MDG November 5, 2014 Forum

In Vivo Optical Cancer Detection

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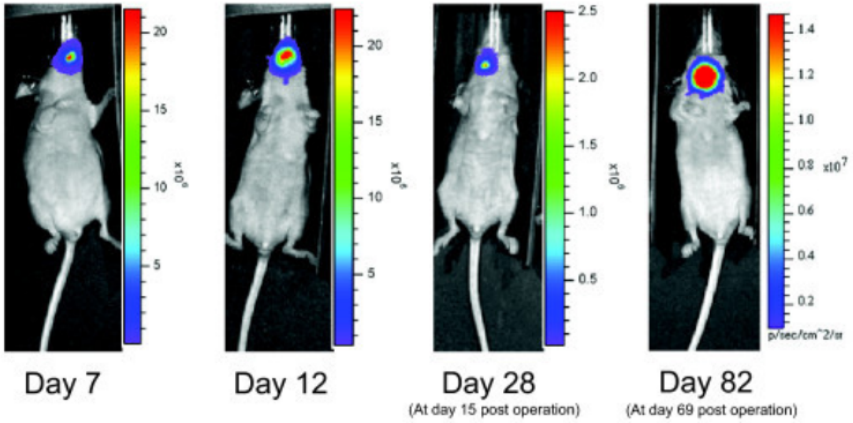
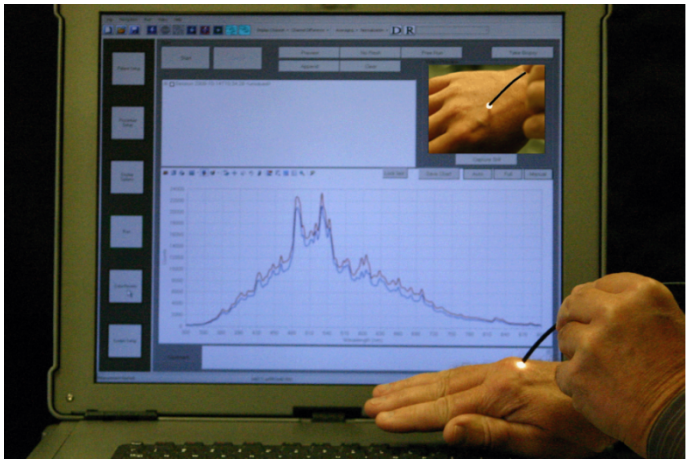
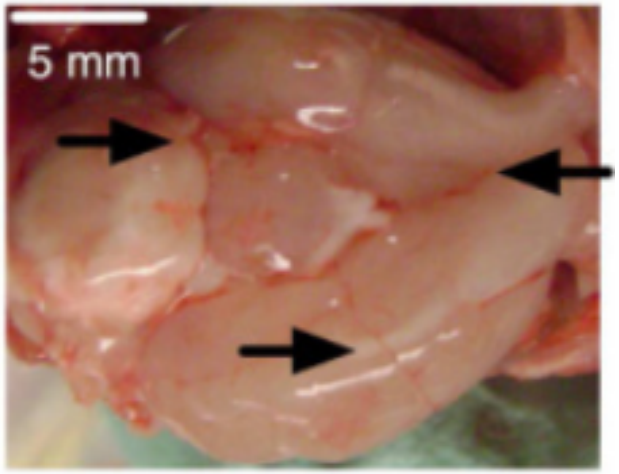
In Vivo Optical Cancer Detection



