New Opportunities in Cancer Research

National Academy of Sciences
Advancing Health Research in Poland and the United States
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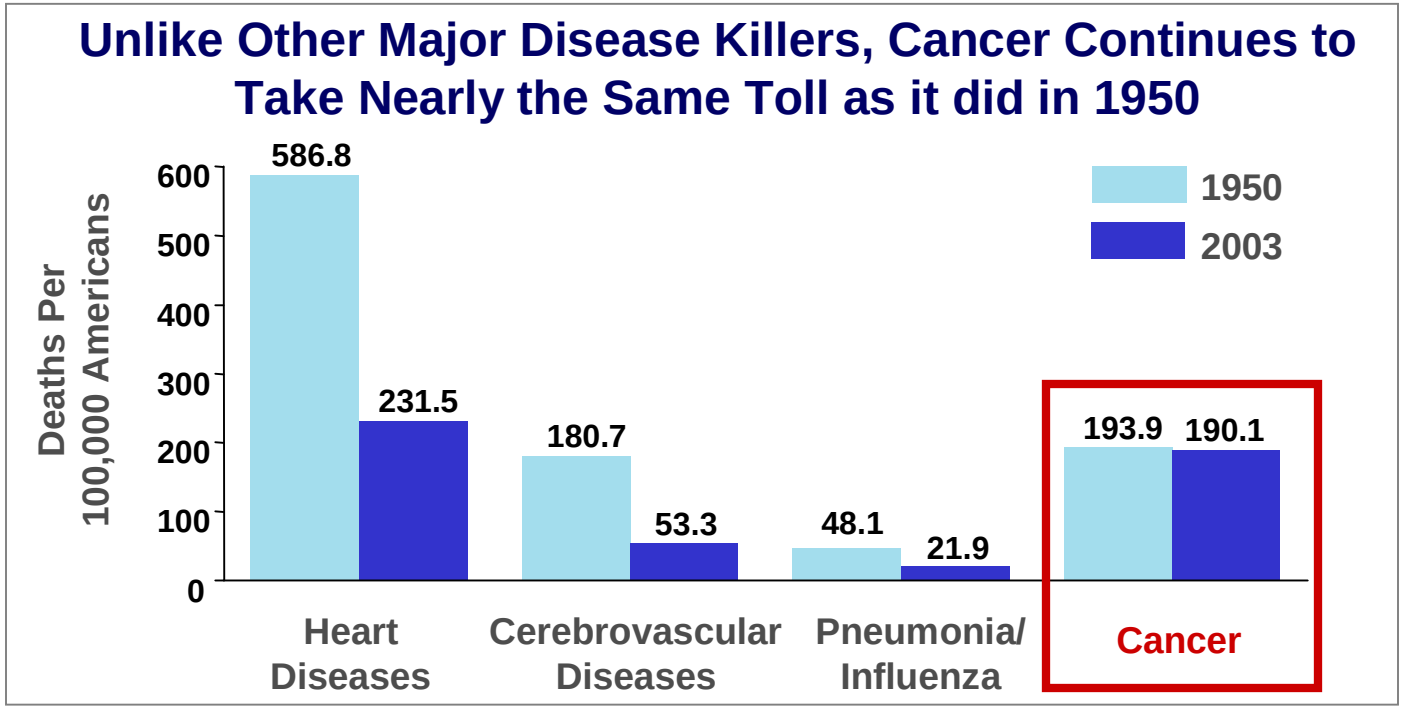
Anna D. Barker, Ph.D.

