

IMPROVING DIAGNOSIS IN HEALTH CARE: A GRAND CHALLENGE & OPPORTUNITY FOR INFORMATICS

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EFFECTIVENESS & SAFETY

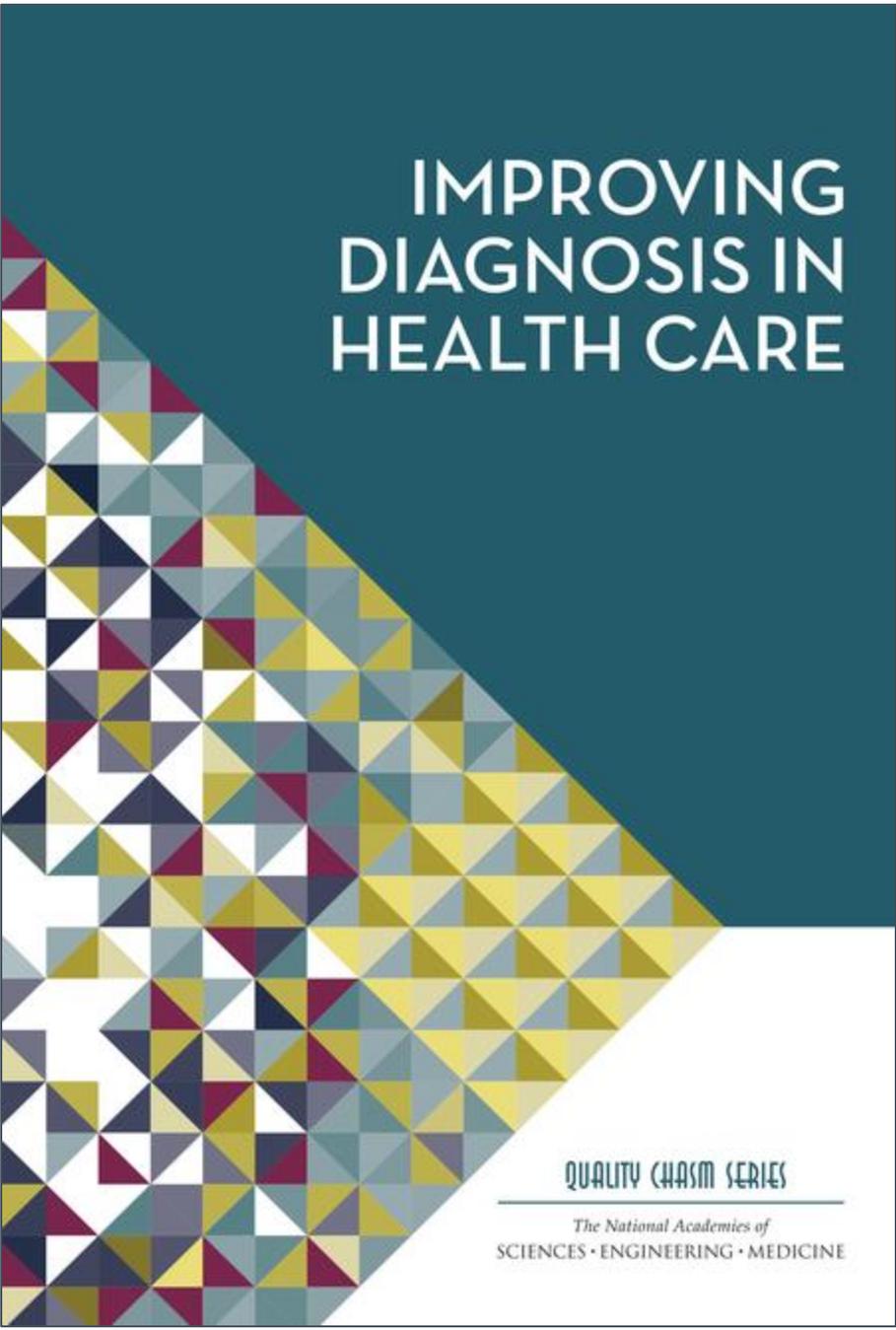
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IMPROVING DIAGNOSIS IN HEALTH CARE

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To Your Health

Most Americans will get a wrong or late diagnosis at least once in their lives

By [Lena H. Sun](#) September 22

Most Americans who go to the doctor will get a diagnosis that is wrong or late at least once in their lives, sometimes with terrible consequences, according to a report released Tuesday by an independent panel of medical experts.

This critical type of health-care error is far more common than medication mistakes or surgery on the wrong patient or body part. But until now, diagnostic errors have been a relatively understudied and unmeasured area of patient safety. Much of patient safety is focused on errors in hospitals, not mistakes in diagnoses that take place in doctors' offices, surgical centers and other outpatient facilities.

The [new report](#) by the Institute of Medicine, the health arm of the National Academy of Sciences, outlines a system-wide problem. The report's authors say they don't know how many diagnostic errors take place. But the report cited one estimate that such errors affect at least 12 million adults each year, or about 5 percent of adults who seek outpatient care.



Objectives

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- Describe the burden of diagnostic errors in electronic health record-enabled healthcare settings
- Discuss types of patient safety concerns involving diagnosis that can occur in EHR-enabled health care
- Identify potential informatics solutions and conceptual frameworks for mitigating diagnostic safety risks in EHR-enabled health care

Poll Question #1: My main role in the VA is _____.

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- Research Investigator/Research Staff
- Administrative/Operations
- IT/Informatics
- Clinician/Clinical Staff
- Other (specify)

Early Work

6

- Evaluated evidence of ‘errors’ in integrated system
- Detailed review of comprehensive EHR to evaluate diagnostic process in the patient’s journey across the continuum of care
 - ▣ Data available from primary care, specialty (secondary) care, ER, hospital, diagnostics (lab/imaging/pathology), procedures

High Level Findings

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- Common conditions missed in outpatient settings despite clear red-flags (5% or 1 in 20 US Adults/year)
- About half had potential for clear harm

COMMENTARY

The Battle Against Misdiagnosis

American doctors make the wrong call more than 12 million times a year.

