Advancing Innovation and Convergence In Cancer Research

Jerry S.H. Lee, Ph.D.

Health Sciences Director

Deputy Director, Center for Strategic Scientific Initiatives (CSSI)
Deputy Director, Center for Cancer Genomics (CCG)
Office of the Director, National Cancer Institute (NCI)
National Institutes of Health (NIH)

NEMB2013

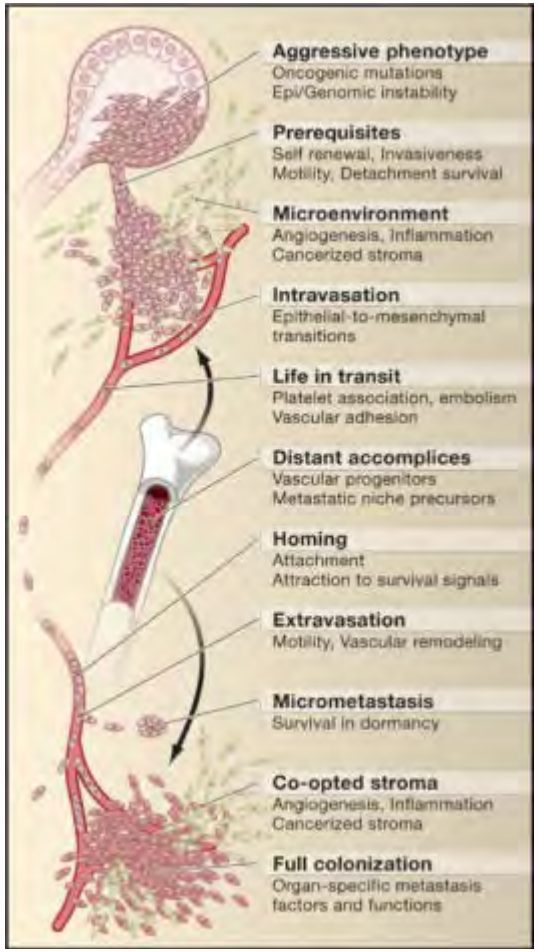
ASME 2nd Global Congress on Nanoengineering for Medicine and Biology:

Track 1- Bioengineering for Medical Diagnostics, Therapeutics and Imaging

February 4, 2013

NCI Alliance for Nanotechnology in Cancer | Office of Physical Sciences Oncology | Office of Cancer Clinical Proteomics Research | Office of Cancer Genomics | The Cancer Genome Atlas

What is It?
Tumor, Cancer, and Metastasis

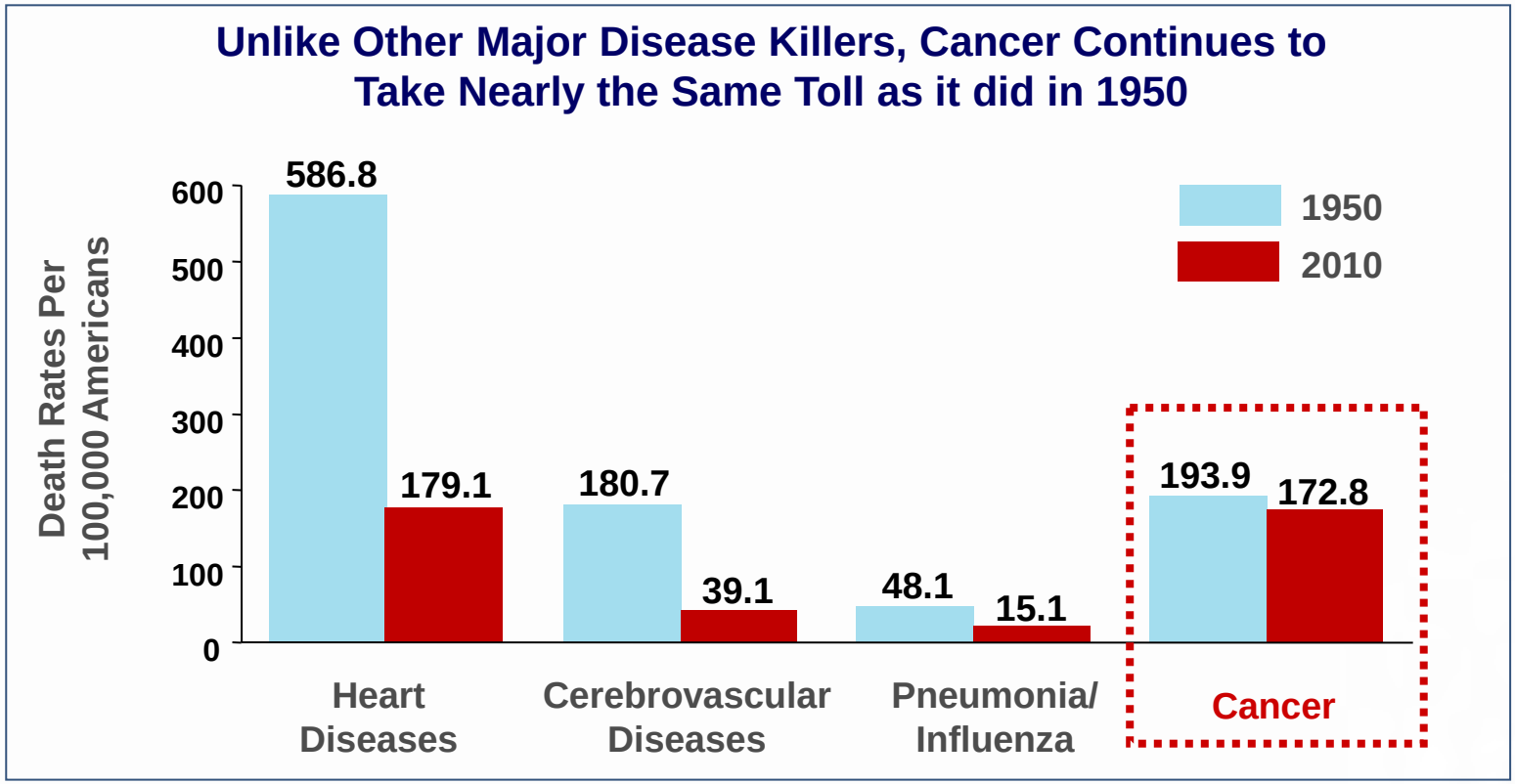


Site	All stages	Local	Regional	Distant
Breast (female)	86.6	97.0	78.7	23.3
Colon and rectum	62.3	90.1	65.5	9.2
Liver	6.9	16.3	6.0	1.9
Lung and bronchus	14.9	48.7	16.0	2.1
Melanoma	89.6	96.7	60.1	13.8
Ovary	53.0	94.7	72.0	30.7
Pancreas	4.4	16.6	6.8	1.6
Prostate	97.5	100.0	--	34.0
Testis	95.5	99.1	95.0	73.1

"…>90% of deaths is caused by disseminated disease or metastasis…"

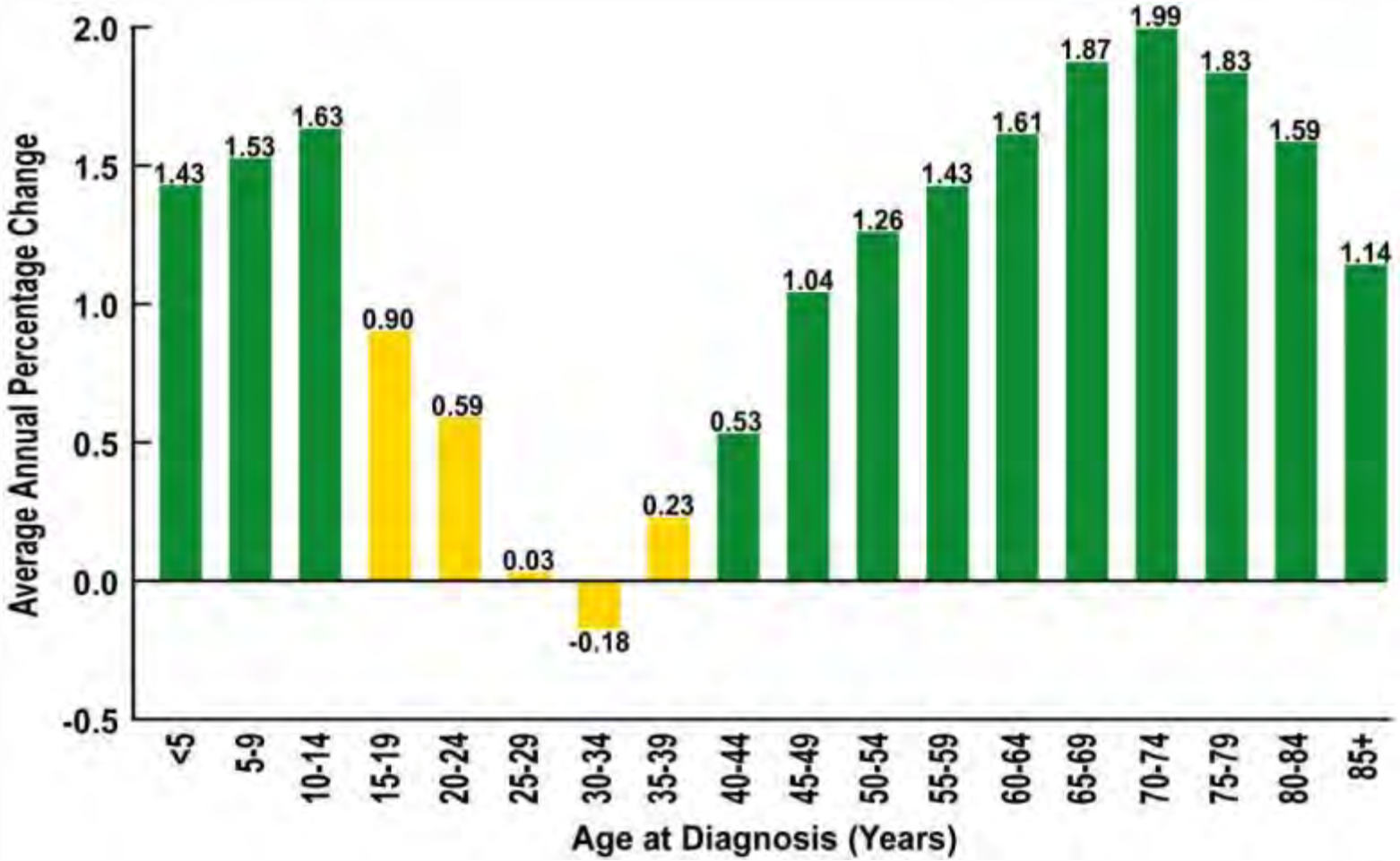
In the U.S., Cancer Continues to Represent an Enormous Burden

- **571,950** Americans died of cancer in 2011
- **1,638,910** Americans will be diagnosed with cancer this year
- **$124.6 billion** in 2010 for cancer healthcare costs

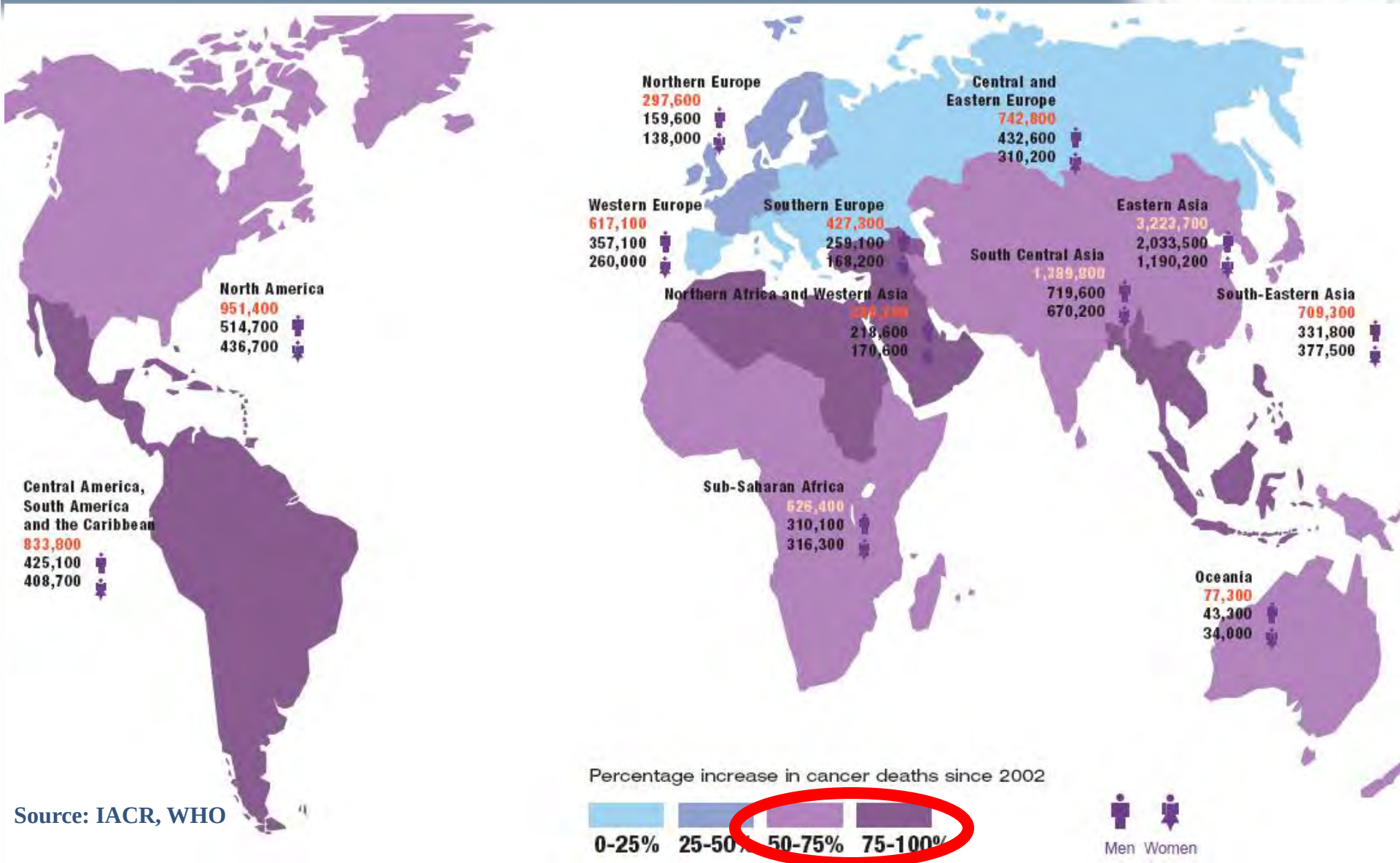


Source for 2011 deaths and diagnoses: American Cancer Society (ACS) 2011 Cancer Facts & Figures; Atlanta, Georgia
Source for 2010 age-adjusted death rate: National Center for Health Statistics, NCHS Public-use file for 2010 deaths.

Survival Improvement Gap: Improvement in 5-Year Relative Survival, Invasive Cancer, 1975 – 1997



Global Burden: By 2020, Cancer Mortality 10 M/yr (Incidence 16 M/yr)



Source: IACR, WHO

Unprecedented Amount of Scientific Knowledge: Omics(ssss)

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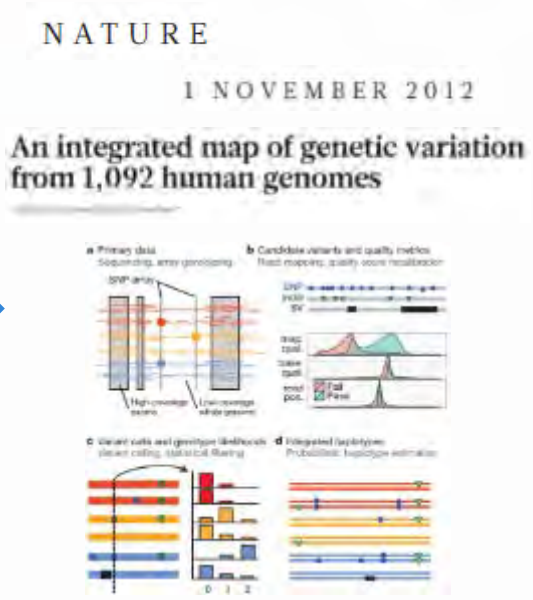
2001

2010



2012

A map of human genome variation from population-scale sequencing

1923 — 2005 — 2012

1923–2005	2005–2010	2010–2012
49,024 pubs	54,587 pubs	**87,793** pubs

38,506 pubs

ISI search for genomics, proteomics, transcriptomics, metabolomics, phenomics, interactomics, glycomics

Is More Knowledge Yielding More Solutions for Patients?