Deputy Director, NCI

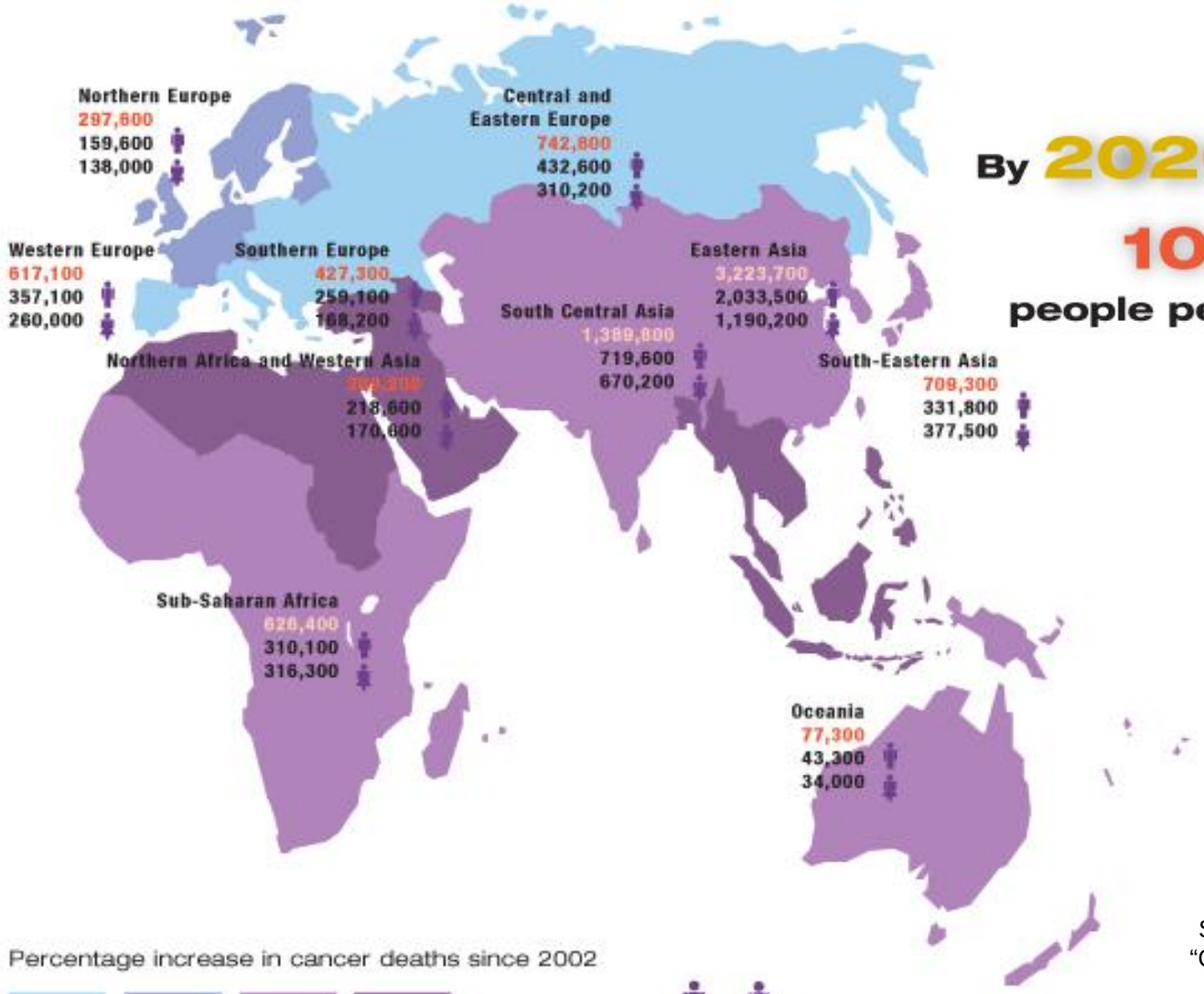
Cancer is a Current Healthcare Crisis in the U.S.

- ~ 560,000 Americans will die of cancer this year
- ~ 1.4 million Americans will be diagnosed with cancer this year
- ~ $213 billion in 2005 for cancer healthcare costs
- Numbers of new cancer cases will increase by 30-50% as we approach 2020 (Aging of the baby boomers)



Source for 2006 deaths and diagnoses: American Cancer Society (ACS) 2006 Cancer Facts & Figures; Atlanta, Georgia
Source for 2003 age-adjusted death rate: National Center for Health Statistics, U.S. Department of Health and Human Services, NCHS Public-use file for 2003 deaths.

A Looming Global Healthcare Crisis



By **2020**, cancer could kill

10.3 million

people per year unless we act

Source: World Health Organization
"Global Action Against Cancer" 2005

The Vision for 21st Century Personalized Medicine

20th Century	21st Century
§ Focus on treatment	§ Focus on understanding genetic predisposition, early detection
§ Diagnosis based on morphologic and pathologic analysis	§ Diagnosis based on molecular characterization and biological processes
§ Expensive; perpetuates unsuccessful approaches	§ Evidence-based; continually assesses standard of care
§ Lack of robust connection between science- healthcar	§ Connects bench Æ bedside Æ bench in seamless ***feedback loop***
§ Not Sustainable	§ ***Sustainable***