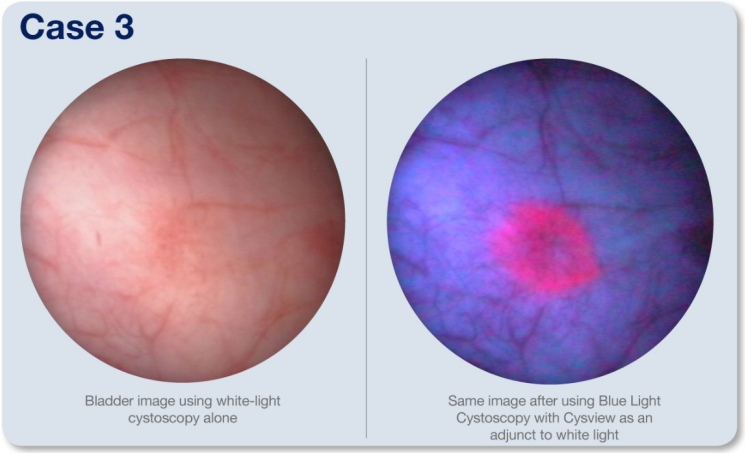
In Vivo Cancer Research



In Vivo Diagnostics



In Vivo Surgical Margin Assessment



In Vivo Post-Therapy Surveillance

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Background

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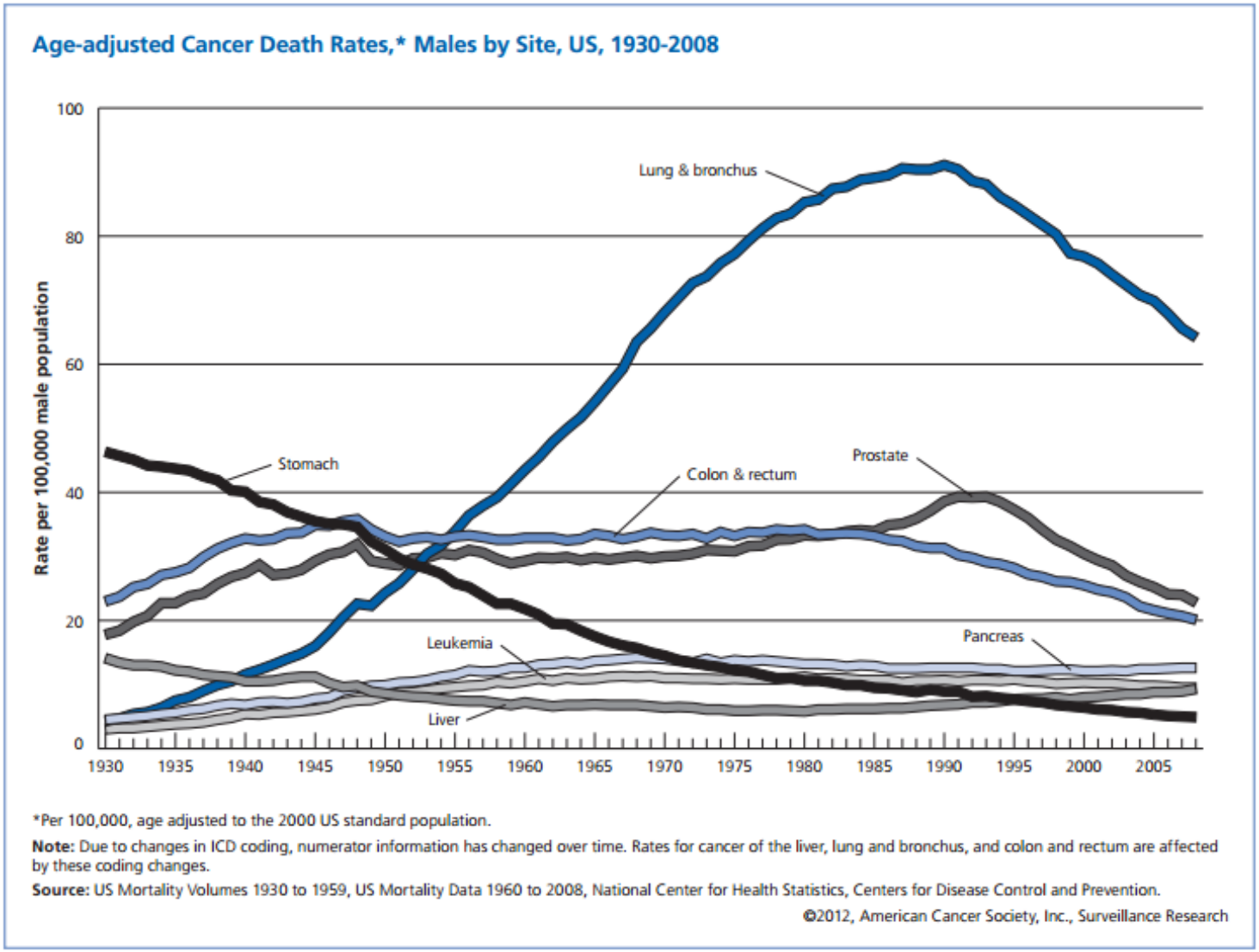
Cancer Rates – U.S. Males



