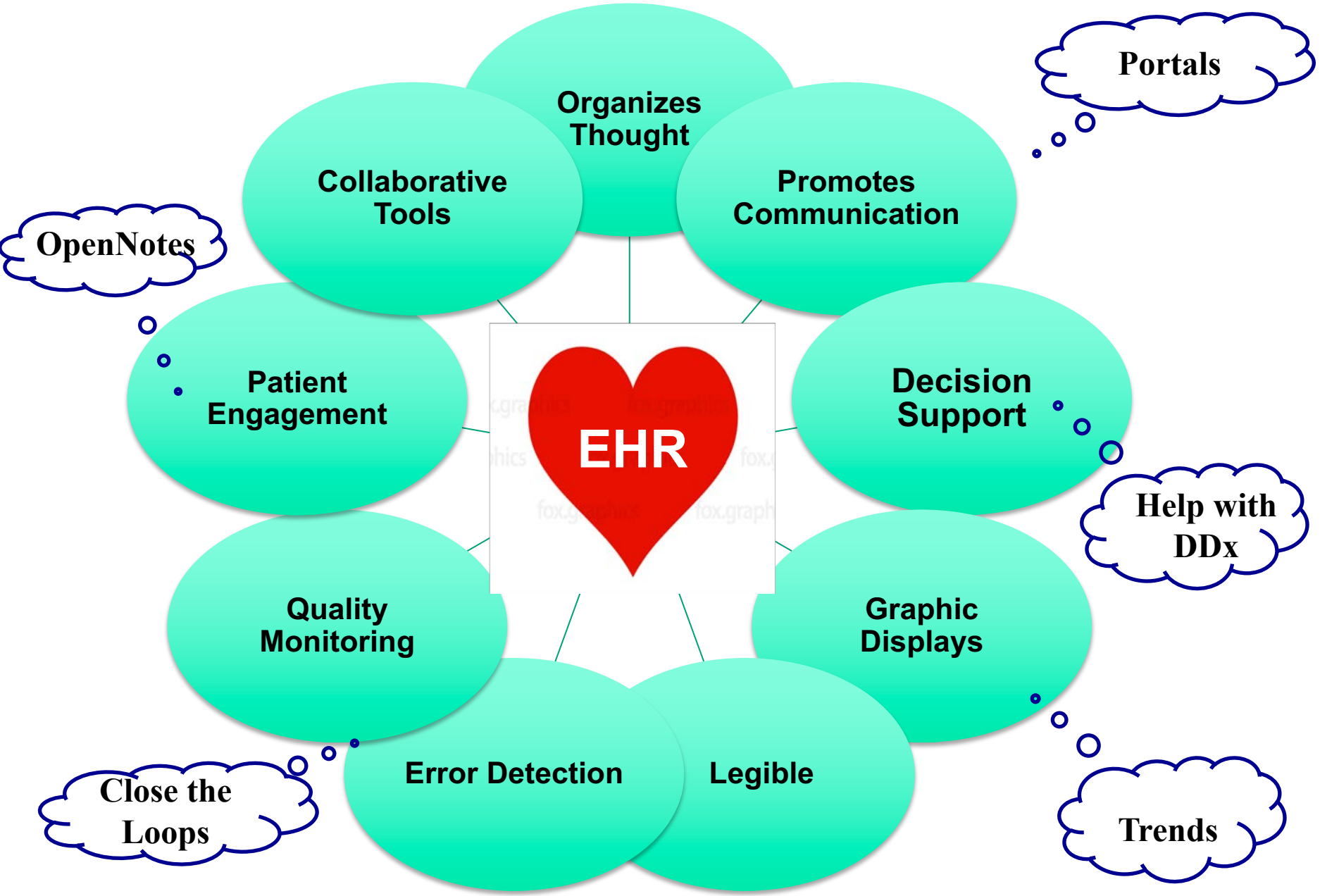
The Copy-Paste Curse

ICU notes: 75% of notes by both trainees and attendings contained > 20% copied text

Why? Electronic notes are too easy to clone; pressure of time; shift mentality

Consequences? Note bloat; Breaks trust, creates safety risk, fraud




Organizes Thought
Promotes Communication
Decision Support
Graphic Displays
Legible
Error Detection
Quality Monitoring
Patient Engagement
Collaborative Tools
EHR
Portals
OpenNotes
Help with DDx
Trends
Close the Loops


Saves me
TIME

Health IT is more than just the EHR
Innovations That Improve Diagnostic Quality and Safety

Portals

Trigger tools

Tele-medicine

Voice and facial recognition

Handheld devices

Wearables

OpenNotes

Home | About | For Patients | For Health Professionals | Our Stories | Blog | Join The Movement

Everyone on the Same Page

OpenNotes is the international movement dedicated to making health care more open and transparent by urging doctors, nurses, therapists, and others to share their visit notes with patients.

