

# Oncologic Imaging

*Gaps & Challenges to High-Quality*

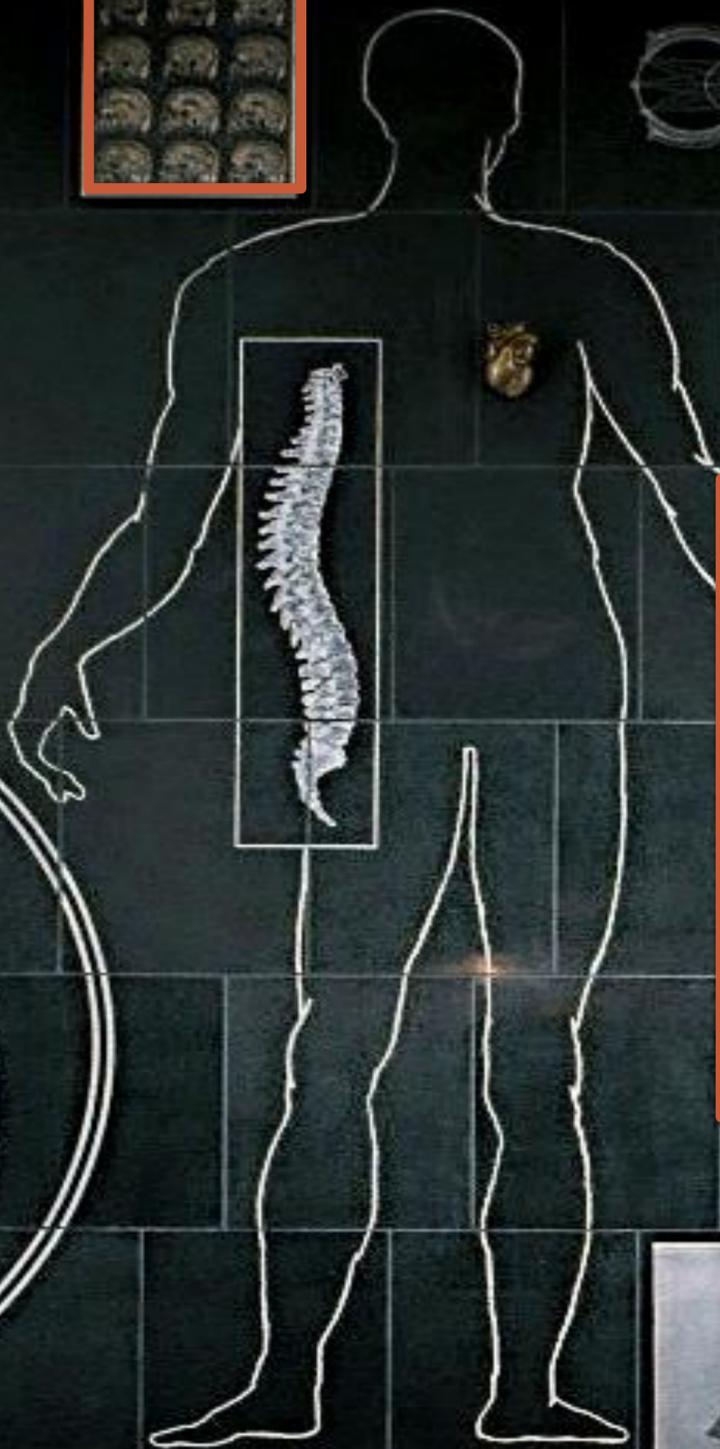
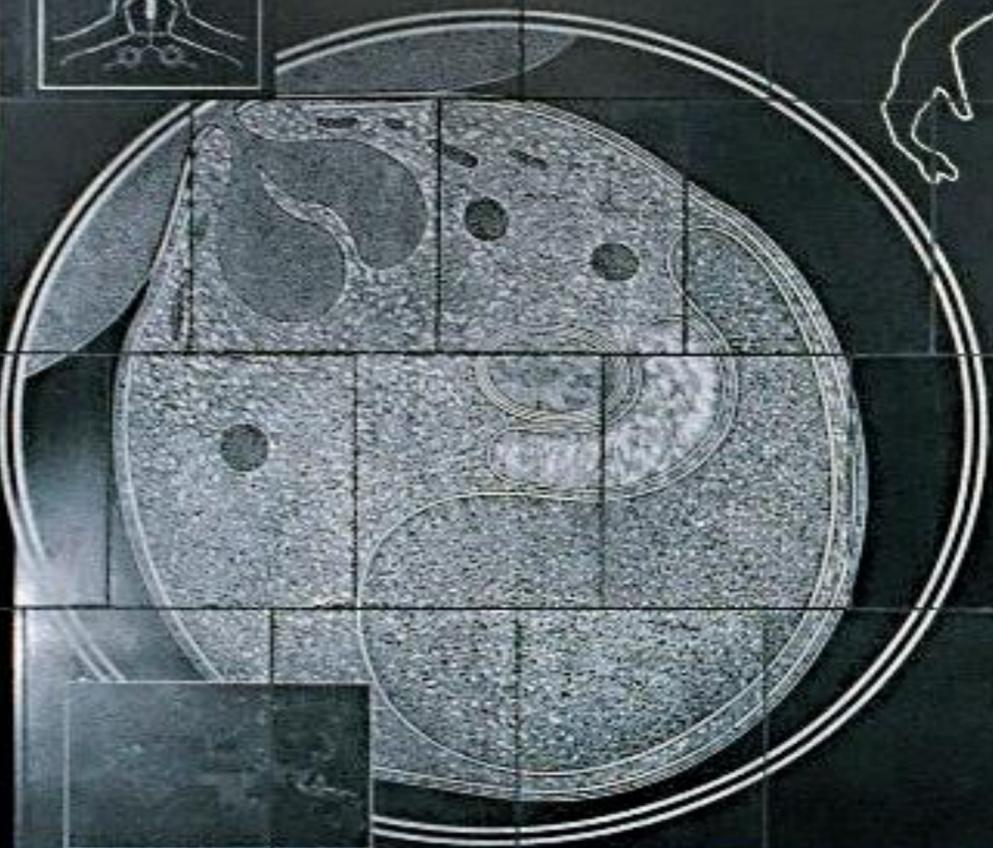
*Cancer Diagnosis in Clinical Practice*