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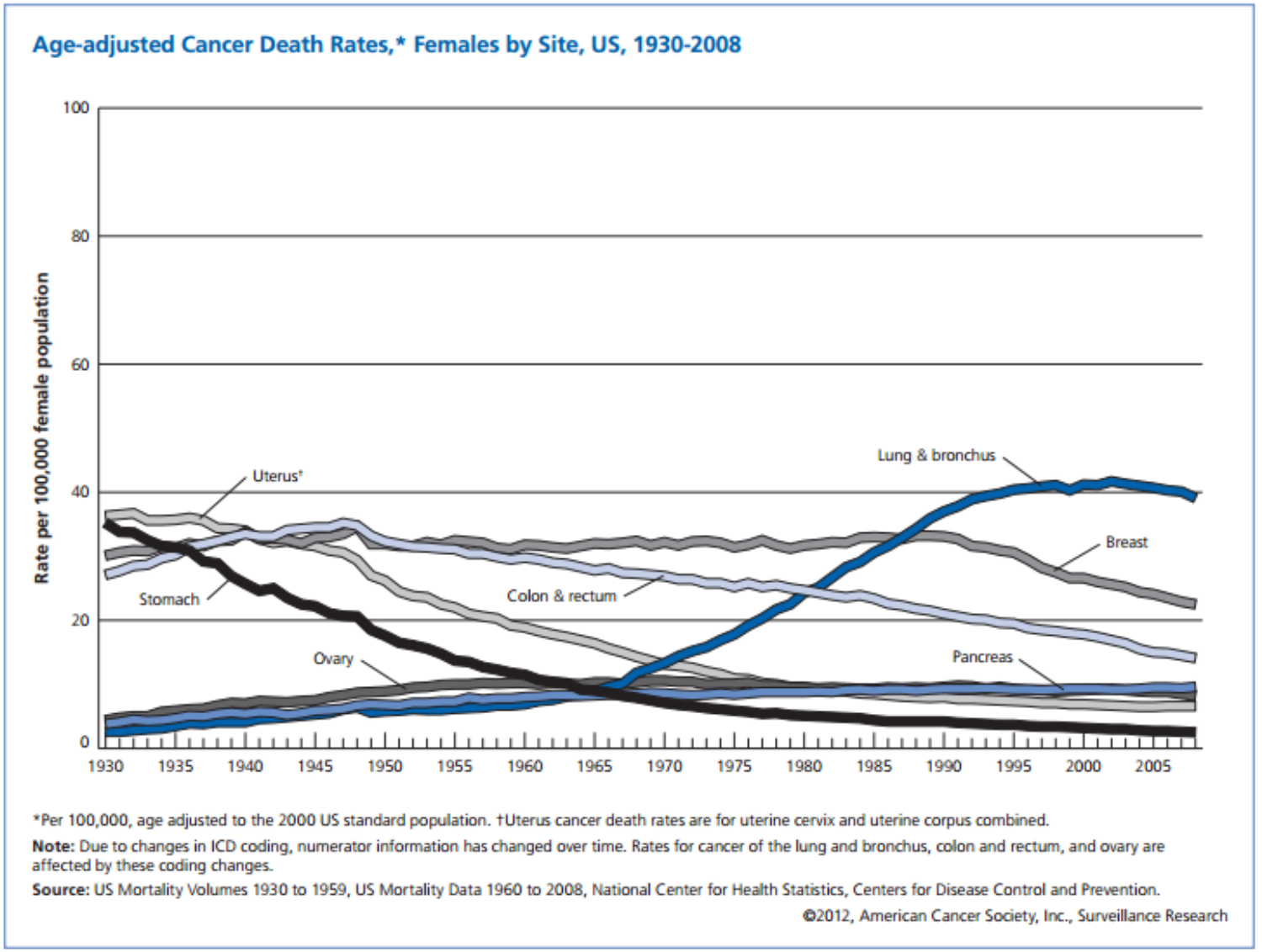
Cancer Rates - U.S. Females