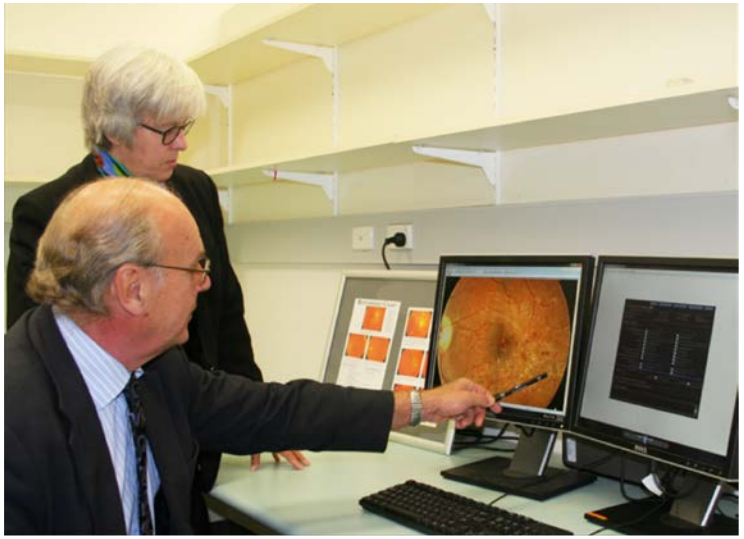
Today **19,907,000** patients have online access to their notes.

How Health IT Improves Diagnostic Quality and Safety

The problem: Access to expertise

The solution: Tele-medicine = Telemetry;

Home health-buddies; Radiology – NightHawk; Retinal imaging



Decision Support:
Aids for Differential Diagnosis

Dxplain

http://www.lcs.mgh.harvard.edu/projects/dxplain.html

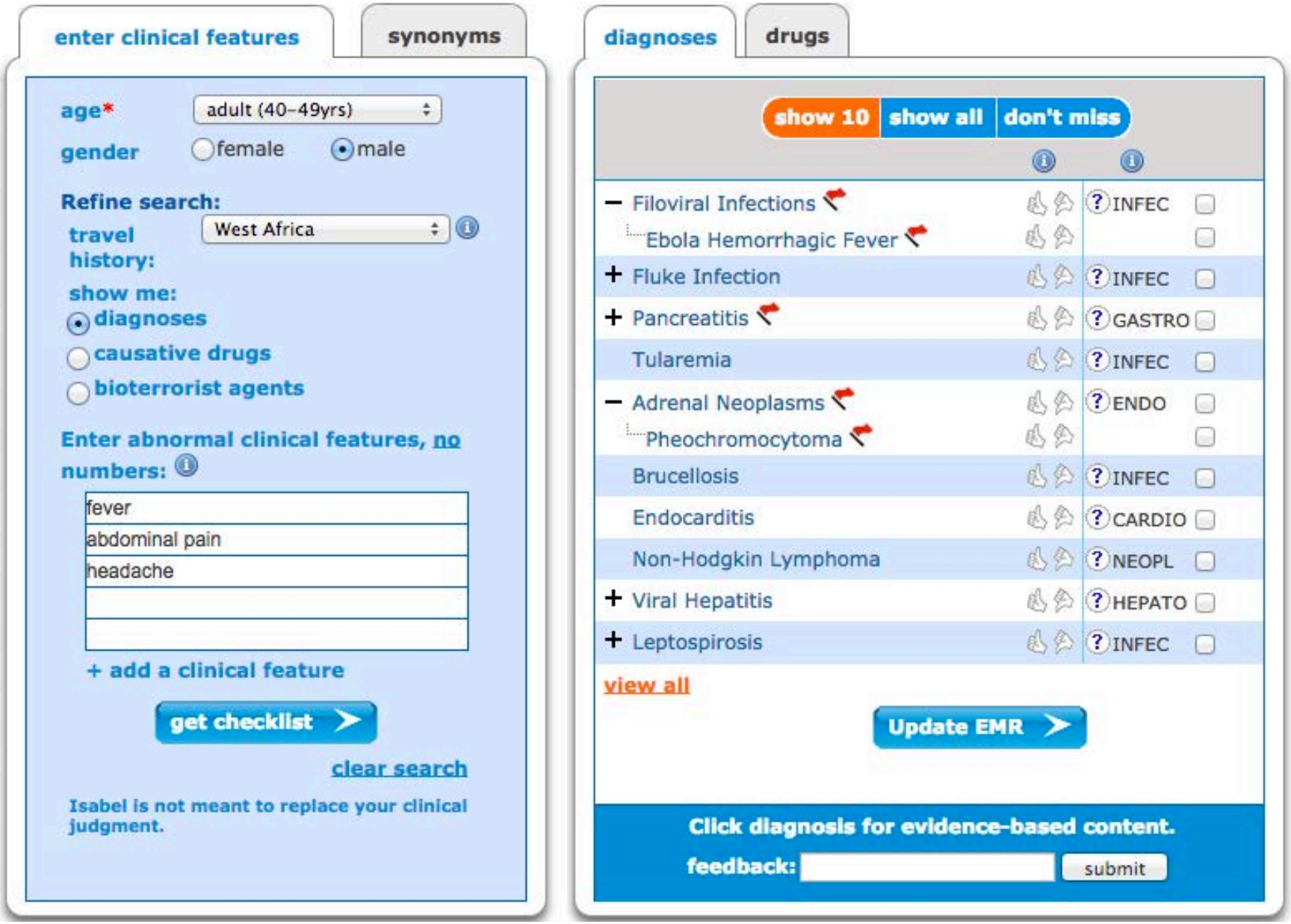
Isabel

www.isabelhealthcare.com

Derm; Medicine

www.visualdx.com

Isabel – Isabelhealthcare.com



IMPACT OF ISABEL

Studied pediatric ICU admissions who did NOT have a diagnosis on admission (n = 206). Correct diagnosis rates:

