Advancing Innovation and Convergence In Cancer Research

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

2014 ASEE Engineering Research Council Annual Meeting
Change and Research Opportunities: Perspectives from NIST, DOE, NGA, and NCI

March 18, 2014
What is It?
Tumor, Cancer, and Metastasis

Gupta et. al., Cell, 2006 and Siegel et. al. CA Cancer J Clin, Feb 2014

>90% of deaths is caused by disseminated disease or metastasis...
In the U.S., Cancer Continues to Represent an Enormous Burden

- **574,743** Americans died of cancer in 2010 (**585,720** projected for 2013)
- **1,665,540** Americans will be newly diagnosed with cancer in 2014 (projected)
- **$216.6 billion** in 2009 for cancer healthcare costs (**$86.6 billion** for direct medical)

Unlike Other Major Disease Killers, Cancer Continues to Take Nearly the Same Toll as it did in 1950

![Bar chart showing death rates per 100,000 Americans for various causes in 1950 and 2010. Cancer death rates are nearly the same in 1950 and 2010.]

Source for 2014 projected deaths and diagnoses: Siegel et. al, Cancer Statistics, 2014
Global Burden: By 2020, Cancer Incidence 16 M/yr (Mortality 10 M/yr)

Source: IACR, WHO
Unprecedented Amount of Scientific Knowledge: Omics

- 2001: Scientific Knowledge
- 2005: Scientific Knowledge
- 2010: Scientific Knowledge
- 2012: Scientific Knowledge

1923: 49,024 pubs
2001: 54,587 pubs
2005: 87,793 pubs
2012: 38,506 pubs

ISI search for genomics, proteomics, transcriptomics, metabolomics, phenomics, interactomics, glycomics
Is More Knowledge Yielding More Solutions for Patients?

**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?

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

NIH Campus – Bethesda, Maryland.

NIH Budget ~ $30.8 Billion (FY12)
• ~82% for extramural support
• ~63,000 grants and contracts

NCI Budget ~ $ 5.07 Billion (FY12)
• ~ 76% for extramural support
• ~7,800 grants and contracts
National Institutes of Health (NIH): 27 Institutes and Centers

NIH FY12 Appropriations Data Taken from http://www.nih.gov/about/almanac/appropriations/index.htm and http://report.nih.gov/nihdatabook/
NIH: Types of Funding Announcements (FOAs)

- **Parent Announcements**
  - Non-specific, investigator-initiated “unsolicited” research
  - May submit any topic within the breadth of the NIH mission.
  - No money set-aside
  - Competition tied mainly to an IC's overall payline

- **IC-Specific Program Announcements (PA)**
  - Often broadly defined or a reminder of a scientific need
  - Investigator-initiated “unsolicited” research
  - No money set aside (unless PAS)
  - Competition tied mainly to the IC's overall payline
  - High-priority applications may be funded beyond the payline

- **Requests for Applications (RFA)**
  - NIH-Requested Research; Well-defined scientific area
  - Specifies funds and targets number of awards
  - Competition depends on number of applicants and dollars set aside

~575 in FY12

~53% NIH-wide
~47% NCI-only

~21% NIH-wide
~34% NCI-only

~26% NIH-wide
~19% NCI-only
NIH Research Portfolio Online Reporting Tools (RePORT)

FY12 grants data from http://projectreporter.nih.gov
The NIH Extramural Team: Checks & Balances

**Scientific Review Officer (SRO)**
- Ensures fair and unbiased evaluation of the scientific and technical merit of proposed research
  - Manages study sections
  - Prepares/Issues summary statements

**Program Official (PO)**
- Does not
  - Assemble review committee
  - Make awards

**Grants Management Officer (GMO)**
- Ensures all required business management actions are performed by the grantee and federal government
  - Participates in budget negotiations
  - Prepares/Issues Notice of Awards (NoA)

[http://grants.nih.gov]
National Cancer Program: Stakeholders

~$18 B per year

- NCI: $5 B
- Private Industry: $9.2 B
- Fed/State: $3.4 B
- NPO/Foundations: $0.6 B

NCAB Working Group Report, 2010
National Cancer Institute

Director
Harold Varmus, MD

Deputy Director
Douglas Lowy, MD

Office of the Director

CSSI

~$132 M (~4%)

Funding – Extramural

Center for Cancer Research
~$858M (~17%)