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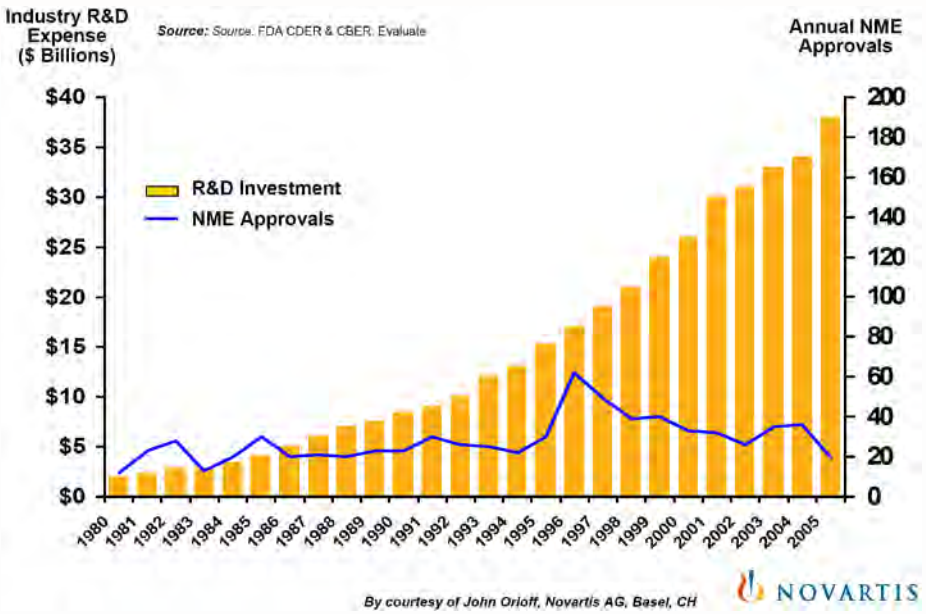
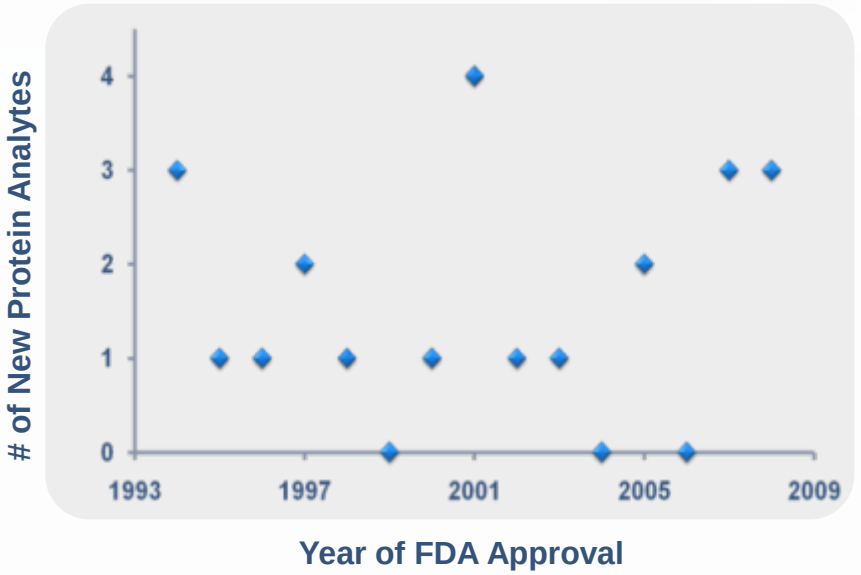
Drug Discovery and Development



- 10 – 15 years at ~ $1.8 billion*
- 2007: 19 NMEs [lowest since 1983]
- 2008: 21 NMEs [**29%** new-in-class]
- 2009: 24 NMEs [**17%** new-in-class]

Diagnostic Biomarkers

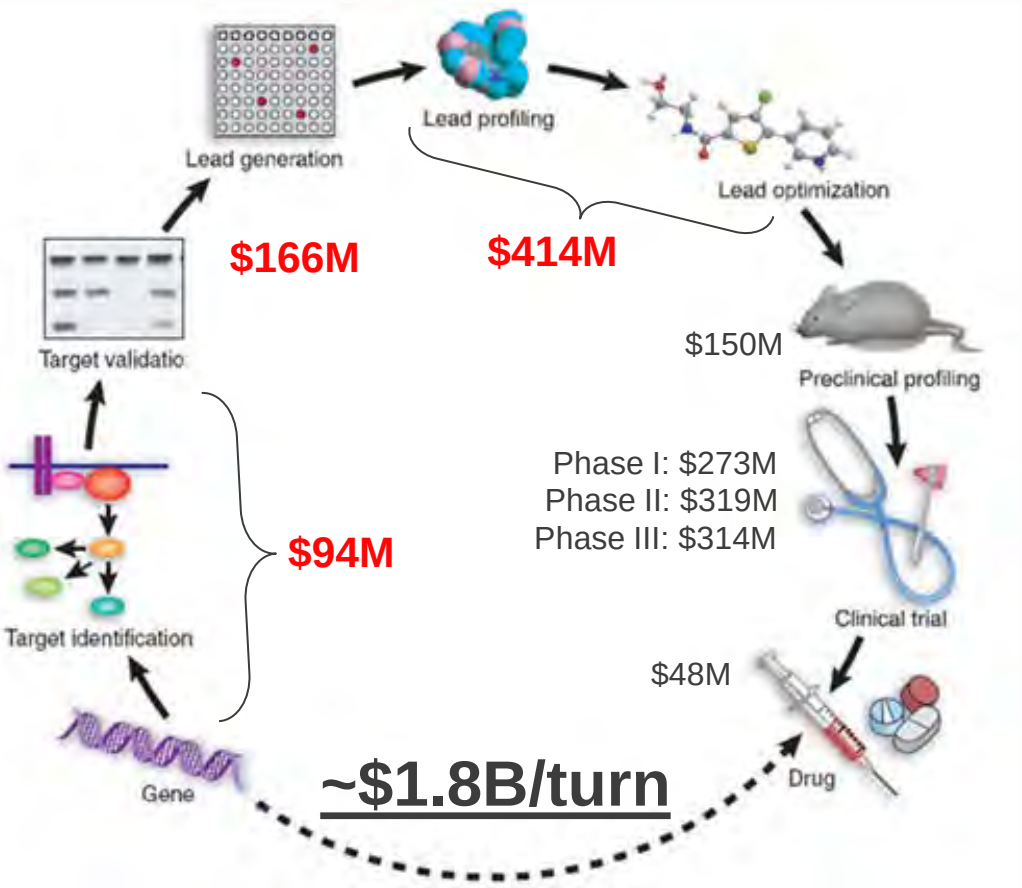


- Averaging 1.5 FDA approvals per year†
- 1000's of samples
- Balancing complexity of biology against heterogeneity of patients

Maybe…but can it be more efficient?

*Paul et. al, *Nature Rev. Drug Discovery,* March 2010; † Leigh Anderson, *Clin Chem*, 2010

Translation Pace: How To Break Out of Current Paradigm?



Turning the Crank…

Key Needs (from community '02)

- Standards and protocols
- Real-time, public release of data
- Large, multi-disciplinary teams
- Pilot-friendly team environment to share failures and successes
- Team members with **trans-disciplinary training**

The potential to transform cancer drug discovery and diagnostics

Paul et. al, *Nature Rev. Drug Discovery,* March 2010

National Institutes of Health (NIH): 27 Institutes and Centers

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NHGRI NIA NIDA

NINDS NIDCD NIMH

NEI NIAAA CIT

NINR NLM NIDDK

FIC CSR NIBIB

NIMHD NIDCR NIEHS

NIGMS NICHD CC

NIAMS NCCAM NIAID NCI NHLBI NCATS

NIH Budget ~ $30.63 Billion (FY11)

- ***~82% for extramural support***
- ***~64,000 grants and contracts***

NCI Budget ~ $ 5.06 Billion (FY11)

- ***~ 76% for extramural support***
- ***~8,000 grants and contracts***

National Cancer Program: Stakeholders

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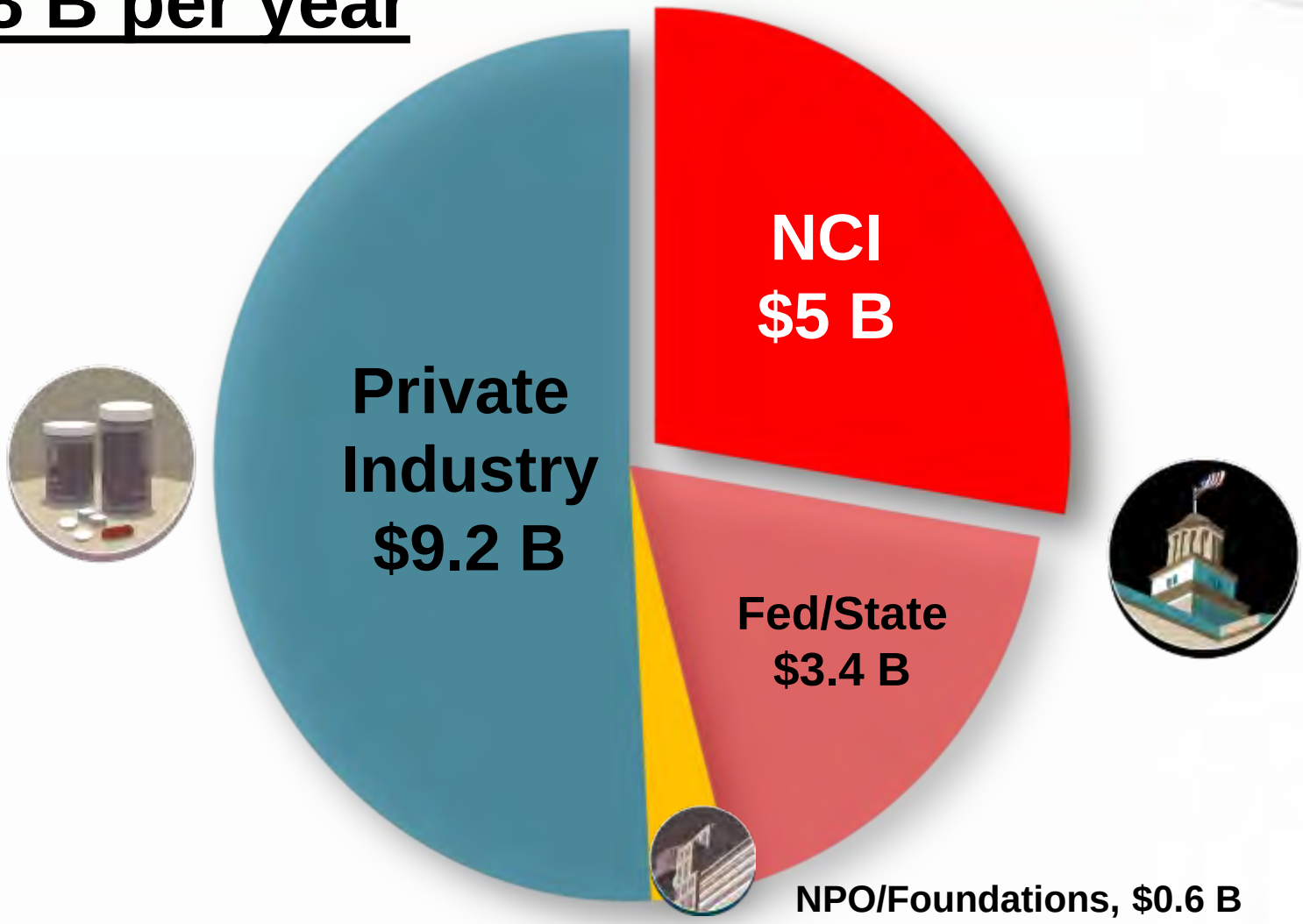
~$18 B per year



NCAB Working Group Report, 2010

National Cancer Institute Organization

Director
Harold Varmus, MD

National Cancer Institute

$5.07B

(FY12)

Deputy Director
Douglas Lowy, MD

Office of the Director

CSSI **CCG**

~$190 M (~4%)

Center for Cancer Research

Division of Cancer Epidemiology and Genetics

Division of Cancer Treatment and Diagnosis

Division of Cancer Biology

Division of Cancer Control and Population Sciences

Division of Cancer Prevention

Division of Extramural Activities

Conducting – Intramural

Funding – Extramural

NCI Center for Strategic Scientific Initiatives (CSSI): Concept Shop

Director
Douglas Lowy, MD

CENTER for STRATEGIC SCIENTIFIC INITIATIVES

Deputy Director
Jerry S.H. Lee, PhD

~$190M (FY12)

Office of Cancer Clinical Proteomics Research

Director
Henry Rodriguez, PhD, MBA

Office of Physical Sciences-Oncology

Director
Larry A. Nagahara, PhD

Office of Cancer Nanotechnology Research

Director
Piotr Grodzinski, PhD

Office of Cancer Genomics

Director
Daniela S. Gerhard, PhD

The Cancer Genome Atlas Program Office

Director
Kenna M.Shaw, PhD

*Center for Cancer Genomics (CCG) shown in yellow

NCI Center for Strategic Scientific Initiatives (CSSI): Concept Shop

Director
Douglas Lowy, MD

CENTER for STRATEGIC SCIENTIFIC INITIATIVES

~$190M (FY12)

Deputy Director
Jerry S.H. Lee, PhD

Mission

"…to create and uniquely implement exploratory programs focused on the development and integration of advanced technologies, **trans-disciplinary approaches, infrastructures, and standards**, to accelerate the **creation and broad deployment** of **data, knowledge, and tools** to empower the **entire cancer research continuum** in better understanding and leveraging knowledge of the cancer biology space **for patient benefit**…"

IMAT — **2003, 2007, 2011**

CLINICAL PROTEOMIC TECHNOLOGIES FOR CANCER — **2005, 2010**

PHYSICAL SCIENCES in ONCOLOGY — **2008**

Provocative Questions Project — **2011**

NCI Alliance for Nanotechnology in Cancer — **2004, 2008**

THE CANCER GENOME ATLAS — **2005, 2008**

Cancer Target Discovery & Development (CTD²) — **2010**

2003 Launch of the Technology Gauge of CSSI: IMAT

Center for Strategic Scientific Initiatives

INNOVATIVE MOLECULAR ANALYSIS TECHNOLOGIES

*To support the **development**, **maturation**, and dissemination of **innovative and/or potentially transformative** next-generation technologies*

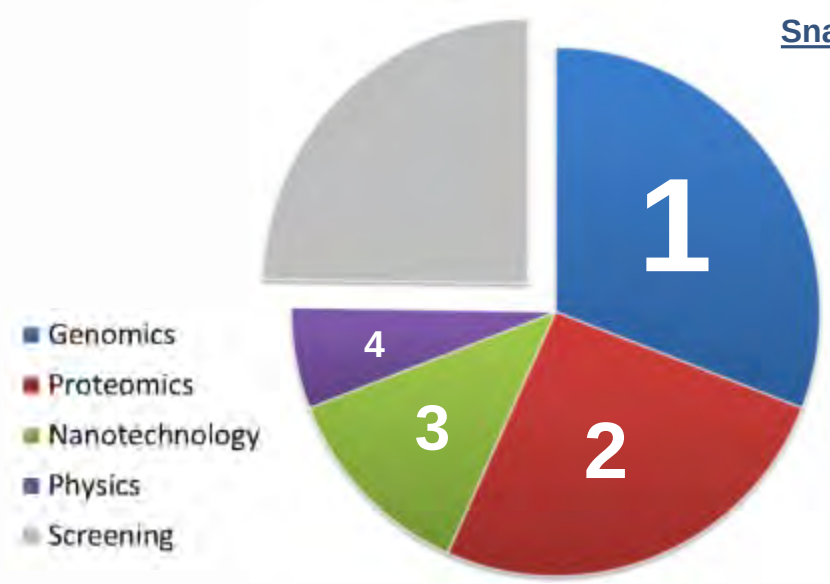
Innovative Technologies for Molecular Analysis of Cancer