- **Residents on their own:** **89.4%**
- **Residents + Isabel:** **92.5%**
- **Residents + Isabel + Attending** **95%**

Thomas et al. International assessment of a web-based diagnostic tool in crically ill chlidren. Technol Health Care 2008; 16:103-110

Googling a Diagnosis:

Sensitivity – 58%

Specificity - 0 %

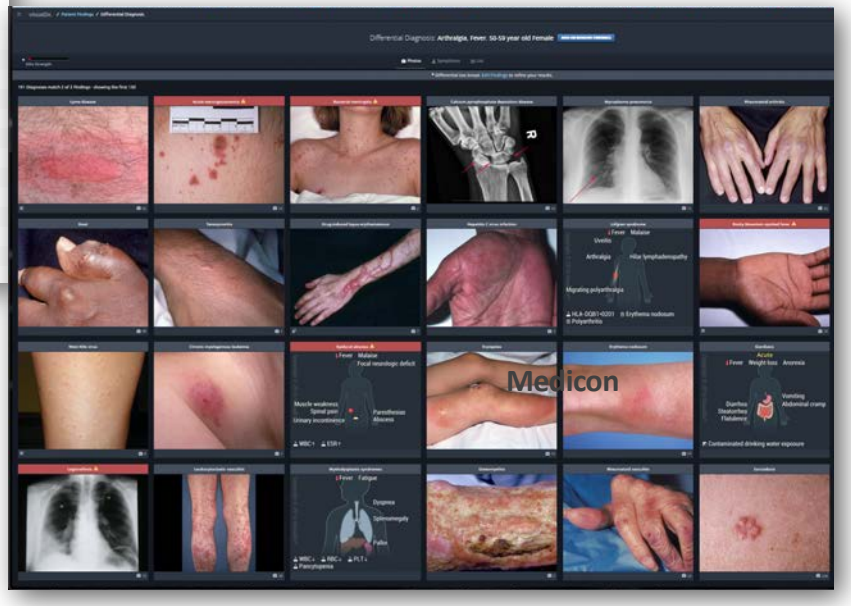
Tang and Ng; BMJ 2006 Dec 2;333(7579):1143-5

Decision Support - visual diagnosis

Transforming the "diagnostic list" by allowing for comparison of disease features.

Search on: Arthralgias and Fever

Chikungunya	3 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile), Bahamas
Dengue Fever	3 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile), Bahamas
Psittacosis	3 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile), Bahamas
Dengue Hemorrhagic Fever	3 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile), Bahamas
Leptospirosis	3 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile), Bahamas
Ebola	2 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile)
Erysipelas	2 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile)
Human Immunodeficiency Virus Primary Infection	2 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile)
Lyme Disease	2 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile)
Malaria	2 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile)
Meningococcemia, Acute	2 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile)
Rocky Mountain Spotted Fever	2 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile)
Viral Exanthem	2 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile)
Coccidioidomycosis	2 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile)
Erythema Multiforme	2 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile)
Giardiasis	2 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile)
Hand-Foot-and-Mouth Disease	2 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile)
Hepatitis A Virus	2 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile)
Syphilis, Secondary	2 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile)
Toxocariasis	2 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile)
West Nile Virus	2 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile)
Bartonellosis	2 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile)
Blastomycosis	2 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile)
Cat-Scratch Disease	2 matching findings: Arthralgia (Joint Pain, Articular Pain), Fever (Febrile)



Searchable by condition, medication or unique patient factors delivering point of care differential diagnosis, testing and therapy.