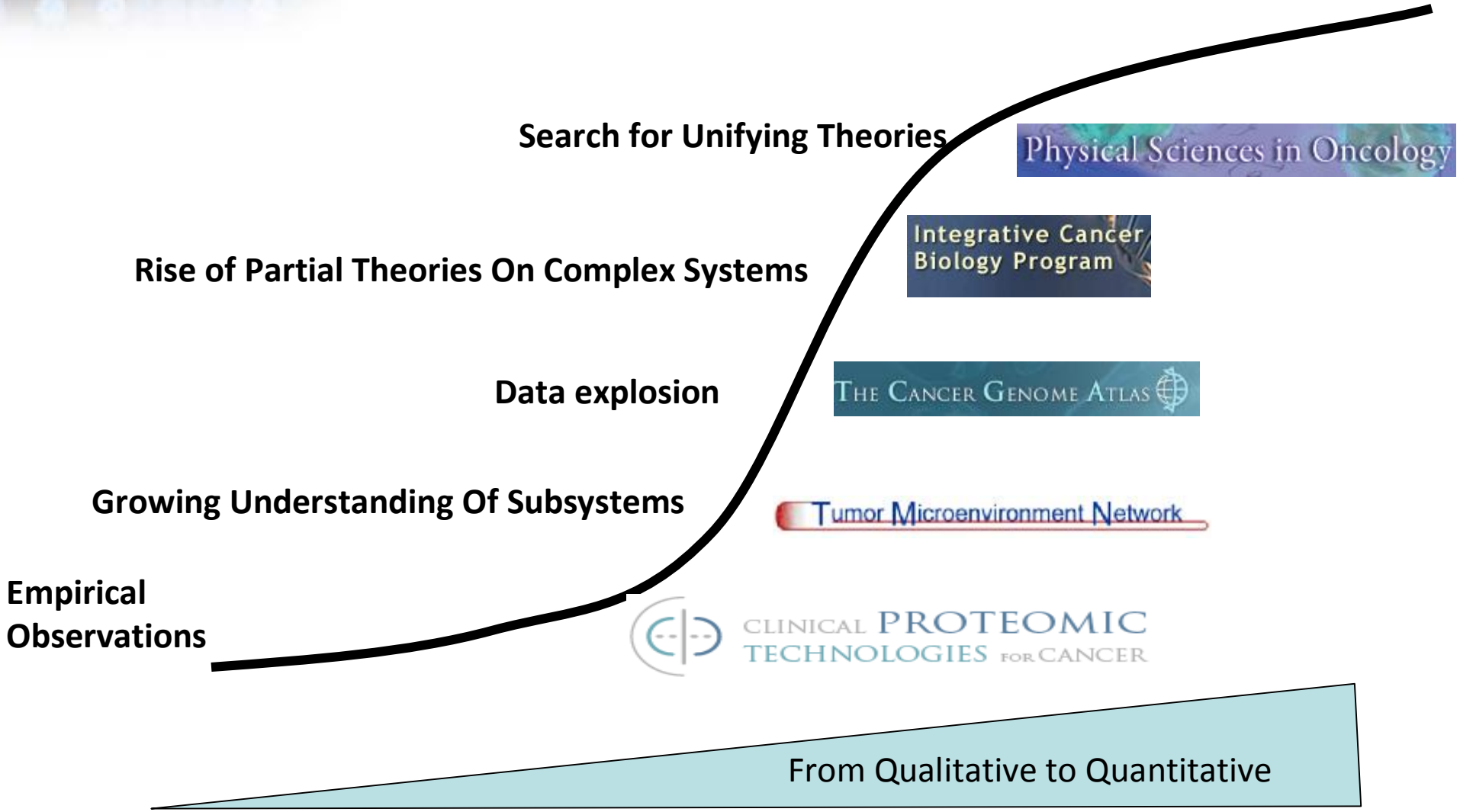
21st Century Medicine is Predictive, Pre-emptive, Personalized, Participatory