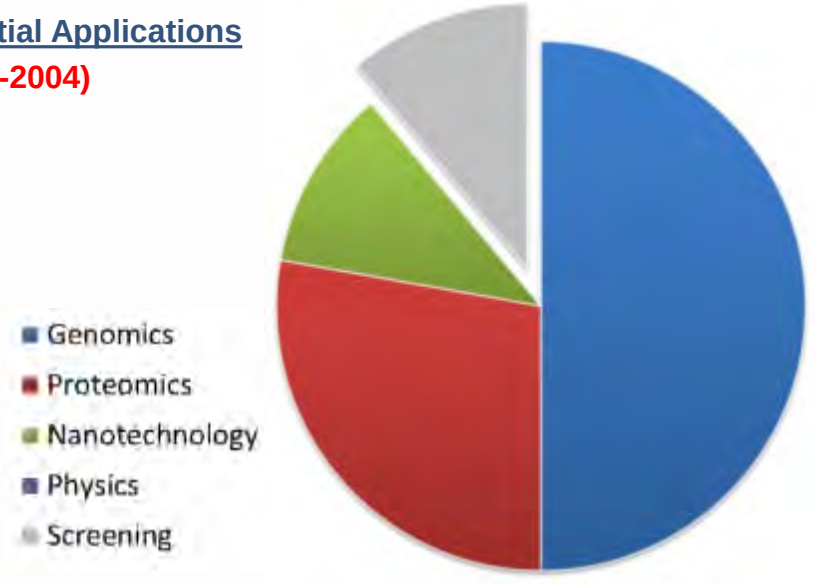
- Proof-of-concept technologies/projects encouraged
- Milestone and technology development driven (no biology)

Application of Emerging Technologies for Cancer Research

- Validation and dissemination of platforms
- Demonstration of impact on basic and clinical research

Snapshot of Initial Applications
(2003-2004)





First Step(back)- Cancer Genomics: Taking a Page from Engineers

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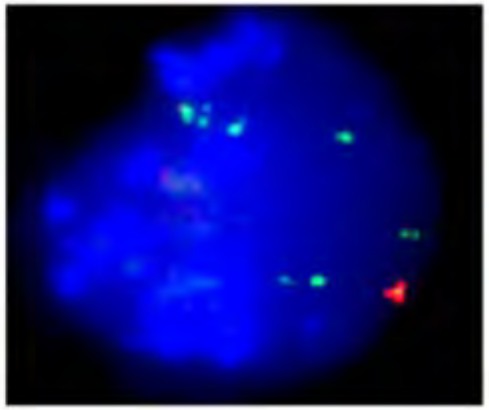
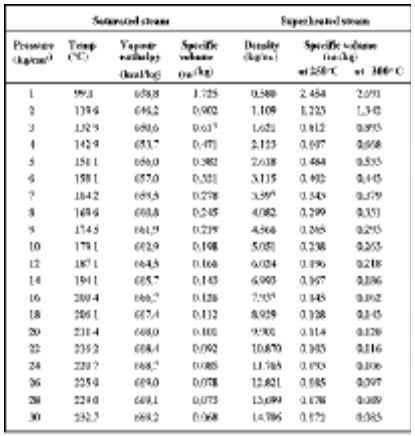
Disease of Genomic Alterations

- Copy number
- Expression (regulation of)
- Regulation of translation
- Mutations
- Epigenome



- **Systematic identification of all genomic changes**
- **Repeat (a lot) for individual cancer**
- **Repeat for many cancers**
- **Make it publically available**



Steam table (Reference)

TCGA: Connecting Multiple Standardized Sources, Experiments, and Data Types

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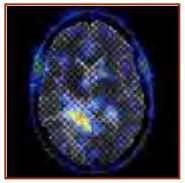
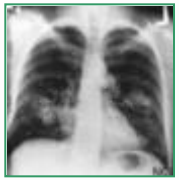
The Cancer Genome Atlas

Three Cancers- Pilot

glioblastoma multiforme (brain)



squamous carcinoma (lung)



serous cystadenocarcinoma (ovarian)

Biospecimen Core Resource with more than 13 Tissue Source Sites

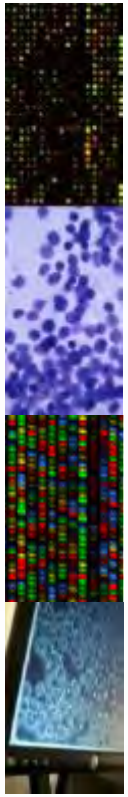
7 Cancer Genomic Characterization Centers

3 Genome Sequencing Centers

Data Coordinating Center

Multiple data types

- Clinical diagnosis
- Treatment history
- Histologic diagnosis
- Pathologic status
- Tissue anatomic site
- Surgical history
- Gene expression
- Chromosomal copy number
- Loss of heterozygosity
- Methylation patterns
- miRNA expression
- DNA sequence



1st Reference Released in 2008: Subsequent Use by Community

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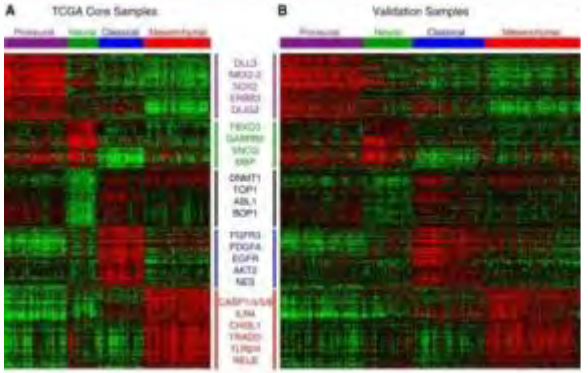
Mid- 2008

- Reference cancer genome for GBM
- Single author paper (TCGA Network)
  - 300+ authors
- Unanticipated Scientific Discoveries
  - Hypothesis on a possible resistance mechanism to temozolomide (TMZ)

Comprehensive genomic characterization defines human glioblastoma genes and core pathways

The Cancer Genome Atlas Research Network*

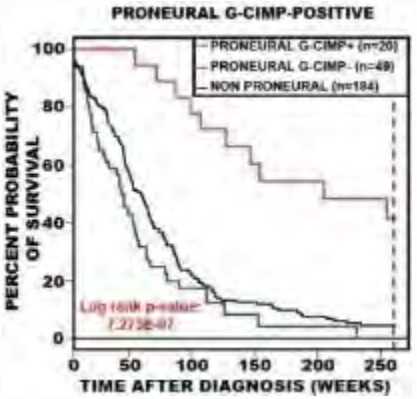


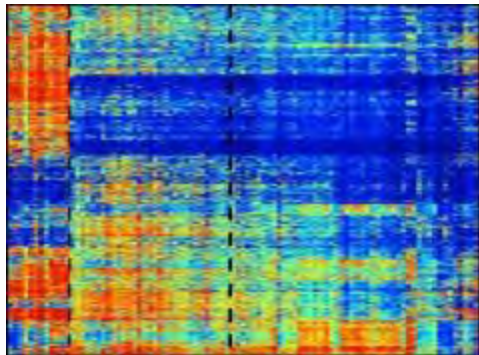
2009

- Gene expression-based classification of GBM
- Response to aggressive therapy differs by subtype- **exclude non-responders**

2010

- Identification of new subset of GBM
- Occurs in younger patients
- Evidence of **better prediction of outcomes**



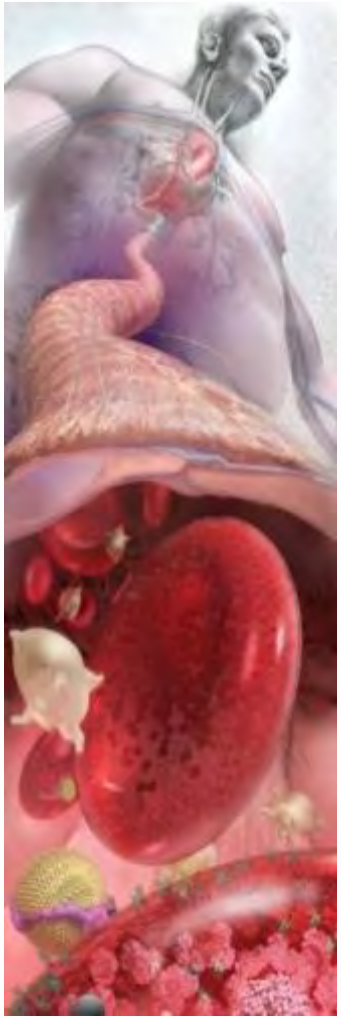


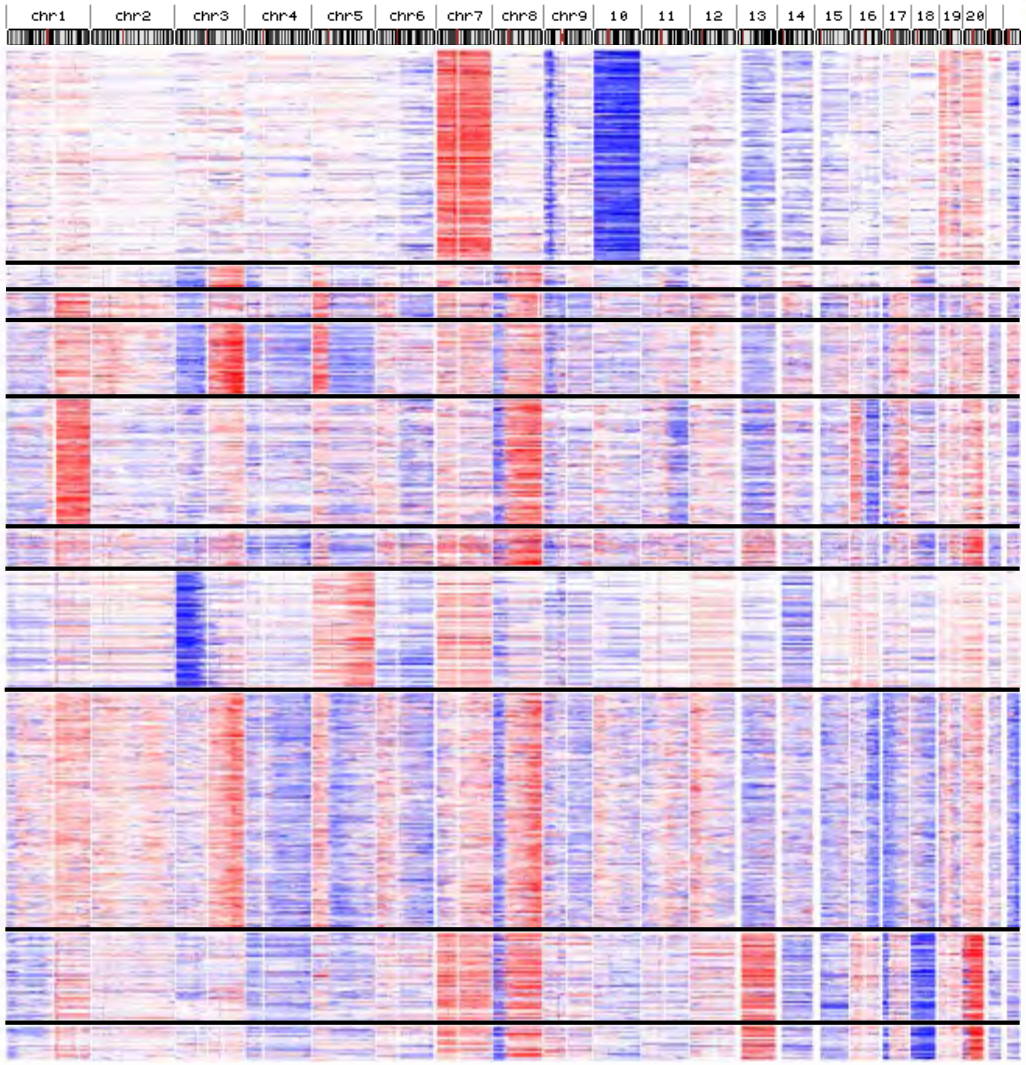
Genomic "Steam Table"

The Cancer Genome Atlas Data Portal — Understanding genomics to improve cancer care

Center for Strategic Scientific Initiatives

Summer 2011





Glioblastoma:	470
Head & neck:	51
Lung adeno:	57
Lung squamous:	159
Breast carcinoma:	180
Stomach adeno:	84
Kidney clear carc:	260
Ovarian serous:	520
Colon adeno:	198
Rectum carcinoma:	74
Total:	**2053**

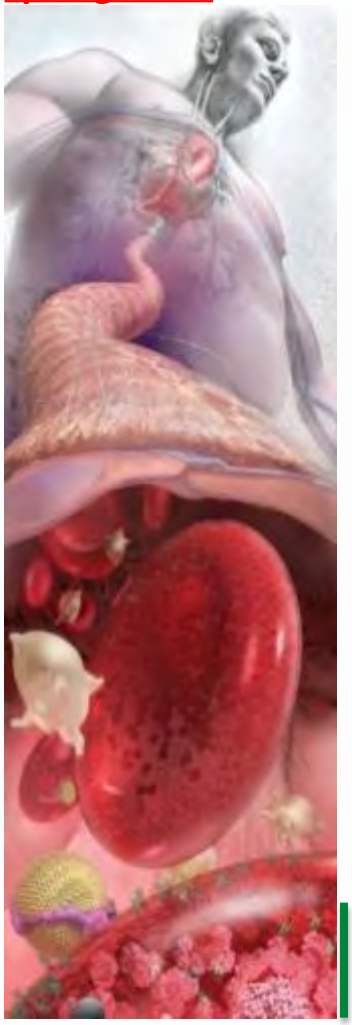
Source: UCSC Cancer Genomic Heatmaps (CopyNumber SNP6)
[https://genome-cancer.ucsc.edu/] Compiled by Jerry S.H. Lee, PhD, May 2011

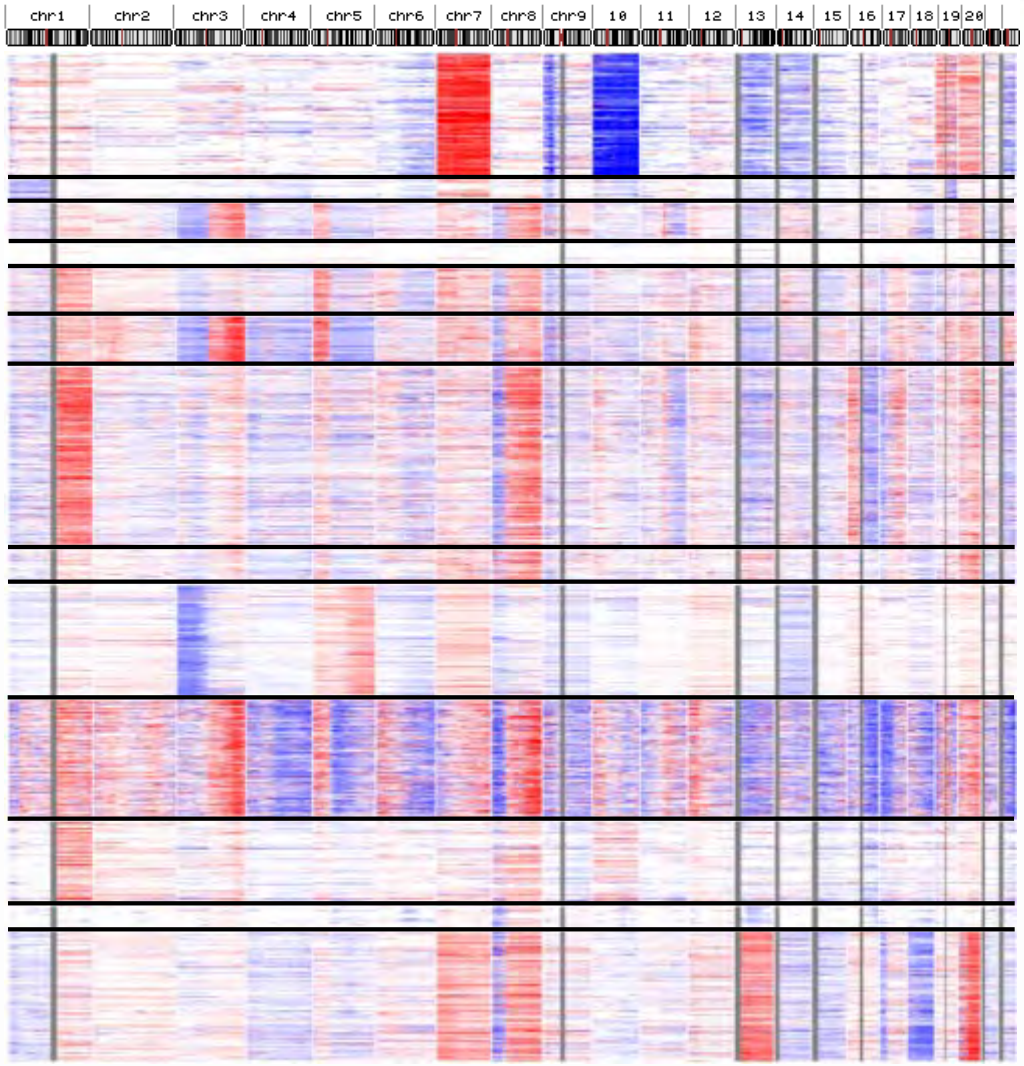
Genomic "Steam Table"