By **HARDEEP SINGH**

97 COMMENTS

Aug. 7, 2014 7:16 p.m. ET

There are times when a single, unexpected death sparks a change in medical practice. In 2012 a 12-year-old boy named Rory Staunton died after being misdiagnosed in a New York City emergency room. Multiple physicians missed the symptoms, signs and lab results pointing to a streptococcal bacterial infection that led to septic shock and

overwhelmed Rory's b
introduce "Rory's regu
similar incidents in hos

Comparable initiatives
level—but there might

New research my colle
Safety shows the exten
seeking outpatient car
adult population. Each
available evidence.



NBC NEWS

Misdiagnosed: Docs' Mistakes Affect 12 Million a Year

By *JONEL ALECCIA*

At least one in every 20 adults who seeks medical care in a U.S. emergency room or community health clinic may walk away with the wrong diagnosis, according to a new analysis that estimates that 12 million Americans a year could be affected by such errors.

Of those misdiagnosis mistakes, about 6 million could potentially cause harm, according to patient safety expert Dr. Hardeep Singh, who is the first to provide robust population-level data on the impact of the problem in outpatient settings.

That means patients with conditions as varied as heart failure, pneumonia, anemia and

Safety Begins with Measurement

*We cannot improve what we cannot
measure!*

We cannot measure what we cannot define!

IOM Definition of diagnostic error

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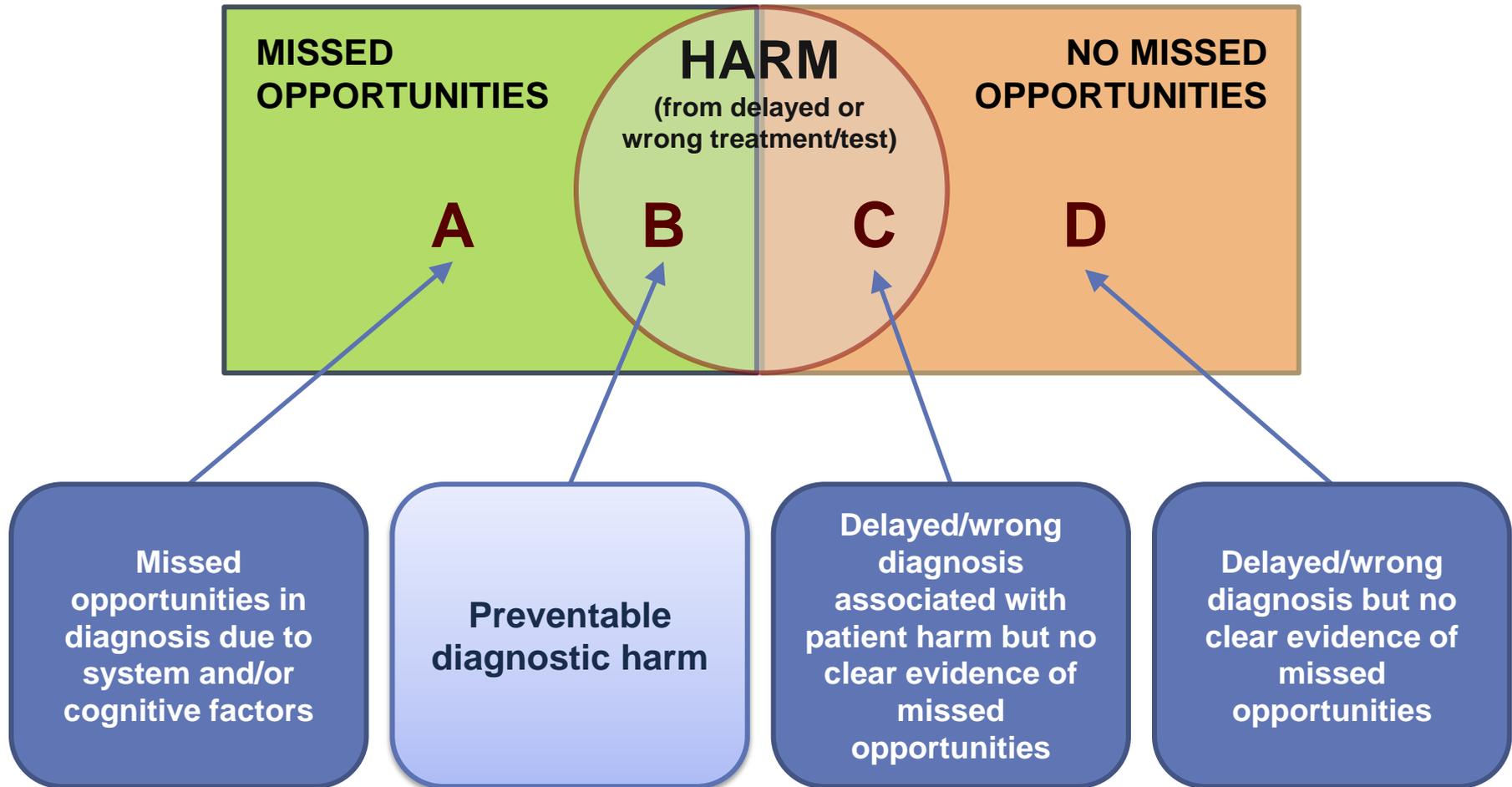
- ***The failure to***
 - a) establish an accurate and timely explanation of the patient's health problem(s) or***
 - b) communicate that explanation to the patient***

What are Diagnostic Errors?

- Case analysis reveals evidence of a missed opportunity to make a correct or timely diagnosis
- Missed opportunity is framed within the context of an “evolving” diagnostic process
- The opportunity could be missed by the provider, care team, system, and/or patient

Defining Preventable Diagnostic Harm

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What Types of Conditions Affected?