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
~$919M (~29%)
~$779M (~25%)
~$441M (~14%) ~$264M (~8%) ~$21M (~0.4%)

Conducting – Intramural

~$5.07B (FY12)

~$779M (~25%)
~$919M (~29%)
~$264M (~8%)
~$21M (~0.4%)

NCI 2012 Fact Book: FY12 Budget Breakdown

**Fiscal Year 2012 Budget**
(Dollars in Thousands)

<table>
<thead>
<tr>
<th>Mechanism</th>
<th>Amount</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Contracts:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>R&amp;D Contracts</td>
<td>589,715</td>
<td>15.4%</td>
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<tr>
<td>Buildings and Facilities</td>
<td>7,220</td>
<td>0.2%</td>
</tr>
<tr>
<td>Construction Contracts</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Subtotal Contracts</td>
<td>597,635</td>
<td>16.6%</td>
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<tr>
<td>Grants:</td>
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<td></td>
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<tr>
<td>Research Project Grants</td>
<td>2,075,295</td>
<td>54.1%</td>
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<tr>
<td>Cancer Centers/Specialized Centers/SPORS</td>
<td>612,789</td>
<td>16.0%</td>
</tr>
<tr>
<td>NRSA</td>
<td>65,992</td>
<td>1.7%</td>
</tr>
<tr>
<td>Other Research Grants</td>
<td>482,671</td>
<td>12.6%</td>
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<tr>
<td>Construction Grants</td>
<td>0</td>
<td>0.0%</td>
</tr>
<tr>
<td>Subtotal Grants</td>
<td>3,238,947</td>
<td>84.4%</td>
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<tr>
<td>Total Extramural Funds</td>
<td>3,634,382</td>
<td>100.0%</td>
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<tr>
<td>Total Intramural/RIMS</td>
<td>1,232,760</td>
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<tr>
<td>Total NCI</td>
<td>5,867,342</td>
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</table>

Data from NCI FY12 Factbook (http://obf.cancer.gov/financial/factbook.htm)
Established in 1972 as one of the nation's 39 FFRDC's and the only one devoted exclusively to biomedical research and development.

Facts
As one of Frederick County's major employers, the contractor Leidos Biomedical Research Inc. employs approximately 1,800 employees.

Economic Impact
In addition to payroll, Leidos Biomedical Research contributes:

- Dollars spent via Leidos Biomedical Research (formerly SAIC-Frederick) purchase orders, Contract Year 2011
  - Frederick County $16,820,351
  - Maryland $183,096,783

- Dollars spent via Leidos Biomedical Research (formerly SAIC-Frederick) purchase orders, 9/28/08–8/10/11
  - Frederick County $36,695,585
  - Maryland $266,944,980

Physical
- 68 acres deeded to the Department of Health and Human Services (HHS)
- 961,217 net square feet
- 1,654,035 gross square feet
- 113 buildings on site

NCI Funding in FY12 $238,204
Translation Pace: How To Break Out of Current Paradigm?

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

Turning the Crank…

Turning the Crank…

The potential to transform cancer drug discovery and diagnostics

Paul et. al, Nature Rev. Drug Discovery, March 2010
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…”
## CSSI Programs (FY99-FY14): Diverse Mechanisms

<table>
<thead>
<tr>
<th>Program</th>
<th>Grants</th>
<th>Cooperative Agreements</th>
<th>Contracts</th>
<th>FFRDC Resource</th>
<th>FFRDC R&amp;D Subs</th>
<th>Interagency Collaborations (Co-funds/joint programs)</th>
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<tbody>
<tr>
<td>Unconventional Innovations Program</td>
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<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Innovative Molecular Analysis Technologies</td>
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<td></td>
<td></td>
<td></td>
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<tr>
<td>NCI Alliance for Nanotechnology in Cancer</td>
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<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>FDA, NIST</td>
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<tr>
<td>The Cancer Genome Atlas</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Clinical Proteomic Tumor Analysis Consortium</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>FDA, NIST</td>
</tr>
<tr>
<td>Biospecimen Research Network</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CTD2 Cancer Target Discovery and Development</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Physical Sciences in Oncology</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
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<td></td>
<td></td>
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<tr>
<td>caHUB The Cancer Human Biobank</td>
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<td></td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Provocative Questions Initiative</td>
<td>✓</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Support Convergence and Innovation At Many Scales
Center Framework: “What is Water?” - Measurements → Insights

