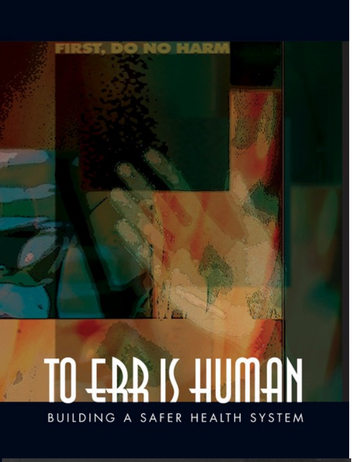
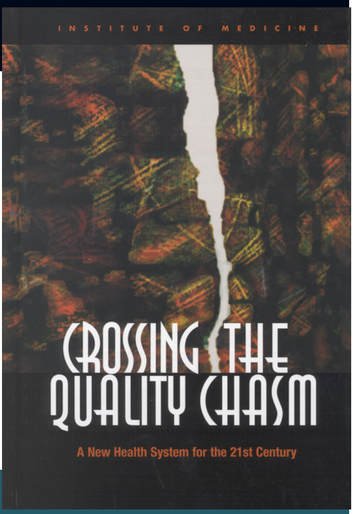




Improving Cancer Diagnosis and Care:

Patient Access to Oncologic Imaging and Pathology Expertise and Technologies

Summary of the February 2018 NCPF workshop

A Call to Action

The diagnostic process is ***complex***, ***collaborative***, and involves ***clinical reasoning*** and ***information gathering***.

Diagnostic Imaging & Pathology

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**

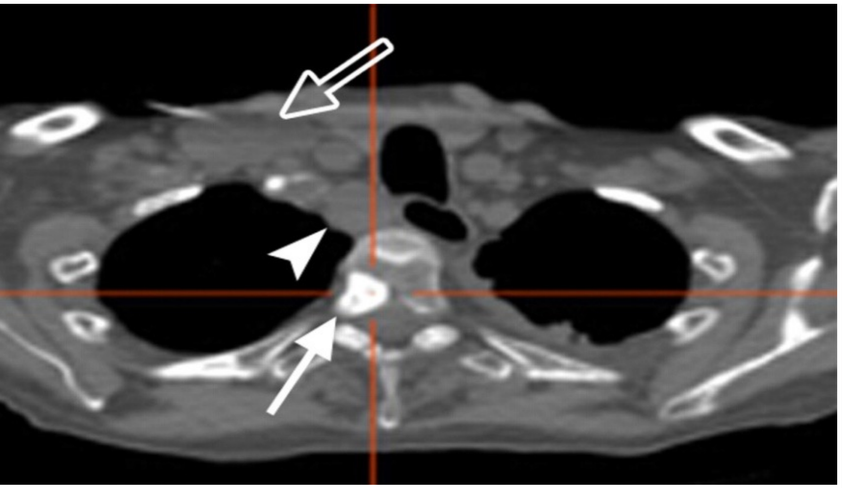
  Imaging is a Road Map (GPS)

  Exploratory Laparotomy
  is no longer used for diagnostics
- **Treatment Follow-up**
  - Monitoring Treatment Response
  - Detection of Tumor Recurrence