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□ US

- ▣ Pediatrics survey: Viral illnesses diagnosed as bacterial, medication side effects, psychiatric disorders, and appendicitis

Singh et al Pediatrics 2010

- ▣ Adult primary care chart review study: Pneumonia, decompensated CHF, symptomatic anemia

Singh et al JAMA Intern Med 2013

□ Netherlands hospitals

- ▣ Chart review study: PE, sepsis, MI, appendicitis

Zwaan et al Arch Intern Med 2010

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%

Contributing Factors

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Premature closure

Affective bias

Faulty synthesis

Overconfidence

Process failure

Unintended consequence of policy

Sample mix-up

Faulty data gathering

Failure to detect physical finding

Perception error

Misinterpretation of test

Wrong estimate of pretest probability

Failure to follow-up abnormal test

Inadequate follow-up

Limited access

Communication failure

Failed heuristic

Language barrier

Knowledge deficit

Uninformed patient

Faulty triggering

Grand Challenges

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- Common diseases missed despite red flags
 - ▣ Failure to elicit key history or exam finding
 - ▣ Overlooking critical information in EHRs
- Complex systems and cognitive issues involved
 - ▣ Not black and white
 - ▣ Under-diagnosis vs. over-zealous diagnostic pursuits
 - ▣ Chaotic clinical settings & inadequate time
- Lack of feedback systems for improvement

Grand Challenges

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- No magic bullet for improving cognition
- No single system fix
- Fine balance between system issues and personal responsibility and accountability
- How many diseases to focus on?

An Opportunity for Informatics

Failure of Engagement

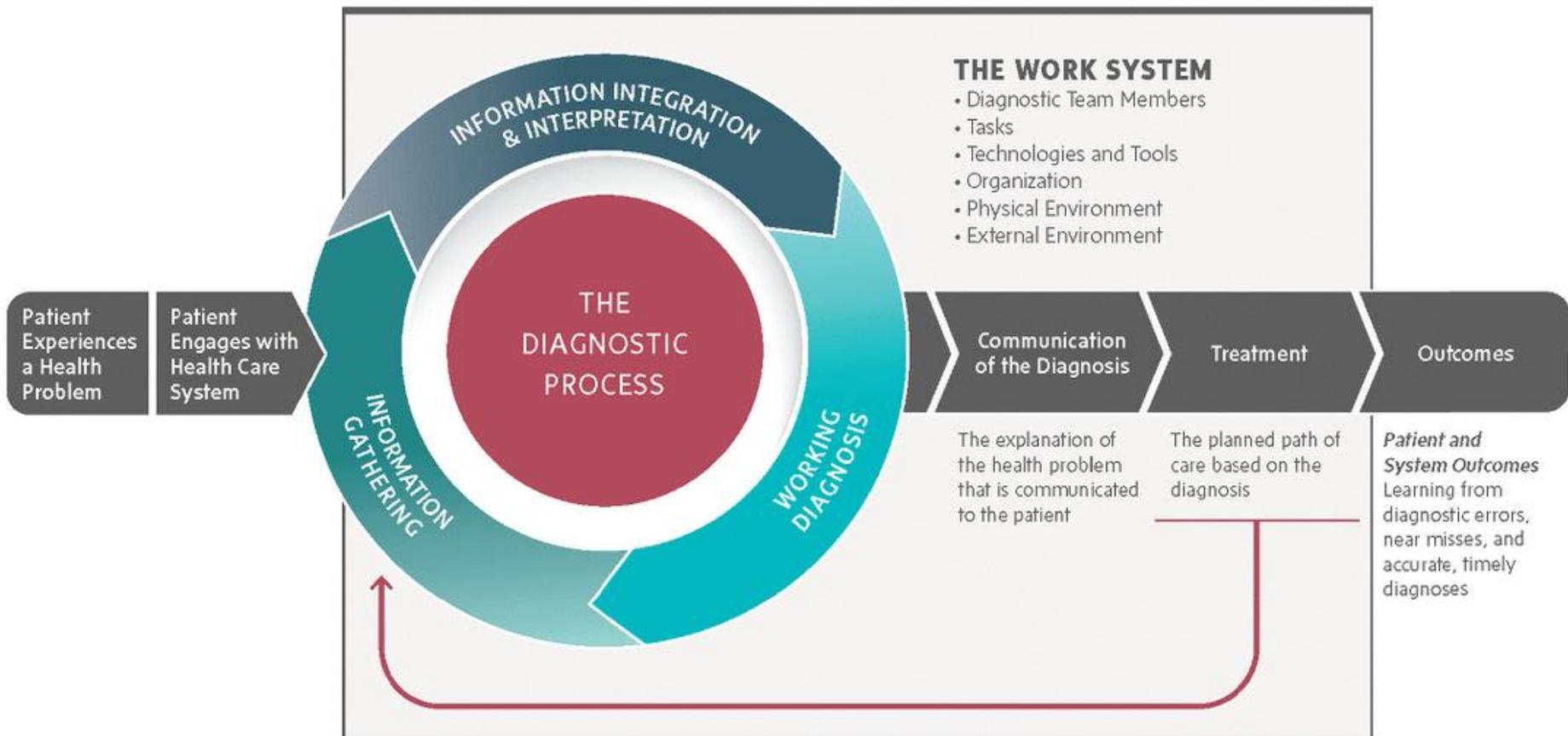
Failure in Information Gathering

Failure in Information Integration

Failure in Information Interpretation

Failure to Establish an Explanation for the Health Problem

Failure to Communicate the Explanation



Potential Areas of Informatics Solutions

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- Information Technology
- Measurement
- Communication and Teamwork
- Patient Engagement

Intersection of Health IT & Diagnostic Safety

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- Our goals are to use health IT to measure and reduce diagnostic errors and harm, but ..
- Current Reality: Trying to ensure health IT itself is being used ‘safely’