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Cancer

- 8.2 million deaths worldwide in 2012
- Leading cause of death worldwide, lung cancer most common since 1985
- > 100 types, depending on tissue/cell of origin
- **At least 1/3 preventable via early diagnosis/treatment → focus on early detection before metastasis has occured**

Source: http://www.cancersupportcommunity.org/

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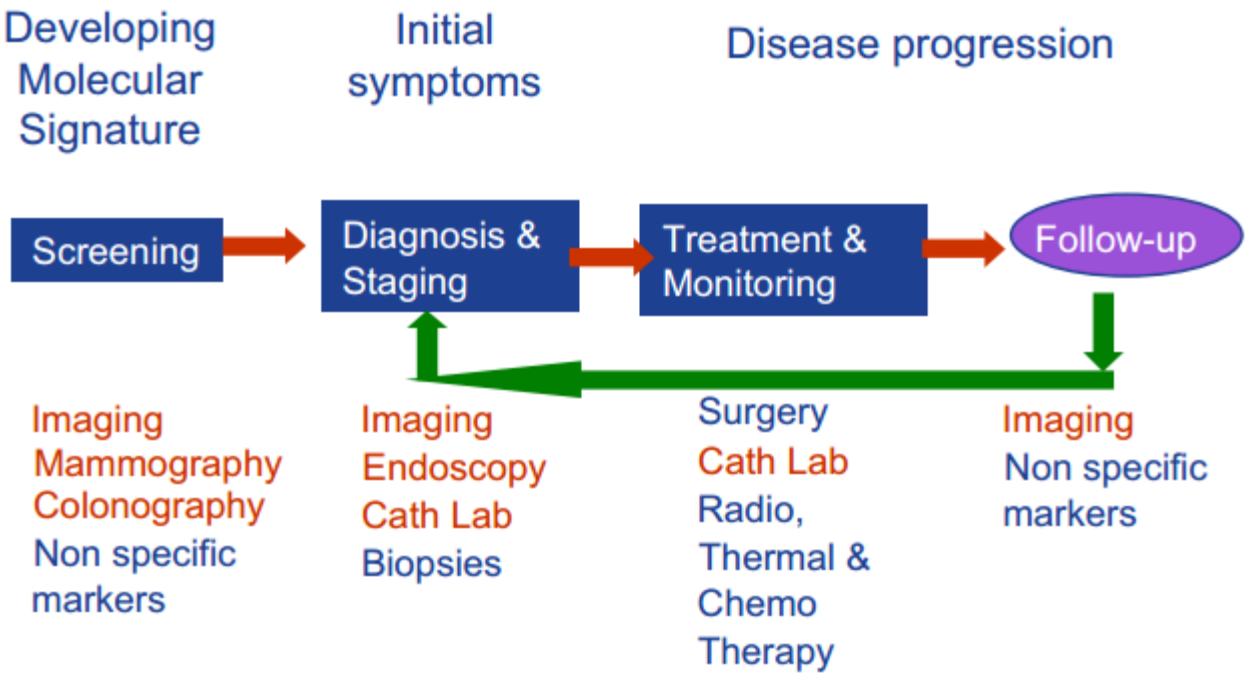
Clinical Cancer Assessment/Management



- Morphological
- Structural
- Metabolic
- Functional

Fass, L., *Imaging and cancer: a review.* Mol Oncol, 2008. **2**(2): p. 115-52.

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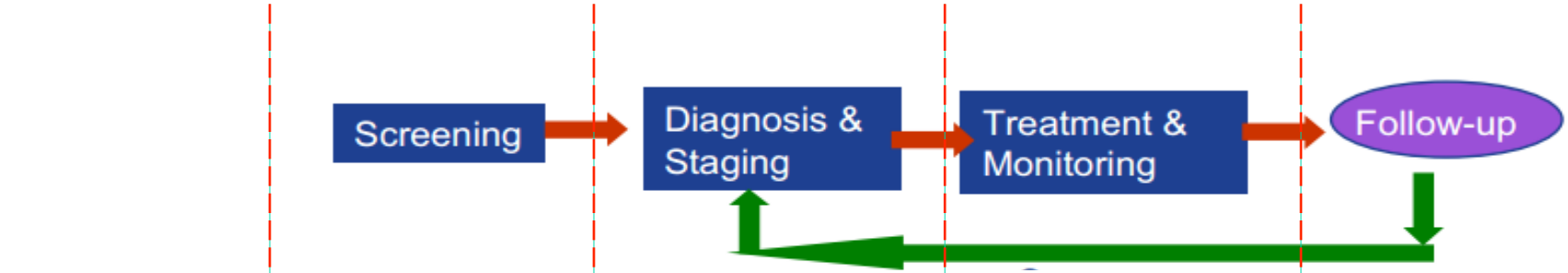
Cancer Detection & Management Strategies - Breast Cancer