The Cancer Genome Atlas Data Portal — Understanding genomics to improve cancer care

Center for Strategic Scientific Initiatives

Spring 2012

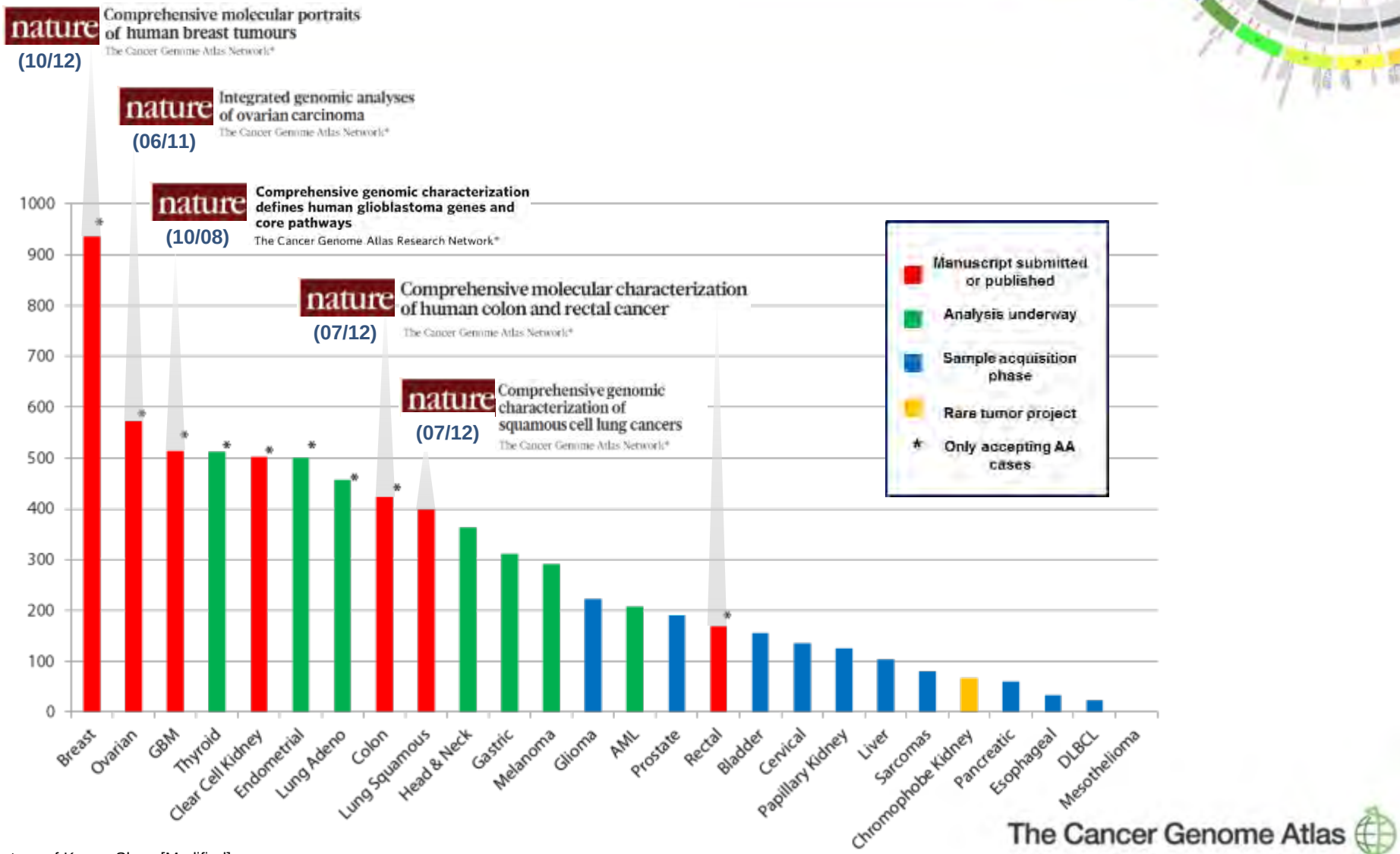




Glioblastoma:	535
Brain lower grade glioma:	80
Head & neck:	165
Thyroid carcinoma:	85
Lung adeno:	205
Lung squamous:	211
Breast carcinoma:	783
Stomach adeno:	149
Kidney clear carc:	489
Ovarian serous:	520
Uterine corpus end. car.:	363
Prostate adenocarcinoma:	82
Colon/rectum adeno:	564
Total:	**4231**

Source: UCSC Cancer Genomic Heatmaps (CopyNumber GISTIC2)
[https://genome-cancer.ucsc.edu/] Compiled by Jerry S.H. Lee, PhD, Feb 2012

Full Speed Ahead! (11/2012)
25 TCGA Tumor Projects Progress



Courtesy of Kenna Shaw [Modified]

What about Biomarkers? Step 1.5- Cancer Proteomics

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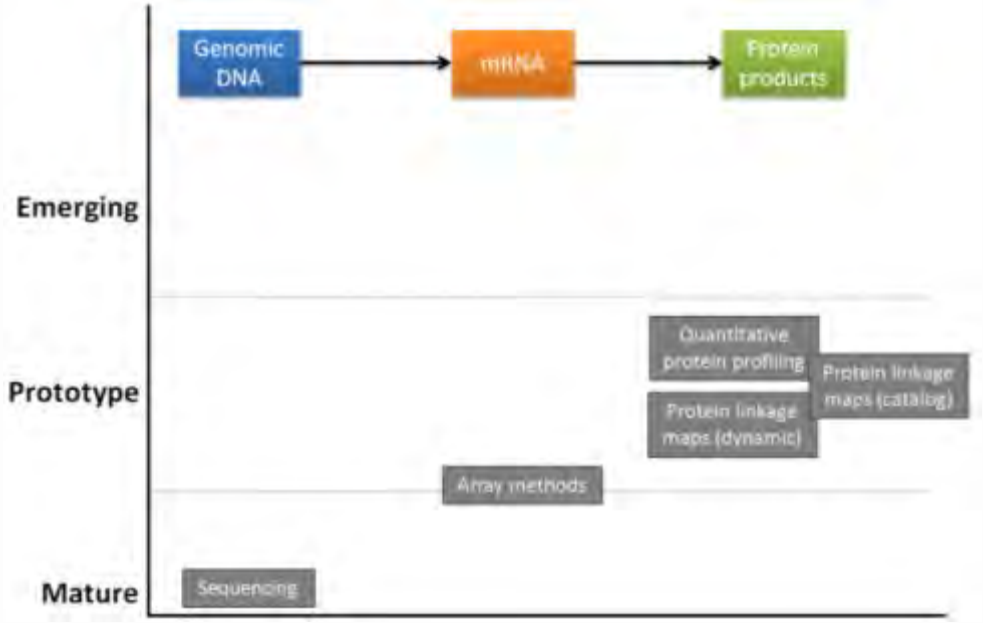
THE NATIONAL ACADEMIES
Advisers to the Nation on Science, Engineering, and Medicine

Technologies for Quantitative Analysis



Major Challenges

- Analytical variability in platforms
- Lack of standards, protocols, and reference data
- No consensus on data acquisition, analysis, and open access reporting of raw data

Unlike genomic technologies, proteomic technologies were not yet fully mature

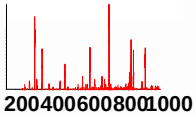
Source: Adopted from "Defining the Mandate of Proteomics in the Post-Genomics Era: Workshop Report." *National Academy of Sciences.* 2002.

Clinical Proteomic Technologies for Cancer (CPTAC) Pilot Highlights

Center for Strategic Scientific Initiatives

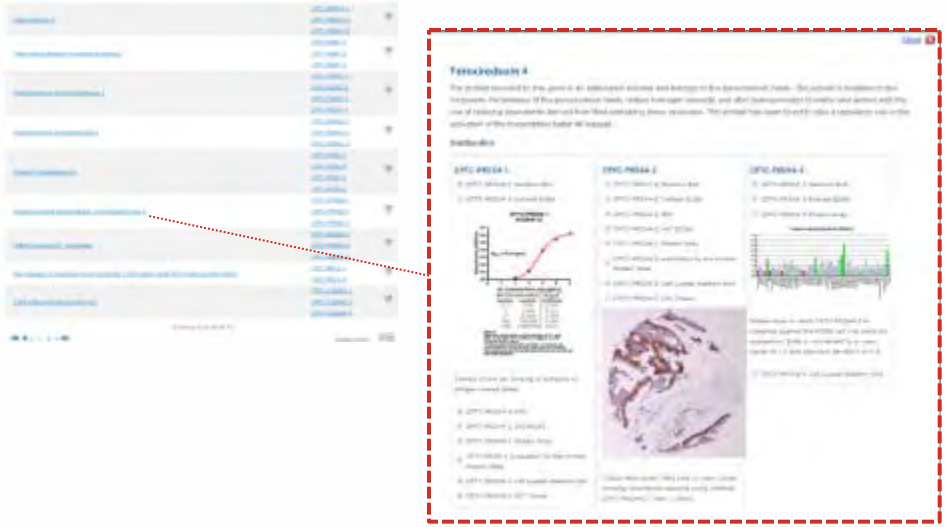
nature biotechnology

Multi-site assessment of the precision and reproducibility of multiple reaction monitoring–based measurements of proteins in plasma



- **First demonstration** that MRM is highly reproducible **across multiple laboratories** and technology platforms

- **Established Antibody Characterization Laboratory**



  - Provides high quality reagents at minimum cost to community
  - All characterization data posted on public database
  - Industry partners and collaborations
  - **224** highly characterized **monoclonal** antibodies corresponding to **80 cancer-associated antigens**

Clinical Proteomic Tumor Analysis Centers (CPTAC Phase II)

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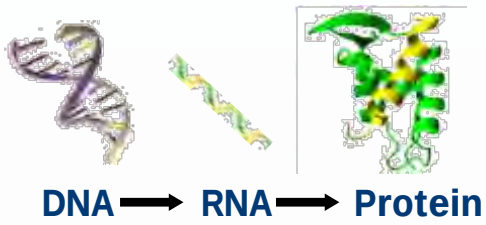
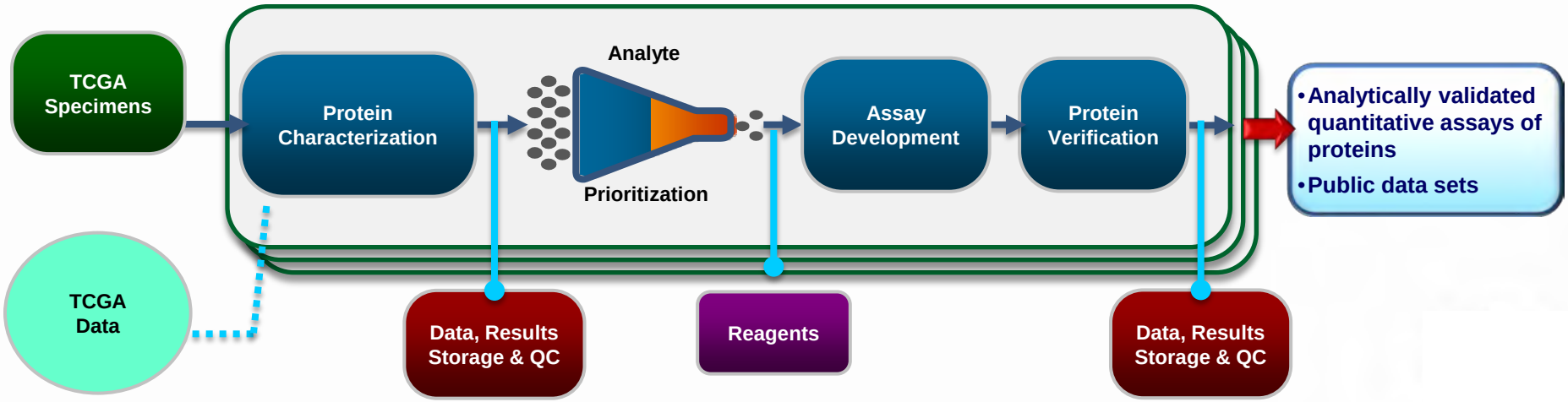
Phase II Launched Sept 2011

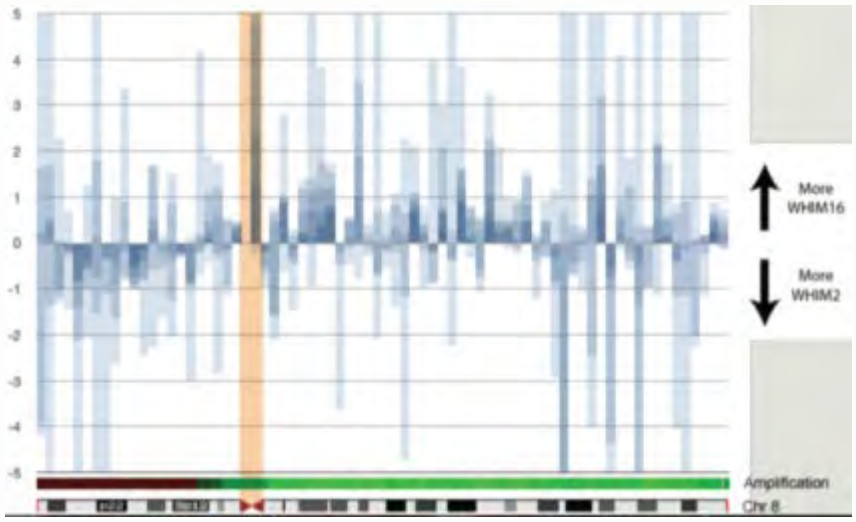


- Analyze matched TCGA samples using two approaches
  - Targeting genome to proteome
  - Mapping proteome to genome
- Develop **validated and quantitative** assays and reagents
  - Lessons from Phase I (mock 510K submission)
  - Antibody Characterization Lab
- Distribute raw and analyzed data via public data portal