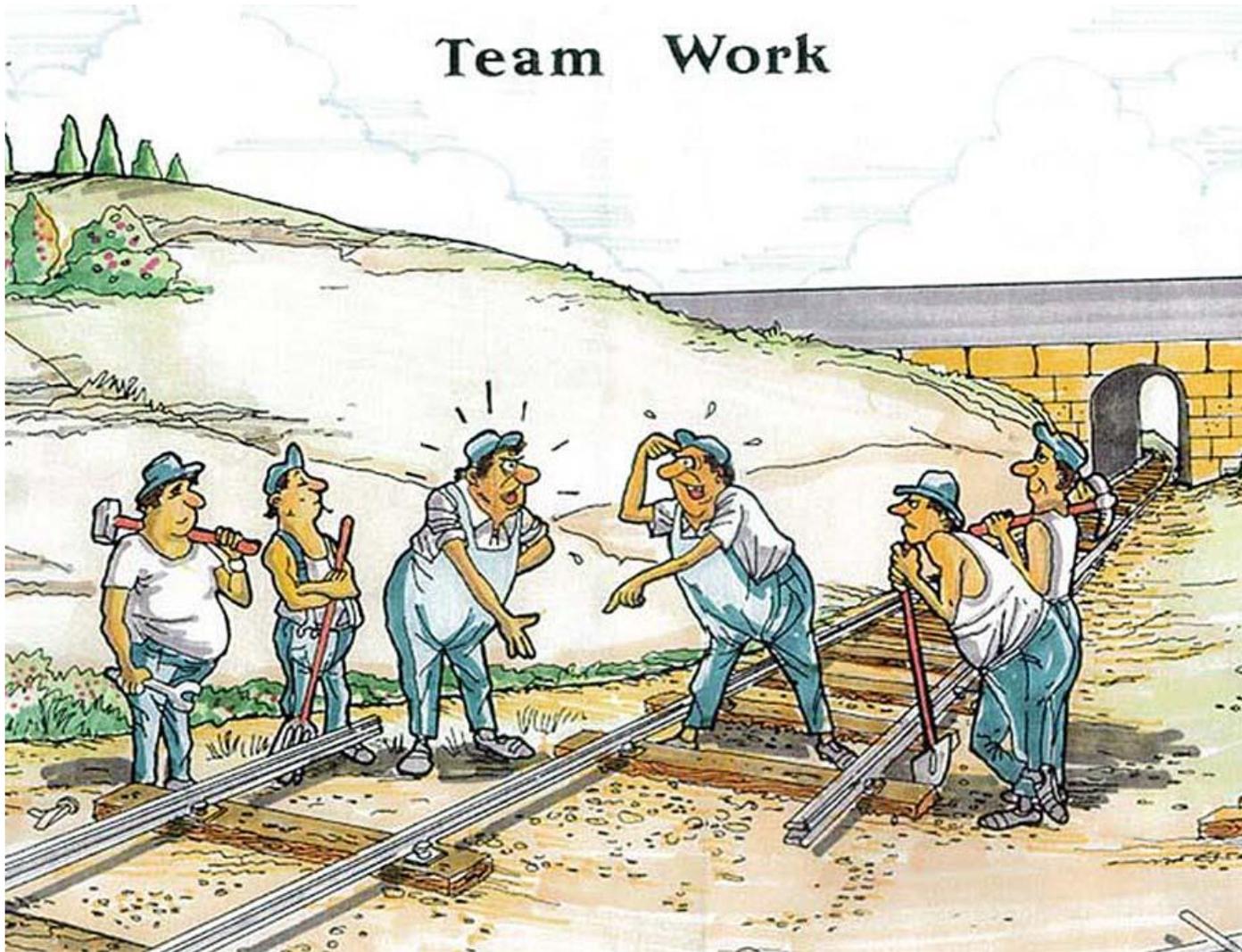
Communication of Test Results

21

- Evaluation of 1,163 outpatient abnormal lab & 1,196 abnormal imaging test result alerts
 - ▣ 7% abnormal labs lacked timely follow-up
 - ▣ 8% abnormal imaging lacked timely follow-up
- Why abnormal test results continue to get missed in health IT-based settings

Ambiguous Responsibility a Huge Issue

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By MICHELLE CASTILLO / CBS NEWS / March 5, 2013, 1:16 PM

Too many electronic health record alerts may be leading doctors to skip them



Your doctor may be more likely to ignore your test results if they come electronically.

A new study published in the JAMA Internal Medicine on Mar. 4 revealed that doctors receive about 63 electronic health record (EHR)-based alerts each day, which are supposed to let them know about abnormal patient results. And, almost one-third of the doctors surveyed -- **about 30 percent** -- admitted

that they had missed some results because of too many alerts.

"If you're getting 100 emails a day, you are bound to miss a few. I study this area and I still sometimes miss emails. We have good intentions, but sometimes getting too many can be a problem," Dr. Hardeep Singh, chief of health policy, quality, and informatics at the Michael E. DeBakey Veterans Affairs Medical Center, in Houston, told TIME.

And More Digital Data Is on the Way

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□ Smartphone

THE WALL STREET JOURNAL. r

The Saturday Essay

The Future of Medicine Is in Your Smartphone

New tools are tilting health-care control from doctors to patients



□ Wearables

HUFF POST **TECH** | The **Blog**

 **Vala Afshar** ♥ Become a fan
Chief Marketing Officer, Extreme Networks

Wearable Technology: The Coming Revolution in Healthcare

Posted: 05/04/2014 | Updated: 07/04/2014

- “Patients can now continuously monitor their data real-time and send it to their docs”