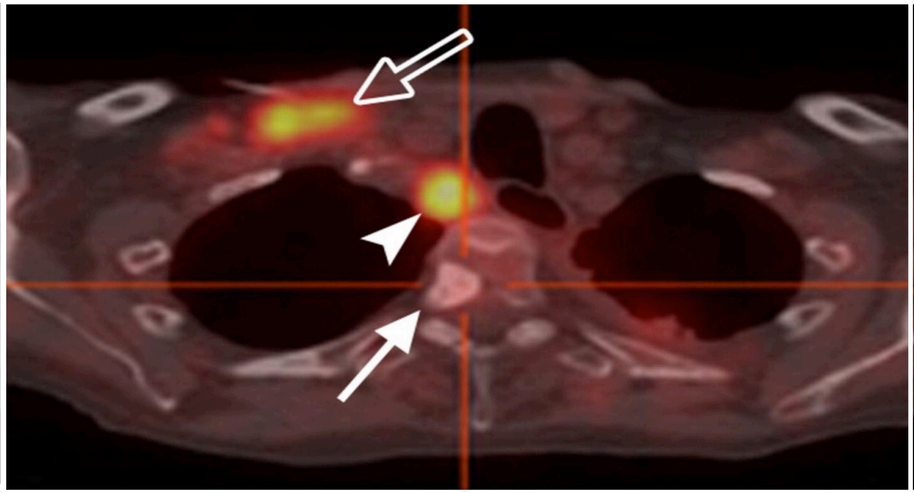
Virtual Laparotomy by Imaging

Molecular Imaging

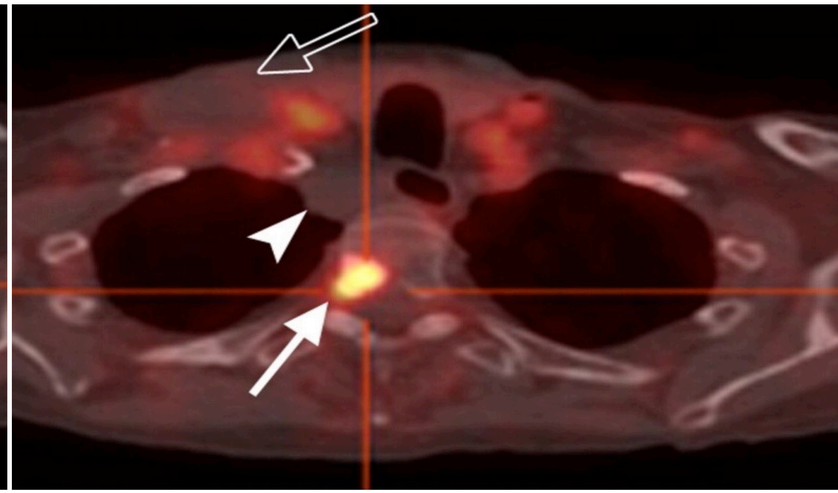
Imaging Biology of Prostate Cancer Metastasis



CT



^{18}F-FDG PET/CT
Glycolysis



^{18}F-FDHT PET/CT
Androgen Receptor

Precision in Therapy Selection

Imaging as In Vivo Companion Diagnostics

Hricak H.: Oncologic Imaging: A Guiding Hand of Personalized Cancer Care; Radiology 2011

Imaging in Drug Development

Imaging in Patient-Centered Value-Driven Population Health

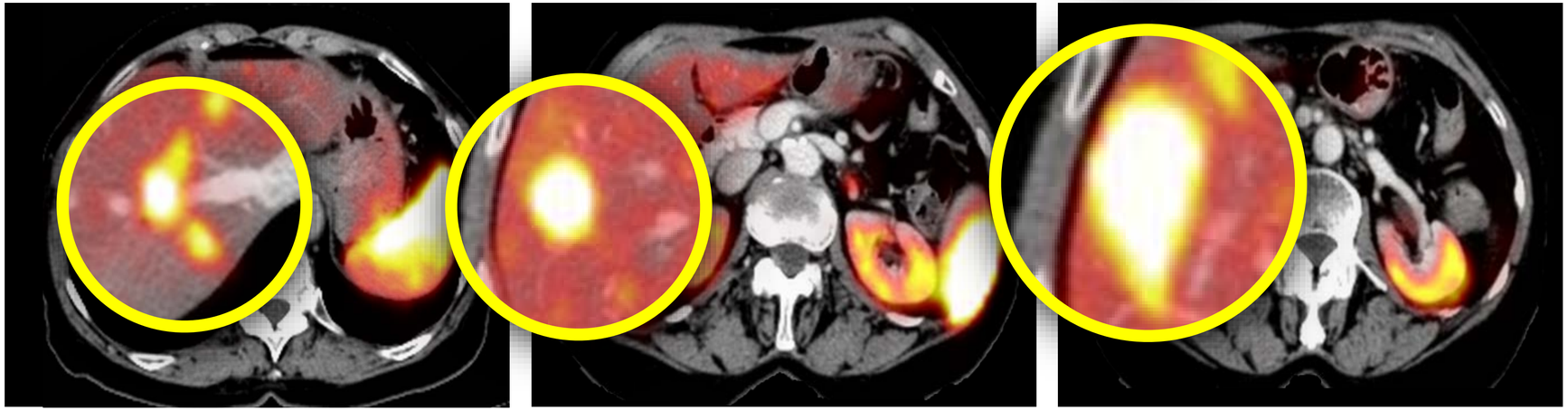
Imaging in Drug Development

Accelerating anticancer drug development-opportunities and trade offs
Nat Rev Clin Oncol. 2018 Oct 1. [Epub ahead of print]