NCI's Strategic Initiatives to Enable Personalized Cancer Medicine

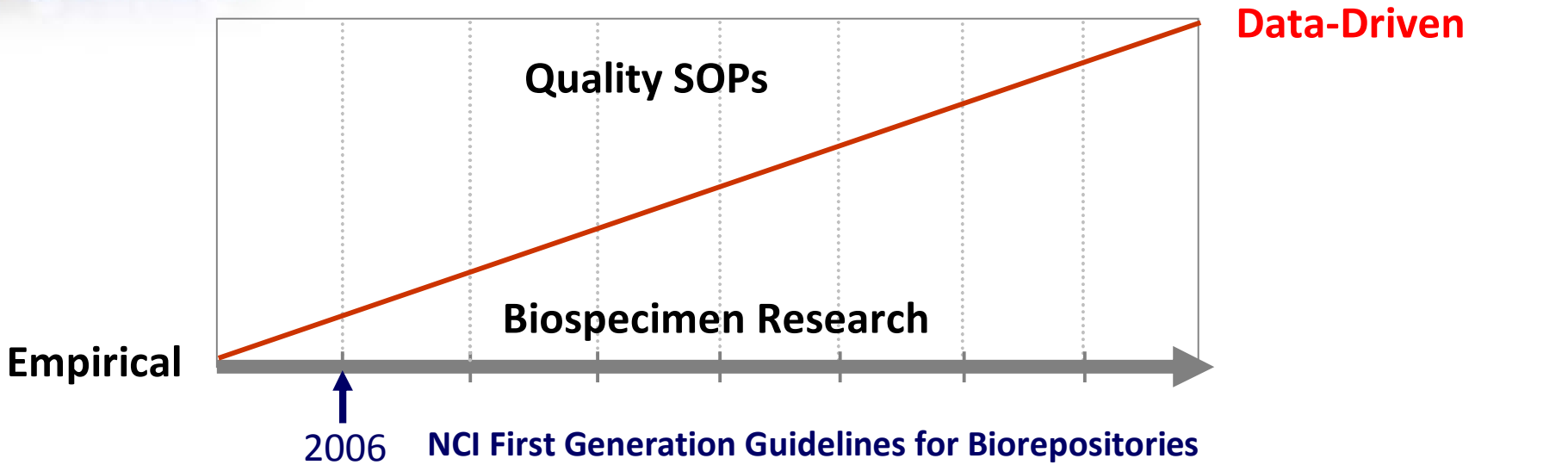
Opportunity:	NCI Initiative:
• *Biorepositories*	• Cancer Human BioBank (caHUB)
• *Bioinformatics*	• Cancer Bioinformatics Grid (caBIG)
• *Genomics*	• The Cancer Genome Atlas (TCGA)
• *Proteomics*	• Clinical Proteomic Technologies Initiative
• *Systems Biology*	• Integrative Cancer Biology Program
• *Physical Sciences*	• Physical Sciences in Oncology Initiative
• *Nanotechnology*	• NCI Alliance for Nanotechnology in Cancer

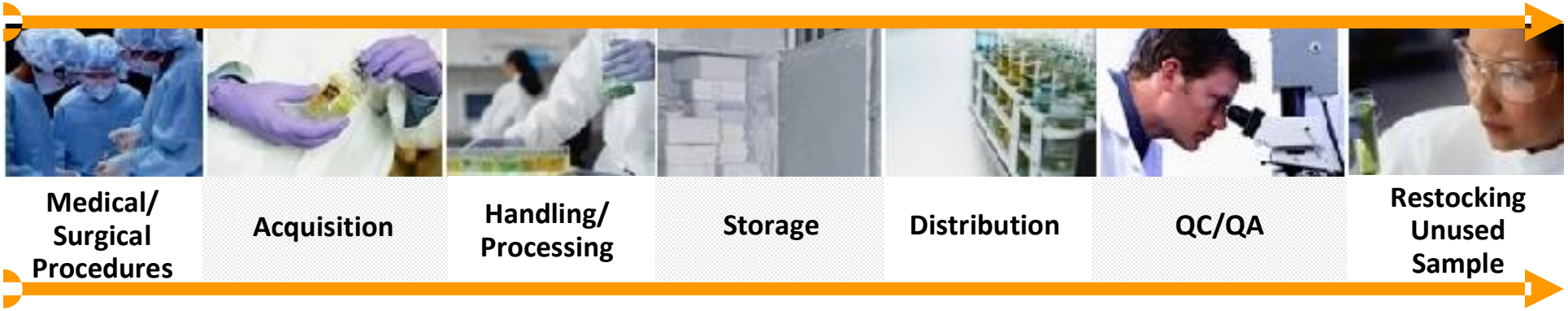
The "S" Curve of Cancer Science

Adapted from E. Zerhouni



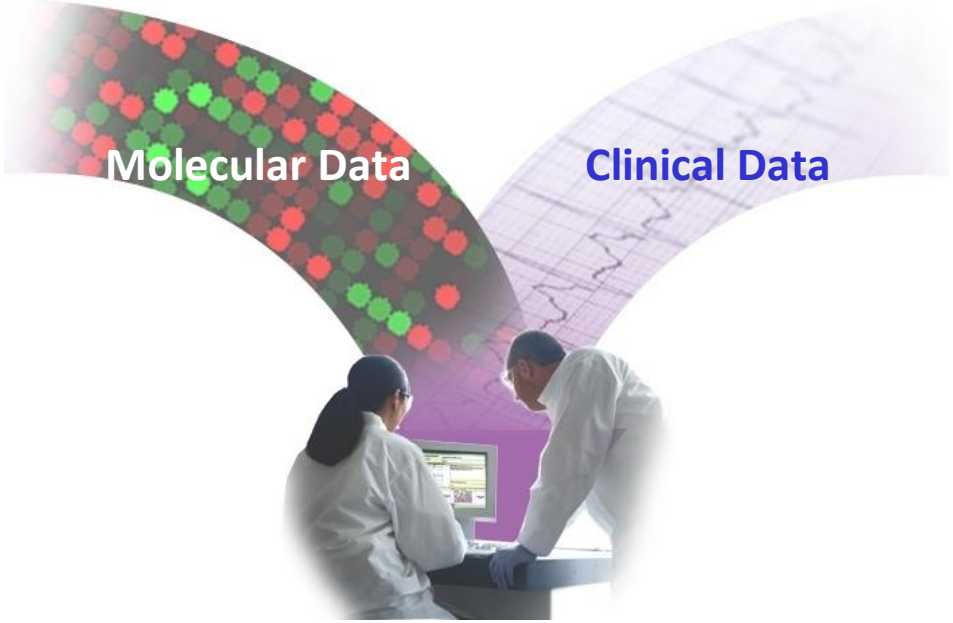
Biospecimens: The Foundation for Personalized Medicine