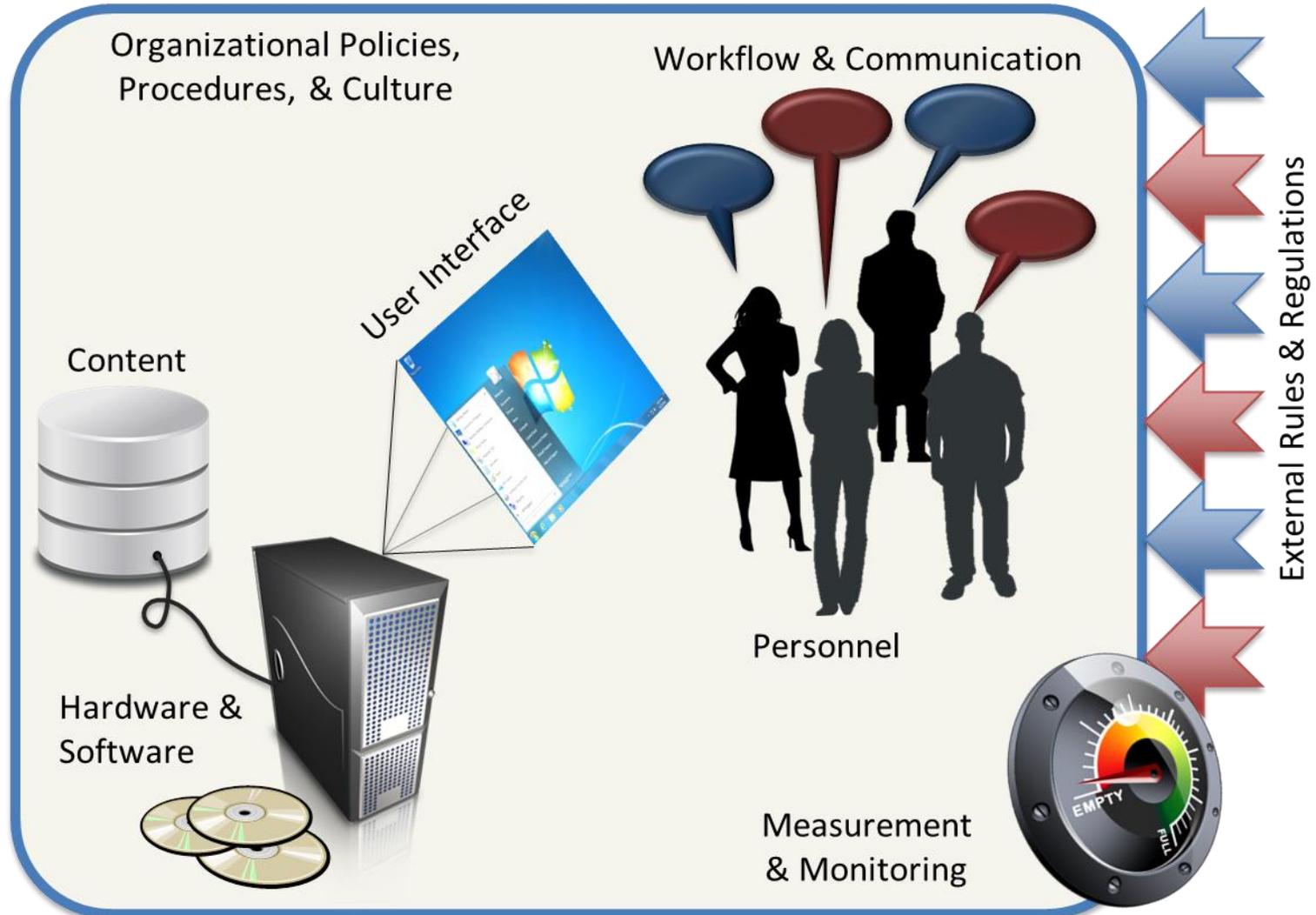
Multiple “Socio-Technical” Issues

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Issue	Examples
<i>Software</i>	no functionality for saving, tracking, and retrieving alerts
<i>Content</i>	too many unnecessary alerts
<i>Usability</i>	poor signal to noise ratio on screen
<i>Workflow</i>	“surrogate feature” to forward alerts when providers out of office not used properly
<i>Providers</i>	lack of knowledge/training
<i>Organizational</i>	policies for follow-up ambiguous

8-dimensional Socio-Technical Model of Safe & Effective Health IT Use

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Health IT Safety Framework – 3 Domains

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- Domain 1: Safe health IT:
 - ▣ Events unique/specific to health IT



Smokers prescribed Viagra to quit

Smokers trying to quit the habit were mistakenly prescribed anti-impotence drug Viagra by doctors.

NHS Greater Glasgow and Clyde said the error was due to a computer glitch at two city GP practices.

When GPs selected anti-smoking pill **Zyban**, computers selected **sildenafil**, the generic name for **Viagra**.

A health board spokeswoman said: "At no time was patient care affected by this as all prescriptions are subject to stringent double checking."

The e-Formulary computer system used by GPs automatically selects a list of the most popular drugs when doctors fill out prescriptions.

Some patients went to the pharmacy with a prescription for the anti-impotence drug instead of tablets to help them stop smoking.



The health board said no-one received Viagra

Health IT Safety Framework— 3 Domains

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- Domain 1: Safe health IT:
 - ▣ Events unique/specific to health IT
- Domain 2: Using health IT safely:
 - ▣ Unsafe or inappropriate use of technology
 - ▣ Unsafe changes in the workflows that emerge from technology use

Divvy K. Upadhyay, Dean F. Sittig and Hardeep Singh*

Ebola US Patient Zero: lessons on misdiagnosis and effective use of electronic health records

Abstract: On September 30th, 2014, the Centers for Disease Control and Prevention (CDC) confirmed the first travel-associated case of US Ebola in Dallas, TX. This case exposed two of the greatest concerns in patient safety in the US outpatient health care system: misdiagnosis and ineffective use of electronic health records (EHRs). The case received widespread media attention highlighting failures in disaster management, infectious disease control, national security, and emergency department (ED) care. In addition, an error in making a correct and timely Ebola diagnosis on initial ED presentation brought diagnostic decision-making vulnerabilities in the EHR era into

non-technical factors will be needed. Ebola US Patient Zero reminds us that in certain cases, a single misdiagnosis can have widespread and costly implications for public health.

Keywords: cognition; decision-making; diagnostic error; Ebola; electronic medical records; health information technology; human factors; misdiagnosis; patient safety.

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Health IT Safety Framework – 3 Domains

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- Domain 1: Safe health IT :
 - ▣ Events unique/specific to EHRs
- Domain 2: Using health IT safely:
 - ▣ Unsafe or inappropriate use of technology
 - ▣ Unsafe changes in the workflows that emerge from technology use
- Domain 3: Using health IT to improve safety
 - ▣ Leveraging health IT to identify unsafe care processes and potential patient safety concerns before harm

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Development and Validation of Electronic Health Record–based Triggers to Detect Delays in Follow-up of Abnormal Lung Imaging Findings¹

BMJ Quality & Safety

The international journal of healthcare improvement

Electronic health record-based triggers to detect potential delays in cancer diagnosis