Theranostics: Molecular Imaging & Therapy

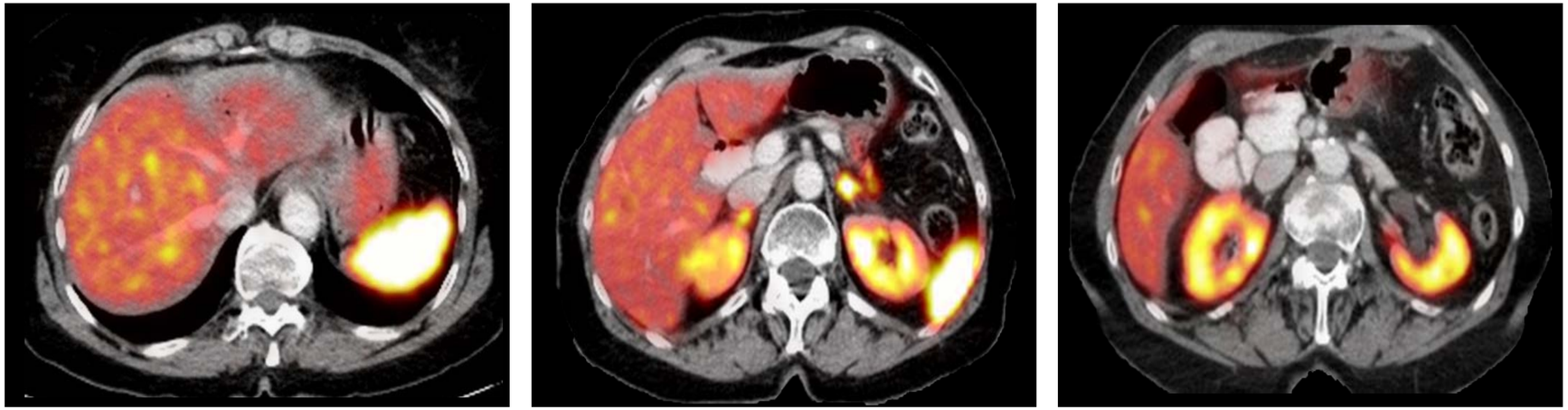
Metastatic NET - *Targeting Somatostatin receptors*

Before therapy



Imaging (^{68}Ga) DOTA-TATE

After Lutetium -177 (177Lu) DOTA-TATE



Therapy (^{177}Lu) DOTA-TATE Lutathera

Hricak H: Beyond Imaging-Radiology of Tomorrow; Radiology 2018

Diagnostic Errors

Imaging & Surgical Pathology

- **Pathology – 6%***
- **Radiology 18%***

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

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

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

Diagnostic Errors – Radiology

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	-	26%	Germany
Lysack JD, 2013	H&N	CT, MRI	94	56%	38%	Canada
Spivey TL, 2015	Breast	US, mammo	380	-	53%	Chicago IL
Hatzoglou V, 2016	Neuro	CT, MRI	283	19%	15%	**MSKCC**
Lakhman Y, 2016	GYN	MRI	469	-	20%	**MSKCC**
Coffey K, 2017	Breast	MRI, mammo	200	28%	13%	**MSKCC**
Horvat JV, 2017	Breast	Real-time US	209	-	32%	**MSKCC**
Mannelli L, 2018	Pancreas	CT, MRI	65	13 %	20%	**MSKCC**