visualDx®

The Value of Recognizing Variants
All of these are SCABIES

burrowing

eschar

nodular

Immuno-compromised pt

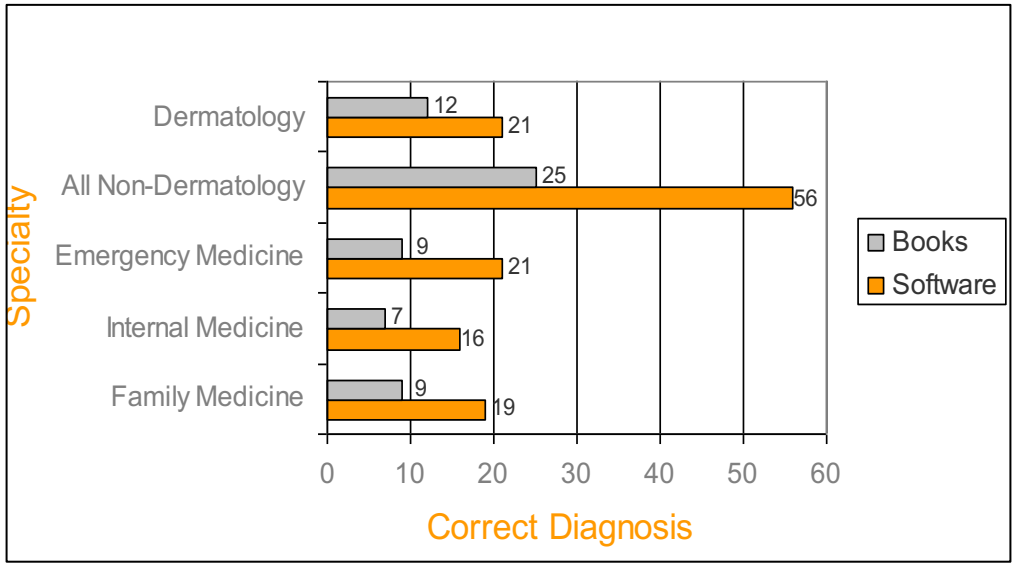
ulcerating

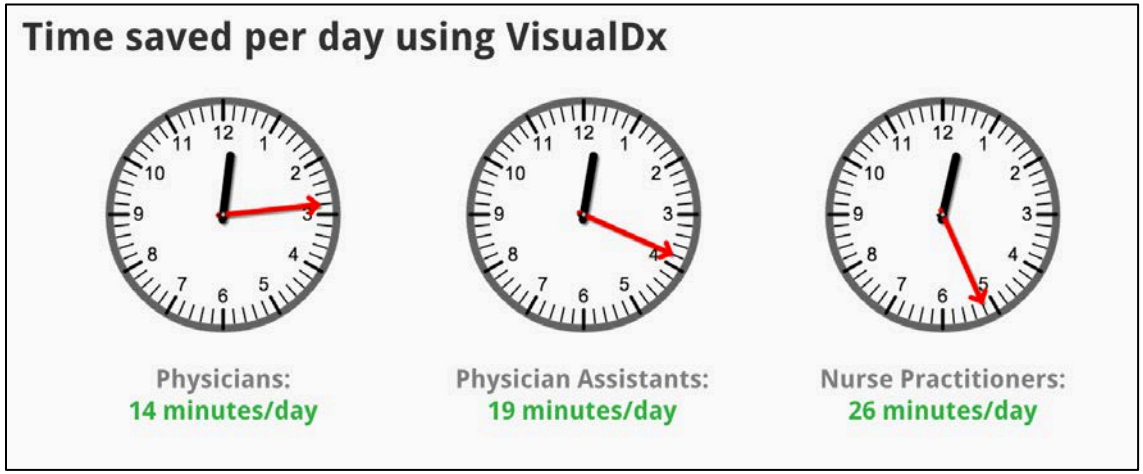
pustular

VisualDx Doubles Diagnostic Accuracy AND Saves Time

Study:

- 50 randomized physicians
- 4 difficult cases
- Usual practice vs. VisualDx
- Results: Significantly increased diagnostic accuracy





TRIGGER TOOLS

Health IT to Improve Diagnostic Quality and Safety

The Problem: 10% of important test results 'fall between the cracks.'

The Solution: Trigger Tools use software algorithms to identify patients at risk for diagnostic error and harm

Hardep Singh et al
Michael Kanter et al. - KP Southern Cal.

Current Portfolio – KP SureNet

Diagnosis Detection/ Follow Up

- PSA Electronic Safety Net
- +FIT Electronic Safety Net
- Abnormal Pap Electronic Safety Net
- Kidney Disease (Repeat Creatinine)
- High Risk CKD Follow-up
- Colon Cancer (Iron Deficiency Anemia/Rectal Bleeding + No colonoscopy)
- Maternal Hepatitis B
- Abdominal Aortic Aneurysm Tracking
- Post Splenectomy Immunizations
- Positive Chlamydia Follow up
- Down Syndrome Care Coordination
- Sickle Cell Care Coordination
- Hepatitis C (+Antibody + No confirmatory test)
- Newborn Hearing Screening
- Lung Nodules
- Unintended Pregnancy Follow up

Medication Safety

- Annual Lab Monitoring: Digoxin (K+, level and SCr), Diuretics (K+ and SCr)
- Amiodarone (Preventive monitoring plan)
- Acetaminophen Overuse
- Elderly Care Drug-Disease (Falls)
- Elderly Care Drug-Disease (Dementia)
- Elderly Care High Dose Digoxin Conversion
- Interacting Statin Combinations (Gemfibrozil and/or Amiodarone)
- Diuretic Medication Induced Hyponatremia
- Medication Induced Hyperkalemia
- NSAIDs in CKD 4-5, Dialysis, Kidney Transplant
- INH ALT monitoring
- Monitoring Plaquenil Eye Monitoring
- Metformin B12 monitoring
- Ethambutol eye monitoring