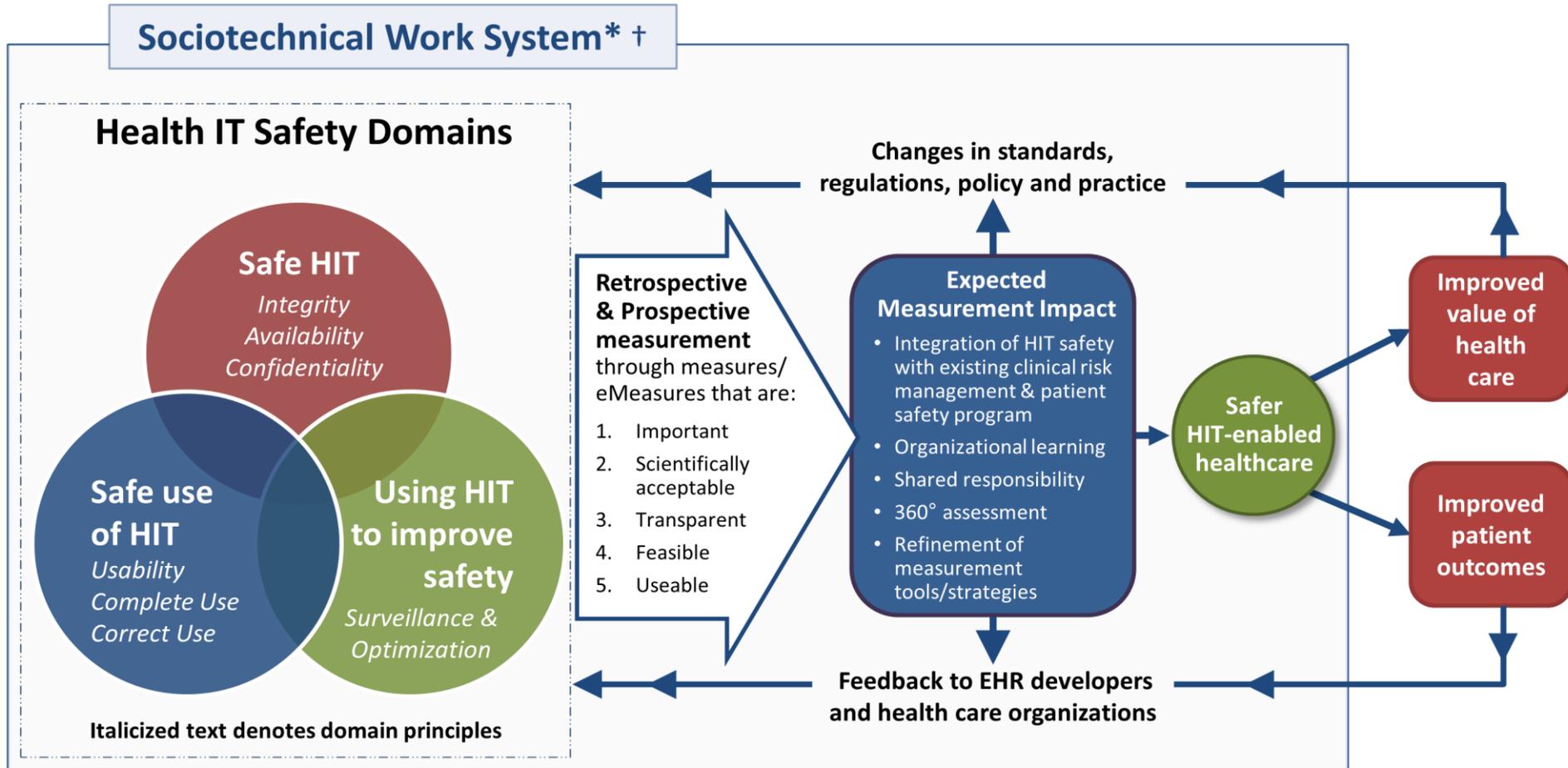
Daniel R Murphy,^{1,2} Archana Laxmisan,^{1,2} Brian A Reis,^{1,2} Eric J Thomas,³ Adol Esquivel,⁴ Samuel N Forjuoh,⁵ Rohan Parikh,⁶ Myrna M Khan,^{1,2} Hardeep Singh^{1,2}

ABSTRACT

Background Delayed diagnosis of cancer can

follow-up of abnormal clinical findings suspicious for cancer.

Health Information Technology Safety Measurement Framework (HITS Framework)



* Includes 8 technological and non-technological dimensions.

† Includes external factors affecting measurement such as payment systems, legal factors, national quality measurement initiatives, accreditation, and other policy and regulatory requirements.