**Qualitative Descriptions**
- Color (clear, yellow, brown)
- Taste (none, metallic, awful)

**Phase (liquid, gas, solid)**
- Phase change (boil, melt, freeze)

**Measurements Taken**
- Temperature
- Pressure
- Density
- Specific volume

**Lots of Quantitative “Data”**

**But also Lots of Disagreements…**
Standards and Sharing of Data → New Insights and Understanding

- Define samples & protocols
- Share collected data

New Parameter: "Pressure"

New Understanding:
- Phase boundaries
- V/L equilibrium
- Triple Point

(Phase Diagram)

LOTS of Quantitative and Reproducible Data

(Steam Table)
2003 Launch of the Technology Dashboard of CSSI: IMAT

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)
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
Many “Thermometers”: Heterogeneity of Platforms

- 454
- Illumina
- SOLiD
- Helicos
- Visigen
- PacBio
- Ion-Torrent
- Complete Genomics
- Oxford Molecular
- Nimblegen
- LaserGen
- ZSGenetics
- NABsys
- Agilent
- Febit
- Intelligent Biosystems
- Raindance
- Halycon
- IBM
- Intelligent Biosystems
- Halycon
- Ion-Torrent
- Oxford Molecular
- Nimblegen
- LaserGen
- ZSGenetics
- NABsys
- Agilent
- Febit
- Intelligent Biosystems
- Raindance
- Halycon
- IBM
“...We found that specimens obtained late in the week (prolonged specimen handling) are more likely to be ER/PR negative than specimens obtained on other weekdays (regular specimen handling)…”
TCGA: Connecting Multiple Standardized Sources, Experiments, and Data Types

Three Cancers - Pilot

glioblastoma multiforme (brain)
squamous carcinoma (lung)
serous cystadenocarcinoma (ovarian)

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

Biospecimen Core Resource with more than 13 Tissue Source Sites

7 Cancer Genomic Characterization Centers

3 Genome Sequencing Centers

Data Coordinating Center
## Genomic Steam Table

### Summer 2011

<table>
<thead>
<tr>
<th>Tumor Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glioblastoma</td>
<td>470</td>
</tr>
<tr>
<td>Head &amp; neck</td>
<td>51</td>
</tr>
<tr>
<td>Lung adeno</td>
<td>57</td>
</tr>
<tr>
<td>Lung squamous</td>
<td>159</td>
</tr>
<tr>
<td>Breast carcinoma</td>
<td>180</td>
</tr>
<tr>
<td>Stomach adeno</td>
<td>84</td>
</tr>
<tr>
<td>Kidney clear carc.</td>
<td>260</td>
</tr>
<tr>
<td>Ovarian serous</td>
<td>520</td>
</tr>
<tr>
<td>Colon adeno</td>
<td>198</td>
</tr>
<tr>
<td>Rectum carcinoma</td>
<td>74</td>
</tr>
</tbody>
</table>

**Total:** 2053
# Genomic "Steam Table"

## Spring 2013

<table>
<thead>
<tr>
<th>Cancer Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glioblastoma</td>
<td>563</td>
</tr>
<tr>
<td>Brain lower grade glioma</td>
<td>180</td>
</tr>
<tr>
<td>Head &amp; neck</td>
<td>306</td>
</tr>
<tr>
<td>Thyroid carc</td>
<td>401</td>
</tr>
<tr>
<td>Lung adeno</td>
<td>356</td>
</tr>
<tr>
<td>Lung squamous</td>
<td>343</td>
</tr>
<tr>
<td>Breast carc</td>
<td>866</td>
</tr>
<tr>
<td>Stomach adeno</td>
<td>237</td>
</tr>
<tr>
<td>Liver hep. carc</td>
<td>97</td>
</tr>
<tr>
<td>Kidney pap. cell carc</td>
<td>103</td>
</tr>
<tr>
<td>Kidney clear cell carc</td>
<td>493</td>
</tr>
<tr>
<td>Ovarian serous</td>
<td>559</td>
</tr>
<tr>
<td>Uterine corpus end. carc</td>
<td>492</td>
</tr>
<tr>
<td>Cervical carc</td>
<td>102</td>
</tr>
<tr>
<td>Bladder carc</td>
<td>135</td>
</tr>
<tr>
<td>Prostate adeno</td>
<td>171</td>
</tr>
<tr>
<td>Colon/rectum adeno</td>
<td>575</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>5979</strong></td>
</tr>
</tbody>
</table>
Clinical Proteomic Tumor Analysis Consortium (CPTAC)