Hedvig Hricak, MD, PhD

Chairman, Radiology

Memorial Sloan Kettering Cancer Center

$$E = mc^2$$



There is grandeur  
in this view of life,  
with its several powers,  
having been originally breathed  
into a few forms or into one;  
and that, whilst this planet  
has gone cycling on  
according to the fixed  
law of gravity,  
from so simple a beginning  
endless forms most beautiful  
and most wonderful have been,  
and are being, evolved.

Charles Darwin, The Origin of Species, 1859



# Diagnostic IMAGING

## *A Critical Component in Cancer Care*

***Today, diagnostic tests influence an estimated  
60-70% of all treatment decisions \****

\*V. J. Dzau: Realizing the Full Potential of Precision Medicine; NAM Perspective, Sept. 2016

***Imaging is essential for initial and follow-up  
treatment decisions for nearly every cancer***

# Oncologic Imaging

*At every step of Cancer Care*

- **Cancer Screening**  
(Ca Breast & Lung)
- **Cancer Detection/Localization**
- **Treatment Planning**  
*Imaging is a Road Map (GPS)*  
Exploratory Laparotomy  
is no longer used for diagnostics
- **Treatment Follow-up**
  - Monitoring Treatment Response
  - Detection of Tumor Recurrence



Virtual Laparotomy by Imaging

# Oncologic Imaging

*A broad scope & unmet needs*

- › The need for training/expertise in Oncologic Imaging is **not widely recognized or acknowledged**

"I am so grateful for my fellowship training! I never realized how much I needed to learn. Its been scary (and fun) to be considered the oncologic "expert."