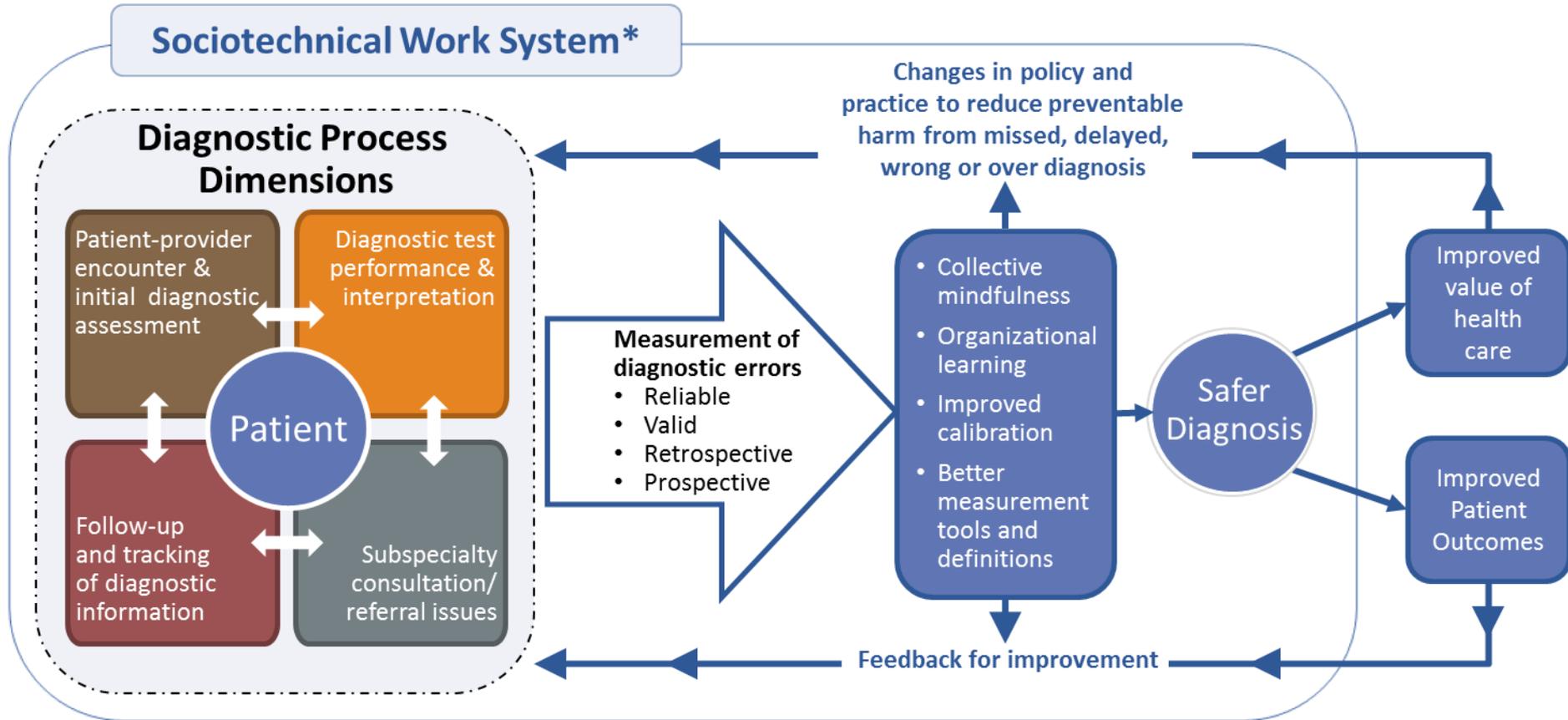
To Enable Rigorous Measurement

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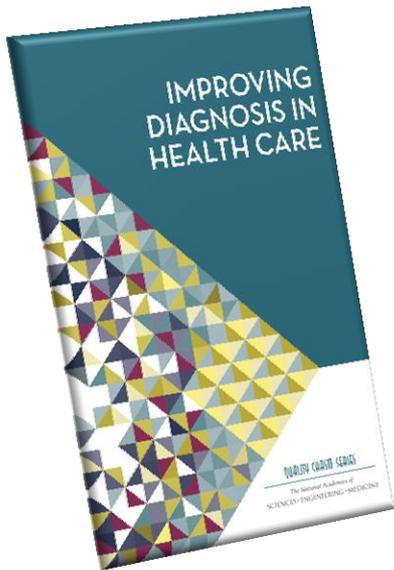
- Missed opportunity measurement must reflect real-world practice
 - ▣ more than just what's in “the doctors head”
 - ▣ systems, team members, and patients, all inevitably influence clinicians' thought processes

Safer Dx Framework for Measurement & Reduction

35



* Includes 8 technological and non-technological dimensions



**Comments from
frontline docs**

“A ‘diagnosis’ is not a static, fixed conclusion; it is a fluid, evolving conclusion based on serial observation and hypothesis building”

“One moves from less certainty to more certainty more or less quickly depending on a number of factors”

“Many of the complications introduced by both medicolegal and quality improvement efforts come from treating diagnosis as a black and white situation”

What Do We Do Now?

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- Measure for quality improvement, learning & research
- Not ready for public reporting, performance measurement or penalties
- Still need more evidence and research in measurement
 - ▣ Good data, standards and operational definitions
- We need to go beyond the few institutions doing this
 - ▣ Others should start measuring for transparency

Targeting a High Priority Area

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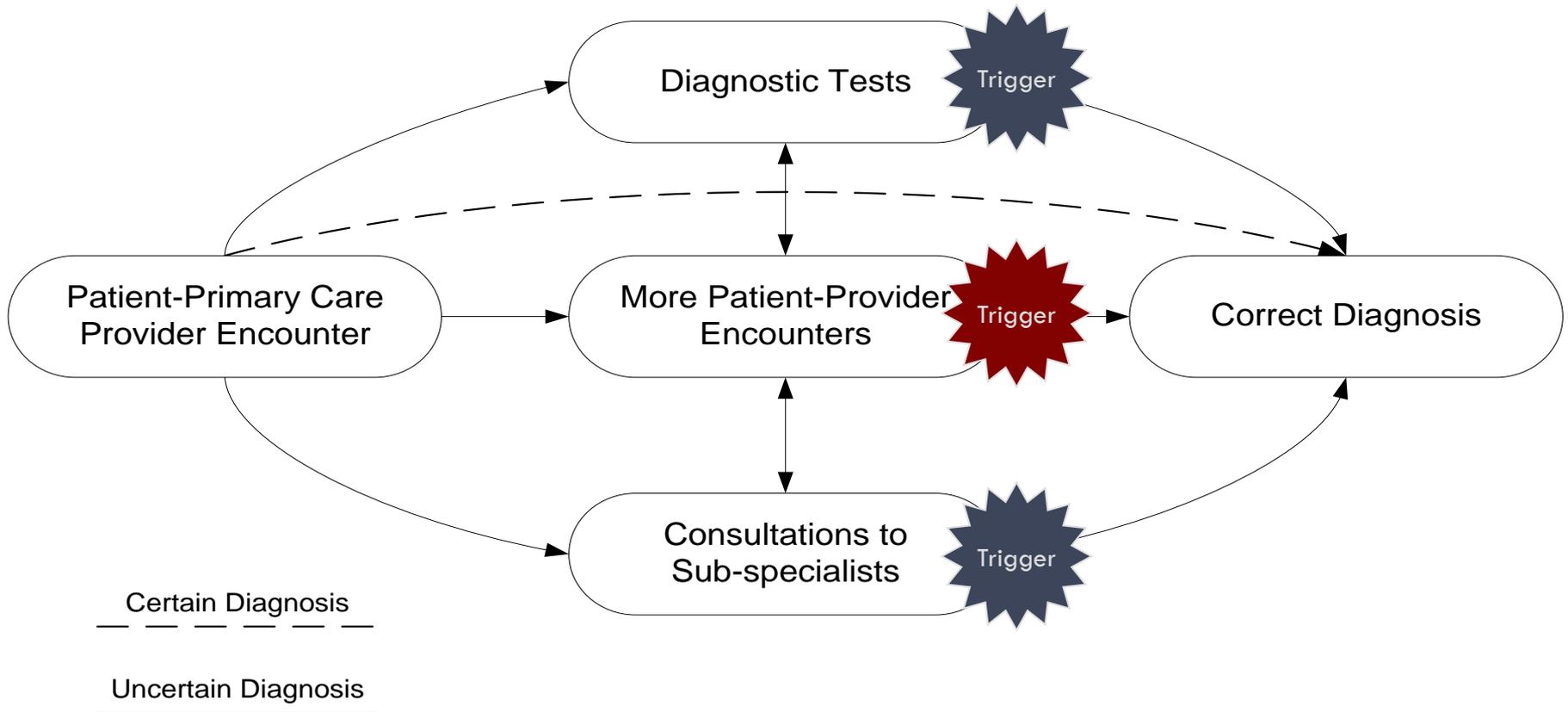
- Missed/delayed Cancer Diagnosis a safety concern
- Major reason: Lack of timely follow-up of cancer-related abnormal test results

Singh et al JCO 2010

Singh et al Am J Gastro 2009

'Trigger'-based Measurements

39



Why Triggers Are a First Step?