Diagnosis Detection and Follow Up: Rectal Bleeding w/o Colonoscopy

168 patients with a history of rectal bleeding and no colonoscopy

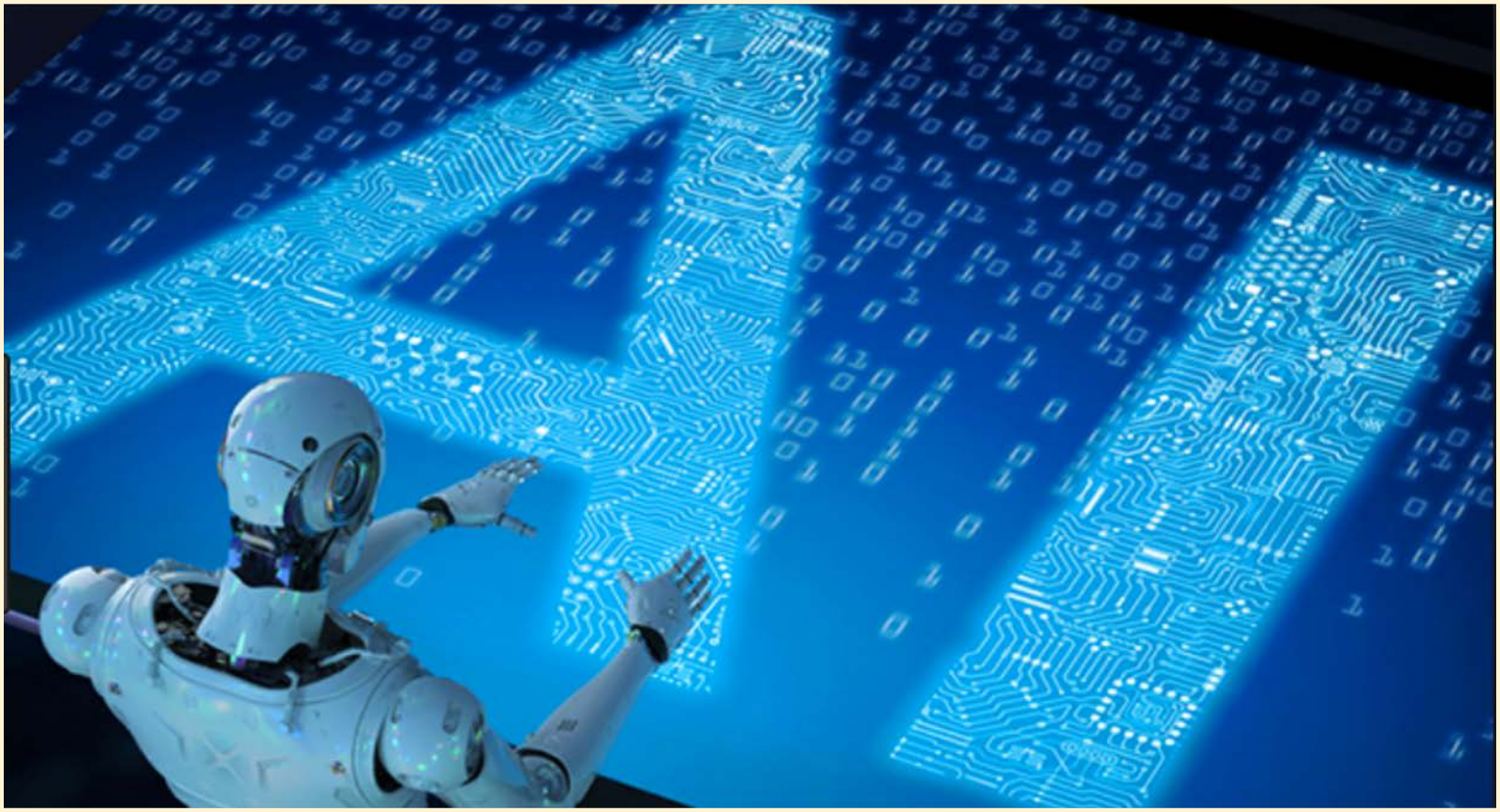
26 completed colonoscopy

1 adenocarcinoma ; 1 carcinoid tumor

7 tubular adenomas, **11** hyperplastic polyps, hemorrhoids or colitis

Michael Kanter; Kaiser Permanente Southern California

See Koopman et al: http://www.researchgate.net/publication/274643786



TED Watch Discover Attend Participate About Search...