Misinterpretation of the Diagnostic Imaging studies

Top Contributing Factors

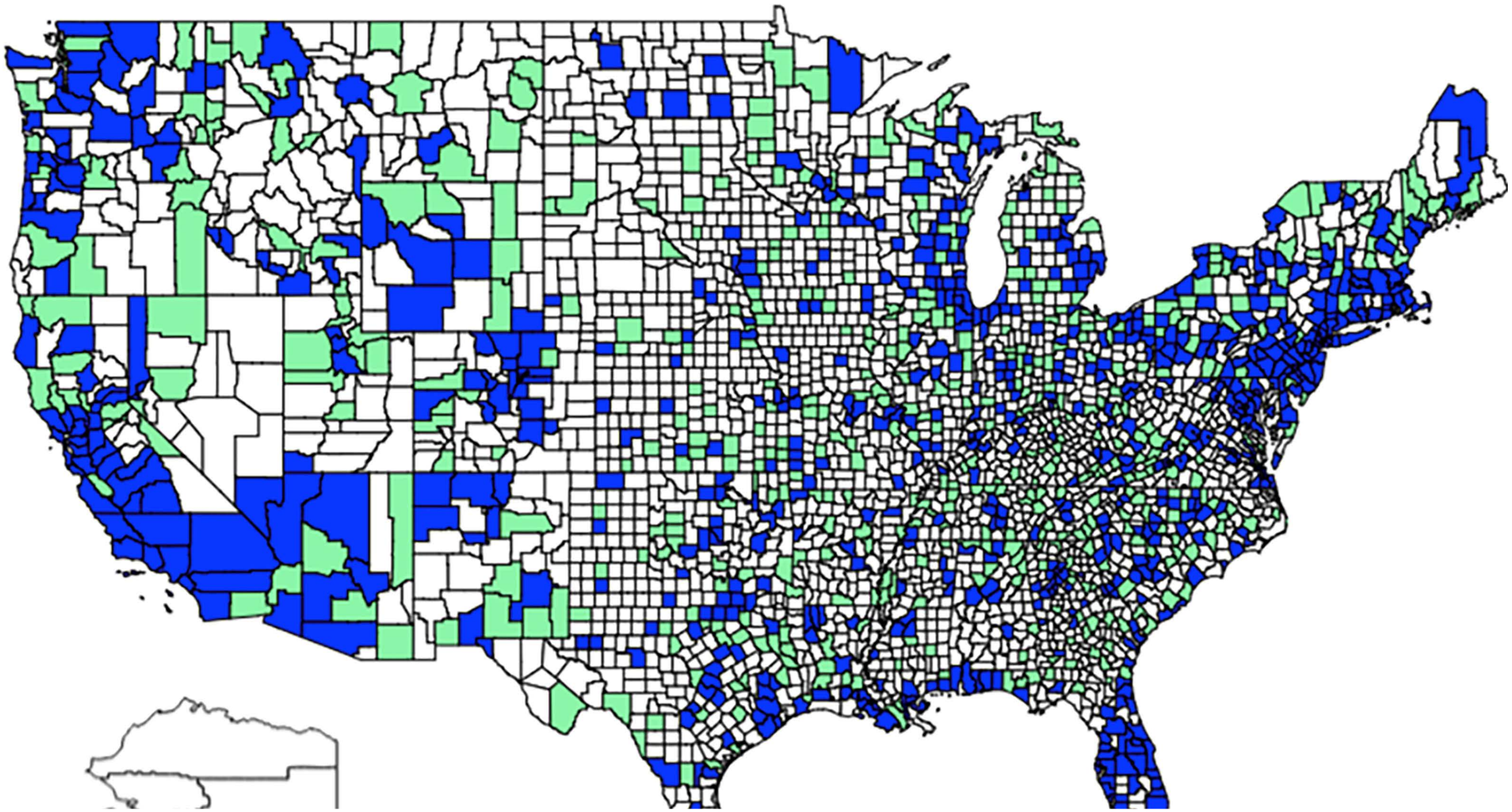
FACTOR	% CASES*
Clinical Judgment	67%
Communication	23%
Technical	22%
Administrative	16%
Clinical Systems	16%

TOP CLINICAL JUDGMENT FACTORS
misinterpretation of dx studies 48% (639)

PROCEDURE	% CASES
CT scan (Abdomen, Head, Chest)	18%
Diagnostic radiography (CXR / Ortho)	13%
Mammography	10%
MRI (Magnetic Resonance Imaging)	10%
Diagnostic ultrasound	3%

ADDITIONAL CLINICAL JUDGMENT FACTORS INCLUDE:
failure to appreciate / reconcile relevant sign/symptom/test result
narrow dx focus—failure to establish differential diagnosis

Where *Are* the Radiologists?