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 Public Resources:

http://proteomics.cancer.gov

- **CPTAC Data Portal**: 11,419 files (2.2 TB)
- **NCI Antibody Portal**: 280 mAbs (~$35)
- **CPTAC Assay Portal**: 542 assays

## Table: CPTAC TCGA Cancer Proteome Study of Colorectal Tissue

<table>
<thead>
<tr>
<th>Release Date</th>
<th>Disease</th>
<th># of Samples</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>9/4/2013</td>
<td>Colorectal</td>
<td>95</td>
<td></td>
</tr>
<tr>
<td>2/20/2014</td>
<td>Breast</td>
<td>105</td>
<td>~8,000 proteins</td>
</tr>
<tr>
<td>4/2014</td>
<td>Ovarian</td>
<td>TBD</td>
<td>~12,000 phospho-proteins</td>
</tr>
</tbody>
</table>
Where Do We Go From Here?
Is it JUST More Data?

Time? (Evolution)

Public dataset available NOW!
The pharmaceutical industry makes billions of dollars a year selling one-size-fits-all medicines. But now the race is on to come up with tailor-made drugs that will treat people based on their individual genetic makeup.

Drug companies hope to create a map of genetic landmarks that will become a potent new tool for uncovering the minute inborn differences.
Incremental Improvements Have Doubled Overall Survival in the Last Decade

<table>
<thead>
<tr>
<th>Study</th>
<th>Treatment</th>
<th>OS (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Saltz, NEJM 2000</td>
<td>5-FU bolus</td>
<td>12.6</td>
</tr>
<tr>
<td>Douillard, Lancet 2000</td>
<td>5-FU infusion</td>
<td>14.1</td>
</tr>
<tr>
<td>Saltz, NEJM 2000</td>
<td>IFL</td>
<td>14.8</td>
</tr>
<tr>
<td>Douillard, Lancet 2000</td>
<td>FOLFIRI</td>
<td>17.4</td>
</tr>
<tr>
<td>Goldberg, JCO 2004</td>
<td>FOLFOX</td>
<td>19.5</td>
</tr>
<tr>
<td>Tournigand, JCO 2004</td>
<td>FOLFOX followed by FOLFIRI</td>
<td>20.6</td>
</tr>
<tr>
<td>Hurwitz, NEJM 2004</td>
<td>IFL + bevacizumab</td>
<td>20.3</td>
</tr>
<tr>
<td>Saltz JCO 2008</td>
<td>FOLFOX + bevacizumab</td>
<td>21.3</td>
</tr>
<tr>
<td>VanCutsem JCO 2011</td>
<td>FOLFIRI + cetuximab</td>
<td>23.5*</td>
</tr>
<tr>
<td>Douillard, JCO 2010</td>
<td>FOLFOX + panitumumab</td>
<td>23.9*</td>
</tr>
</tbody>
</table>

*KRAS wild-type population

Courtesy of Scott Patterson, PhD (Amgen)
2012: Cancer Treatment and Survivorship Statistics

An estimated 13.7 million Americans with a history of cancer were alive on January 1, 2012.