Cancer Biomedical Informatics Grid (caBIG™): Managing a Data Tsunami

caBIG™ *is an open source and open access information (grid enabled) network enabling all constituencies across the cancer enterprise – researchers, clinicians, patients – to share data and knowledge to accelerate the discovery of new cancer interventions and deliver them to patients.*



The Cancer Genome Atlas: High-Throughput Medical Genomics

§**T**he **C**ancer **G**enome **A**tlas **(TCGA)** is a an unprecedented collaborative project between the **NCI** and the **NHGRI that is designed to develop a complete "atlas" of all of the genomic changes in cancer – and** increase our comprehensive understanding of the **genetic basis of cancer.**

TCGA is large-scale – high throughput - and will undertake the complete characterization of 20 tumors in the next 5 years

It is anticipated that TCGA's integrated database of molecular and clinical information will provide unprecedented opportunities to discover and develop a new generation of targeted diagnostics, therapies, and preventives for cancer.

The Cancer Genome Atlas

TCGA: Connecting multiple sources, experiments, and data types

Three forms of cancer

glioblastoma multiforme (brain)

squamous carcinoma (lung)

serous cystadenocarcinoma (ovarian)

Biospecimen Core Resource with more than 13 Tissue Source Sites

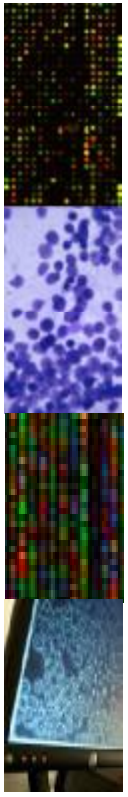
7 Cancer Genomic Characterization Centers