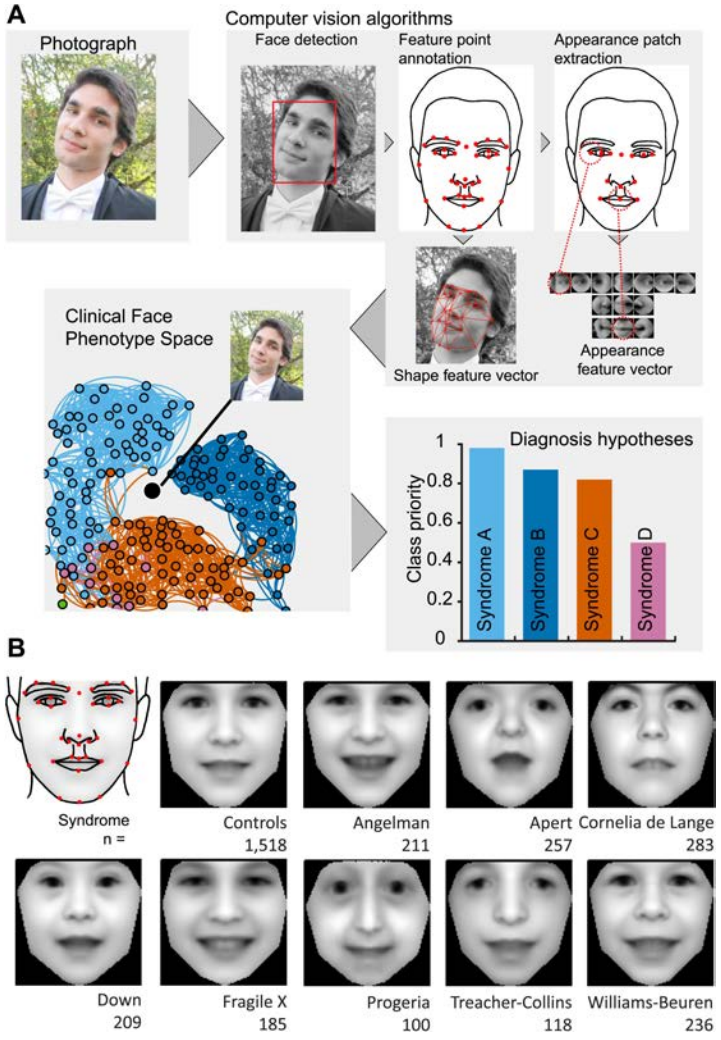
Parkinsonsvoiceinitiative.com

Parkinsonism Relat Disord. 2015 Jun;21(6):650-3. doi: 10.1016/j.parkreldis.2015.02.026. Epub 2015 Mar 7.

Detecting and monitoring the symptoms of Parkinson's disease using smartphones: A pilot study.

Arora S[1], Venkataraman V[2], Zhan A[3], Donohue S[3], Biglan KM[4], Dorsey ER[5], Little MA[6].

Facial Recognition



Diagnostically relevant facial gestalt information from ordinary photos

Quentin Ferry, Julia Steinberg, Caleb Webber, David R FitzPatrick, Chris P Ponting, Andrew Zisserman, Christoffer Nellåker

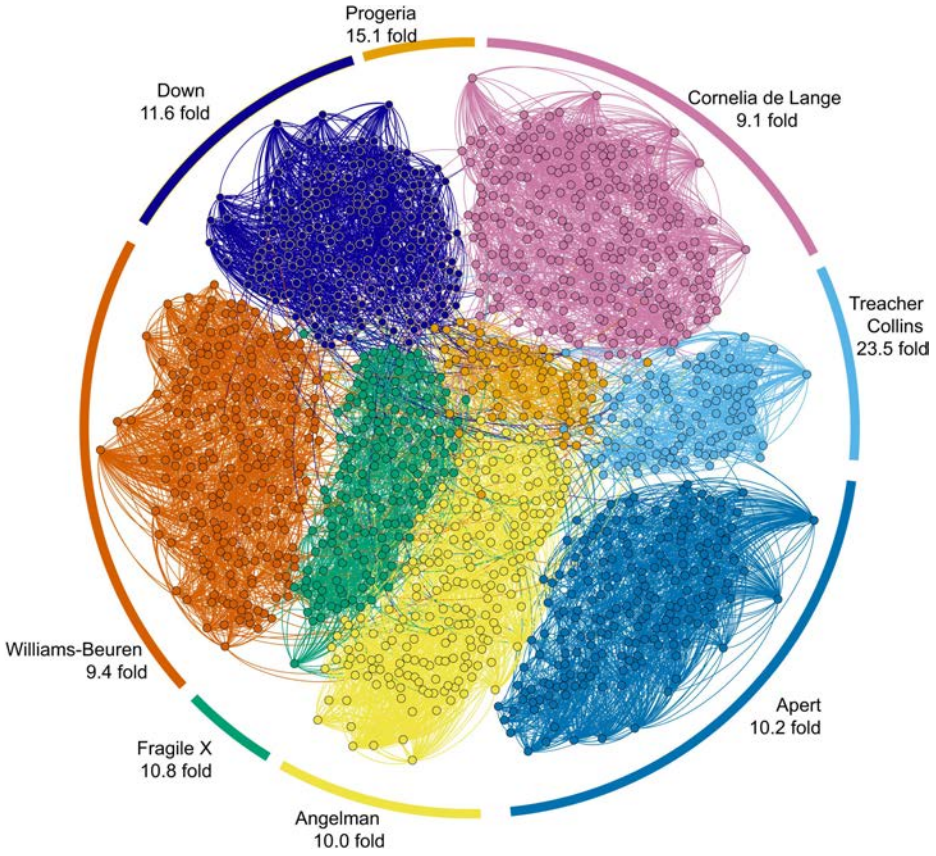
University of Oxford, United Kingdom; The Wellcome Trust Centre for Human Genetics, University of Oxford, United Kingdom; Institute of Genetics and Molecular Medicine, United Kingdom

DOI: http://dx.doi.org/10.7554/eLife.02020
Published June 24, 2014
Cite as eLife 2014;3:e02020