KM – class of 2011

# Added Value of Second Opinion by Oncologic Imager

Author	Site	Modalities	n	Disagreement	Change in Management	Institution
Lorenzen J, 2012	Breast	Real-time US, mammo	374	-	<b>26%</b>	Germany
Lysack JD, 2013	H&N	CT, MRI	94	56%	<b>38%</b>	Canada
Spivey TL, 2015	Breast	US, mammo	380	-	<b>53%</b>	Chicago IL
Hatzoglou V, 2016	Neuro	CT, MRI	283	19%	<b>15%</b>	<b>MSKCC</b>
Lakhman Y, 2016	GYN	MRI	469	-	<b>20%</b>	<b>MSKCC</b>
Coffey K, 2017	Breast	MRI, mammo	200	28%	<b>13%</b>	<b>MSKCC</b>
Horvat JV, 2017	Breast	Real-time US	209	-	<b>32%</b>	<b>MSKCC</b>
Mannelli L, 2018	Pancreas	CT, MRI	65	13 %	<b>20%</b>	<b>MSKCC</b>

# What drives diagnostic failure in cancer cases

FACTOR	% CASES*
Clinical Judgment	72%
Communication	27%
Clinical Systems	25%
Behavior-related	19%
Documentation	17%

\*A case will often have multiple factors identified.

CBS N=1,347 PL cases closed 1/1/08–12/31/12 with a diagnosis-related major allegation and a final diagnosis of cancer.

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TOP CLINICAL JUDGMENT FACTORS	# CASES*
Failure/delay in <b>ordering diagnostic test</b>	457
<b>Misinterpretation</b> of dx studies (X-rays, slides, films)	375
Narrow dx focus, <b>failure to establish differential dx</b>	246
Failure/delay in obtaining <b>consult/referral</b>	235
Failure to rule out <b>abnormal finding</b>	167

TOP COMMUNICATION FACTORS	# CASES*
Communication <b>among providers</b> regarding pt's condition	164
<b>Patient/family communication</b> -follow up instructions	159
Failure of provider to read medical record	61

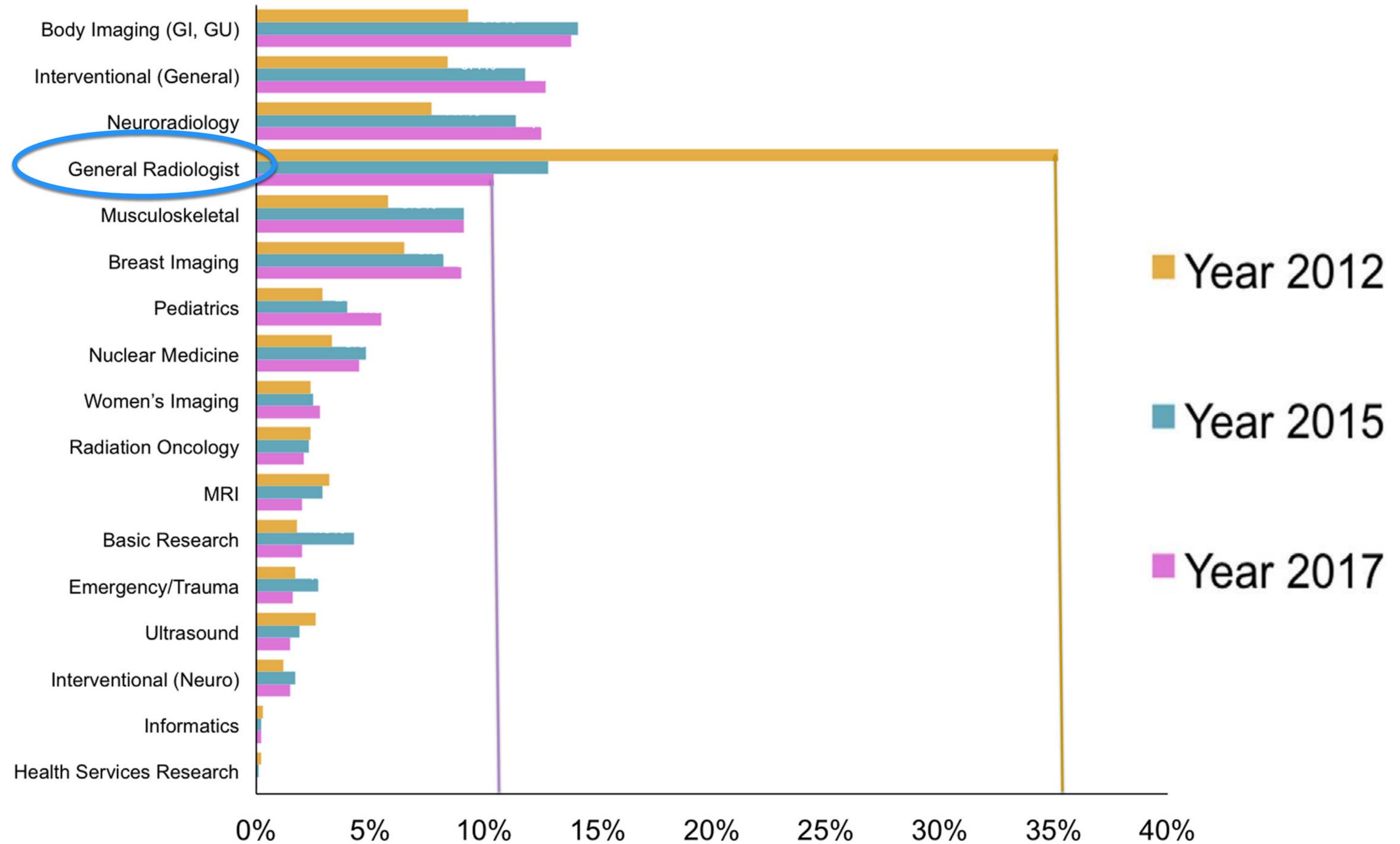
TOP CLINICAL SYSTEM FACTORS	# CASES*
<b>Patient did not receive results</b>	133
<b>Lack of/failure in follow/up system, new finding</b>	113
<b>Clinician did not receive results</b>	43
Failure to identify <b>provider coordinating care</b>	33