	Screening	Diagnosis & Staging	Treatment & Monitoring
Non-Optical	• Palpation/CBE • Mamography • Ultrasound	Collection: • FNA • Lavage	Therapies: • Surgery • Radiation • Chemotheray
Optical	• Thermography • Tomography (both still in research stage)	Analysis: • Cytology • Histopathology • Spectroscopy	Assessments (Margin Detection): • Spectroscopy • Molecular probes

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Optical Cancer Detection

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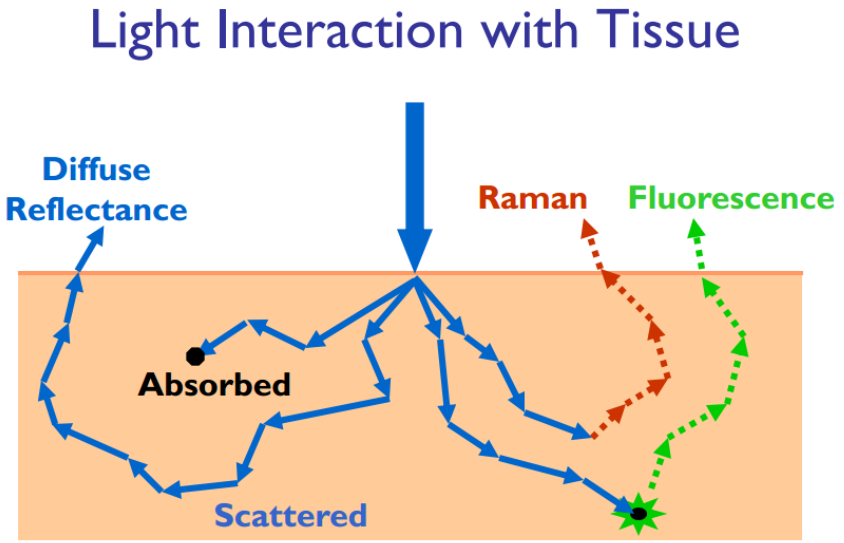
“Optical Biopsy”

Advantages:

- Non-invasive / Non-ionizing
- Less risk of spreading biopsied malignant cells
- Nearly unlimited sampling
- High diagnostic accuracies
- High resolution
- Instant results
- No samples to be lost or mishandled



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Clinical Techniques for Optical Cancer Detection *In Vivo*

- White Light Imaging/Endoscopy (WLE)
- Optical Coherence Tomography (OCT)
- Chromoendoscopy/CVC/Multispectral Imaging
  - Olympus Narrow Band Imaging (NBI)
  - Fujinon Intelligent Color Enhancement (FICE)
  - Pentax iScan
- Confocal Laser Endoscopy
  - tissue reflectance or fluorescence (IV dye)
- Fluorescence
- Elastic Scattering / Diffuse Reflectance
- Cherenkov Luminescence Imaging
- Lesion Morphology
- Polarization methods and/or extrinsic contrast agents can be used with some of the above methodologies to enhance detection

http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3280351/pdf/WJGE-4-22.pdf

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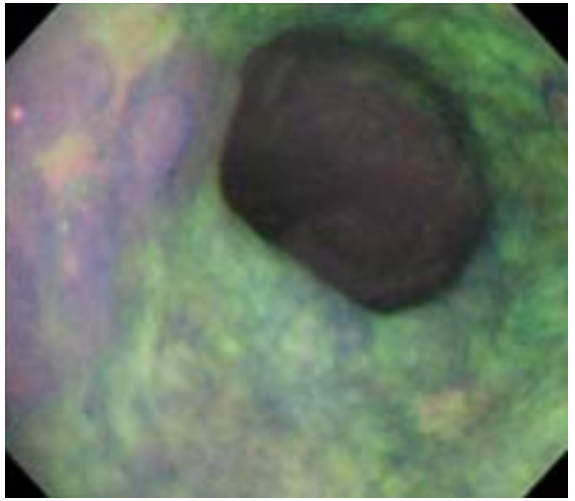
Standard Endoscopy: Once Revolutionary, But Now Not Good Enough