CPTAC Phase II: Highlights, Progress to Date, and Data Release

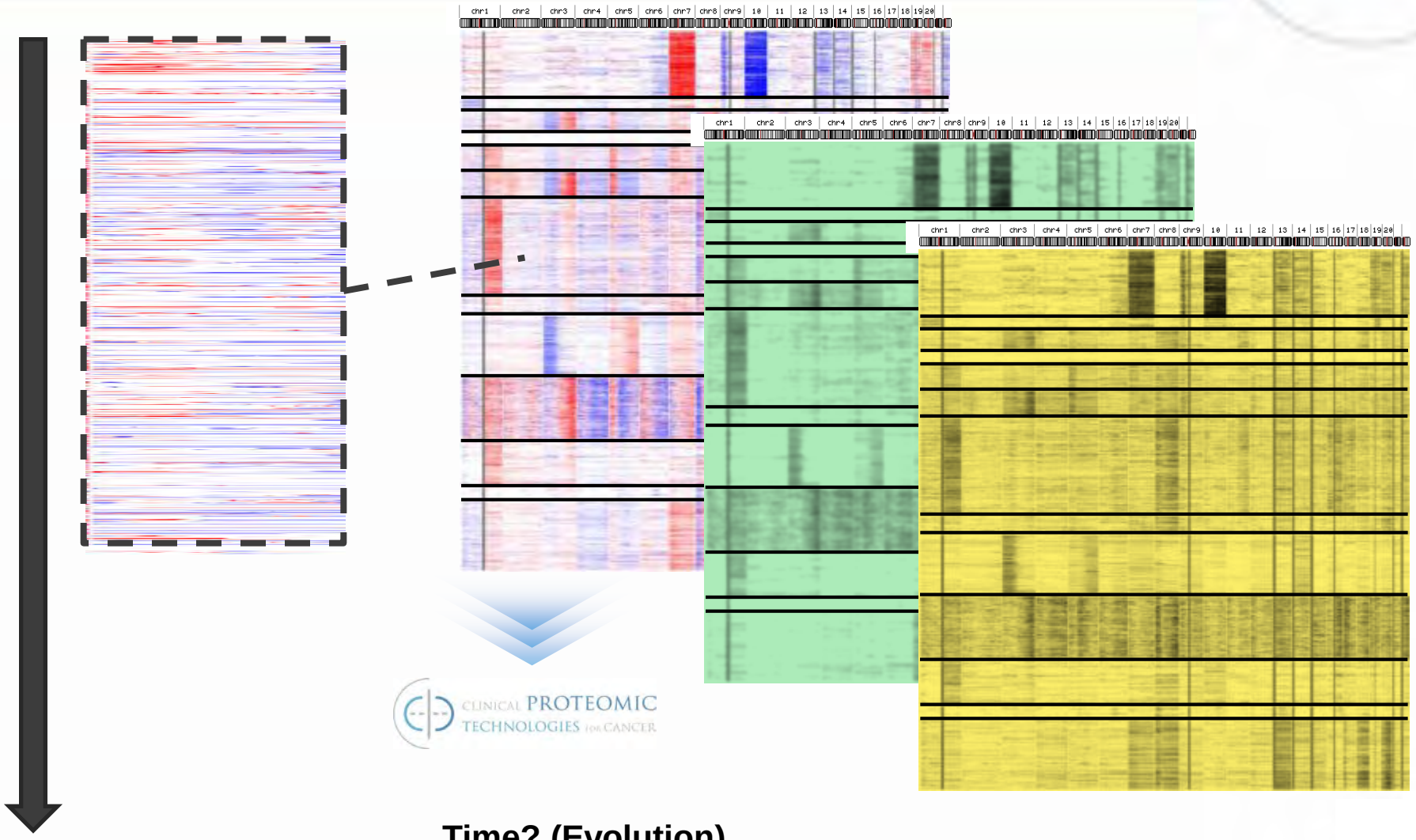
Status Update: Fall 2012



Chr 8

- **Due diligence studies** near completion
  - Cross network experiments show comparable lab-to-lab measurements
- **Orthogonal** proteomic platforms and analysis (proteome → genome vs. genome → proteome) reveal **additional unexpected complexities**
- Verifying new insights will require **additional sample sets** and **development of novel analysis** algorithms and techniques
- Public data portal access **OPEN!**
  (Phase I: 351 GB, Phase II: 616 GB)

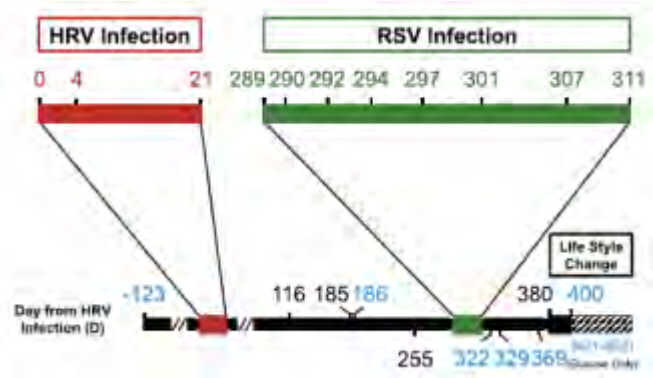
Where Do We Go From Here?
Is it JUST More Data?



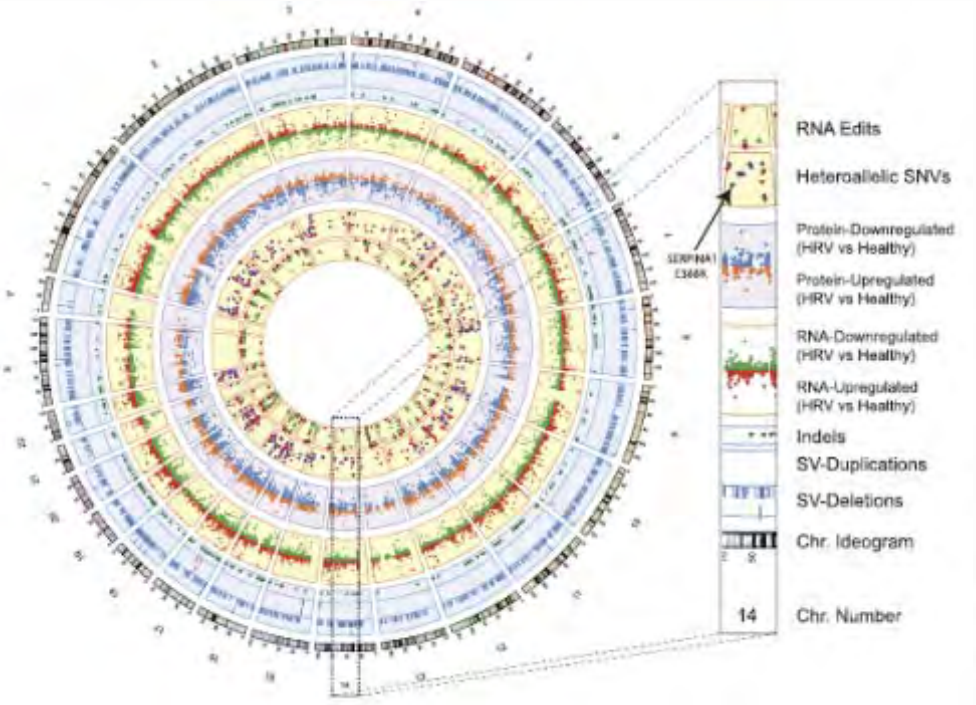
Case Study: integrative Personal Omics Profile (iPOP)

Center for Strategic Scientific Initiatives

Cell **Personal Omics Profiling Reveals Dynamic Molecular and Medical Phenotypes**



- **Collected blood components of single patient over 400 days**
  - PBMC, plasma, sera
  - Human rhinovirus (HRV) @ Day 0
  - Respiratory syncytial virus (RSV) @ Day 289



- **Characterization included:**
  - Whole genome sequencing
  - Whole transcriptome sequencing
  - Proteome profiling
  - Cytokine profiling
  - Metabolome profiling
  - Autoantibody profiling
  - Medical/lab tests

Chen et. al., *Cell,* March 2012

iPOP: Adding Time scale and Perturbations Yield New Insights

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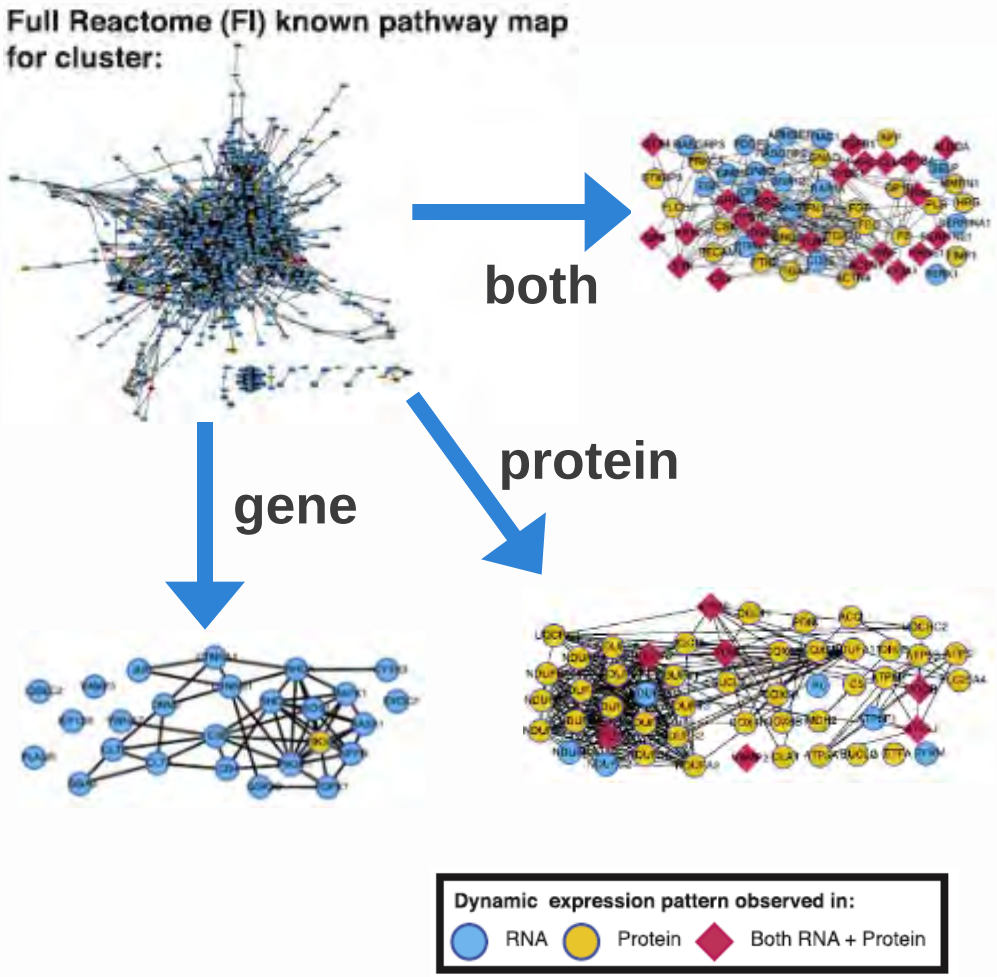
what we "know"



- **Examined temporal response to RSV infection**
  - o **~13,000** genes
  - o **~20,000** transcript isoforms
- **New patterns emerged**
  - o **Gene analysis only**
    - ~1:1 ratio of genes to RNA
    - **~70** proteins
  - o **Protein analysis only**
    - ~1:1 ratio of genes to RNA
    - **~500** proteins
    - **~20** metabolites
  - o **Integrative analysis**
    - ~1:1 ratio of genes to RNA
    - **~770 proteins**
    - **~83 metabolites**

Chen et. al., *Cell,* March 2012

Bringing Nanotechnology to Cancer Research & Oncology: ANC Network

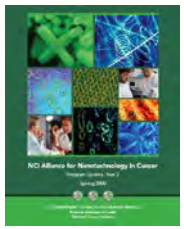
CENTER for STRATEGIC SCIENTIFIC INITIATIVES

Cancer Nanotechnology Plan Published

NCL Launches

NCI **Alliance** for **Nanotechnology** in Cancer

Phase I (Pilot) Awarded



Evaluation and Update

- Scientific Output
  - Over 600 pubs
- Clinical Translation
  - 50 companies
  - Over 200 patent apps
  - **8-10 clinical trials**

NCI **Alliance** for **Nanotechnology** in Cancer

Program Renewed

NCI **Alliance** for **Nanotechnology** in Cancer

Phase II (Clinical) Kick-Off

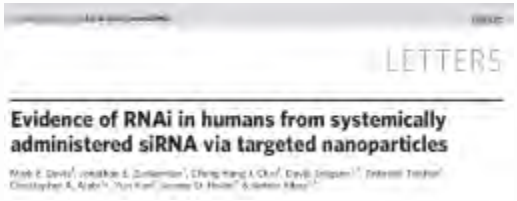
Update 2012

- **Diagnostics**
  - ✓ 6 ongoing trials
- **Therapy**
  - ✓ 5 ongoing trials
- **Imaging**
  - ✓ 5 ongoing trials

2004 2005 2006 2007 2008 2009 2010 2011 2012

Nano Imaging

Nano Diagnostics



Nano Therapy

Basic **Translational** **Pre-Clinical** **Clinical**

What's Next: Single Cell Acquisition/Analysis?

CENTER for STRATEGIC SCIENTIFIC INITIATIVES

TECHNOLOGY FEATURE

THE DEEPEST DIFFERENCES

To understand biological heterogeneity, researchers are learning how to profile the molecular contents of individual cells.

1 DECEMBER 2011 | VOL 480 | NATURE |

The NIH gets singular

The challenges of single-cell analysis have caught the attention of the US National Institutes of Health (NIH). The agency has launched a programme to fund advances in single-cell research, with a budget of around US$90 million over five years from the NIH Common Fund, which backs science that crosses disciplines.

Total FY12 Investment: $14.7M

U01 Projects [3 awardees, $5.5M (FY12)]

- Role of Single Cell mRNA Variation in Systems Associated Electrically Excitable Cells
- Evaluation of Cellular Heterogeneity Using Patchclamp and RNA-Seq of Single Cells
- Single-cell sequencing and in situ mapping of RNA transcripts in human brains

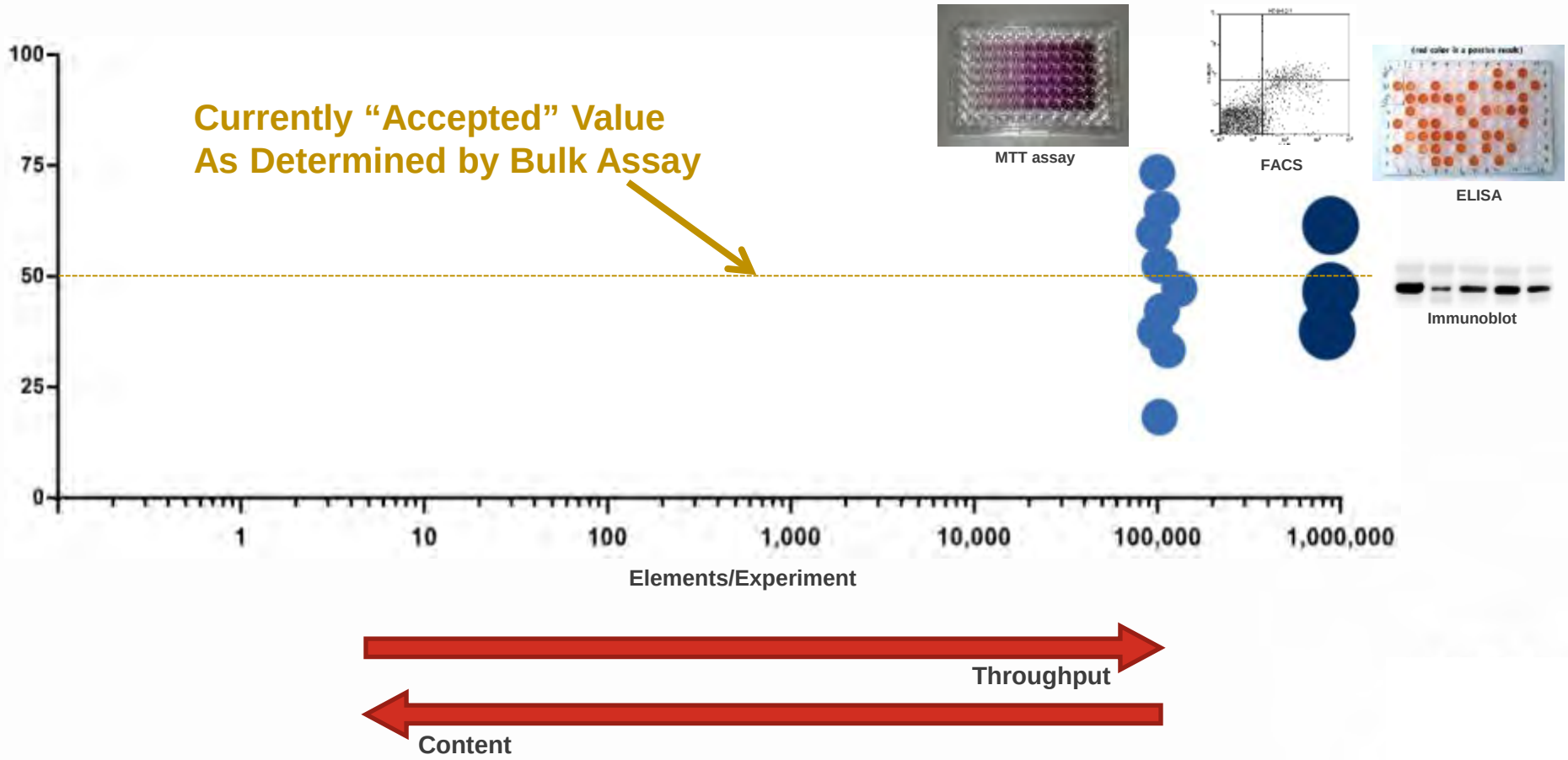
R01 Projects [8 awardees, $5.9M (FY12)]

- An integrated system to monitor complex tissues at single-cell resolution
- High-throughput robotic analysis of integrated neuronal phenotypes
- Multiplex RNA imaging in single cells by superresolution microscopy& barcode FISH
- Quantitative single-cell biomarkers of T-cells to optimize tumor immunotherapy

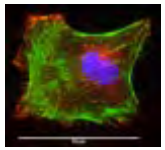
R21 Projects [15 awardees, $3.3M (FY12)

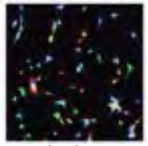
- Mapping pH at the surface of individual cell
- Nanoscale Laser Ablation Capture Mass Spectrometry for Single Cell Proteomics
- Developing a whole-genome sequencing method for single human cells
- ….