# Where is the problem?

*Where are the Oncologic Imaging experts?*

- 1. Few role models in Oncologic Imaging:** *individual or institutional*
- 2. Lack of appreciation for additional knowledge:** *Expertise in oncologic imaging extends beyond pattern recognition; it includes cancer biology; cancer as a multisystem disease; treatment options; the needs/expectations of referring clinicians & mandates participation in the interdisciplinary team-based cancer care*
- 3.**
- 4. Misconception about the job market:** *Fear that an Oncologic Imager can only work in a tertiary care center (~65% of cancer patients are treated in a community setting)*

# Radiology is progressing towards subspecialization



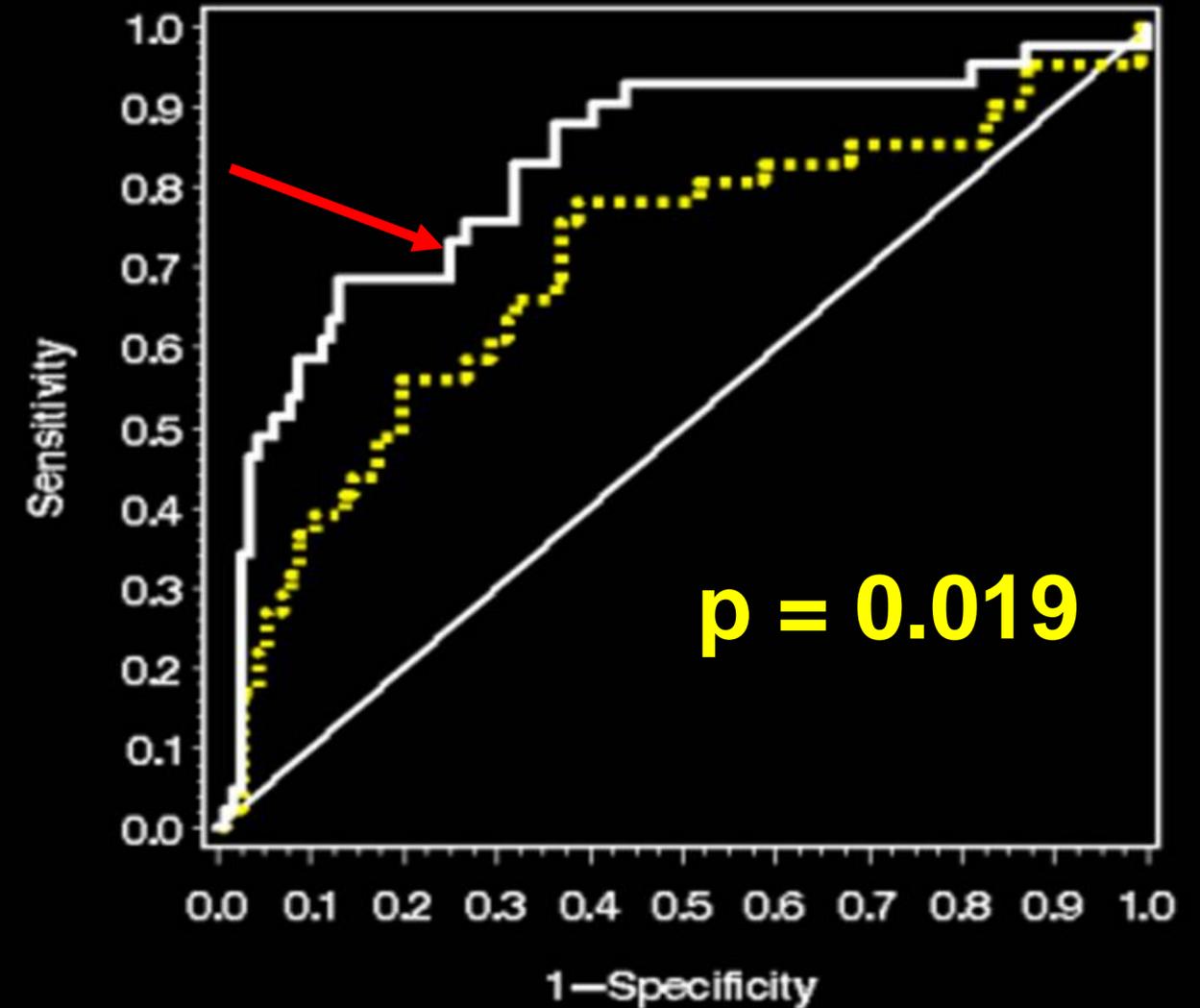
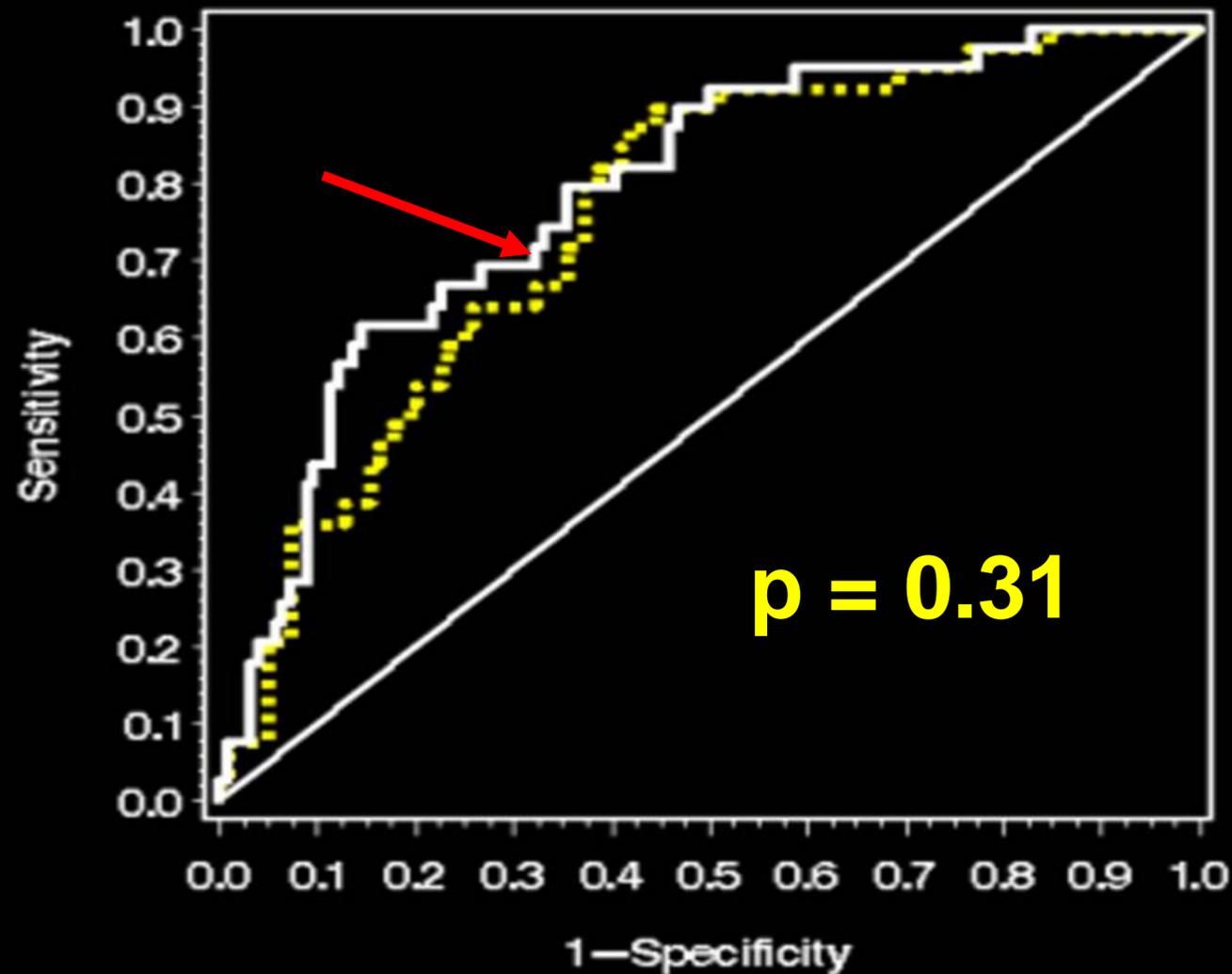
The 2017 ACR Commission on Human Resources Workforce Survey: percentage of radiology workforce currently employed by subspecialty; J Am Coll Radiol; 2017