- Endoscopy
  - Has technical & clinical limitations
- New optical techniques provide new information related to:
  - Tissue differentiation (Identification)
  - Morphology/Orientation
  - Stability
  - Molecular markers
  - 3D volume of lesion
  - Blood Flow/Oxygen Saturation
  - Tissue Mechanics
  - Targeted probes can further increase contrast, specificity, and signal



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Clinical Techniques for Optical Cancer Detection *In Vivo*

- "Cancer Field Effect"

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Challenges & Limitations

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Challenges &Limitations

- Regulatory
- IP
- Funding
- Reimbursement
- Turf wars
- Cultural

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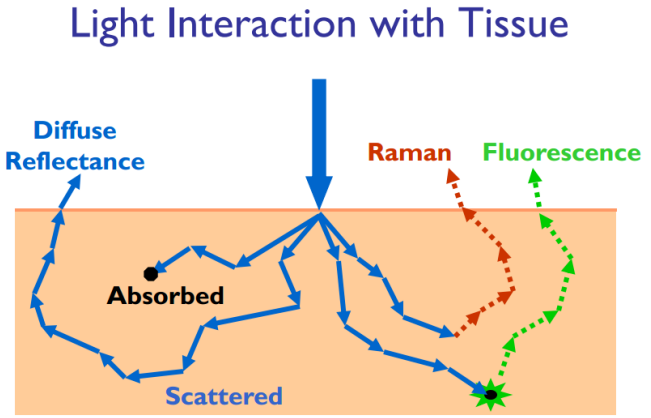
Challenges & Limitations -- Technical

- Limited tissue penetration
- Blood absorbs light
- Different skin types

Lead to:

- Inadequate specificity
- Poor margin discrimination



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Approved Devices

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Some FDA Approved OCD Devices

NinePoint Medical Nvision VLE for esophageal screening

VelScope intraoral cancer screening

MelaFind hyperspectral imager for skin lesions

SpectraScience Luma scanner for cervical dancer

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OPTIMUM™ TECHNOLOGIES

Looking Ahead

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PromisingTechnologies

Tissue structure
- OCT
- Photoacoustic Imaging
- SHG/THG

Functional
- Diffuse Optical Tomography/Spectroscopy

Cellular structure
- Endocytoscopy

Metabolic
- Raman Spectroscopy

Neovascularization
- Laser Speckle Imaging

Molecular
- NIR Fluourescence

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Technology Trends

- Smaller image sensors
- Smaller optical/scanning components
- Better detectors
- Greater signal processing power
- Molecular probes

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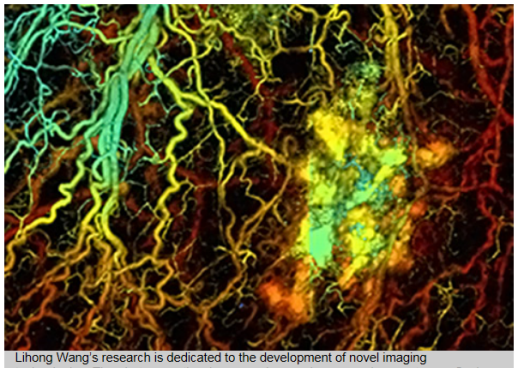
International Approval and FDA Pipeline

Imaging Diagnostic Systems, Inc (IDSI) Computed Tomography Laser Mammography

Caliber I.D. VivaScope 1500 for skin cancer screening

Guided Therapeutics LuViva cervical cancer screening



Lihong Wang's research is dedicated to the development of novel imaging technologies. The photoacoustic microscopy image shows a melanoma tumor. Such an imaging capability is expected to play an important role in both preclinical and clinical applications.

Photoacoustic microscopy (PAM), Washington Univ.

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OPTIMUM™ TECHNOLOGIES

end

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