<table>
<thead>
<tr>
<th>Male</th>
<th>As of January 1, 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prostate</td>
<td>2,778,630 (43%)</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>595,210 (9%)</td>
</tr>
<tr>
<td>Melanoma</td>
<td>481,040 (7%)</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>437,180 (7%)</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>279,500 (4%)</td>
</tr>
<tr>
<td>Testis</td>
<td>230,910 (4%)</td>
</tr>
<tr>
<td>Kidney &amp; renal pelvis</td>
<td>213,000 (3%)</td>
</tr>
<tr>
<td>Lung &amp; bronchus</td>
<td>189,080 (3%)</td>
</tr>
<tr>
<td>Oral cavity &amp; pharynx</td>
<td>185,240 (3%)</td>
</tr>
<tr>
<td>Leukemia</td>
<td>167,740 (3%)</td>
</tr>
<tr>
<td><strong>All sites</strong></td>
<td>6,442,280</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Female</th>
<th>As of January 1, 2012</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breast</td>
<td>2,977,610 (41%)</td>
</tr>
<tr>
<td>Uterine corpus</td>
<td>696,910 (8%)</td>
</tr>
<tr>
<td>Colon &amp; rectum</td>
<td>603,530 (8%)</td>
</tr>
<tr>
<td>Melanoma</td>
<td>496,210 (7%)</td>
</tr>
<tr>
<td>Thyroid</td>
<td>436,590 (6%)</td>
</tr>
<tr>
<td>Non-Hodgkin lymphoma</td>
<td>255,450 (4%)</td>
</tr>
<tr>
<td>Uterine cervix</td>
<td>245,020 (3%)</td>
</tr>
<tr>
<td>Lung &amp; bronchus</td>
<td>223,150 (3%)</td>
</tr>
<tr>
<td>Ovary</td>
<td>192,750 (3%)</td>
</tr>
<tr>
<td>Urinary bladder</td>
<td>148,210 (2%)</td>
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<tr>
<td><strong>All sites</strong></td>
<td>7,241,570</td>
</tr>
</tbody>
</table>

Cancer Treatment Patterns by Stage, 2008.

**Female Breast Cancer**

- BCS alone
- Mastectomy + RT
- Mastectomy + RT + chemo
- BCS + RT + chemo
- Mastectomy alone
- Mastectomy + chemo
- BCS indicates breast-conserving surgery.

**Non-Small Cell Lung Cancer**

- Surgery alone
- Surgery + chemo or RT
- Chemo alone
- Chemo + RT
- RT alone
- No treatment

**Colon Cancer**

- Polypectomy alone
- Colectomy alone
- Colectomy + chemo (w/ or w/o RT)
- Chemo and/or RT
- No treatment

Estimated Numbers of US Cancer Survivors by Site.

Provocative Question (PQ) Project:
Seeding Innovations for the Future

**Goal:**
- Challenge the scientific community to creatively think about and answer *important, but non-obvious or understudied*, provocative questions (PQs) in cancer research

**Implementation:**
- PQs solicited through website and workshops
  - Phase 1: requested R01/R21 applications on 24 final PQs *(55 awards)*
  - Phase 2: new set of 24 PQs for R01/R21 apps *(93 awards)*
  - Phase 3: new set of 20 PQs

**PQA4:** For tumors that arise from a pre-malignant field, what properties of cells in this field can be used to design strategies to inhibit the development of future tumors?

**PQC4:** What in vivo imaging methods can be developed to portray the "cytotype" of a tumor?

**PQB1:** Why do second, independent cancers occur at higher rates in patients who have survived a primary cancer than in a cancer-naïve population?

**PQD1:** What molecular properties make some cancers curable with conventional chemotherapy?

**PQD4:** What are the mechanistic bases for differences in cancer drug metabolism and toxicity at various stages of life?
Bringing In New Perspectives

- 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”
PS-OC Model: **PI Driven Interactions Inside/Outside of Network/Center**

**PS-OC #1 Organizing Framework**

- Core A
- Core B
- Project 1
- Project 2
- Outreach and Dissemination Unit
  - $100K/yr (Designed by Center, 121)

- Education and Training Unit
- Pilots Projects (Admin Unit)
- Trans-Network (Admin Unit)

- Trainee Exchanges
  - $50K/yr (132)

- Trans-Network Projects
  - $100K/yr

**PS-OC #2 Organizing Framework**

- Core A
- Core B
- Project 1
- Project 2
- Outreach and Dissemination Unit
  - $50K/yr (Designed by Center, 48)

- Education and Training Unit
- Pilots Projects (Admin Unit)
- Trans-Network (Admin Unit)

- Outreach Pilots
  - ~$1.2M/yr
    - [$100K/center]
    - (Designed by Network, 75)

- Outreach Pilots
  - $50K/yr
    - (Designed by Center, 48)
Then…(2002)

Drew Sheneman, The Star-Ledger, Newark, NJ

~150


~100

Comprehensive genomic characterization defines human glioblastoma genes and core pathways

The Cancer Genome Atlas Research Network

Integrated genomic analyses of ovarian carcinoma

The Cancer Genome Atlas Network

Comprehensive genomic characterization of squamous cell lung cancers

The Cancer Genome Atlas Network

2014
Need to Look Beyond Publications
Join the Team!
Upcoming Funding Opportunities

**Provocative Questions ($30M)**
Due Date 06/20/14
PQ Program Director
emily.greenspan@nih.gov

**Innovative Molecular Analysis Technologies ($10.5M)**
Due Dates 05/20 and 9/18/14
IMAT Program Director
anthony.dickherber@nih.gov