# Added Value of Subspecialization

*Prostate Cancer ECE: incremental value of MRI (N=181)\**

MRI read by **General MRI** radiologists

MRI read by **GU MRI** radiologists



**Yellow: clinical parameters only**  
**White: clinical parameters & MRI**

\*Mullerad et al: Radiology 2004

# Oncologic Imaging

*How to increase expertise in Oncologic Imaging?*

## › **Oncologic Imaging Fellowship**

There are **only 5 Oncologic Imaging Fellowships** in the US (there are more than ~240 other imaging fellowships)

› Should a dedicated **Oncologic Imaging training** be offered as a 4th-year Mini-fellowship, or as a rotation during a standard fellowship?

› **Oncologic Imaging section** (e. g. UCLA, Staten Island Univ Hosp)

› Develop and/or expand **Oncologic Imaging CME and Peer-Learning programs**

› **Oncologic Imaging CAQ** (Certificates of Added Qualification )

# Cancer Diagnostics - *in the age of Precision Oncology*

## Convergence of Life Sciences, Physical Sciences & Engineering

A word cloud of terms related to cancer research and clinical practice. The words are arranged in a roughly rectangular shape, with varying sizes and colors. The most prominent words are 'IMAGING' (large, dark blue, vertical), 'Big Disease Progression' (large, orange, horizontal), 'PRECISION MEDICINE' (medium, orange, horizontal), 'Clinical' (medium, blue, horizontal), and 'Trials' (medium, blue, horizontal). Other visible words include 'Reference Databases', 'BioBanking', 'High-Performance Computing', 'Data', 'BioPortal', 'Machine Learning', 'PROTEOMICS', 'CLINICAL BIOFORMATICS', 'Pattern Discovery', 'Genome Sequencing', 'Treatment Planning', and 'Clonal Heterogeneity'.