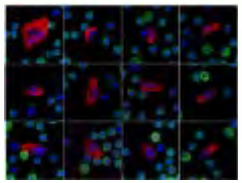
Connecting Single vs. Bulk Assays: Heterogeneity of Biology



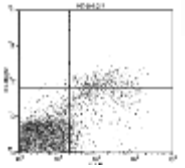
Connecting Single vs. Bulk Assays: Heterogeneity of Biology


Cell Morphology


Genomics/Proteomics


CTC platforms


MTT assay


FACS

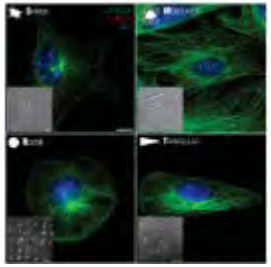

ELISA

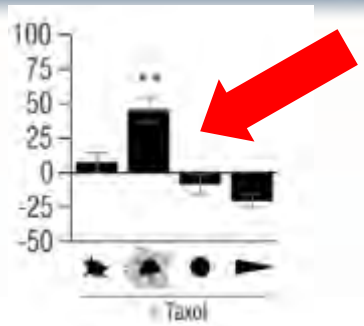

Immunoblot

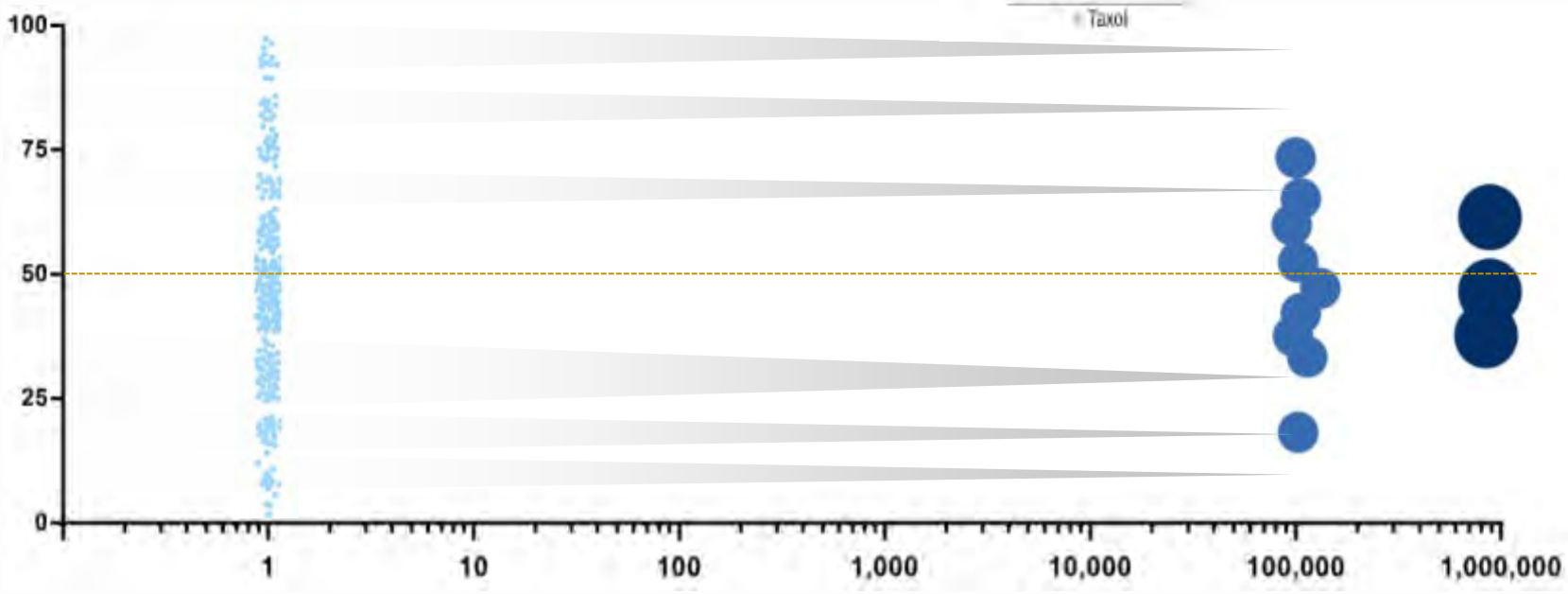
Throughput

Content

Connecting Single vs. Bulk Assays: Heterogeneity of Biology



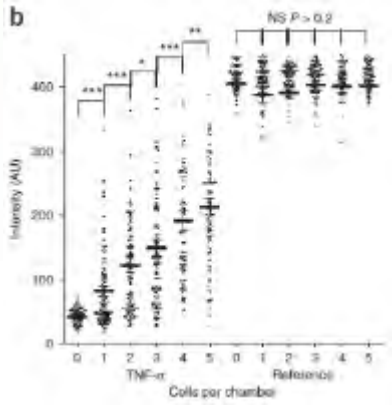


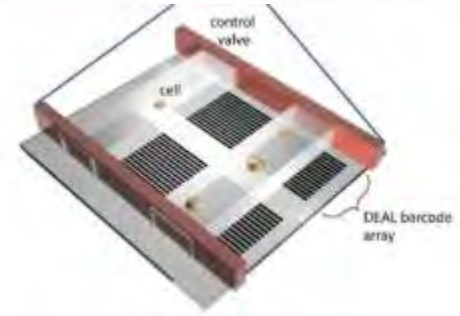


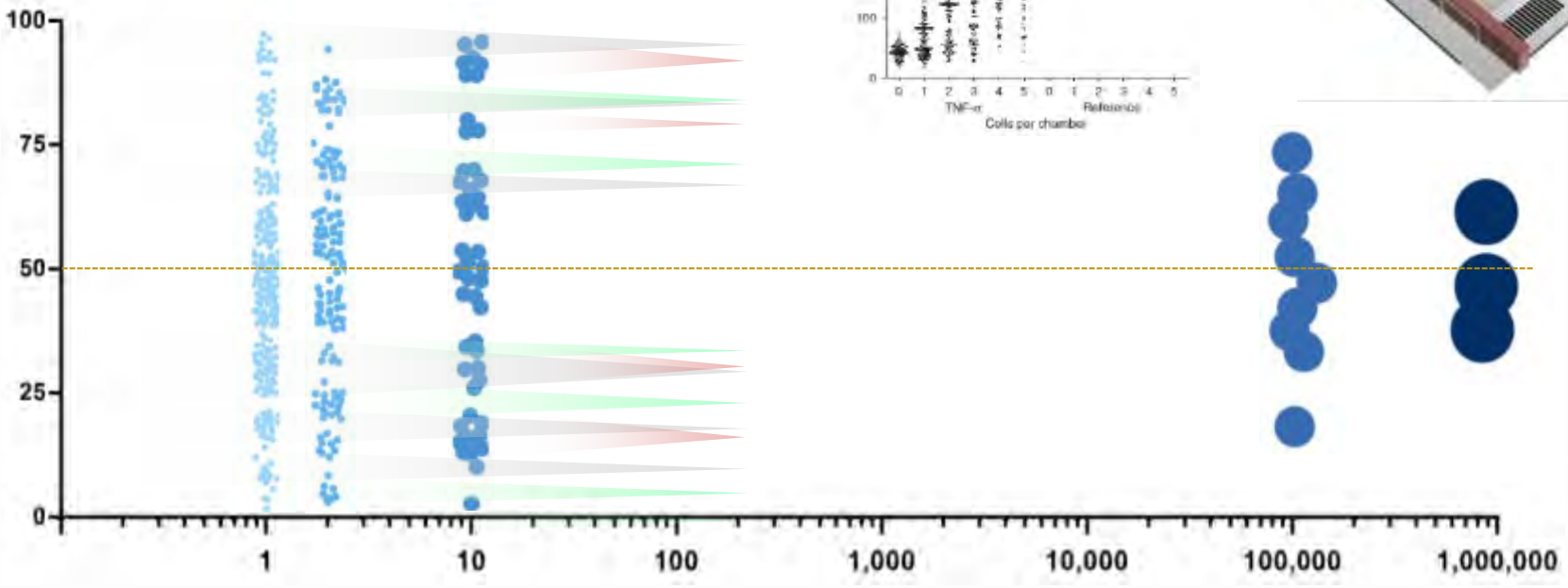
Throughput

Content

Connecting Single vs. Bulk Assays: Heterogeneity of Biology







Throughput

Content

Ma et. al, *Nature Med.,* June 2011

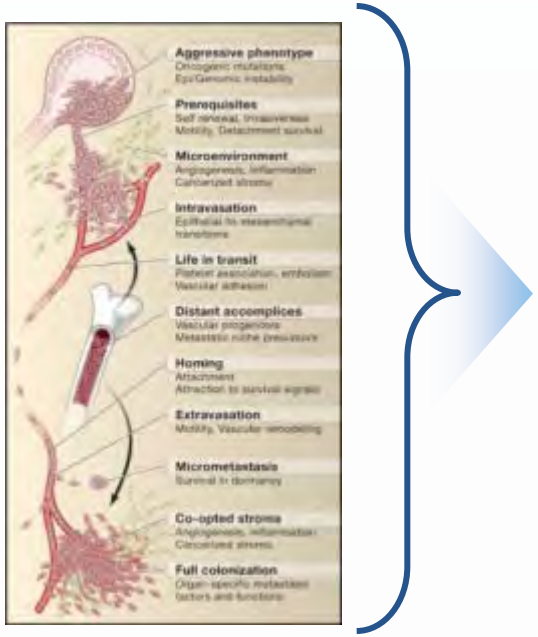
Bringing In New Perspectives and Teams (2009)

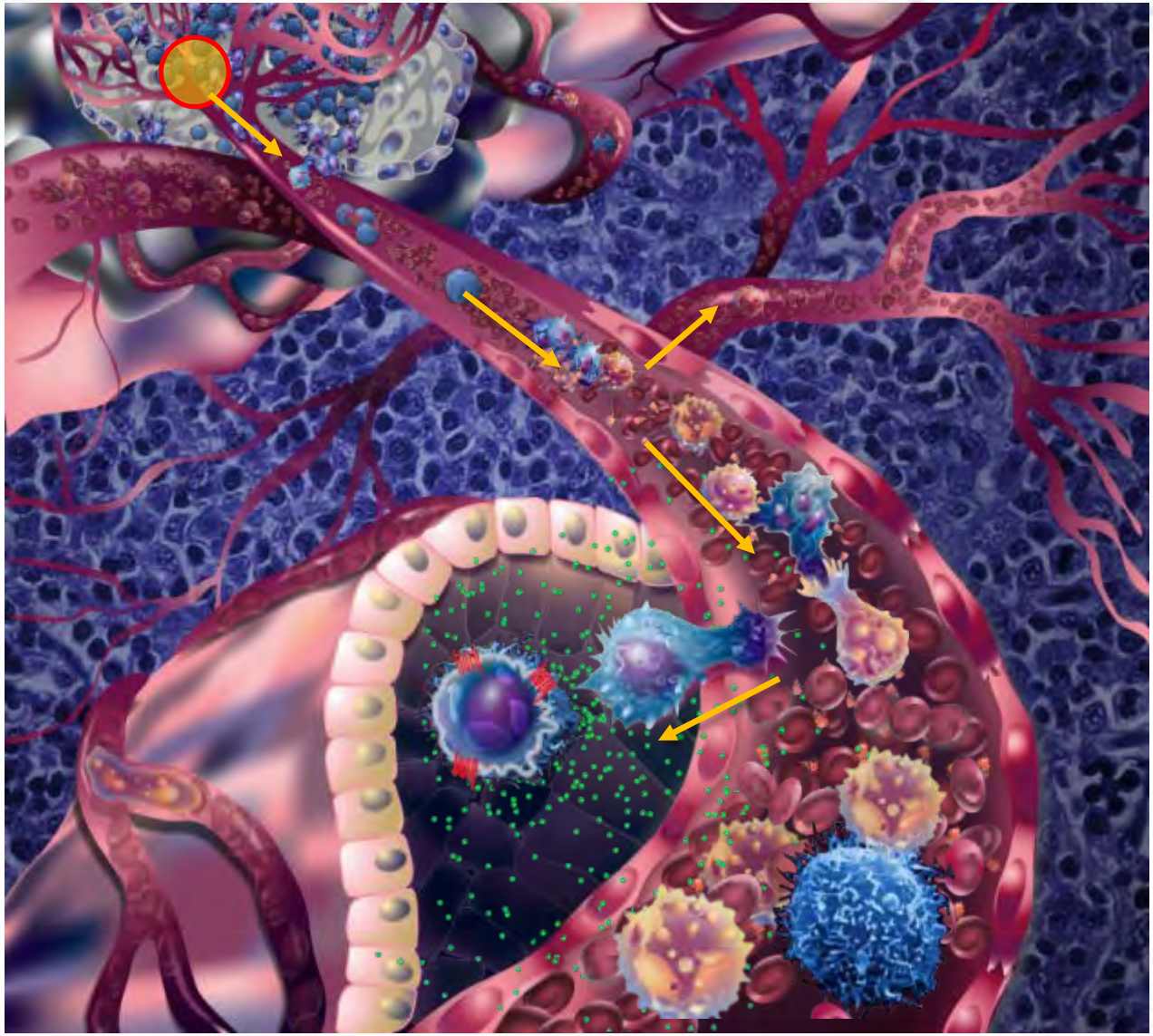
PHYSICAL SCIENCES in ONCOLOGY

- To generate ***new knowledge*** and catalyze ***new fields of study*** in cancer research by utilizing physical sciences/engineering principles to enable a better understanding of cancer and its behavior at all scales.
- Not looking for new tools to do "better" science, but new perspectives and approaches to do ***paradigm-shifting*** science that will lead to exponential progress against cancer.
- Build ***trans-disciplinary teams*** and infrastructure to better understand and control cancer through the convergence of physical sciences and cancer biology.

New – "Schools of Thought"

Metastasis: Deleterious but also Rare and Random- Why?