Counties with no local radiologist

Counties with only general radiologists

Counties with one or more subspecialist radiologists

Less populous and more rural counties have fewer radiologists overall and less radiologists subspecialty

Potential Actions to Improve Patient Access to High-Quality Oncologic Imaging

Improve Education and Training in Oncologic Imaging

- Update core and continuing radiology curricula, training, and evaluation to include a greater emphasis on oncologic imaging competencies
- Facilitate and recognize oncology subspecialization in radiology
- Use peer-learning programs to promote quality improvement among radiologists
- Prepare radiologists to incorporate machine learning algorithms into clinical practice
- Emphasize communication and intra- and interdisciplinary collaboration

Expand Access to Expertise in Oncologic Imaging

- Form second-opinion networks and cancer imaging consortia
- Develop tools and mechanisms for imaging referrals at cancer centers
- Build community capacity in oncologic imaging through telementoring
- Create oncologic imaging expertise within radiology departments

Adapted with Permission from the National Academies Press, 2018[2]

Potential Actions to Improve Patient Access to High-Quality Oncologic Imaging

Increase Integration and Collaboration Among Specialties in Cancer Care

- Engage tumor boards to help integrate specialties for diagnosis and care management
- Provide incentives for interdisciplinary collaboration

Improve and Adopt Use of Clinical Decision Support

- Collaborate with patients and physicians to design decision support tools
- Effectively embed decision support tools into clinical workflow
- Incorporate patient-reported outcome measures (PROMs) within these systems
- Create machine-readable clinical practice guidelines

Adapted with Permission from the National Academies Press, 2018[2]

Potential Actions to Improve Patient Access to High-Quality Oncologic Imaging

Support Innovation in Oncologic Imaging

- Develop machine learning methods to process complex, multi-modality, time-based data
- Use artificial intelligence and interconnectivity to create a more dynamic, proficient, precise, and efficient healthcare workforce
- Ensure appropriate validation and workforce training before disseminating new technologies into clinical practice.

Improve Data Curation, Integration, and Sharing

- Develop systematic approaches for data curation, anonymization, and aggregation
- Standardize data elements and information nomenclature
- Use structured or synoptic reporting to ensure data completeness and quality
- Adhere to the FAIR principles (findable, accessible, interoperable, and reusable)
- Include data from diverse populations

Adapted with Permission from the National Academies Press, 2018[2]

Improving Cancer Diagnosis and Care

Patient Access to Diagnostic Expertise in Oncology - Pathology

- Issues similar to Radiology are faced by pathology
- Should there be mandatory review of all new cancer diagnoses?
- Use of checklists for pathology sign out?
- Beware of dissemination of new technologies without an adequate evidence base & workforce training.
- Need for standardized display of meaningful data, data integration, timely communication of findings
- Convergence of imaging and pathology on the horizon as pathology goes digital – **Integrated Diagnostics**

Cancer Diagnostics - Integrated Diagnostics - ***A Team Effort***

Convergence of Life Science, Physical Science, Engineering & Beyond

Precision Oncology: Integrated Diagnostics

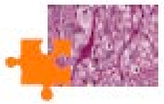
Quantitative, Multidimensional, Dynamic Evaluation of Cancer

Measurement Domains - Standardized and Quantitative

Nucleic Acids

Proteins

Small Molecules/ Metabolites



Pathology

Radiology

Clinical Informatics

Personalized Treatment

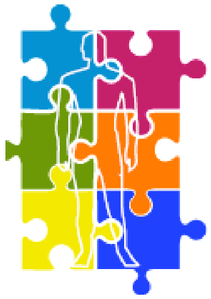
Precision Oncology
Medicine, Surgery, Rad Onc and/or Image-guided Intervention

Predictive Modeling

Biomarkers
Prior Outcome data

Integrative Analysis

Computable data
Connected databases
Intuitive visualization



Radiology & Pathology – *Common Themes*

The **complexity of cancer diagnosis and treatment requires a multidisciplinary approach** - integrated teams of oncologists, surgeons, rad. onc, pathologists, radiologists, APP, nursing & **biomedical informaticians**.

- **Governance:** Formal interdisciplinary governance structure within an organization is critical to set standards and monitor progress.
- **Measurement:** Measure outcomes frequently, and modify plans accordingly
- **Essential requirements for quality improvement:**
  - Culture (constructive not punitive)
  - Infrastructure (data systems and analysts)
  - Leadership (clinical and operational)

Thank you!