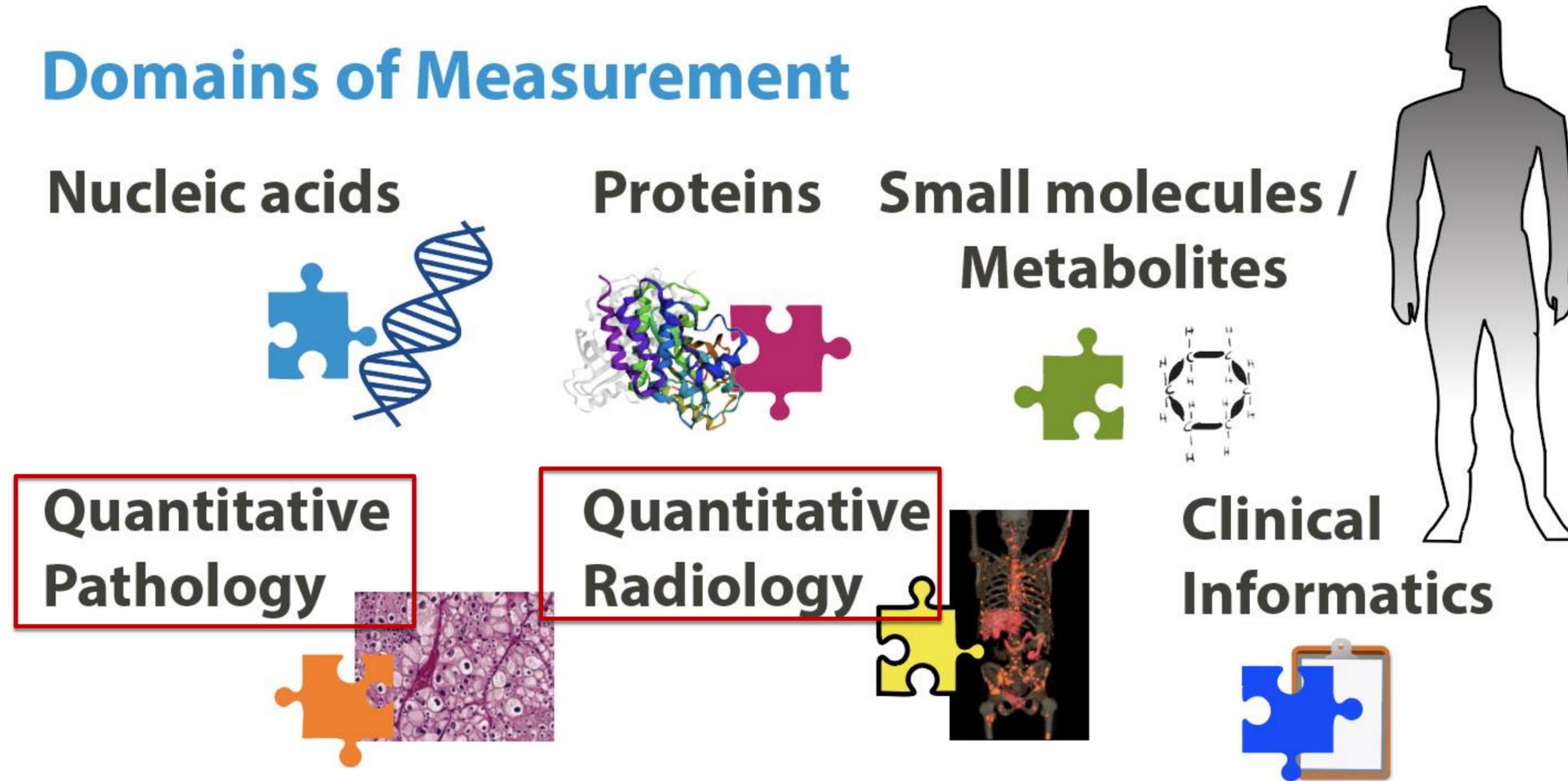
Reference Databases  
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PROTEOMICS  
Pattern Discovery  
CLINICAL BIOFORMATICS  
Clinical  
Trials  
Genome Sequencing  
Treatment Planning  
Clonal Heterogeneity



# Integrated Diagnostics

*Quantitative, Multidimensional, Dynamic Evaluation of Cancer*

## Domains of Measurement



**Bioengineering and computational methods/technologies for quantitative precision measurements are essential for the next generation diagnostics**

# Oncologic Imaging

## *Unmet needs – Points for Discussion*

### Recognize the need for expertise in Oncologic Imaging

- › Increase venues for education in Oncologic Imaging  
*Oncologic Imaging Fellowships, Peer- Learning, CME courses*
- › Institute Oncologic Imaging CAQ
- › Form Second Opinion Networks and/or Cancer Imaging Consortium