Ferry Q et al. eLife Sciences 2014;3:e02020

eLIFE

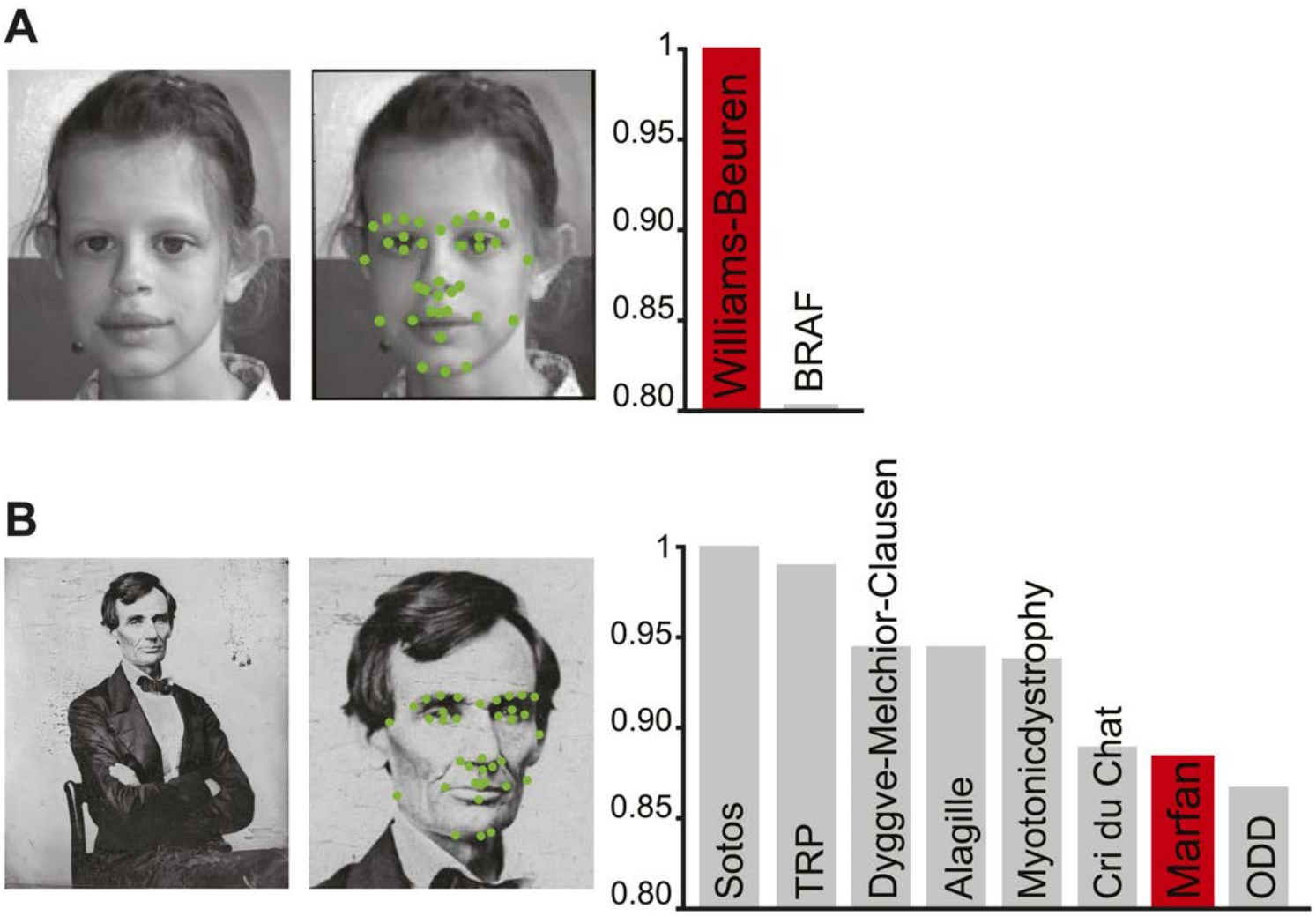
Clinical Face Phenotype Space



Ferry Q et al. eLife Sciences 2014;3:e02020

eLIFE

Facial Recognition

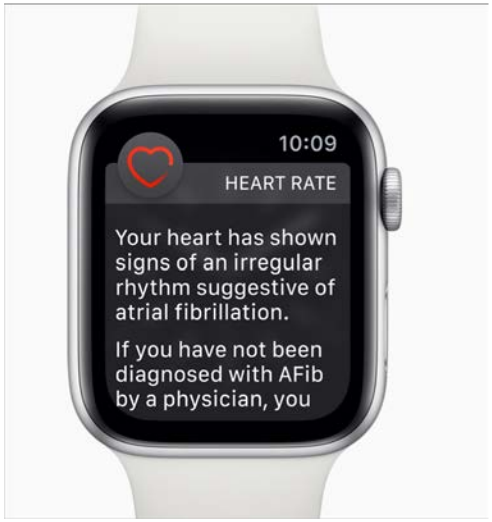


Ferry Q et al. eLife Sciences 2014;3:e02020

eLIFE

POCUS

MobiSante's smartphone-based ultrasound

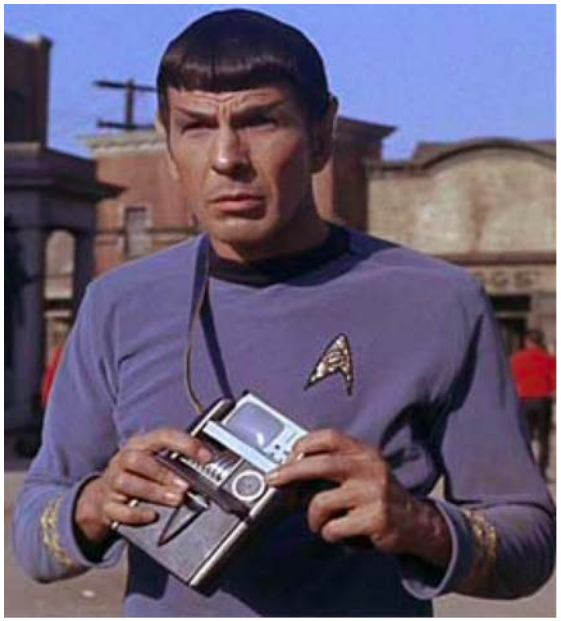


M-Health & 'wearables'

J Neurotruama. 29:1047-53, 2012.

QUEST Earcheck Monitor

QUALCOMM TRICORDER XPRIZE



Announced January 2012

MUST: Weigh 5 pounds or less, measure 5 vital signs, and dx or exclude core conditions:

Anemia, Afib, COPD, Diabetes, Leukocytosis, Pneumonia, Otitis media, Sleep apnea, UTI

QUALCOMM TRICORDER XPRIZE

2017 Winner: Final Frontier's "Dx-ER"

An explosion of interest
A paucity of data on impact

Brenner S.K, *et al.* J Am Med Inform Assoc 2016;23:1016–1036. doi:10.1093/jamia/ocv138, Review

Find
diagnos
Previous
▸ Replace with

Effects of health information technology on patient outcomes: a systematic review

RECEIVED 10 March 2015
REVISED 28 July 2015
ACCEPTED 29 July 2015