3 Genome Sequencing Centers

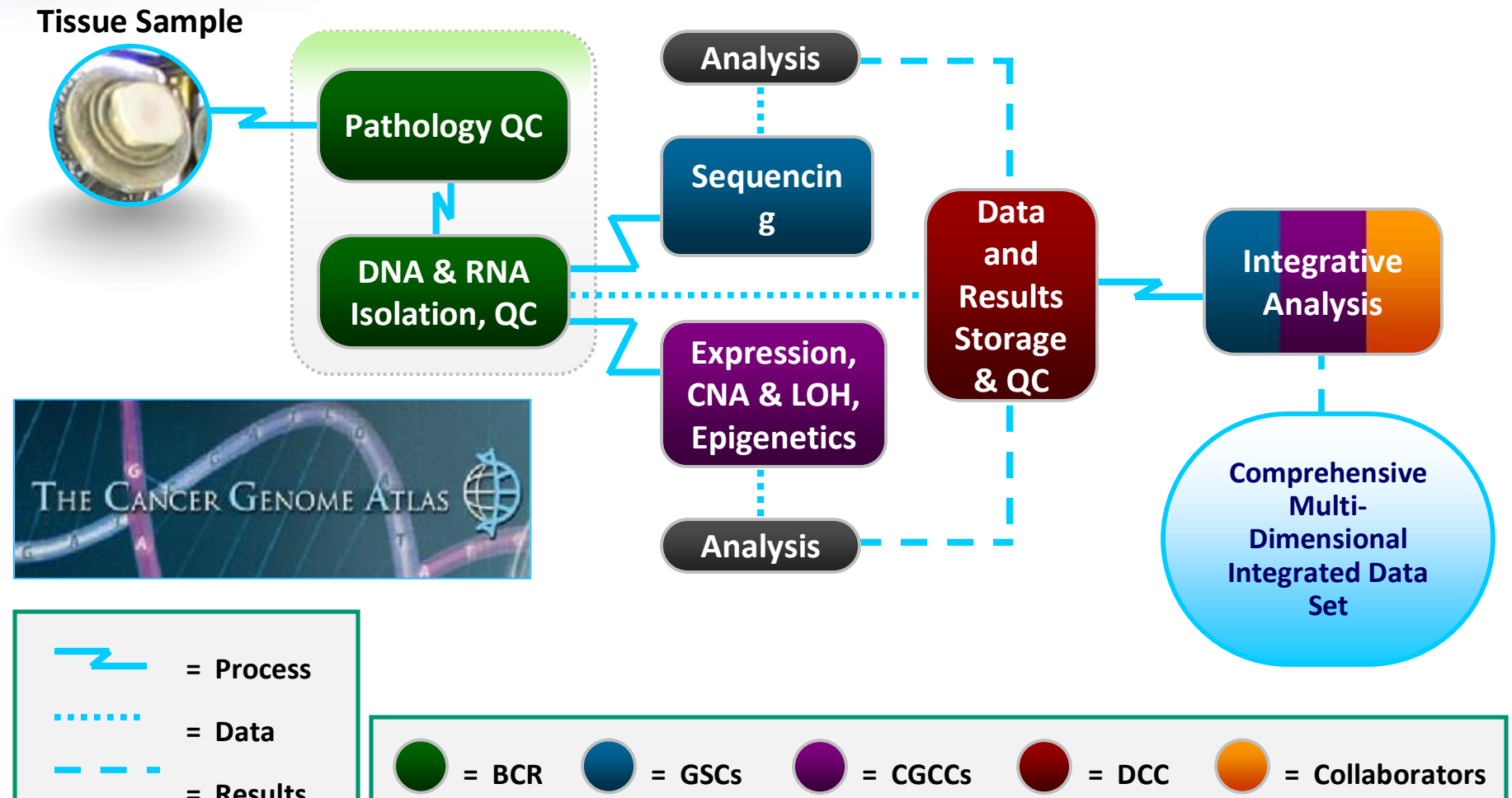
Data Coordinating Center

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

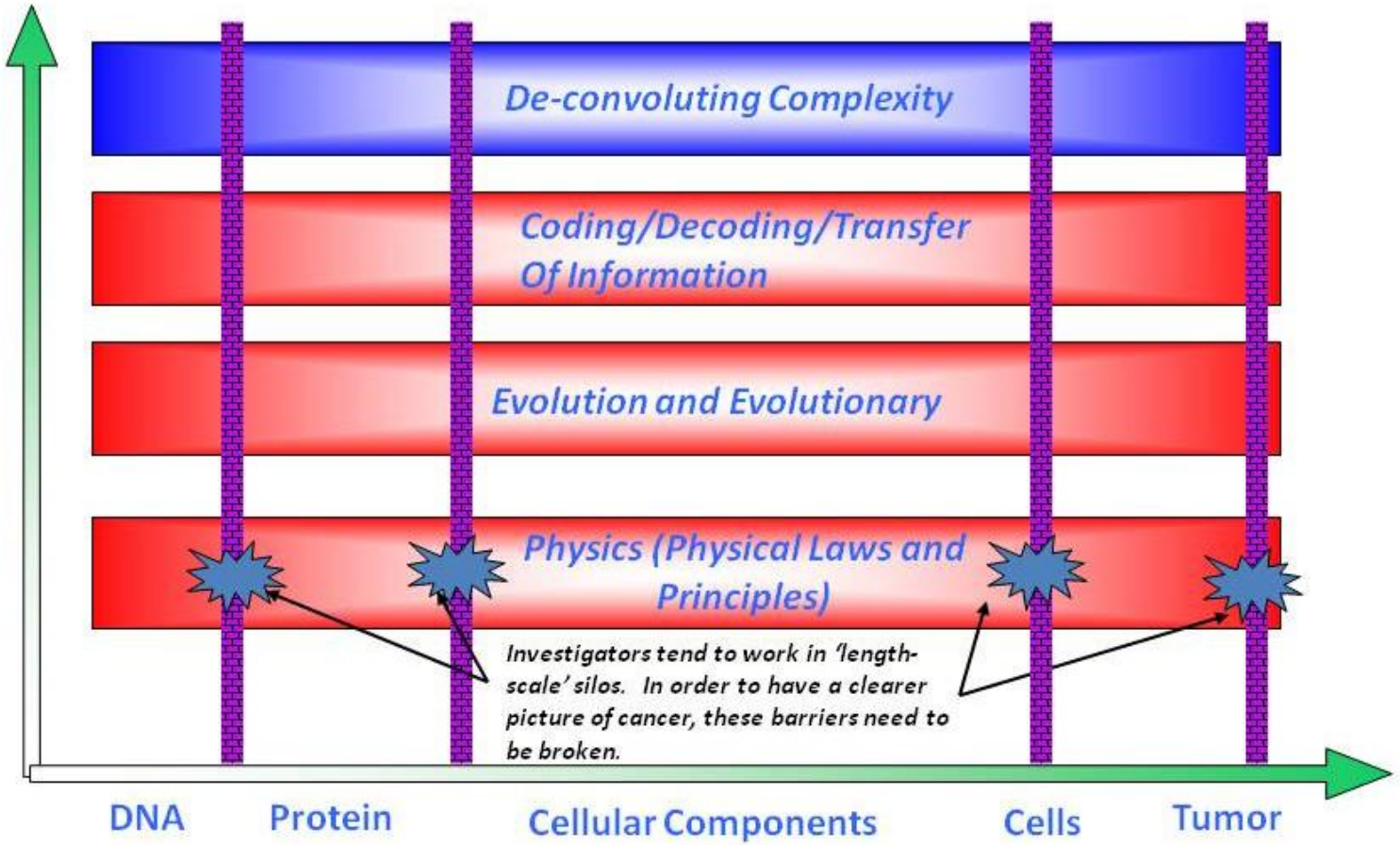


The Cancer Genome Atlas

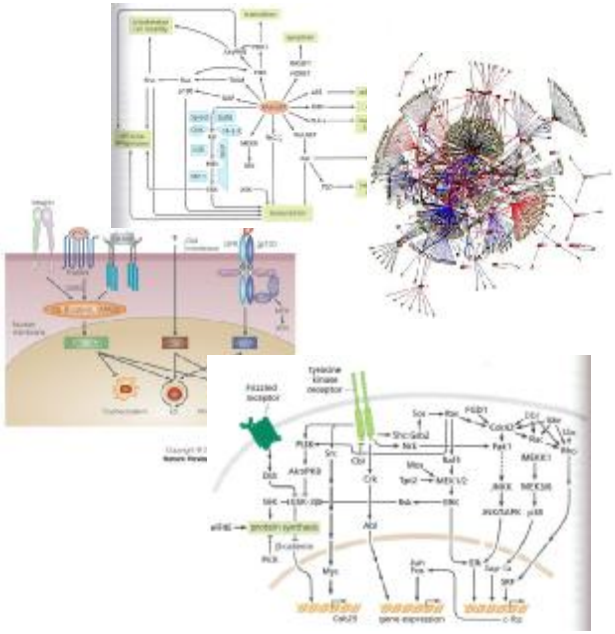


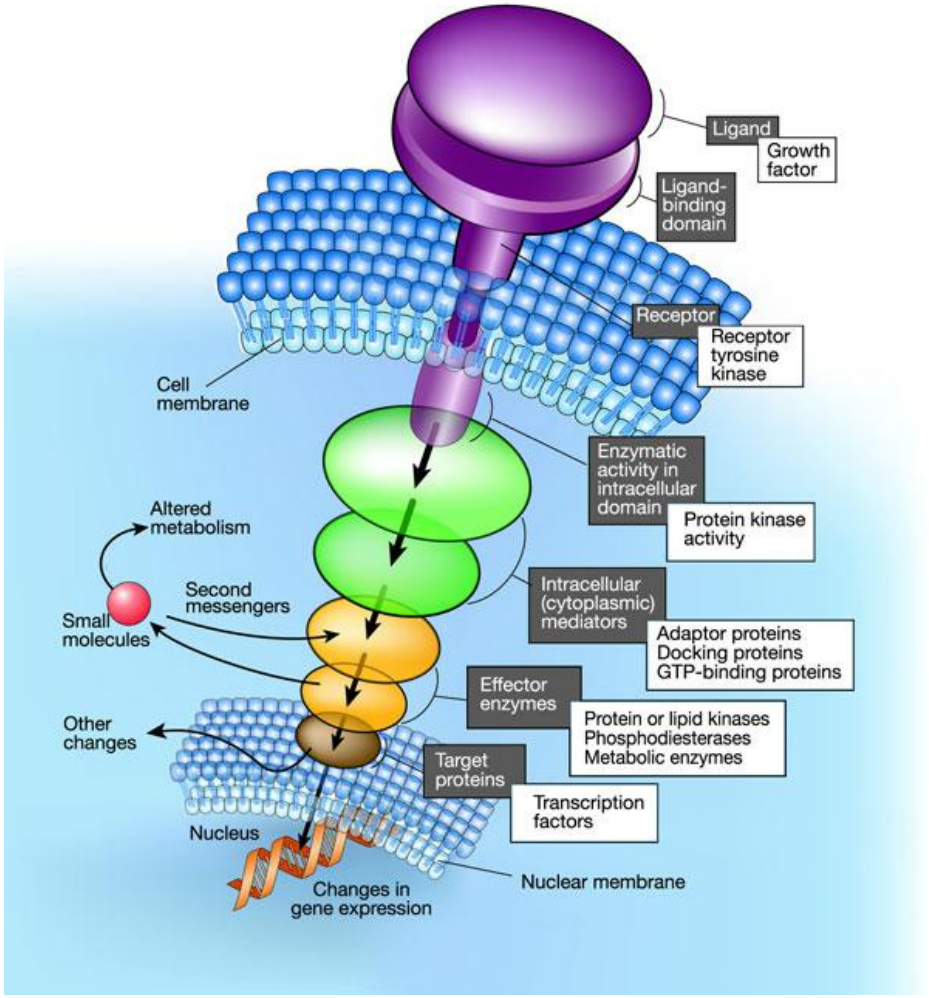
Physical Sciences in Oncology

Integrating and Leveraging the Physical Sciences to Open a New Frontier in Oncology



Critical to Think in Terms of Space and Time





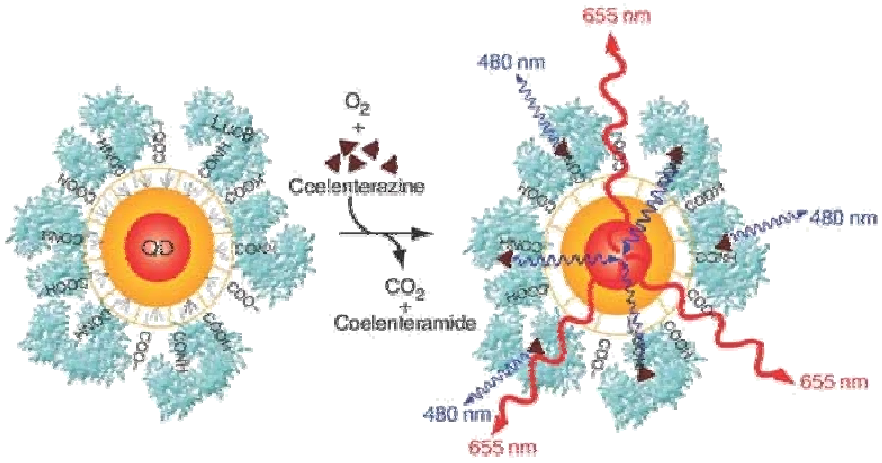
Nanotechnology:
A New Frontier to Drive Innovation in Medicine