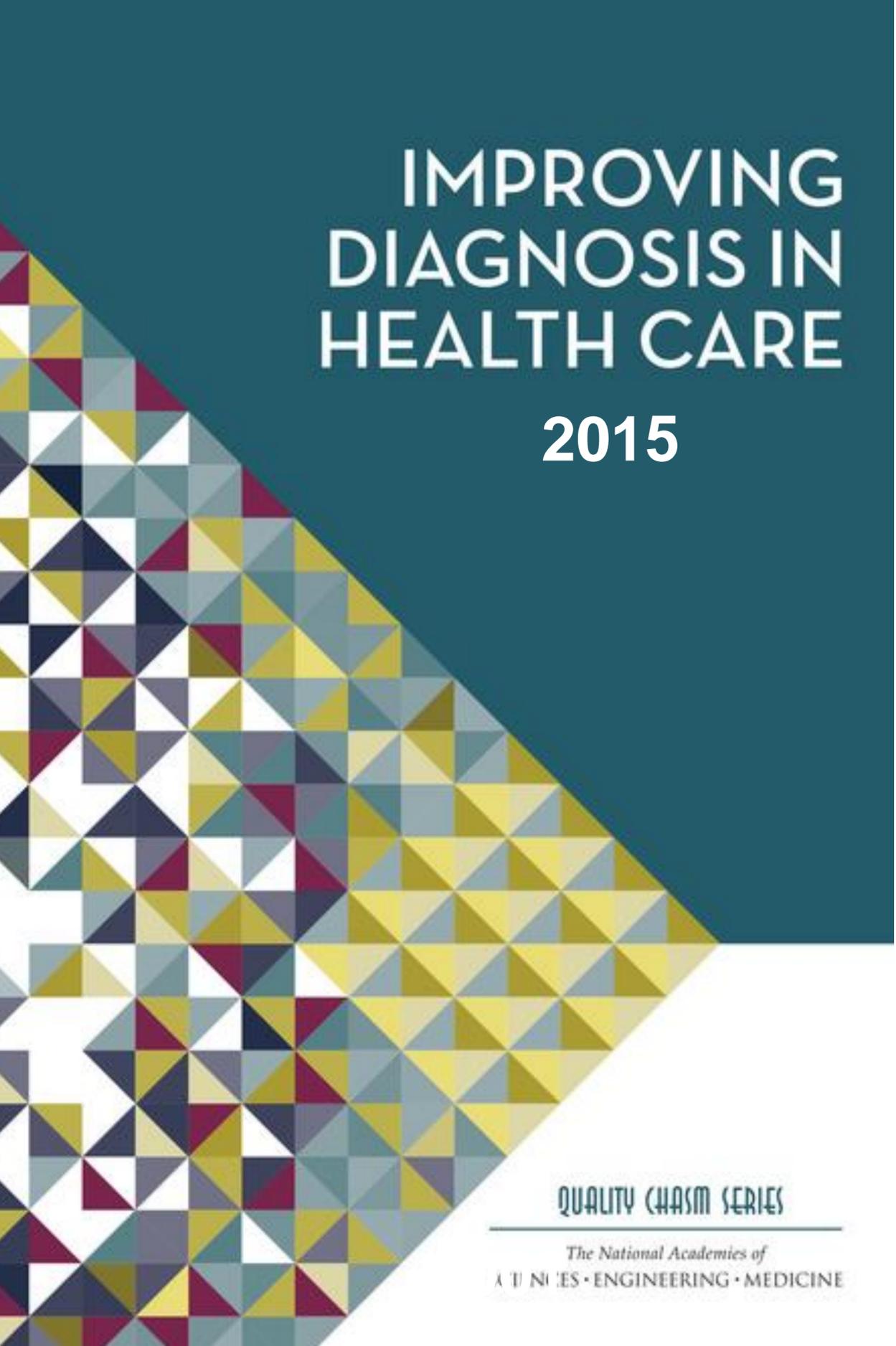
# Oncologic Imaging

## *Unmet needs – Points for Discussion*



## Oncologic Imaging at the Intersection of Human Ingenuity and Intelligent Technology

- › Facilitate development of AI & Machine Learning to help *with repetitive and non-cognitive tasks* (e.g. tumor measurement, summary of pertinent history)
- › Implement Data Analytics & Integrated Diagnostics as Predictive and Prognostic Biomarkers for Cancer Care



# IMPROVING DIAGNOSIS IN HEALTH CARE

2015

QUALITY CHASM SERIES

The National Academies of  
SCIENCES • ENGINEERING • MEDICINE

## A Call to Action

Getting the right diagnosis is a key aspect of health care .....

The diagnostic process is *complex ...*

Improving diagnosis will require collaboration and a *widespread commitment to change...*



Memorial Sloan Kettering  
Cancer Center

*Thank You*