Data from projectreporter.nih.gov

98 active projects at the end of 2011
Join the Team!
Upcoming Network Funding Opps

PS-OC Program*

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Larry Nagahara, PhD
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Proposed PS-OC PAR Program FY’14-FY’16: Organization and Process

- FY09
  - Pre-Award
  - RFA-CA09-009

- FY14
  - USA
  - PS-OC Network PAR

- FY16
  - Future

Issuances of PS-OC Program (PAR)

- 2 Themes (suggested):
  - The Physical Dynamics of Cancer
  - Spatial Organization and Cancer

- Competition under **Type 1**
  - US4 mechanism up to $1.5M (DC)/year – center (5 years max.)
    - 2-3 Projects/Center
    - Education/Training Unit
    - Pilot/Trans-Network Projects

- Two receipt dates per year for 3 years, except FY’14 having only one receipt date

Discussion from NCI Board of Scientific Advisors (Nov 2013)


NCI Alliance for Nano Program (Approved 3/2014)

Cancer Research

Future Opportunities in Cancer Nanotechnology - NCI Strategic Meeting Report
Piotr Grodzinski and Dorothy Farrell
Cancer Res. Published Online First January 10, 2014.

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Summary of Responses to RFI on Directions and Needs for Cancer Nanotechnology Research and Development

The National Cancer Institute Office of Cancer Nanotechnology Research published a summary of its request for information on the directions and needs for cancer nanotechnology research and development. The purpose of the RFI was to gain feedback, comments, and ideas from the extramural community, as well as NCI Alliance leaders, investigators, trainees, and related thought leaders, on the status and future of the field and the role NCI funding has played and should continue to play in the future.
Relevant CSSI Funding Opportunities

- **Research Answers to NCIs Provocative Questions - Group A-E (R01)**
  - Due Date: 06/20/2014 RFA-CA-13-016, 018, 020, 022,024 ($2-3M each RFA, $10-$15M total)

- **Research Answers to NCIs Provocative Questions - Group A-E (R21)**
  - Due Date: 06/20/2014 RFA-CA-13-017, 019, 021, 023, 025 ($0.5-$1M each RFA, $2.5M - $5M total)

- **Early-Stage Innovative Molecular Analysis Technology Development (R21)**
  - Due Date: 05/20/2014 and 09/18/2014 RFA-CA-14-003 ($5M)

- **Validation and Advanced Development of Emerging Molecular Analysis Technologies (R33)**
  - Due Date: 05/20/2014 and 09/18/2014 RFA-CA-14-004 ($4M)

- **Early-Stage Development of Innovative Technologies for Biospecimen Science (R21)**
  - Due Date: 05/20/2014 and 09/18/2014 RFA-CA-14-005 ($0.8M)

- **Validation and Advanced Development of Emerging Technologies for Biospecimen Science (R33)**
  - Due Date: 05/20/2014 and 09/18/2014 RFA-CA-14-006 ($0.7M)
Relevant NCI Funding Opportunities

- **Innovative Molecular Analysis Technology Development for Cancer Research and Clinical Care (R43/R44)**
  - Due Date: 5/28/2014 and 11/4/2014  PAR-13-327

- **Early-Stage Development of Informatics Technology (U01)**
  - Due Date: 6/18/2014 and 11/18/2014  PAR-12-288

- **Advanced Development of Informatics Technology (U24)**
  - Due Date: 6/18/2014 and 11/18/2014  PAR-13-294

- **Imaging and Biomarkers for Early Cancer Detection (R01)**
  - Due Date: 7/10/2014 and 12/11/2014  PAR-13-189

- **Image-guided Drug Delivery in Cancer (R01)**
  - Due Date: 6/19/2014 and 11/19/14  PAR-13-185

- **Biomarkers for Early Detection of Hematopoietic Malignancies (R21/R01)**
  - Due Date: 6/16/2014 (R21) & 7/5/2014 (R01) [Standard]  PA-12-220 (R21) & PA-12-221 (R01)
Acknowledgements/Thanks to the “Secret Ingredients”

Clinical Sciences

Life Sciences

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