PUBLISHED ONLINE FIRST 13 November 2015

Samantha K Brenner,[1,2,3,4] Rainu Kaushal,[1,2,4,5,6] Zachary Grinspan,[1,2,5,6] Christine Joyce,[5,6] Inho Kim,[6,7] Rhonda J Allard,[9] Diana Delgado,[8] and Erika L Abramson[1,2,5,6]

AMIA INFORMATICS PROFESSIONALS, LEADING THE WAY.
OXFORD UNIVERSITY PRESS

69 articles: None on diagnosis

ONC SAFER GUIDES

https://www.healthit.gov/safer/safer-guides

The BEST advice on how to use health IT safely, and how to use health IT to improve safety

The Future of Health IT & Diagnosis

Short Term Prognosis: ROCKY

Get beyond the current problems

Address the factors that are frustrating

that detract from diagnostic quality

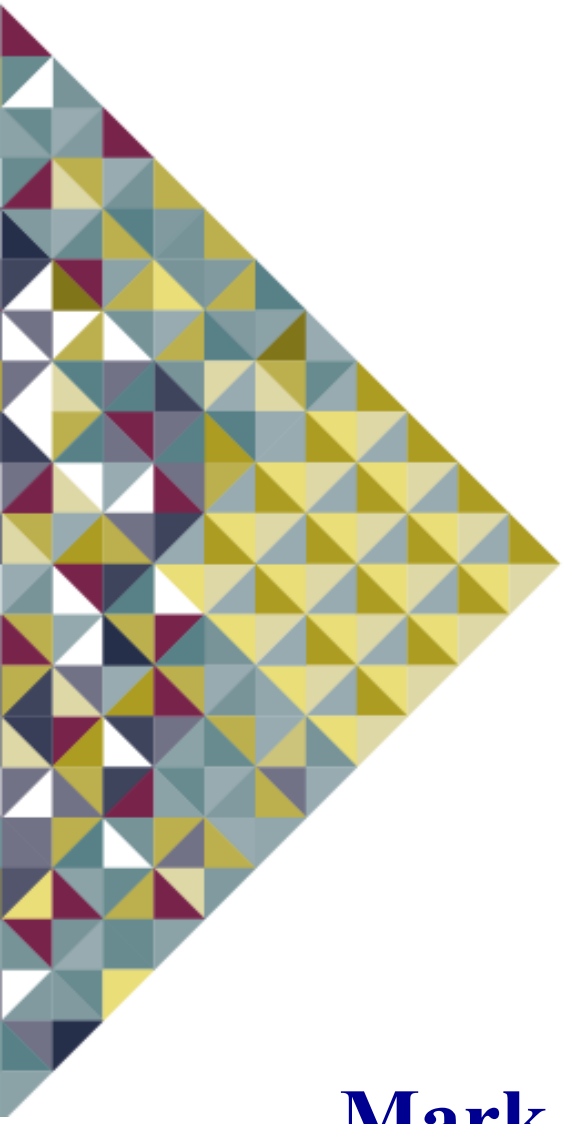
that distance doctors from each other

and our patients

Long Term Prognosis: GOOD !

Health IT that improves diagnosis &

Restores quality and efficiency to patient care



“Improving the diagnostic process is not only possible, but it also represents a moral, professional, and public health imperative.”

Mark.Graber@ImproveDiagnosis.Org


Reflections?
Questions?
Comments?