Well-known to be an inefficient process (0.01%)

From the Clinician's Perspective, Metastasis is More of a Binary Event …

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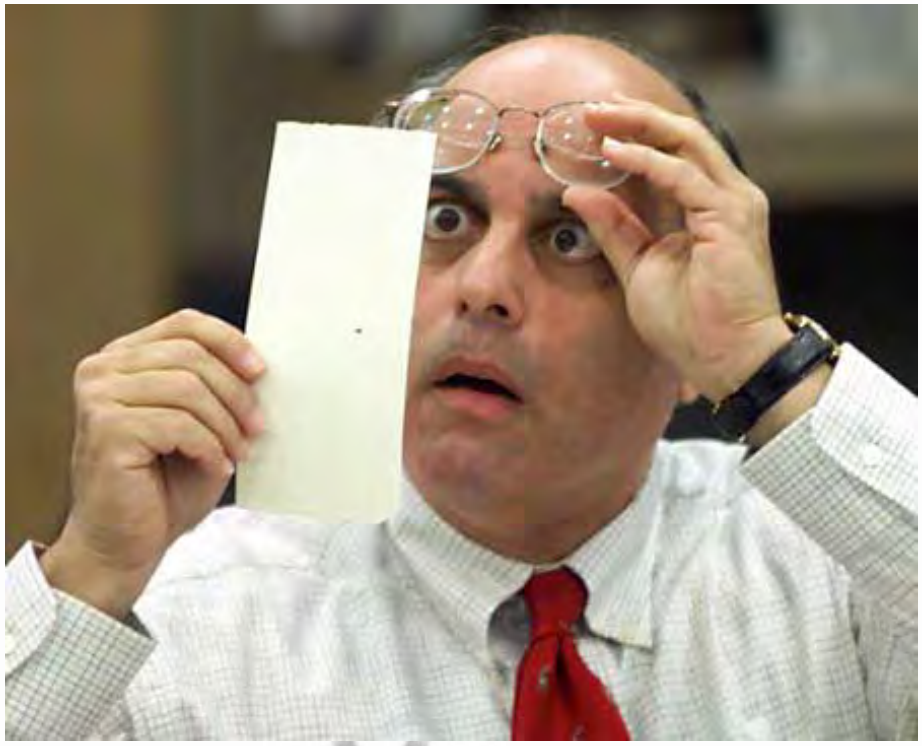
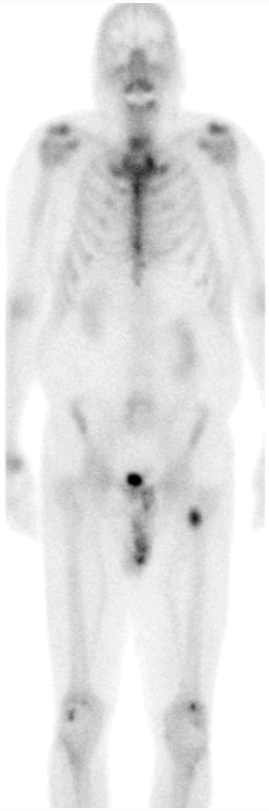
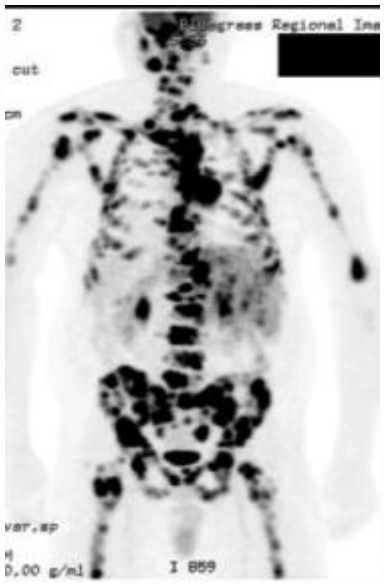
M0



M1



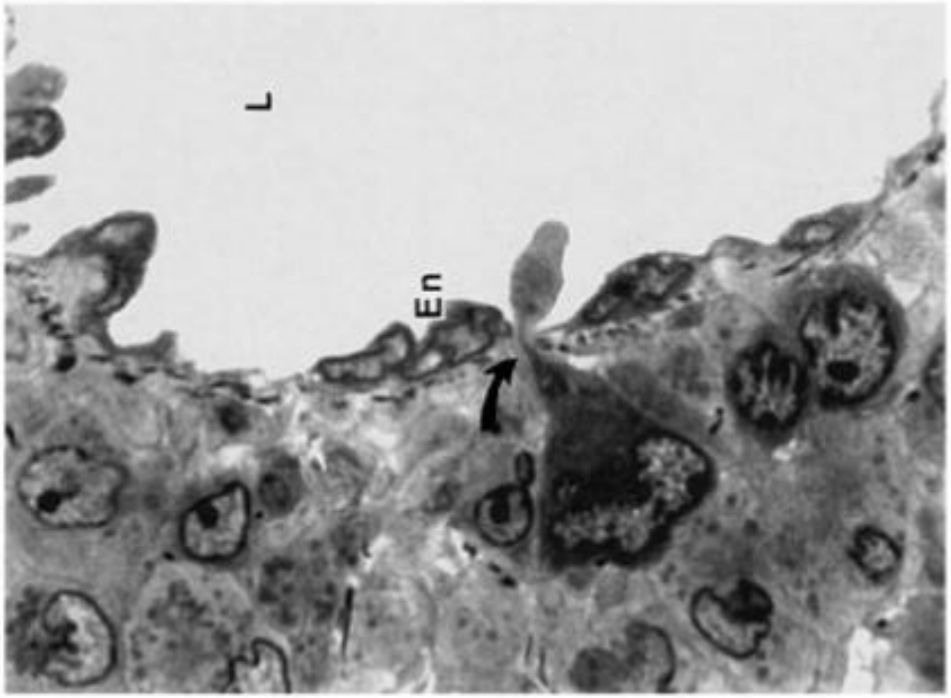
M1



Distant metastasis (M)§	
M0	No distant metastasis
M1	Distant metastasis

Adapted from and courtesy of David Morse, M.D., Moffitt PS-OC

Cancer:
A Disease of…Cell Mechanics?



"…metastatic cells must overcome numerous physical obstacles barring metastasis…in this way, cancer may progress as a disease of genetically heterogeneous cell populations driven to evolve by sequential environmental pressures…"

- **Primary tumor "leak" cancer cells into vasculature and establish secondary sites**
- **Well-known to be an inefficient process (0.01%) ~1 million cells per day!**

***Cancer Metastasis: Building a Framework, Gupta et. al.* Cell 2006**

But is it clinically relevant? Perhaps…

Clinical Indication	Physical Property	Mechanism of Action	Development Status (Agent Example)
Anesthesiology	**Shape Motility**	Membrane Fluidity Intracellular Calcium	FDA Approved (Tetracaine)
Cardiovascular	**Shape Motility Contraction**	ERK Kinase Rho-Rho-kinase Intracellular Calcium ROCK Inhibitor	Preclinical (SAR407899) Preclinical (Thyroid hormone) Clinical Phase II (Resveratrol) Clinical Phase II (Fasudil) FDA Approved (Atorvastatin)
Diabetes	**Contraction**	Rho-Rho-kinase PI3 Kinase	FDA Approved (Insulin)
Endocrinology	**Contraction**	Rho-Rho-kinase	Preclinical (Somatostatin)
Glaucoma	**Shape**	Ion Co-transport Inhibition ROCK Inhibitor	Preclinical (Ethacrynic acid) Preclinical (ATS907)
Immunology	**Shape**	DP2 Receptor Inhibition	Clinical Phase II (AM211)
Nephrology	**Elasticity**	ERK1/2 Kinase	Preclinical (Aldosterone)
Neurology	**Shape Size Elasticity**	Dopamine Receptor Serotonin Receptor ROCK Inhibitor	Preclinical (TIMP-1) Clinical Phase II (Epothilone D) FDA Approved (Imipramine) Approved in Japan (Fasudil)
Oncology	**Shape Size Motility Elasticity**	Microtubule Microfilament Anti-mitotic Tyrosine Kinase ROCK Inhibitor	Preclinical (RKI-1447) Clinical Phase II (Vinflunine) Clinical Phase II (AEE788) Clinical Phase III (Xyotax) FDA Approved (Abraxane)
Orthopedic	**Shape Elasticity**	Metalloproteinase	FDA Approved (IL-1β)
Pulmonary Disease	**Contraction**	E-cadherin Vimentin	Preclinical (TGF-β1)
Regenerative Medicine	**Shape Size**	Rho-Rho-kinase	Marketed (Vitamin D3)

- **16** Pre-clinical
- **10** Phase I/II
  - Novartis, Kosan Pharma, Roche, Bayer, etc.
- **15** FDA Approved
  - Pfizer, Merck, GSK

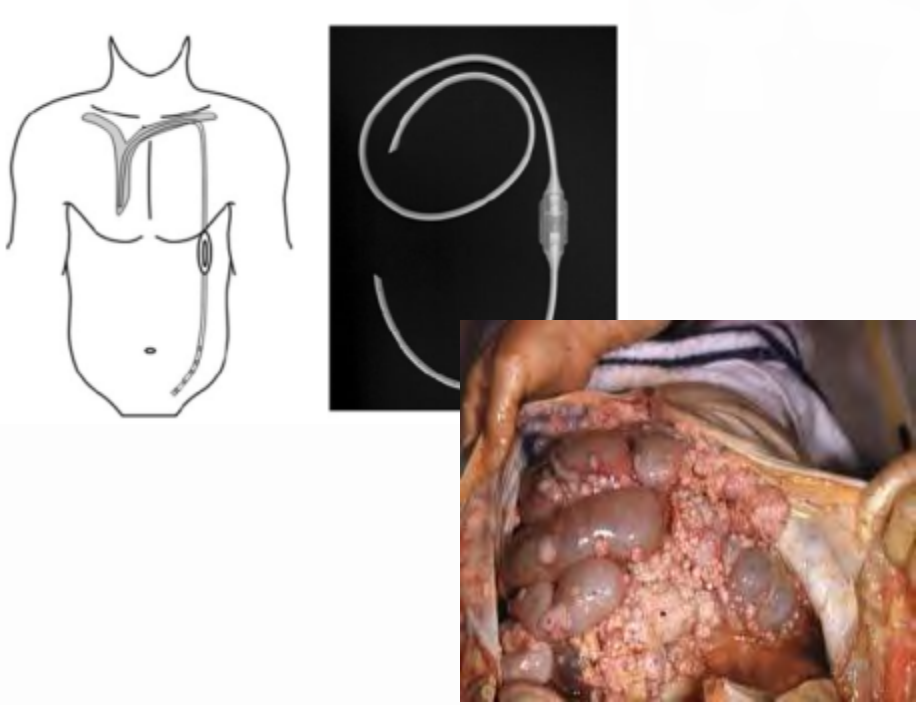
Independent analysis conducted by CCS Associates

Exceptions…The Only Sure Thing in Cancer…

Mechanisms of Metastasis in Patients with Peritoneovenous Shunts (PVS)

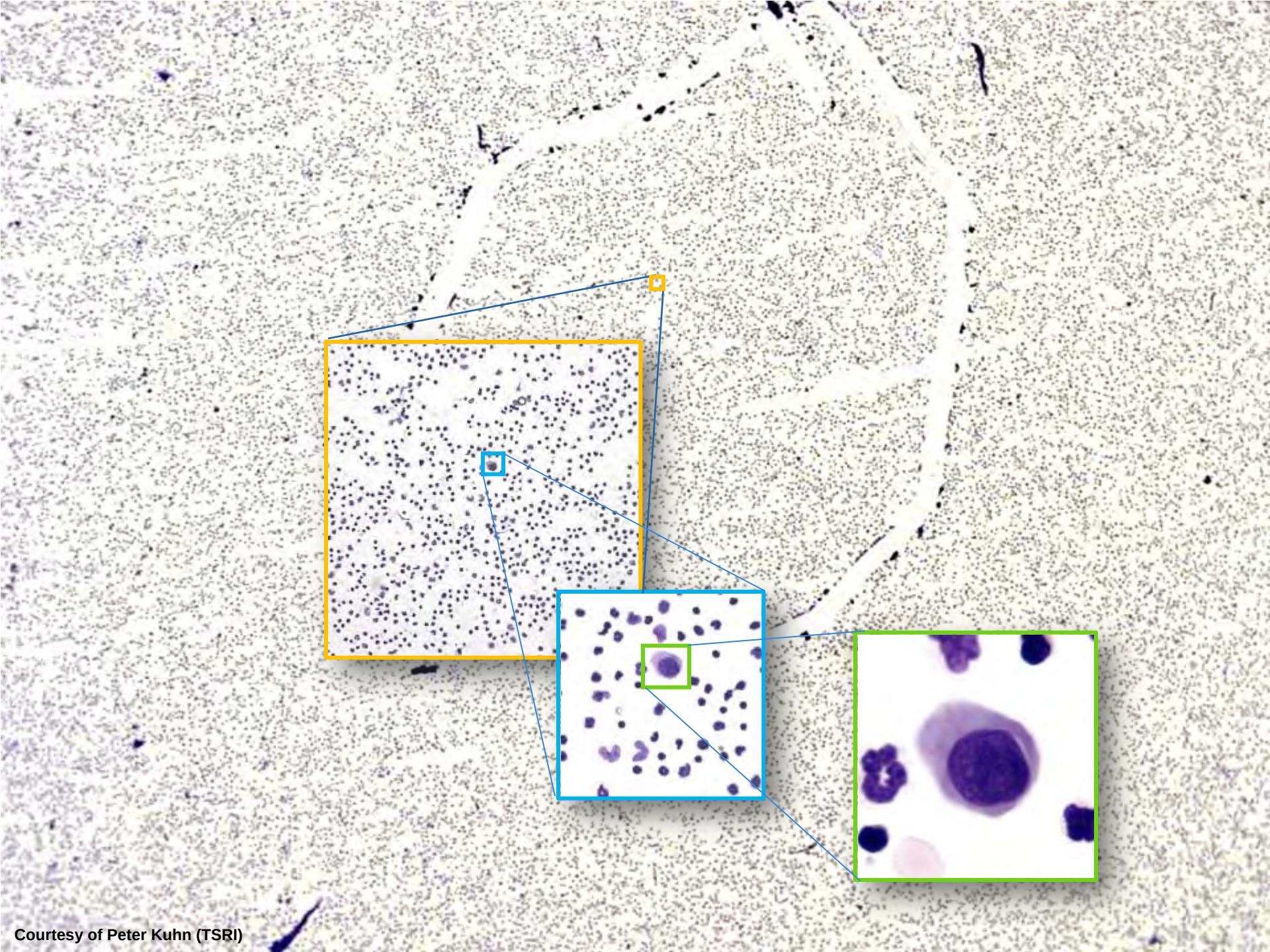
- Performed peritoneovenous shunting on **29 patients** to alleviate abdominal pain and distension in malignant ascites due to **inoperable cancer.**

- **15** that were autopsied **did not** develop metastases even after 27 months of survival.