40

- Algorithms to select high-risk patient records for further reviews to look for missed opportunities
 - ▣ Picking up ‘needles in a haystack’ by making the haystack smaller
- Application retrospective or prospective surveillance

Creating a Trigger-Based Safety Net

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- Electronic health record (EHR)-based triggers look for follow-up actions on clues (or red flags) to detect delays prospectively

- Basic versions:
 - + hemocult or microcytic anemia with no subsequent colonoscopy in 60 days
 - suspicious chest-x ray with no follow-up CT scan in 30 days

Randomized Control Trial Results

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- Intervention reduced delays in diagnostic evaluation of colorectal and prostate cancer
- More diagnostic evaluation by final review

Time for Surveillance?

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- Creating 'intelligence' related to diagnostic safety needs resource and time investment
 - ▣ Institutions/practices have too many competing priorities
 - ▣ Will it give bang for the buck outside of research?

Ten Strategies to Improve Management of Abnormal Test Result Alerts in the Electronic Health Record

Hardeep Singh, MD, MPH,*† Lindsey Wilson, MA,* Brian Reis, BE,*

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The Joint Commission Journal on Quality and Patient Safety

National Patient Safety Goals

Missed abnormal test results in the electronic health record setting. Failure to act on diagnostic errors, and delays in diagnosis, are often attributed within electronic health record implementation of abnormal test results. Computerized Patient Record System (CPRS) at a large tertiary care facility, uses an alert system for abnormal diagnostic test results. In a study of 7% of abnormal test results that were not up within 30 days. We also found that 10% of abnormal test results (per day), some of which had specific features in the

Eight Recommendations for Policies for Communicating Abnormal Test Results

Hardeep Singh, M.D., M.P.H.; Meena S. Vij, M.D.

Failures of communication in diagnostic test results. Ability claims. Prioritized safety as a National Patient Safety Goal. Critical results basis.⁶ Although largely preventable, cited areas of concern in defining the problem. In laboratory value representation with normal and quickly and fo

Improving Test Result Follow-up through Electronic Health Records Requires More than Just an Alert

Dean F. Sittig, PhD¹ and Hardeep Singh, MD, MPH^{2,3}

¹University of Texas – Memorial Hermann Center for Healthcare Quality & Safety, School of Biomedical Informatics, University of Texas Health Sciences Center, Houston, TX, USA; ²Houston VA Health Services Research and Development Center of Excellence and The Houston VA Patient Safety Center of Inquiry, Michael E. DeBakey Veterans Affairs Medical Center, Houston, TX, USA; ³Section of Health Services Research, Department of Medicine, Baylor College of Medicine, Houston, TX, USA.

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DOI: 10.1007/s11606-012-2161-y
© Society of General Internal Medicine 2012

A recent American Medical Association report highlighted failures in communication of abnormal test results as an important but understudied facet of improving safety in ambulatory care.¹ Because many outpatient test

appropriate follow-up within 3 days in the intervention group (28 % vs. 13 % in controls). Neither group's laboratory follow-up rate was particularly encouraging.

On the bright side, both studies used distinctly different research approaches to reach similar conclusions, i.e., application of information and communication technologies, such as electronic health records (EHRs) with alerting capability, can increase the likelihood of appropriate test result follow-up. In paper-based systems, evaluating evidence of follow-up is itself challenging. On the other hand, both

Proactive Measurement

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- The Office of the National Coordinator for Health Information Technology (ONC)-sponsored “Safety Assurance Factors for EHR Resilience (SAFER) project”
- Proactive risk assessment and guidance
- “1st draft” of best practices and knowledge
- Self-assessment; not meant to be regulatory
 - ▣ Focused on high-risk areas
 - ▣ Nine guides—all freely available

<http://www.healthit.gov/safer>



Recommended Practices for Phase 3 – Monitoring Safety

- 19 Summarization tools to are available in the EHR
- 20 Test results can be sorted according to clinically r time, severity, hospital
- 21 The EHR has the capabi reminders for future tas follow-up.

22 As part of quality assurance activities, organizations monitor selected practices related to test result reporting and follow-up. Monitored practices include clinician use of the EHR for test results review and clinician follow-up on abnormal test results.

Recommended Practices for Phase 3 – Monitoring Safety

- 22 As part of quality assurance activities, organizations monitor selected practices related to test result reporting and follow-up. Monitored practices include clinician use of the EHR for test results review and clinician follow-up on abnormal test results.
- 23 As part of quality assurance, the organization monitors and addresses test results sent to the wrong clinician or never transmitted to any clinician (e.g., due to an interface problem or patient/provider misidentification).

Implementation Status

Fully in all areas Partially in some areas Not implemented [Worksheet 22](#) [Worksheet 23](#) [reset](#)

e.g., radiology abnormal/ associated

Implementation Status

Fully in all areas Partially in some areas Not implemented

Implementation Status

Fully in all areas Partially in some areas Not implemented

Patient Perspectives- Test Results

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“The result was abnormal but I didn’t realize it. There’s a comment section but the doctor never leaves a comment. My triglycerides are high. Ok, what does that mean? What am I supposed to do?”

“I had to figure out the sodium was low. There’s a problem with low sodium, what can I do?”

“I’m not a doctor. I hope they’ll call if it’s problematic.”

Implications

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- Patient engagement key in improving safety of test results follow-up
- Many opportunities for improvement in test results through portals
- We must preach “No news is **not** good news”

Take Away Points

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- Diagnostic error will likely affect all of us
- Challenges to address them involve complex cognitive and systems issues
- Several opportunities for informatics interventions

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