The Alliance for Nanotechnology in Cancer:

- **To ignite nano-product development and commercialization**
- **Encompasses public and private sectors**
- **Six key areas of focus:**
  - **Molecular Imaging and Early Detection**
  - ***In Vivo* Imaging**
  - **Reporters of Efficacy**
  - **Multifunctional Therapeutics**
  - **Prevention and Control**
  - **Research Enablers**

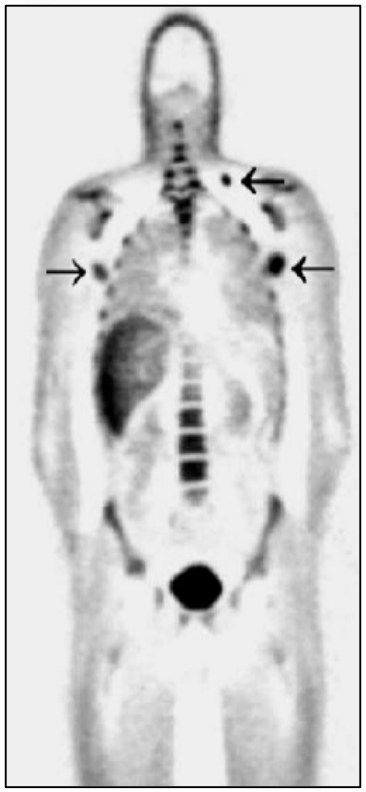
Nanodevices:

- **Nanopores**
- **Dendrimers**
- **Nanotubes**
- **Quantum dots**
- **Nanoshells**



NCI Alliance for
Nanotechnology
in Cancer

Advances We Need in the Next Decade



- Unprecedented knowledge of nearly every cancer – most certainly an affordable cancer genome
- Real diagnostic and predictive biomarkers
- A connected bioinformatics enterprise - searchable databases that are evolving toward in silico discovery – new development (clinical trials models)
- Evidence based cancer risk prediction models
- Very early detection technologies – (chip based – biosensors – advanced imaging technologies)
- Large numbers of evidence-based cancer interventions in development
- Electronic medical records to support personalized cancer medicine