"The findings in female patient D. J. are particularly interesting in this regard, because the cells of her tumor had already shown capability to form blood-borne metastases (in the liver and vertebrae) before the shunt was inserted, yet did not form any elsewhere even after the cells were directly infused into the systemic veins."-

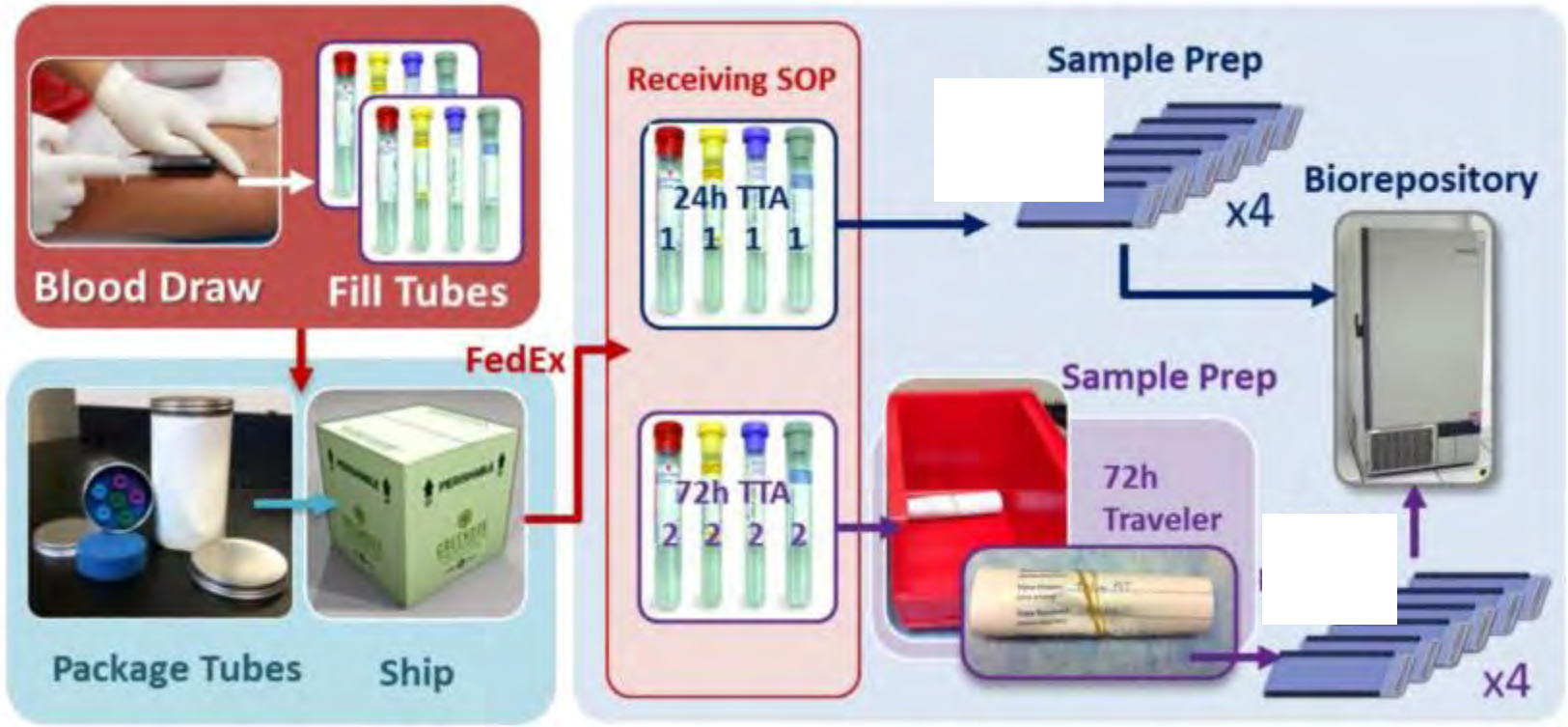
Tarin et. al. *Cancer Research*, 1984


Courtesy of Peter Kuhn (TSRI)

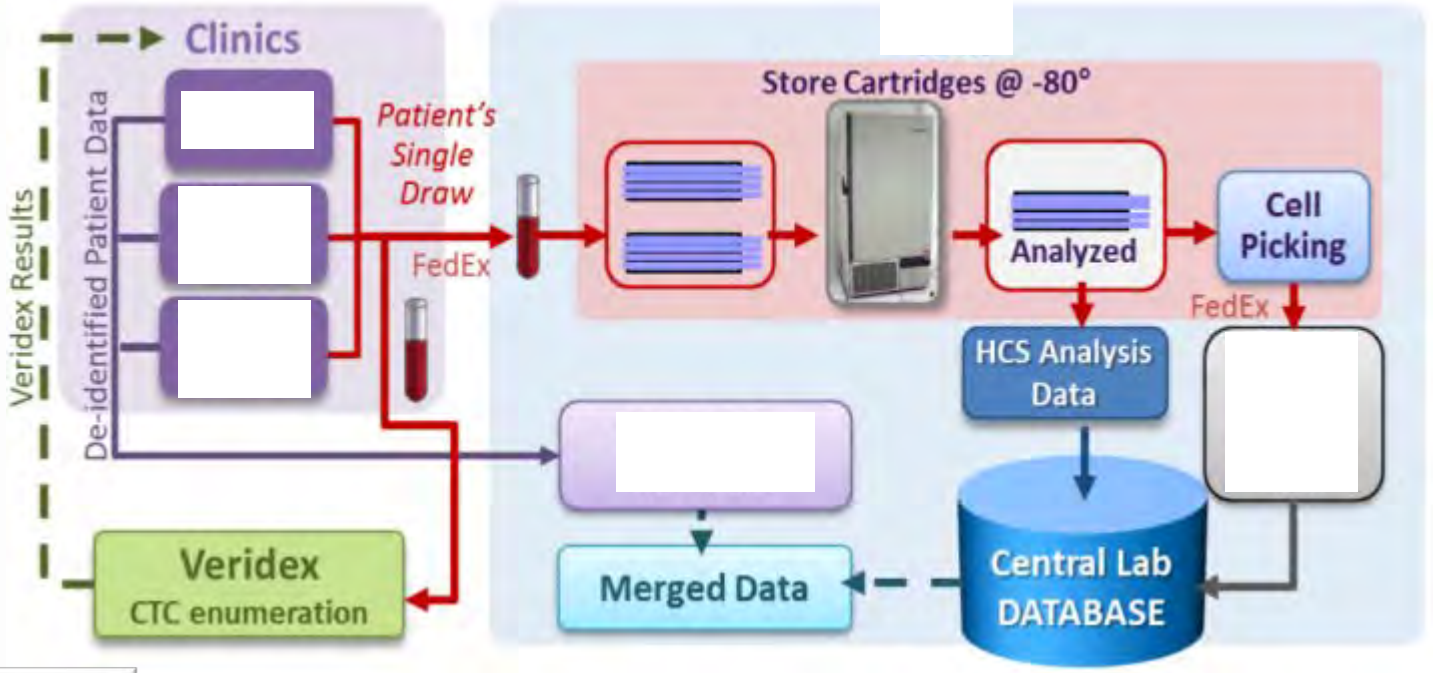
Pilot: High Content Data Integration of Pre-analytical Variables on CTCs

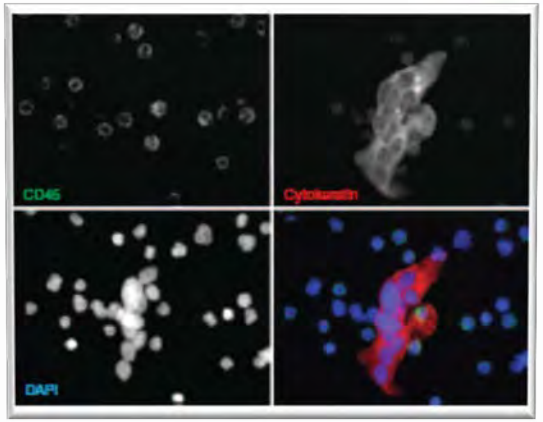
Pilot Objective:

- Strengthen the research use and clinical utility of HCS CTC assays
- Develop SOPs using the best pre-analytical conditions for blood CHP (collection, handling, processing)
  - Blood collection tube type (Streck, EDTA, Citrate, Heparin)
  - Time to assay (24 and 72 hours)



Key Pilot Output: Public Release, Use, and Analysis of Collected Data

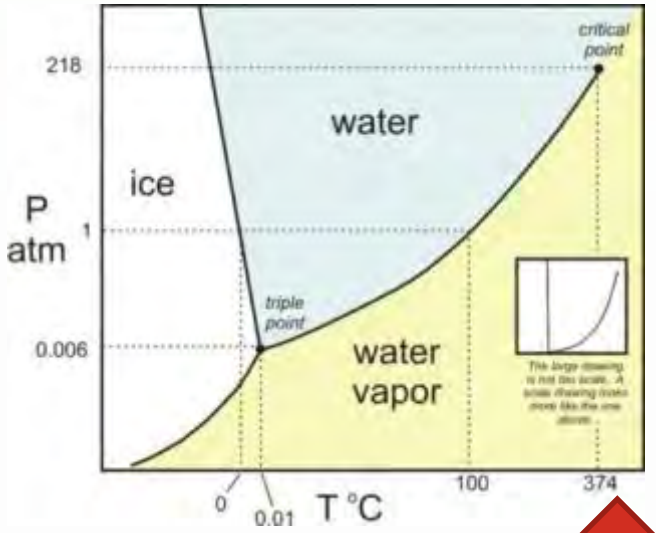




- Results will be compared to the Veridex CellSearch® system and **will be deposited in a publically available database**

Standards and Sharing of Data → New Insights and Understanding

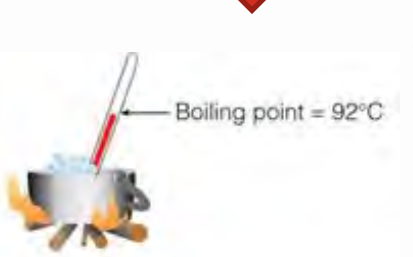
- Define *samples & protocols*
- ***Share collected data***



New Understanding

- **Phase boundaries**
  - V/L equilibrium
- **Triple Point**

(Phase Diagram)

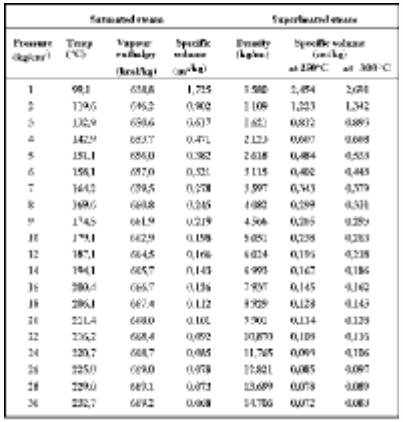


2400m

0m

New Parameter

"Pressure"



LOTS of Quantitative and Reproducible Data

(Steam Table)

Relevant CSSI Funding Opportunities

Center for Strategic Scientific Initiatives

http://cssi.cancer.gov/resources-current_funding.asp

Innovative Molecular Analysis Technologies ($10.5M)

Due Dates: 2/20/13
5/20/13

- **Early-Stage Innovative Technology Development**
  - RFA-CA-13-001 (R21, 3 years) **[$5M]**
- **Validation and Advanced Development of Emerging Technologies**
  - RFA-CA-13-002 (R33) **[$3.5M]**
- **Early-Stage and/or Validating Technologies in Biospecimen Science**
  - RFA-CA-13-003 (R21) **[$0.8M]**
  - RFA-CA-13-004 (R33) **[$0.7M]**

IMAT Program Director

Tony Dickherber, PhD

Provocative Questions ($30M)

Due Date: 6/20/12

- **Research Answers to NCIs Provocative Questions**
  - **Group A:** RFA-CA-12-015 (R01) **[$5-$7M]**
    RFA-CA-12-016 (R21) **[$2-$3M]**
  - **Group B:** RFA-CA-12-017 (R01) **[$5-$7M]**
    RFA-CA-12-018 (R21) **[$2-$3M]**
  - **Group C:** RFA-CA-12-019 (R01) **[$5-$7M]**
    RFA-CA-12-020 (R21) **[$2-$3M]**
  - **Group D:** RFA-CA-12-021 (R01) **[$5-$7M]**
    RFA-CA-12-022 (R21) **[$2-$3M]**

PQ Program Manager

Emily J. Greenspan, PhD

NCI CSSI Chaired Sessions (Track 1)

Today

- **1.3 Bioresponsive Materials for Imaging, Diagnostics, and Therapeutics**
  - Chairs: Sara Hook, PhD and Piotr Grodzinski, PhD
  - Keynote: Sangeeta Bhatia, MD, PhD

Sara Hook

- **1.4 Materials and Devices for Quantitative Biomarker Detection and Single Cell Analysis**
  - Chairs: Sara Hook, PhD and Piotr Grodzinski, PhD
  - Keynote: Daniel Haber, MD, PhD

Tomorrow

- **1.2 Diagnostic Biomarkers, Technology, and Regulatory Considerations (9:10 AM)**
  - Chairs: Christopher Kinsinger, PhD
  - Keynote: Fred Regnier, PhD

Chris Kinsinger

- **1.5 Tissue Engineering for High Content Analysis (3:10 PM)**
  - Chairs: Emily Greenspan, PhD and Tony Dickherber, PhD
  - Keynote: Gordana Vunjak-Novakovic, PhD

Acknowledgements/Thanks to the "Secret Ingredients"

Center for Strategic Scientific Initiatives

Physical Sciences

Clinical Sciences

Life Sciences

NIH Early Career Reviewer Program

PURPOSE

- Train and educate qualified scientists
- Help emerging researchers advance their careers by exposing them to review experience
- Enrich the existing pool of NIH reviewers

REQUIREMENTS

- ≤ 1 mail-in review
- Faculty appointment or equivalent
- Active independent research program
- Recent publications

Interested in serving as an NIH reviewer?
Send your CV to petersonjt@csr.nih.gov

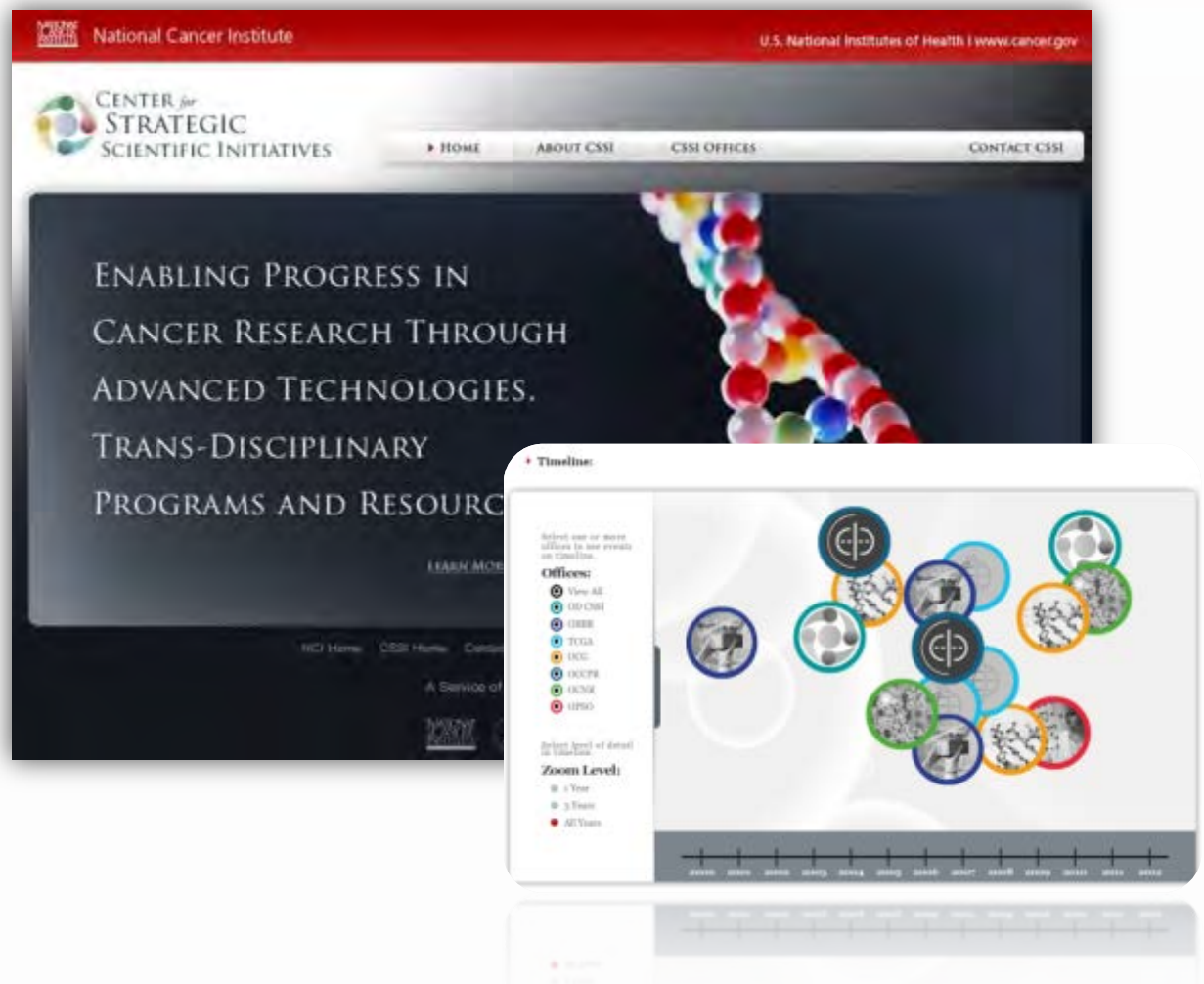
***Hope to meet you at the conference*.**

J. Thomas Peterson
(Chief of Bioengineering Sciences and Technologies)

Learn More About Us…

CENTER for STRATEGIC SCIENTIFIC INITIATIVES

http://cssi.cancer.gov



Jerry S.H. Lee, PhD

jerry.lee@nih.gov